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UNITED STATES DEPARTMENT OF THE INTERIOR

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES

PART 2, M–Z

GEOLOGICAL SURVEY BULLETIN 896

POLITECHNIKA GDAŃSKA
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UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Bulletin 896

LEXICON OF GEOLOGIC NAMES OF THE UNITED STATES

(INCLUDING ALASKA)

(Also includes the names and ages, but not the definitions, of the named geologic units of Canada, Mexico, the West Indies, Central America, and Hawaii)

Compiled by

M. GRACE WILMARTH
Secretary of the Committee on Geologic Names
of the United States Geological Survey
April 1, 1905, to April 30, 1937

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ZAKŁAD GEOLOGII

PART 2, M–Z

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LEXICON—Part 2, M-Z

Mabb amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan (Keweenaw Point).

L. L. Hubbard, 1898 (Mich. Geol. Surv., vol. 6, pt. 2, pp. 132, 135, 136). Cgl. No. 3 can be traced for only a short distance back of Houghton, beyond the old workings of *Mabbs vein* in sec. 1, T. 54, R. 34. The cgl. lies upwards of 100 ft. E. of Mabbs vein. [*Mabbs vein* was used by A. R. Marvine (in Mich. Geol. Surv. vol. 1, pt. 2, 1873, pp. 17, 63) and probably other early writers.]

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 34, 58, 190, 229, 472, pl. X, fig. 44). The *Mabb ophite* of Isle Royale section is over 200 ft. thick and lies just above Lac la Belle cgl. Is exposed in old Mabb workings [Houghton Co.] and dump and along N. line of sec. 6–55–33. [This rock has for many years been called *Mabb amygdaloid.*]

Belongs to Bohemian Range group. Is younger than Baltic West amygdaloid. The mineralized part is the Mabb lode.

Mabb flow.

Includes Mabb amygdaloid and the underlying trap.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Mabou formation.

Carboniferous: Nova Scotia (Cape Breton Island).

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 323).

P. D. Trask, 1929 (Nova Scotia Rept. on Mines 1928, p. 285).

McAdam formation.

Silurian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 203). [Assigned to Sil.]

Many later repts, by other geologists, assign this fm. to Sil.

McAlester formation. (Also **McAlester shale.**)

Pennsylvanian (Allegheny): Eastern Oklahoma and western Arkansas coal field.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 437). *McAlester sh.*—Consists of (ascending): (1) 800 ft. of sh. with thin ss. and coal, the Hartshorne or Grady coal at or just above base; (2) three or four beds of ss. separated by sh. beds, 100 to 200 ft. thick, aggregating 500 ft.; and (3) 700 ft. of blue, gray, or black sh., with McAlester coal about 50 ft. above base and several thin coals higher up. Overlies Hartshorne ss. and underlies Savanna ss.

In 1907 (U. S. G. S. Bull. 326) the McAlester sh. was raised to rank of a *group* in Ark. coal field, where its supposed equivalents were named (descending) *Paris sh., Fort Smith fm.,* and *Spadra sh.,* the ss. overlying Paris sh. being supposed to correspond to true *Savanna ss.* of Okla. Later work (by T. A. Hendricks and C. B. Read) led to opinion that true Savanna ss. of Okla. corresponded to lower part of Savanna ss., the Paris sh., and upper part of Fort Smith fm. of Ark. (See A. A. P. G. Bull. vol. 18, No. 8, 1934, pp. 1050–1058.) Subsequent work (by B. Parks and T. A. Hendricks) led to (1) identification of Boggy sh. of Okla. with so-called Savanna ss. and upper part of Paris sh. of Ark. coal field; (2) identification of true Savanna ss. of Okla. with lower part of Paris sh. and upper part of Fort Smith fm. of Ark.; and (3) identification of lower part of Fort Smith fm. and Spadra sh. of Ark. with true McAlester sh. of Okla. They therefore extended the Okla. names (descending) Boggy sh., Savanna ss., and McAlester sh. into Ark. coal field, to replace so-called Savanna ss., Paris sh., Fort Smith fm., and Spadra sh. of that area, all of which names were discarded, as was McAlester *group* as used in Ark.

The base of McAlester sh. in Okla. is drawn at top of 1st ss. below Upper Hartshorne coal, and in Ark. at top of 1st ss. below Lower Hartshorne coal.

Named for exposures around McAlester, Pittsburg Co., Okla.

McAras Brook formation.

Mississippian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 244).

McArthur member. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio (Vinton and Jackson Counties).

H. Morningstar, 1922 (Ohio Geol. Surv., 4th ser., Bull. 25, p. 116). *McArthur memb.*—Consists of (1) 4 ft. of sh., in places sparingly fossiliferous, and shaly calc. sss., underlain by (2) 1½ ft. of impure ls. or calc. sh., not persistent but very fossiliferous. Is of marine origin. Overlain by Homewood sh. and ss. and underlain by Tionesta or No. 33 coal. Named by Stout in 1919 [where?] McArthur ls., from typical exposures in vicinity of McArthur, central part of Vinton Co., where the memb. consists of massive bluish gray ls., very fossiliferous. Thickness 2 to 14 ft. Best developed in Vinton and Jackson Counties, but pinches out and disappears S. of Monroe Furnace in S. part of Jackson Co.

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 170, footnote). Putnam Hill ls. of central Ohio is correlative with McArthur memb. of Morningstar (Bull. 25) of Vinton Co., and in this (Vinton Co.) rept is called Putnam Hill ls.

W. Stout, 1930 (Letter dated Feb. 25). *McArthur ls.* is only a shaly phase of the Putnam Hill of central Ohio, being very dissimilar, however, in fossils and lithologically. The name has been dropped, and the fossils should be credited to Putnam Hill.

Macastey black shale.

Macasty black shales.

A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, p. 2), mentioned (but did not describe) that *Macastey black sh.* of Anticosti Island is certainly of Utica (Upper Ord.) age.

W. H. Twenhofel, 1928 (Canada Geol. Surv. Mem. 154, p. 22), described (under heading) *Macasty black sh.*, and in the description (pp. 22, 23) referred to Makasti Cliff, Makasti Bay, and Makasti Hill.

McBean formation.

Eocene (Claiborne): Eastern Georgia and western and central South Carolina.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 60, 237–284). *McBean fm.*—Mainly clays, in nature of fullers earth, shell marls, sandy lss., and calc. glauconitic sands; the marls are for most part massive bedded and friable, but hard, compact, and even partially silicified beds were noted on Savannah River. Basal bed of McBean fm. consists principally of fullers earth and drab or greenish sandy clays, here called *Congaree clay memb.* [p. 268]. Thickness of fm. 100 to 400 ft. Underlies Barnwell sand and overlies Wilcox fm. Is a shallow-water marine deposit included in Claiborne group, along with Barnwell sand. *Ostrea georgiana* zone at Shell Bluff, on Savannah River, Ga., is top memb. of McBean fm.

C. W. Cooke and H. K. Shearer, 1918 (U. S. G. S. P. P. 120C), showed that the faunas of Barnwell sand and of *Ostrea georgiana* zone are of Jackson age, and restricted Claiborne group of Ga. and McBean fm. to the beds beneath *Ostrea georgiana* zone and above Wilcox fm., including the *Ostrea georgiana* zone in Barnwell fm. They also showed that Congaree clay memb. of Veatch and Stephenson does not lie at base of Claiborne group and of McBean fm., but that it is of Jackson age and much younger than Congaree shales of Sloan, to which it was supposed to be equiv. They therefore discarded Congaree clay, renamed the beds *Twiggs clay memb.*, and included them in Barnwell fm. They showed (p. 53) *Ostrea georgiana* zone to be contemp. with lower part of Twiggs clay memb., and that Twiggs memb. thins out in Ga. near Savannah River and is absent in S. C. These are the definitions of McBean and Barnwell fms. at present used by U. S. Geol. Survey.

Named for exposures at McBean and on McBean Creek, in Richmond Co., eastern Ga.

McCann sandstone.

Permian: Central northern Oklahoma (Kay County).

C. N. Gould, 1900 (Kans. Univ. Quart., vol. 9, pp. 175–177). *McCann ss.*—Dark-red or mottled ss., 2 to 5 ft. thick, forming basal ledge of Harper fm. Not known to have any counterpart in Kans. It forms dividing line from blue to red shales, or from the Wellington to the Harper. Named for McCann's quarry, on Deer Creek, 20 mi. SW. of Blackwell, Kay Co.

C. N. Gould, 1927 (Obsolete Okla. names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, p. 235). *McCann ss.* died a natural death.

McCarthy shale (also **formation**).

Upper Triassic: Alaska (Nizina-Tanana region).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 426). *McCarthy Creek shales.*—A series of soft black, highly fissile shales and slates, typically exposed on McCarthy Creek. Rest on Chitistone ls. Underlie (uncon.?) Kennicott series. Contain Triassic fossils.

The simplified name *McCarthy sh.* has been in use many years. The underlying fm. is now known as *Nizina ls.*, a name introduced many years ago for the upper thin-bedded lss. composing top part of Chitistone ls. as originally defined, Chitistone now being restricted to the massive lss. forming lower part of the original Chitistone.

†McCarthy Creek shale.

See under *McCarthy sh.*

McCartys basalt flow.

See under *Laguna basalt flow.*

McCaulley dolomite.

Permian: Central northern Texas (Fisher County).

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 26, pl. 1). *McCaulley dol.*—A series of white, chalky dolomites comprising a thickness of 3 to 20 ft., consisting of 1-in. to 1-ft. dolomites separated by 6-in. to 1-ft. partings of red and blue shales. Part of town of McCaulley, Fisher Co., rests on this dol. Is older than Aspermont dol. and younger than Guthrie dol. Included in Double Mtn group.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, p. 951, pl. 9). Acme dol., which lies 64 ft. above Mangum dol. and 90 ft. below Guthrie dol., can be correlated with reasonable certainty with McCaulley beds of Fisher Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). Acme dol. is probably same as McCaulley dol., and McCaulley dol. is discarded, as Acme is in more general use.

McClearys Bluff formation.

Pennsylvanian: Indiana.

See 1935 entry under *St. Wendell ss.*

McClesky sand.

A subsurface sand, 10 to 50 ft. thick, in Marble Falls ls. (Penn.) of Ranger and other fields of central northern Tex. Lies 170 to 230 ft. below top of Black lime, which is also in Marble Falls ls.

McClosky sand.

Name that has been applied to subsurface sands in Ste. Genevieve ls. and overlying rocks of Chester group (Miss.) of Ind. and Ill. (See Ill. Geol. Surv. Bull. 54, index.) In western Ky. (see Ky. Geol. Surv. ser. 6, vol. 42, 1931, frontispiece) the name has been applied to a sand that is said to lie 150 ft. below top of Ste. Genevieve ls.

McCloud limestone.

Permian (?): Northern California (Redding region).

H. W. Fairbanks, July 1894 (Am. Geol., vol. 14, pp. 29–30). The ls. peaks along E. side of the McCloud extend in N.-S. direction, but strike of strata is about N. 30° W. The repetition of the ls. bodies in N.-S. direction, as well as that of the fossiliferous beds along the river, is undoubtedy due to sharp folding or faulting. If this were not so the thickness of the ls. would be immense. The *McCloud lss.* are considered by Mr. [J. P.] Smith as belonging to Upper Carbf.

J. P. Smith, October 1894 (Jour. Geol., vol. 2, pp. 592, 599–601). Immediately above Baird shales, and probably conformably with them, lies *McCloud ls.*, consisting of about 2,000 ft. of massive lss. and marbles of McCloud river, rich in corals and brachiopods. Underlies McCloud shales [Nosoni fm.]. Form upper div. of McCloud fm.

Later treated as distinct fm., overlying Baird sh. and underlying Nosoni fm. (†McCloud shales).

N. E. A. Hinds, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 274, and Calif. Univ. Dept. Geol. Sci. Bull. 20, p. 403), assigned McCloud ls. to Perm., as did H. E. Wheeler, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 218). The U. S. Geol. Survey at present classifies this fm. as *Perm. (?)*.

†McCloud shales.

Permian: Northern California (Redding region).

H. W. Fairbanks, July 1894 (Am. Geol., vol. 14, p. 30). The uppermost horizon of fossiliferous strata on the McCloud occurs about 20 mi. above the Fisheries on E. side of the river. Here is found a calc. argillite rich in several species of *Productus*, besides other forms, which according to Mr. Smith belong in upper part of Carbf. These argillitic lss. and associated shales are embraced under designation *McCloud shales*.

J. P. Smith, October 1894 (Jour. Geol., vol. 2, pp. 592, 601–602). *McCloud shales.*—Siliceous and calc. shales and cgls., with Upper Carbf. fauna at base. Occurs on E. bank of McCloud River, about 20 mi. N. of U. S. Fisheries. Thickness 1,000 ft. Basal fm. of Pitt fm. Underlies Pitt shales and overlies McCloud ls.

Same as Nosoni fm., which is now classified as Perm.

†McCloud formation.

Permian (?) and Mississippian: Northern California (Redding region).

J. P. Smith, 1894 (Jour. Geol., vol. 2, pp. 592–593). *McCloud fm.* (H. W. Fairbanks ms.) is especially well developed in region of McCloud River in Shasta Co., and from this it receives its name. Divided into Baird shales (Lower Carbf.), 500 ft. thick, overlain by McCloud ls. (Upper Carbf.), 2,000 ft. thick. Is overlain by McCloud shales [Nosoni fm.], basal fm. of Pitt fm., and underlain by Sacramento fm. (Kennett lss. and shales).

Unnecessary name, with conflicting usages. Includes Baird sh. (Miss.) and McCloud ls. (Perm. ?).

McClure sandstone member (of Norton formation).

Pennsylvanian: Southwestern Virginia.

J. B. Eby, 1923 (Va. Geol. Surv. Bull. 24, pp. 63, 67). *McClure ss. memb.*—Lies near middle of Norton fm., just below Kennedy coal. Consists of coarse ss. 50 to 200 ft. thick. On Pine Mtn it is sparingly conglomeratic.

Named for McClure River, Dickinson Co.

McCoy formation.

Pennsylvanian: Northwestern Colorado (northern part of Eagle County).

R. Roth, 1930 (A. A. P. G. Bull., vol. 14, No. 9, pp. 1265–1267). The Penn. sediments at McCoy, Eagle Co., Colo., are here given name *McCoy fm.* for following reasons: The beds form lower part of so-called "Undifferentiated Carboniferous" on Colo. State geol. map. The contained fauna is a unit and cannot be divided into zones. Correlation with Mid-Continent Cherokee sh. can be made precisely. The fm. is unique. It is very fossiliferous, fossils occurring in thin beds of ls. and black sh., which are separated from each other by beds of red shales and massive arkosic cgls. 50 ft. or more thick. Thickness of the cgls. above the measured section is unknown. Includes at base 200± ft. of thin-bedded pink qtzites, interbedded with maroon and red micaceous shales, which are separated from rest of fm. by seeming uncon., probably due to deltaic nature of sediments. General aspect of all fossils seems to be lower Cherokee. Thickness of measured section of fm. at McCoy aggregates 1,011 ft. It rests on undiff. Camb. or Ord. and granite.

R. Roth, 1934 (A. A. P. G. Bull., vol. 18, No. 7, p. 947). A comparison of fauna of Hermosa fm. with that of McCoy fm. shows them to be identical and therefore equiv. in age.

McCoytown sandstone.

Silurian: Central Pennsylvania.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, p. xxvii). *McCoytown ss.*—Near middle of the lower red shales of Clinton fm. of Juniata dist., occur layers of soft brown ss. from 6 in. to 2 ft. thick, which break with square fracture. Near McCoytown, in Tuscarora Valley, these layers become very hard and siliceous and exhibit on the surface numerous quartz crystals.

Maccrady shale.

Mississippian (Osage): Southwestern Virginia.

G. W. Stose, 1913 (U. S. G. S. Bull. 530, pp. 233, 234). *Maccrady fm.*—Underlies Newman ls. and overlies Price ss. Replaces "Pulaski sh.," preoccupied. Thickness 1,025 ft. Consists of (descending): (1) Earthy ls. and sh., abundantly fossiliferous, dark gray, weathering lighter and crumbly, 470± ft.; (2) gray ss., mostly calc. and crumbly, and shaly argill. or earthy ls., fossils at top, 240 ft.; (3) soft rocks, including shaly ls. and probably earthy ss. and red sh., 225 ft.; (4) upper part red sh. and shaly ss. with some gray shaly ss.; lower part soft light-buff sh. with thin black carbonaceous sh. and coal seamlets, 90 ft. Best section measured at Maccrady [Smyth Co.], for which the fm. is named.

C. Butts, 1927 (Va. Geol. Surv. Bull. 27). It is doubtful if typical "Pulaski sh." includes any representative of ls. of Warsaw age, as does typical Maccrady. In author's opinion *Maccrady* should be *restricted* to the red beds of pre-Warsaw age, and the beds of Warsaw age should be called *Warsaw ls.* [This *restricted definition* of *Maccrady sh.* was adopted by U. S. Geol. Survey in Dec. 1931.]

C. Butts, 1933 (Va. Geol. Surv. Bull. 42, pp. 37–38). In his original definition Stose included in the Maccrady the overlying ls. of Warsaw age, here separated as a distinct fm. *Maccrady sh.* as here *restricted* is a red sh. or mudrock with less red argill. ss. Stose believes that the salt and gyp. at Saltville are in the Maccrady. In Greendale syncline the Maccrady is 50 to 60 ft. thick, where its top is defined by overlying ls. of Warsaw age, and as much as 500 ft. thick in Pulaski-Blacksburg region, where even with this thickness it is not known to be all present, owing to overthrust faulting.

McCum limestone.

Misprint for *McCune ls.*, U. S. G. S. Bull. 191, p. 247.

McCune limestone.

Middle Ordovician: Central eastern Missouri.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 61). *McCune ls.*—Very fossiliferous massive buff dolomitic ls., 25 or 30 ft. thick, forming upper part of what has heretofore been called *Trenton* in NE. Mo. Overlies Bryant ls. and underlies Buffalo sh. in Pike and Lincoln Counties. [In later repts Keyes gave thickness as 50 ft.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), showed *McCune dol.* as of Trenton age, as uncon. underlying Fernvale ls., and as overlying Prosser ls. (of basal Trenton age); and he defined Kimmswick ls. as consisting wholly of beds of late Black River age. This definition was repeated by R. S. Bassler, 1915.

A. F. Foerste, 1920 (Denison Univ. Bull. Jour. Sci. Lab., vol. 19, pp. 175+). Kimmswick ls. (broad sense) is=McCune ls. of Keyes (1898). [This same statement was made by Keyes, 1923 (Pan-Am. Geol., vol. 39, pp. 67–70).]

J. H. Bradley, Jr., 1925 (Jour. Geol. vol. 33, pp. 53–54, 65, 69). [See 1925 entry under *Kimmswick ls.*]

The Kimmswick ls. is now considered to be of Trenton age, possibly including some beds of Black River age at base.

Named for exposures near McCune Station, Pike Co.

McCurtain shale member (of McAlester shale).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, McIntosh, and adjacent Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *McCurtain sh. memb. of McAlester sh.*—Almost wholly dark-blue fissile sh., containing several layers of iron concretions, and (10 in. to 4 ft. above base) the Upper Hartshorne coal. Thickness in Muskogee-Porum area 144± ft. Basal memb. of McAlester sh. Is overlain by Warner ss. memb. Named for fact McCurtain, Haskell Co., is built on this sh.

McDermott formation.

Upper Cretaceous: Northwestern New Mexico (San Juan Basin) and southwestern Colorado.

J. B. Reeside, Jr. 1924 (U. S. G. S. P. P. 134, pp. 22–25). *McDermott fm.*—A series of lenticular sss., shales, and cgls. containing much andesitic debris and usually in part of purple color. Thickness at most places in Colo. 200 to 400 ft.; in northern San Juan Co., N. Mex. 150 to 200 ft.; to S. of San Juan River 30 to 50 ft. Except near Durango, Colo., the McDermott seems to be conformable with underlying Kirtland sh. restricted and bdy to be arbitrary. In Durango region it appears to be uncon. with Kirtland. In Colo. it is in places uncon. overlain by Animas fm. (restricted) and in other places the younger Torrejon fm. uncon. overlies it. In N. Mex. it is uncon. overlain by Ojo Alamo ss. restricted. The McDermott fm. in Colo. was included in lower part of "Animas River beds" of Cross (1896) and Animas fm. of Gardner (1909). It is same as Animas fm. of Shaler (1907). In N. Mex. it was included in upper part of Ojo Alamo beds of Brown (1910), in uppermost part of Kirtland sh. of Bauer (1916), and in Ojo Alamo ss. in part and in Kirtland sh. in part of Bauer and Reeside (1921). It is here tentatively assigned to Cret. (?), because of somewhat conflicting paleontologic evidence, which, however, on the whole seems to favor Cret. age. Named for McDermott Arroyo, SW. part of La Plata Co., Colo.

This fm. is now classified as Upper Cret., since it underlies Ojo Alamo ss., which is demonstrably of that age.

MacDonald formation.

Pre-Cambrian: Southern British Columbia and northwestern Montana (Galton Range).

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 2, 3). *MacDonald fm.*—Thin- to thick-bedded gray metargillite with rare lenses of dol. [MacDonald Range, B. C., is on this sheet and MacDonald fm. is mapped there.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 101, 178). Chiefly metargillite. Top 700 ft. weathers light brown or buff, a few gray beds; middle 1,100 ft. weathers light gray; lower 550 ft. weathers light brown or brownish gray. Underlies Wigwam fm. and rests, with some abruptness, on Hefty fm. Named for fact it underlies extensive surface in MacDonald Range, B. C.

McDonald sand.

A subsurface sand, of probable late Upper Dev. age, in western Pa. and W. Va. Younger than Bayard or Sixth sand and probably=Fifth sand. Is older than Gordon or Third sand. Named for McDonald oil field, Washington Co., Pa.

†McElmo formation.

Jurassic (Upper): Southwestern Colorado, northwestern New Mexico, and southeastern Utah.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). *McElmo fm.*, the name here proposed for upper div. of Gunnison fm., the lower div. being here named *La Plata ss.* As developed in this quad. consists of a variable complex of shales and sss., the latter much more prominent here than elsewhere. The sss. are fine-grained, quartzose, of yellowish or gray color, and usually soft and crumbling. Some beds are locally massive, cross-bedded, and 50 ft. thick, but sh. partings of variable importance subdivide most of ss. members. The shales are either reddish or greenish or variegated by a mixture of these 2 colors; they are seldom pure clay shales, but are commonly both calc. and sandy; ss. layers appear in the shales. Basal memb. is a usually highly colored sh. and upper stratum is also a marked sh. beneath a massive ss., commonly conglomeratic, which is assumed as base of Dakota Cret. No fossils in Telluride quad. but is assigned to Juratrias.

Later work showed that the names "McElmo fm." and "La Plata ss." had been variously used in repts. The McElmo fm. of some areas is exactly the same as Morrison fm.; the McElmo fm. of other areas is only upper part of Morrison fm., the so-called "Upper La Plata" being the lower part of the Morrison; the McElmo fm. of still other areas included Morrison fm. and Upper Jurassic deposits down to top of Entrada ss., the Entrada alone in those areas having been called "La Plata ss." The names "McElmo fm." and "La Plata ss." have therefore been replaced by *Morrison fm.* and the other recently adopted subdivisions of SE. Utah, which can also be discriminated in SW. Colo. See U. S. G. S. P. P. 183, 1936 (especially chart opp. p. 39), by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.

Named for exposures on McElmo Creek, Montezuma Co., Colo., and SE. Utah.

McElroy member (of Fayette sandstone).

Eocene (upper): Eastern Texas.

O. L. Brace, 1931 (A. A. P. G. Bull., vol. 15, No. 7, pp. 779–781). *McElroy beds.*—Local. Thickness 500± ft. Overlain by Fayette and separated from underlying Cockfield by 100± ft. of beds [not described] called *Dibollensis* zone. Includes in upper part Simms, Holzmark, and Nichols sands. [Derivation of name and lithology of beds not stated.]

L. P. Teas, 1931 (p. 788 of book cited above). *McElroy zone* is 500 or more ft. thick at Pettus. It is bentonitic, grayish brown to brownish, and consists almost entirely of sh. The peculiar McElroy lithology has not been reported in any exposures in Karnes Co. [Derivation of name not stated.]

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 680–681, 685–687, 693, 696). *McElroy memb. (of Fayette fm.)* was named by Miss Ellisor (ms. read at meeting Soc. Econ. Pal. and Min., San Antonio, March 1931) for McElroy, a small town in Sabine Co. Previously the basal ss. beds of this div. had been named *Wellborn* by Kennedy, and the clays above named *Manning beds* by Dumble. Dumble did not define his div. clearly nor designate a type section, and consequently geologists have had difficulty in distinguishing the limits of Manning beds. Cushman and Applin (1926) referred to the middle div. of the Fayette as *"Textularia hockleyensis* zone." Most other geologists have preferred the new name *McElroy*. The memb. consists of brownish-gray gypsiferous plastic clays containing fossiliferous, limonitic concretions and layers of thin-bedded fossiliferous sand or ss. Thickness averages 200 ft. along outcrop. It is limited at top by a more or less persistent ss. (Alva Ellisor, personal communication, 1932), which passes through town of Groveton, Trinity Co., and caps Lipan Hills near Campbellton, Atascosa Co. [On p. 687 he says top is limited by base of Whitsett memb.] It is limited at base by Caddell clays, the dividing line being drawn at base of Wellborn ss. Type loc. is the R. R. cut just N. of station of McElroy, a small town N. of Brookeland, on Santa Fe R. R., in Sabine Co. [NE. Tex.] Fossils listed.

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11). *McElroy fm.* of Jackson group, underlies Whitsett fm., overlies Caddell fm., and is divided into (descending) Manning beds, Wellborn sands, and Wooley's Bluff clays.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

McEwin sand.

A subsurface sand, of Penn. age and 30 ft. thick, in NE. Okla., which lies 125± ft. above Big lime, and probably corresponds to part of Nowata sh.

MacFarlane red beds.

Carboniferous (Pennsylvanian?): Nova Scotia (Cape Breton Island).

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 323).

McGee glacial stage.

Pleistocene: Sierra Nevada, California.

E. Blackwelder, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 91-92) and 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865-922). *McGee stage.*—Oldest glacial stage on E. slope of Sierra Nevada. Represented by several thick patches of a deposit strongly resembling till and consisting largely of granite debris resting on Paleozoic ls. and marble. Best exposed on high ridge W. of McGee Peak, Mount Morrison quad. Correlated with Nebraskan stage.

McGraw bed.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *McGraw bed.*—Ferruginous ss. with oolitic hematite. Overlain by Beach fm., and underlain by Lance Cove fm. Included in Bell Island series. [Derivation of name not stated.]

McGregor member (of Platteville limestone).

Middle Ordovician (Black River): Northeastern Iowa, northwestern Illinois, southeastern Minnesota, and southwestern Wisconsin.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 64, 70, 71, fig. 1). *McGregor ls. memb. of Platteville fm.*—Shaly ls., 22 to 30 ft. thick, underlying Spechts Ferry memb. and overlying Pecatonica memb. of the Platteville. [Section 1 mi. W. of McGregor gives thickness of 22 ft.; at Guttenberg, 30 ft.; near Dubuque, 25 ft.]

G. M. Kay, 1935 (pp. 286-295 of book cited above). *McGregor memb. of Platteville fm. (new name).*—*McGregor ls.* is here defined as consisting of the ls. succeeding Pecatonica (Lower Buff) memb. of Platteville fm. and underlying Spechts Ferry memb. Includes Blue Beds and Upper Buff Beds of older Wis. classification. Type section is in a ravine S. of highway 1½ mi. W. of McGregor, Clayton Co., Iowa, where the beds consist of 21½ ft. of gray-blue, rather fine-textured fossiliferous ls. with greenish sh. partings and interbeds. Thickness normally 20 to 25 ft.; about 27 ft. in type section of Platteville fm., where it includes at top the "Glass Rock," 3 ft. 4 in. thick, underlain by 27 ft. of the gray ls. In southern Minn. the Pecatonica memb. is absent and the McGregor memb. lies on Glenwood memb. of Platteville.

C. A. Bays and G. O. Raasch, 1935 (pp. 297-298 of 1935 Conf. Rept. cited above), restricted McGregor memb. to Lower Blue memb. of Chamberlin, and introduced a new name (*Magnolia memb.*) for upper part of McGregor memb. of Kay.

McGregor lime.

A term applied to subsurface beds correlated with Platteville ls. of NE. Iowa. (See A. Folger, A. A. P. G. Bull., vol. 12, p. 206, 1928.)

Machapoorie formation.

Miocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 59).

McHenry formation.

Pleistocene and Recent: Northeastern Maryland (Baltimore County).

P. R. Uhler, 1901 (Md. Acad. Sci. Trans., n. s., vol. 1, pp. 395-400). *McHenry fm.*—A series of marshes and beds constituting one of latest fms. of Modern Period. Extends over parts of recent beaches of Patapsco River and Chesapeake Bay, and near Baltimore composes upper part of Fort McHenry Plateau, in marsh of which many trees grew, as evidenced by the many stumps in the black mud.

Varies greatly in thickness, and where complete continues up from the black marsh, or marshy sand, deposited in the depressions of the Cret. clays. Probably thickest section of this fm. is where the sewer was dug beneath Eutaw St., S. of West St. Omitting the 5-8 ft. of gravel, sand, and soil of the surface the total thickness is 23 ft.

Probably includes deposits of Recent and Pleist. age.

Machias moraine.

Pleistocene (Wisconsin): Southeastern Maine.

G. H. Stone, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 381). *Machias moraine.*—The western part at least is a terminal moraine. Named for occurrence about 5 mi. S. of Machias, Washington Co., near first fork of the road.

Machias shale.

Upper Devonian: Western New York (Cattaraugus County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). Beds of Chemung age in Cattaraugus Co. divided as follows (descending): Cuba ss.; *Machias* (=Northeast sh. of Chautauqua Co.); unnamed ss.; Gowanda beds; and Dunkirk sh.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 152). Northeast sh. is nearly barren to W., but to E. it contains an easily recognized fauna, best exhibited in Pierce quarry, W. of Machias. The *Machias fauna* is present in road hill S. of Persia turnout and at least as far W. as S. of Wango. It is fully developed in railway cut at Cattaraugus. In all these localities it involves the Northeast beds from top downward, and the change is lithologic as well as faunal. Apparently the Northeast (*Machias*) embraces those beds which on Genesee River intervene btw. the heavy sss. of Caneadea and the Cuba ss. and which become the main mass of Wellsburg ss. Farther E. the Cuba ss. goes above Machias-Northeast series.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 200), shows *Machias* as overlain by Cuba ss., underlain by Rushford ss., and as=Northeast sh. On p. 202 he states that the Machias is a fossiliferous phase of Northeast sh. containing many bryozoans.

Machuca formation.

Tertiary (Oligocene?): Nicaragua.

C. W. Hayes, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 285, 313).

McIntire Upper Conglomerate.

See under *Scranton ss.*

McIntyre series.

Pre-Cambrian: Ontario.

L. C. Graton and H. E. McKinstry, 1933 (Canadian Min. and Met. Bull. 250, also Trans., pp. 3, 7).

McKay group.

Upper Cambrian and Ordovician: British Columbia.

C. S. Evans, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A_2, p. 126).

McKean group.

A term that has been applied to 600 or 700 ft. of subsurface beds, of probable Chemung and Portage age, lying about 500 ft. below Venango oil group in McKean Co., western Pa. Includes (descending) Cherry Grove-Balltown sand, Darling sand, Cooper sand, and Bradford Third sand. (See J. F. Carll, 2d Pa. Geol. Surv. Rept. I_5, p. 135, 1890.)

McKenzie formation (also **McKenzie limestone**). (In Cayuga group.)

Silurian: Central Pennsylvania to northeastern West Virginia, northern Virginia, and western Maryland.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 522, 545, 591, pl. 28). *McKenzie fm.*—Basal fm. of Cayugan series in Pa., Md., and Va. Uncon. underlies Bloomsburg ss. and uncon. overlies Clinton group. The *Kiefer* [Keefer] *ss.* of Md. has hitherto been referred to [but not named] as top memb. of the

Clinton. On investigation it was established that it is a locally developed deposit, that it passes without break into overlying sandy shales of *McKenzie fm.*, and that it is bounded below by an uncon. which in places cuts out Rochester memb. or fm. of Clinton group. On these grounds, which are supplemented by good faunal evidence, the Kiefer ss. is now classified as a local basal memb. or facies of McKenzie fm.

G. W. Stose, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179, p. 5). *McKenzie fm.*—Thin beds of gray crystalline ls. in gray sh., with 40 ft. of hard white ss. (*Keefer ss. memb.*) at base. Thickness 170 to 300 ft. Overlies Clinton sh. and underlies Bloomsburg red ss. memb. of Wills Creek sh. Basal fm. of Cayuga group. In Cumberland area, to W., the Keefer ss. is not recognizable and ls. and shales of the Clinton pass into those of the Cayuga without marked lithologic break, a faunal change only being observed.

G. W. Stose, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 89). The stratigraphy presented by Mr. Swartz in the diagrams [not published] is no doubt more accurate and final than that in my rept on E. part of area about Hancock, Md. In regard to faunal relations of *Kiefer ss.*, I do not feel competent to speak, but Mr. Ulrich, who was responsible for having it made a memb. of McKenzie fm. in my rept, has, in recent table [not published] placed it as a memb. of Clinton fm., thus agreeing with Mr. Swartz.

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 536). *Keefer ss. memb.* included in Clinton fm. [This is present generally accepted definition.]

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol.), identified 20 to 45 ft. of beds as composing Rochester fm. of Clinton group of Md., consisting of (ascending) *Keefer ss. memb.* (11 to 35 ft. thick), Roberts iron ore, and a few ft. of interbedded calc. sh. and thin gray crystalline ls.

The McKenzie is lower fm. of Cayuga group, as generally classified, but F. M. Swartz (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1165–1194, 1935) believes lower part is=Lockport dol. of Niagara group.

Named for McKenzie Station, Allegany Co., Md.

McKenzie Hill limestone.

Ordovician (Lower): Central southern Oklahoma (Murray County).

J. Bridge, 1936 (A. A. P. G. Bull., vol. 20, No. 7, pp. 982–983). C. E. Decker has recently subdivided Arbuckle ls. into several units, but the published digest of his paper (Tulsa Geol. Soc. Digest, 1933, pp. 55–57) does not give much idea of boundaries of his subdivisions. The Honey Creek, Fort Sill, Royer, and Signal Mtn fms. had previously been described by Ulrich. The names *Chapman Ranch* and *McKenzie Hill* (the former from Chapman's Ranch on Highway 77 and the latter from a small hill S. of Signal Mtn, near Fort Sill, Okla.) have never been defined, although Ulrich has used them repeatedly in correspondence and ms. The following is sequence and approx. position of these units (descending): (1) Undiff. Arbuckle ls.; (2) *McKenzie Hill*, bdy indefinite to (3) *Chapman Ranch;* (4) unnamed unit, bdy indefinite to (5) Signal Mtn; (6) Royer; (7) Ft. Sill; and (8) Honey Creek, which rests on Reagan ss. In describing fossils from Mo., Ulrich and I (Mo. Geol. Surv. Bull. 24, 1930, p. 195) stated that some of sp. also occur in Ulrich's proposed Chapman Ranch fm., and also that the Chapman Ranch is in part=the Van Buren. Ulrich now considers Chapman Ranch fm. to be exact equiv. of the Van Buren. This would restrict it to the 144 ft. of beds in Decker's unit 184 and possibly some of unit 183. Ulrich has always used *McKenzie Hill* to denote lss. in Arbuckle and Wichita Mtns which carry Gasconade fauna, and in this section the name should be applied to Decker's units 181, 182, and possibly 183. The contact btw. the two has not been satisfactorily established in the section.

See also under *Arbuckle group*, Decker, 1933.

McKerney limestone member (of Hannibal shale).

Mississippian: Southeastern Iowa (Des Moines County) and central western Illinois (Pike County).

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 20, 21, 22, 49, 58–59). *McKerney ls. memb. of Hannibal fm.*—Bluish-drab "fragmental" ls., fine-grained, very hard, compact, with sharply conchoidal fracture, slightly irregular bedding and partially altered to brown mag. ls. Thickness at Kinderhook, Ill., 6 ft.; at Burlington, Iowa, 10 ft. 8 in. At Burlington, Iowa, it underlies Prospect Hill ss. memb. of Hannibal fm. and overlies English River ss. memb. of the Hannibal. At Kinderhook, Ill., is discon. overlain by Lower Burlington ls., and rests on a ss. tentatively correlated with English River ss. Only 7 fossil sp. found, not one of which is present in typical Louisiana ls. fauna of Mo., with which this ls. has hitherto been correlated, and its strat. position appears certainly to be distinctly higher than the Louisiana. Judged by fauna and lithology there is nothing in Hannibal fm. of Mo. corresponding to McKerney ls. Exposed in small deep ravine in Miss. bluffs just S. of McKerney Creek, at Kinderhook, Ill.

McKim graywacke.

Pre-Cambrian: Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept. 1905, vol. 14, pt. 3, p. 14).

Mackinac limestone.

Middle Devonian: Northern Michigan.

C. C. Douglass, 1839? (Mich. Leg. House Doc. 27, btw. pp. 97 and 111). *Mackinac ls.*—Very porous and much shattered ls. of Mackinac Island.

C. Whittlesey, 1851 (rept. of J. W. Foster and J. D. Whitney on geol. Lake Superior land dist., pt. 2, S. Ex. Doc. 4, special sess., March 1851, pp. 177–183). *Mackinac ls.*, 350 ft. thick, is=in part Onondaga salt group and upper Helderberg ls. Overlies Coralline and marly beds 200 to 250 ft. thick near Mackinac.

Mackinaw limestone.

Same as *Mackinac ls.*

McKinney basalt.

Pleistocene: Southern Idaho (Gooding County region).

H. T. Stearns, 1932 (Correlation chart of Idaho, compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *McKinney basalt.*—Decidedly porphyritic grayish-black pahoehoe basalt containing phenocrysts of fresh green olivine and long laths of plagioclase. Thickness 20 ft. on plains and 500 ft. in Snake River Canyon. Issued from McKinney Butte, NW. of Gooding, and displaced part of Big Wood River and Snake River btw. King Hill and Bliss. Older than Sand Springs basalt and may be older than Bliss basalt, or latter may be a subaqueous facies of the McKinney.

McKissick shale formation.

See following entries under *McKissick Grove fm.*: VerWiebe and Vickery, 1932, and Condra, 1935.

McKissick Grove shale. (In Wabaunsee group.)

Pennsylvanian: Southwestern Iowa and southeastern Nebraska.

G. L. Smith, 1909 (Iowa Geol. Surv. vol. 19, pp. 617, 631, 638, 645). *McKissicks Grove sh.*—Blue and gray shales, 75 ft. thick, with two or three thin ls. beds and a thin ss., forming top part of Atchison shales. Overlies Tarkio ls. (25 ft. thick) and represents close of Carbf. in Iowa. Included in Missouri stage.

J. L. Tilton, 1924 (Iowa Geol. Surv. vol. 29, p. 239). *McKissick Grove sh.* is here applied to all the strata that are found in Iowa above Tarkio ls. Thickness 91 to 93 ft.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 73, 74, 80).—*McKissick Grove sh. memb. of Wabaunsee fm.*—As originally defined by Smith it included all Penn. beds above Tarkio ls. in Iowa. This definition is objectionable, because topmost bed of Penn. of Iowa probably is covered somewhere in Missouri River bluffs or in uplands, awaiting discovery, and therefore is not a fixed horizon. Highest known exposed Penn. horizon of Iowa is in lower part of Aspinwall sh., but highest well-defined marker would be Brownville ls. or the better-shown Dover ls., which outcrops at McKissick Grove, below which Tarkio ls. is exposed. If McKissick Grove is to be retained it should have definite upper and lower boundaries. This has been taken up with Iowa Geol. Surv. in field and decided that top of McKissick Grove memb. should be at base of Brownville ls. As thus defined the memb. is 63 ft. thick, and is divided into (descending) Pony Creek sh., Dover ls., Table Creek sh., Maple Hill ls., and Pierson Point sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 96). *McKissick Grove sh.* includes (descending) Pony Creek sh., Jim Creek ls., Table Creek sh., Dover ls., Frenck sh., Maple Hill ls., and Pierson Pt. sh. Underlies Brownville ls. and overlies Tarkio ls.

W. A. VerWiebe and W. R. Vickery, 1932 (p. 110 of book last cited above), used *McKissick sh. fm.* for beds below Brownville ls. and above Tarkio ls.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised chart). *McKissick Grove sh.* includes (descending) Pony Creek sh., Nebraska City ls., Frenck sh., Dover ls., Table Creek sh., Maple Hill ls., and Pierson Point sh. Underlies Brownville ls. and overlies Tarkio ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 9–10). *McKissick sh. fm.* [restricted] underlies *Dover ls. fm.* and overlies Tarkio ls. Includes (descending) Table Creek sh., Maple Hill ls., and Pierson Point sh. [The beds btw. Brownville ls. and his Dover ls. fm. he called *Pony Creek sh. fm.*]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 232), discarded McKissick Grove sh. and treated its subdivisions as fms. in Wabaunsee group.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for McKissick's Grove, 2 mi. NE. of Hamburg, Fremont Co., Iowa.

McKittrick formation.

Pliocene and lower Pleistocene (?): Southern California (McKittrick-Sunset district).

R. Arnold, 1909 (U. S. G. S. Bull. 396, p. 22). At most localities along flanks of Diablo and Temblor Ranges S. of Coalinga dist. it is impossible to separate the post-Santa Margarita (?) Tert. fms., and to these beds—the equiv. of Jacalitos, Etchegoin, and possibly Tulare fms. of Coalinga dist.—the name *McKittrick fm.* has been given in McKittrick dist. (R. Arnold and H. R. Johnson, U. S. G. S. Bull. 406 [1910]). This name was chosen because of importance of the beds in that dist., the basal members yielding the petroleum found in the productive McKittrick field.

R. Arnold and R. Anderson, 1910 (U. S. G. S. Bull. 398, p. 79). To S. of Coalinga dist. the *McKittrick fm.* is distributed over both sides of Temblor Range along most of its length and forms whole of Buena Vista and Elk Hills. On E. side of Temblor Range it consists of coarse to fine cgls. and coarse sands near its base, then a zone of bluish sandy clay, then medium to coarse sands and sandy shales, and at top a succession of alternating coarse gravel and clay beds. Thickness ranges from 1,300 to possibly 2,500 ft. Uncon. overlies Monterey and Santa Margarita (?) fms. and is uncon. overlain by Quat. deposits. Is=Jacalitos, Etchegoin, and Tulare fms. of Coalinga dist.

R. Arnold and H. R. Johnson, 1910 (U. S. G. S. Bull. 406, pp. 74–90). [Same definition as above.] Named for exposures ½ mi. S. of McKittrick, Kern Co.

Macksburg sandstone.

Pennsylvanian: Southeastern Ohio.

E. Lovejoy, 1888 (Ohio Geol. Surv. vol. 6, pp. 628, 635). *Macksburg ss.*, 60 ft. thick, lies at top of Upper Coal Measures in Athens and Morgan Counties. Underlain by Macksburg coal.

Probably named for Macksburg, Washington Co.

Macksburg sands.

Pennsylvanian: Southeastern Ohio.

J. A. Bownocker, 1903 (Ohio Geol. Surv. Bull. 1). *Macksburg 500-foot sand*, 22 ft. thick, is top memb. of Pottsville group in Ohio.

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21). *Macksburg 500-foot sand* appears=Clarion ss. of Allegheny fm.

J. R. Lockett, 1927 (A. A. P. G. Bull., vol. 11, No. 10). *Macksburg sand* of eastern Ohio lies 125 ft. below Peeker sand and 50 ft. above Second Cow Run sand.

K. Cottingham, 1927 (A. A. P. G. Bull., vol. 11, p. 951). *Macksburg (500-foot) sand* is basal part of Allegheny fm.

W. Stout et al., 1935 (Geol. of nat. gas, A. A. P. G., pp. 901–902). *Macksburg 300-foot sand* is Mahoning ss. memb. of Conemaugh fm.; *Macksburg 500-foot sand* seems to be same as Clarion ss. memb. of Allegheny fm.

Mackworth slate. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Washington Acad. Sci. Jour., vol. 7, p. 198). [*Mackworth sl.* mentioned as a fm. of Casco Bay group. Not defined.]

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 172). *Mackworth sl.*—Qtzite and quartz-chlorite-mica sl., in beds less than an inch to 2 or 3 ft. thick. Rocks dominantly siliceous and laminated and characterized by abrupt alternations from flinty to chloritic slate. Range from white through drabs and light grays to dark grays and browns. Estimated thickness 100 ft. Top of fm. unknown. Is uppermost fm. of Casco Bay group. Probably overlies Jewell phyllite conformably. Assigned to Penn. (?). Named for development on Mackworth Island, Casco Bay.

McLeansboro formation.

Pennsylvanian: Illinois and western Kentucky.

F. W. DeWolf, 1910 (Ill. Geol. Surv. Bull. 16, p. 181). *McLeansboro fm.*—Uppermost Penn. fm. in Ill. Conspicuously shaly, but locally contains sss., lss., and thin coals. Base defined by top of coal No. 6 [Herrin coal]. Thickness 919 to 1,155 ft.

Overlies Carbondale fm. In western Ky. and SE. Ill. underlies Henshaw fm. Is correlated by D. White with upper part of Allegheny fm. and with Conemaugh fm.

Named for McLeansboro, Hamilton Co., Ill.

McLeod member (of Kootenai formation).

Lower Cretaceous: Alberta.

J. A. Allan and R. L. Rutherford, 1924 (Alberta Sci. and Indus. Research Council Rept. No. 9, p. 23).

McLish formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle and Wichita Mountains).

E. O. Ulrich. [See under *Falls fm.*]

C. E. Decker, 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498–1505). *McLish fm.*—Chiefly lss.; some sh.; with ss. (8 to 200 ft. thick) at base and some sss. higher up. Contains limited but very distinctive fauna. Thickness 300 to 500+ ft. Underlies Tulip Creek fm. and overlies Oil Creek fm. Same as Falls fm., and latter name abandoned.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 12, 98). A 7-partite div. of Simpson group has been used during part of this study, and the 2 additional fm. names used temporarily are *Falls Creek* and *Criner*. Briefly these 2 fm. names were used and later discarded for the following reasons: The McLish has a distinctive though rather limited fauna the major part of which has been traced to the region a short distance S. of Sulphur, and it was then thought the McLish was not represented in W. part of mtns, and *Falls Creek* was used for the fm. in this western region, btw. the Oil Creek and Tulip Creek fms. But, because the marked lower cystid zone, which occurs a short distance above the second ss. called "Burgen" along Highway 77, extends E. and ties in with McLish fauna at Roff, in region E. of Sulphur, and at Bell school house 2½ mi. NW. of Connerville, it is thought the body of rocks temporarily named *Falls Creek* is approx. = the McLish to E. Further confirmation of this view is found at N. edge of Criner Hills.

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 105). Falls fm. is an older unit than McLish. It is confined mainly to SW. half of Arbuckle uplift and McLish to NE. half, the two fms. occurring one above the other in a few intermediate localities. *Simpson group* divided into 8 fms. [See this entry under *Simpson fm.*]

C. E. Decker, 1933. [See this entry under *Simpson fm.*]

Named for McLish ranch, T. 1 S., R. 7 E., Johnston Co.

McLure shale member (of Monterey shale).

Miocene (upper): Southern California (Fresno and Kings Counties).

G. Henny, 1930 (A. A. P. G. Bull., vol. 14, No. 4, p. 403). *McLure sh.* is name given by writer to the brown sh. of southern Coalinga region, Fresno and Kings

Counties, previously termed *Santa Margarita (?) sh.* on geol. maps of U. S. Geol. Survey. It is found, however, that this sh. lies with angular uncon. on Santa Margarita ss. (Mio.), and that the Etchegoin (Plio.) lies uncon. on the sh. Whether it is upper Mio. or lowest Plio. in age has not been determined. Average thickness 800± ft. Base consists of 30± ft. of light-gray coarse ss. with concretions. Borders McLure Valley on nearly all sides. Type loc. is a canyon crossing Tent Hills S. of Avenal Creek near W. line of sec. 6, T. 24 S., R. 17 E. In Zapata Canyon it overlies Temblor ss. In Devils Den it rests uncon. on Monterey sh.

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, pp. 1175–1177, 1180). Because Reef Ridge sh. weathers brown it is not certain whether Henny intended to include in his McLure sh. both the Reef Ridge sh. and the underlying siliceous shales, or merely the latter. The ambiguity is increased by fact that Arnold and Anderson were inconsistent in mapping of Reef Ridge sh., sometimes including it as upper part of Santa Margarita (?) fm. and sometimes in "Transition zone mapped as Jacalitos." Writers are tentatively using *McLure sh.* to designate that body of brown sh. recognized in Kettleman Hills wells as lying uncon. below the blue sh. of the Reef Ridge and uncon. above Temblor fm. The term is thus restricted to lower memb. of Santa Margarita (?) of Arnold and Anderson in their mapping in SE. end of Reef Ridge and to Santa Margarita (?) of same authors in NW. end of Reef Ridge. Upper members are chocolate-brown but weather white. The McLure sh. is unquestionably a part of Maricopa sh. Thickness in Kettleman Hills 1,200–1,600 ft. In the outcrops along Reef Ridge there is a thin cgl. at base of McLure sh. containing pebbles derived from Franciscan fm.

W. F. Barbat and F. L. Johnson, 1934 (Jour. Pal., vol. 8, No. 1, p. 4). Henny defined "McLure sh." as replacing Santa Margarita (?) of Arnold and Anderson. But as Arnold and Anderson were inconsistent in their mapping of "Santa Margarita (?)," Henny's definition of "McClure sh." is ambiguous. Whether "McLure" is applicable to present Reef Ridge sh. and lower div. of Arnold and Anderson's "Santa Margarita (?)," or only to Arnold and Anderson's lower div., is a matter of opinion; but it is believed Henny had in mind only the lower div. of "Santa Margarita (?)" when he proposed "McLure." To avoid confusion, the "McLure sh." is to be regarded as former "Santa Margarita" exclusive of Reef Ridge sh. None of the Reef Ridge is exposed at type loc. of "McLure." The "McLure" is of Santa Margarita age. [See also under *Reef Ridge sh.*]

The U. S. Geol. Survey now treats this sh. as a memb. of Monterey sh., and assigns it to upper Mio. (See 1934 entry under *Reef Ridge sh.*)

†Maclurea limestone.

†Maclurea limestone series.

Lower Ordovician: Eastern Tennessee and Alabama.

Paleontologic names used in early Tenn. and Ala. repts for rocks of Chazy age, containing sp. of *Maclurea*.

McMicken member. (In Latonia shale.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 10). *McMicken.*—Highly calc. and extremely fossiliferous shales and lss., 60 ft. thick, holding the bryozoan *Dekayella ulrichi* in great abundance, and comprising upper third of Eden fm.

Now treated as upper memb. of Latonia sh., of Eden group.

Named for McMicken Avenue, Cincinnati, Ohio.

McMillan formation. (In Maysville group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 10). *McMillan fm.*—The Bellevue, Corryville, and Mount Auburn members are closely related and not of sufficient importance to be mapped separately. The three are here recognized as members of the new fm., the *McMillan,* from the street of that name at Cincinnati along which the 85 ft. of strata comprising this fm. are fairly well exposed. Overlies Fairview fm. and underlies Richmond group.

Now treated as upper fm. of Maysville group.

McMillan sand.

A subsurface sand, of Penn. age, in Runnels Co., north-central Tex., lying at 2,600 ft. depth.

McMurray formation.

Lower Cretaceous: Alberta.

F. H. McLearn, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 147). [Assigned to Cret.]

J. A. Allan and R. L. Rutherford, 1934 (Alberta Sci. and Indus. Research Council Rept. No. 30, p. 13), assigned this fm. to Lower Cret.

†McNairy shell bed.

Upper Cretaceous: Western Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 156). *McNairy Shell-bed (Green sand).*—Sometimes called rotten ls., because it has appearance, especially in Ala. and Miss., of a soft chalky ls. Consists of fine quartzose sand mixed with clay and much calc. matter. Contains also green grains of glauconite, which give greenish color to the stratum, hence the name green sand. Abundance of fossil shells of many varieties. Overlies Coffee sand and underlies Ripley fm. Occupies belt through E. part of McNairy and Henderson Counties and extreme W. part of Hardin and Decatur Counties. Max. thickness of 350 ft. is in McNairy Co.

Same as Selma chalk, older name.

Named for McNairy Co.

McNairy sand member (of Ripley formation).

Upper Cretaceous: Western Tennessee and Kentucky, southwestern and southeastern Illinois, and northern Mississippi.

L. W. Stephenson, 1914 (U. S. G. S. P. P. 81, pp. 18, 22). *McNairy sand memb. of Ripley fm.*—In vicinity of [southern] Tenn. State line and northward in Tenn. all but basal beds of Ripley fm. appear to merge along the strike into shallow-water equivalents consisting of irregularly bedded, largely nonglauconitic sands and subordinate clays, probably in part marine, in part estuarine, and in part fresh water. Since time of Safford these beds have been correlated with Ripley fm. Their lithologic dissimilarity to typical Ripley materials seems to justify use of a memb. name to designate them. Type section is in cut of Southern Ry. 1¼ mi. W. of Cypress Station, McNairy Co., where the railroad passes through a ridge known as "Big Hill." Max. thickness probably 400 to 500 ft. Uncon. overlain by Eocene. [As thus defined included Owl Creek fm. at top and as mapped included at base the ferruginous clays, 100 ft. thick, of Wade's 1917 rept.]

B. Wade, 1917 (Johns Hopkins Univ. Circ., n. s., No. 3, pp. 73–100), divided Ripley fm. of SW. Tenn. into (descending): (1) *Owl Creek horizon;* (2) McNairy sand memb. [restricted]; (3) ferruginous clay horizon, 100 ft. thick; and (4) Coon Creek horizon, 30 ft.

B. Wade, 1926 (U. S. G. S. P. P. 137), divided Ripley fm. of Tenn. into (descending): (1) *Owl Creek tongue;* (2) McNairy sand memb.; and (3) Coon Creek horizon, including at top the 100 ft. of ferruginous clay described in his 1917 rept.

According to L. W. Stephenson, 1936 (personal communication July 17), McNairy sand memb. is present in Pulaski Co., SW. Ill., and in Massac Co., SE. Ill. The Owl Creek is now treated as a distinct fm. by U. S. Geol. Survey.

McNamara formation.

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deiss, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 680, figs. 2, 3). *McNamara fm.*—Upper memb., 1,780 ft. thick, chiefly argillites, some qtzite and some ss.; middle memb. 810 ft. thick, almost wholly qtzites; lower memb., 410 ft. thick, purple to green-gray micaceous sandy argillite, with thin sandy qtzite beds in upper part. Rests conformably on Hellgate fm. 2 mi. N. of McNamaras Landing. Overlain by Garnet Range fm. [Gives details of type section, along Blackfoot River, in vicinity of McNamaras Landing.] Included in Missoula group.

McNaughton sandstones.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll. vol. 57, No. 12, pp. 335, 339).

McNulty rhyolite.

Eocene: Western central Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48). *McNulty rhyolite* cuts both Lincoln and Quail porphyry. Occurs in small irregular masses in McNulty Gulch and extends to S.

Called *McNulty Gulch rhyolite* by W. Cross, 1886.

McNulty Gulch rhyolite.

Eocene: Western central Colorado (Tenmile district).

W. Cross, 1886 (U. S. G. S. Mon. 12, p. 350). *McNulty Gulch rhyolite.*—Light colored; numerous slightly pinkish quartz crystals, white glassy feldspars, and brown biotite leaves, with subordinate ashen gray groundmass btw. them.

Called *McNulty rhyolite* by S. F. Emmons, 1898.

Named for occurrence in one large and several small bodies at head of McNulty Gulch, which runs N. and enters Tenmile River at Carbonateville, Summit Co.

Macoma sands.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 224).

Macomb granite.

Pre-Cambrian: Northern New York (St. Lawrence County).

H. P. Cushing, 1916 (N. Y. State Mus. Bull. 191, pp. 13, 17, 18, 19, 25, 26). *Macomb granite.*—In large part a fine-grained red orthogneiss, composed chiefly of feldspar and quartz, but with a variable amount of black mica. Occurs at Macomb [St. Lawrence Co.]. Is pre-Camb., but uncertain whether it belongs to the older Laurentian intrusives or to the younger "Algoman" intrusives. We are disposed to class it as Laurentian.

Macomb's Dam gneiss.

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116–120). [On his "Section across New York [Manhattan] Island along southern shore of Spuyten-Duyvel Creek and Harlem River" the name *Macomb's Dam gneiss* is applied to one of the bodies of gneiss shown. In U. S. G. S. New York City folio (No. 83) the gneiss of this region is mapped as Fordham gneiss.]

Macon City shale.

Pennsylvanian: Northern Missouri.

C. H. Gordon, 1893 (Mo. Geol. Surv. Sheet Rept. No. 2 (vol. 9), p. 60). *Macon City sh.*—Soft plastic fine-grained olive-green sh., 5 to 15 ft. thick, overlying Macon City coal in Bevier quad. (parts of Macon, Randolph, and Chariton Counties).

Is a part of Cherokee sh. and is separated from underlying Macon City (Mulky) coal by a cap of ls.

Named for Macon, Macon Co.

Macoupin limestone. (In McLeansboro formation.)

Pennsylvanian: Southwestern Illinois (Macoupin County) and central western Illinois (Sangamon County).

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804), showed *Macoupin ls.* lying a few ft. above coal No. 9, about 30 ft. below Shoal Creek ls., and 35± ft. above Carlinville ls., but he did not describe it.

J. R. Ball, 1934 (Ill. Acad. Sci. Trans., vol. 26, No. 3, p. 97). *Macoupin ls.* of Carlinville quad. [type region] resembles Centralia ls. but lies 17± ft. higher, and lies 40± ft. above Shoal Creek ls., which has also been called "Carlinville ls."

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129–138). Macoupin ls. is 4 to 7 ft. thick locally in Sangamon Co. and is known as *Crows Mill ls.*

Apparently named for Macoupin, Macoupin Co., which adjoins Sangamon Co. on S.

Macoupin cyclical formation.

A name applied by H. R. Wanless (Geol. Soc. Am. Bull., vol. 42, 1931, pp. 801–812) to a middle portion of McLeansboro fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 9 and Macoupin ls. Derivation of name not stated.

McPherson marble.

Middle Ordovician: Central eastern Missouri.

B. F. Shumard, 1873 (Mo. Geol. Surv. Rept. 1855–1871, p. 307). Light-drab brittle ls., 2½ ft. thick, with bluish cloudings, forming handsome and durable building rock (*McPherson marble*). Included in lower part of Bird's-Eye ls. Underlies compact even-bedded light-bluish ls. with dark-bluish cloudings and containing chert nodules and crystalline bands, also included in Bird's-Eye ls. Lies 30 ft. above First Mag. ls.

Is a bed in Plattin ls.

Named for McPherson's marble quarry, Jefferson Co.

McPherson formation.

Pleistocene (pre-glacial): Central Kansas.

E. Haworth and J. W. Beede, 1897 (Kans. Univ. Geol. Surv. vol. 2, pp. 287–296). *McPherson Equus beds.*—Alternating layers of fossiliferous sand and clay, with stratum of volcanic ash in part of northern area and in places heavy gravel stratum near bottom. Thickness 65 ft. Overlies Dakota ss.

Named for exposures in McPherson Co. Kans. Geol. Surv. Bull. 6, pt. 2, 1920, pl. xiii, on p. 92, mapped the distribution of this fm. in Kans.

Macquereau series.

Ordovician or Cambrian: Quebec.

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 39).

McRoberts sand.

A subsurface sand in Mansfield ss. (Penn.) of Ind.

Madame Joie formation.

Miocene: Haiti.

W. P. Woodring, 1922 (Haiti Geol. Surv., Stratigraphy, structure [etc.], of central plain, p. 6).

†Madder dirt.

See †*Kimball or* †*Madder dirt.*

Maddox limestone.

Silurian: West-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 565, 579). At base of Sil. section at Swallow Bluff, Maddox mill, and W. D. Helton's, also at New Era and Kelley Landing, there is a considerable section of ls., usually whitish in color, massive at base and more distinctly bedded near top. Occurs below the beds referred to Osgood horizon. Thins out toward Riverside and Iron City. Base of section at least is equal to the [so-called] Clinton; top may belong to Osgood horizon; position of intermediate part is doubtful. It is evident the plane of div. btw. Clinton and Osgood beds is rising southward and that the lithological divisions here do not correspond strictly to those farther N. and NE. For present the name *Maddox ls.* may prove convenient for the massive ls. in question.

Named for Maddox mill, Hardin Co.

Madera diorite.

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Madera diorite.*—Quartz mica diorite; usually a gray rock of granitic texture and habit, consisting essentially of plagioclase, feldspar (usually andesine) with quartz and biotite. Named for Mount Madera, one of the peaks of Pinal Range (in Globe quad.), of which it occupies the crest. Intrudes Pinal schist, which is overlain by Apache group.

Madera limestone. (Of Magdalena group.)

Pennsylvanian: Central New Mexico.

C. R. Keyes, 1903 (Ores and Met., vol. 12, p. 48). The upper Carbf. blue to gray beds, the superior part of the great ls. fm., are called *Madera ls.* in Sandia Mtns. They overlie middle Carbf. lss.

C. R. Keyes, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 360–362). *Madera fm.* consists of 300 ft. of lss. underlying Bernalillo shales and overlying Sandia lss., 300 ft. thick, which rest on Lake Valley ls.

C. H. Gordon, 1907 (Jour. Geol., vol. 15, pp. 810–816). *Madera ls.*—Dark-blue ls., 300 to 700 ft. thick. Top fm. of Magdalena group. Overlies Sandia fm. and uncon. underlies Manzano group.

Maderan series.

A time term introduced by C. R. Keyes to cover part of the Carbf. (Penn.?) rocks of N. Mex.

†Madison water limestone. (In Richmond group.)

Upper Ordovician: Southeastern Indiana.

D. D. Owen, 1859 (Rept. geol. reconn. Ind. made in 1837, p. 28). *Madison water ls.*—Dark-gray fossiliferous ls. 13 ft. thick. Overlain by 93 ft. of mag. lss. and underlain by 40 feet of thin-bedded blue lss. alternating with dark marlite.

Conflicts with better-established name of Miss. ls. in Rocky Mtns. Probably forms lower part of †Madison beds (Saluda) of later repts, according to Cumings (1922).

Named for Madison, Jefferson Co.

†Madison beds. (In Richmond group.)

Upper Ordovician: Indiana, southwestern Ohio, and north-central Kentucky.

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., p. 139). *Madison rocks.*—Thin stratified dark-blue crystalline lss. with intermediate layers of lighter-colored coarse-grained ls. Top fm. of Cincinnati group.

A. F. Foerste, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., pp. 218, 220). *Madison beds.*—Argill. lss., 30 to 60 ft. thick, consisting of white ls. layer at top, *Murchisonia hammelli* beds in middle, and typical Madison beds (argill. or very impure ls.) at base. Form topmost part of Cincinnati group. Underlain by 80 ft. of richly fossiliferous interbedded shales and lss.

A. F. Foerste, 1902 (Am. Geol., vol. 30, p. 369). "Madison bed" replaced with *Saluda bed*, because of conflict of Madison.

J. M. Nickles, 1903 (Am. Geol., vol. 32, pp. 202–218). *Madison fm.* preferred by writer to *Saluda*. Top fm. of Richmond group in Cincinnati area. Writer includes at top the Belfast bed of Foerste, which Foerste excluded from Madison.

Named for Madison, Jefferson Co., Ind.

Madison sandstone.

Cambrian (Upper): Southern Wisconsin.

R. D. Irving, 1875 (Am. Jour. Sci., 3d, vol. 9, p. 442). *Madison ss.*, 35 ft. thick in south-central Wis., underlies ls. correlated with Shakopee ls. [as here used includes Oneota dol.] of Minn. and overlies Mendota ls.

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, p. 260). *Madison ss.*—Rather coarse-grained, thick-bedded, compact, soft, slightly calc., light-colored ss. 35 ft. thick. Top subdivision of Potsdam ss. Grades into underlying Mendota ls. Named by Prof. Irving from its occurrence in vicinity of Madison, where it is quarried. He regards it as a memb. of Calciferous group above, but I differ with him.

R. D. Irving, 1877 (Geol. Wis., vol. 2, pp. 525, 577, 584, 590, 591, 592, 602, 603). *Madison ss.*—Larger part nearly pure white quartz sand, or sand turned brown by oxide of iron; toward top generally becomes somewhat dolomitic, the upper limit being frequently marked by layers of greensand and oolitic chert. Quarried at Madison. Thickness 35 to 60 ft. Overlies Mendota ls. and grades into overlying Lower Mag. ls. Only intended as local name in central Wis.

In subsequent repts this ss. was correlated with Jordan ss. by several authors, including E. O. Ulrich. Later work, however, led Ulrich to belief that it is younger than Jordan ss. He later stated (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93, 1924) that it lies stratigraphically below Oneota dol., and is younger than Jordan ss., and he assigned the Madison, Mendota, and underlying Devils Lake ss. of eastern Wis. to his Lower Ozarkian and the Jordan ss. to underlying Upper Camb.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 63, 64). Unless we are mistaken the 39 ft. of Madison ss. at Madison, Wis., is = whole of Jordan fm. elsewhere.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 6, 8, 25–26). *Madison fm.* overlies Trempealeau fm. (the top memb. of which is Jordan ss.) and is uncon. overlain by Oneota fm. It is composed of sss. The Mendota dol. is now considered to be same as Black Earth dol. memb. of St. Lawrence (†Trempealeau fm. of some authors). [See under *Mendota dol.*]

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 61). *Madison memb of Trempealeau fm.* (*Madison fm.* of Raasch, p. 302) is introduced at Victory, Wis. The Madison has not been recognized in Iowa and Minn. as a separate memb. or fm., but these beds occur in sections at McGregor [Iowa] and Lansing. Being unable to find a plane of separation btw. these beds and underlying Jordan ss. that can be recognized in more than a few sections, the stratigraphers of Minn. and Iowa classify the Madison of Wis. merely as upper beds of the Jordan. [In this Field Conf. rept many geologic sections are given in Wis., and one in Minn., showing Madison ss. overlying Jordan ss. Page 21 (also pp. 313–315) states Raasch objects to including Madison in Trempealeau fm. Fig. 1, however, includes the Madison in † Trempealeau fm., but excludes it from Jordan ss. Page 442 gives a section at city quarry at Madison, Wis., and restricts *Madison* to upper 10 ft. of sss. present there, or to "Madison building stone." Page 445 gives a "general section" at Madison, Wis., in which the 39 ft. of ss. present at top of section is all assigned to Jordan ss.]

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1687–1743). *Madison memb.* is here treated as top div. of Trempealeau fm., overlying the Jordan memb., although Twenhofel and Thwaites think Madison represents a lithic phase, succeeding, and perhaps in part lateral to, the sss. of Jordan aspect. If long sections could be seen, possibly this gradation could be traced. At type exposures the base of the Madison is concealed. The ss. has been quarried at type loc. (Madison, Wis.) for over 90 years. It overlies Jordan memb. of the Trempealeau, which is not seen in the quarries, and which differs from the quarry stone in less evenness of bedding, more cross lamination, and poorer cementation. The Jordan memb. can be seen in South Madison railroad cut, where the quarry stone is not present, and in the Mendota cut N. of Madison, where a few ft. of quarry stone are present. So far as known to writers the Madison is absent in Chippewa River country and northwestward. In some districts sand-pebble cgls. occur at different levels in the Jordan. Raasch is strongly inclined to concur with bulk of published accounts of last quarter century in regarding the Madison as separate fm., younger than Jordan. He bases his opinion primarily on sedimentary and lithologic criteria. The other authors place little weight on criteria used by Raasch and prefer to follow Trowbridge and Atwater in considering the Madison as top memb. of Trempealeau fm. In places it is difficult to locate top of Trempealeau fm., because overlying Oneota fm. not infrequently begins with sss. not greatly unlike the Madison and Jordan. But in places there is well-developed cgl. at base of Oneota, and not uncommonly an erosion surface.

F. W. Sardeson, 1936 (Pan-Am. Geol., vol. 65, p. 344). *Madison ss.* is synonym of Jordan ss.

E. O. Ulrich, 1936 (Geol. Soc. Am. Proc. 1935, p. 113). There are 3 sss. in Wis. that previously have been regarded as constituting an indivisible strat. unit. The Norwalk ss. is top memb. of Trempealeau fm., the Jordan is a separate final deposit of the Camb. of upper Miss. Valley, and the Madison is first deposit of Ozarkian of the region.

The U. S. Geol. Survey at present treats Madison ss. as a distinct fm., overlying Jordan ss. and underlying Oneota dol., and classifies it as Upper Camb.

Madison limestone.

Mississippian (lower): Montana (widespread), Wyoming (rather widespread), Idaho, northern Utah.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Madison ls.*—Consists of (descending): Massive jaspery lss., 575 ft.; light bluish gray massive lss., 350 ft.; dark-colored compact laminated lss., 325 ft. Fossils listed. Rests on Dev. Threeforks sh. and is overlain by Quadrant fm.

Named for Madison Range, central part of Threefords quad., Mont., where it is conspicuously developed.

Madison coral reef. (In Richmond group.)

Upper Ordovician: Southwestern Ohio and southeastern Indiana.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull., vol. 14, p. 290). *Madison coral reef* lies at base of Saluda bed in Ind. and Ohio.

Probably named for Madison, Jefferson Co., Ind.

†Madison sand. (In Vicksburg group.)

Oligocene (lower): Southwestern Mississippi.

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 82). *Madison sands.*—Distinctly stratified, non-fossiliferous, prevailingly gray sands, sometimes varying from gray to yellow and white. Thickness 50 to 75 ft. First noted in Madison Co., hence the name. Also exposed near Madison, Madison Co. May belong to either Jackson or Vicksburg group.

Name preoccupied and replaced by Forest Hill sand. More recent studies (by C. W. Cooke) have shown this sand to be basal fm. of Vicksburg group, and the nonmarine equivalent of Red Bluff clay (marine). (See also *Forest Hill sand* and *Red Bluff clay*.)

Named for Madison Co. and for exposures near Madison in that county.

Madison Hill sand.

A subsurface sand, of probable Dev. age, in western N. Y., lying higher than Bradford and Richburg sands.

Madisonic period.

Pre-Cambrian: Montana.

See under *Bitterroot period.*

†Madison Valley beds.

Tertiary (upper Miocene or lower Pliocene): Central southern Montana (Three Forks region).

E. Douglass, 1903 (Carnegie Mus. Annals, vol. 2, pp. 151–155). *Madison Valley beds*, a phase of Loup Fork Mio. in lower Madison Valley. Overlie White River Olig.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65, 115), assigned †*Madison Valley beds* of Mont., 1,200 ft. thick, to upper Mio.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 9, 25, 27), assigned these beds to upper Mio. or lower Plio.

Madisonville limestone. (In McLeansboro formation.)

Pennsylvanian: Western Kentucky.

C. J. Norwood, 1878 (Ky. Geol. Surv. n. s., vol. 4, pp. 319–320). *Madisonville ls.*—Massive fossiliferous ls., 4 ft. thick, usually drab and dove-colored, some parts blue, exposed at spring at Madisonville. Overlain by sh. and underlain by 1 ft. of nodular ls. succeeded below by shales and interbedded nodular and other lss. Lies about 80 ft. above coals A and B. [Later rept (Ky. Geol. Surv. Bull. 19, p. 13) states this ls. lies almost midway btw. coals Nos. 14 and 15, or about 300 ft. above coal No. 9.]

F. M. Hutchinson, 1912 (Ky. Geol. Surv. Bull. 19, p. 94), applied *Upper Madisonville ls.* to a ls. 4½ ft. thick, lying 32 ft. above Madisonville ls.

Named for Madisonville, Hopkins Co.

Madras formation.

Pleistocene and late Tertiary: Central northern Oregon (Cascade Mountains).

E. T. Hodge, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 163). [See under *Crooked River fm.*]

E. T. Hodge, 1928 (Pan-Am. Geol., vol. 49, pp. 350–356). *Madras fm.*—Composed of at least 6 flows of basaltic and andesitic lavas separated by torrential and lacustrine deposits. The torrential deposits are chiefly pumice, aggl., and arkosic and obsidian sands. Rests uncon. on Clarno, John Day, and Columbia basalt fms. West of Deschutes River contains fragments of Black Crater and all older fms. Includes part of Satsop fm. and all of Dalles beds, Deschutes sands, and Deschutes fm. The latter name is objectionable because Deschutes River exposes at least 8 fms., several of which occupy larger sections than Madras fm., and it leads to impression several much older fms. may belong to it. Entire fm. is exposed in vicinity of Madras [Jefferson Co.]. Is late Pleist. or post-Pleist.

E. T. Hodge, 1930 (Mon. Weather Rev., vol. 58, pp. 405–411). *Madras fm.* closely resembles The Dalles fm., but does not furnish direct proof that glaciers extended more than a few mi. to E. of Cascade Divide. Lies S. of Mutton Mtns. Extends S. almost to Bend, Oreg., and lies W. of Deschutes River and W. of Crooked River. Fills structural and erosional depressions that are younger than Columbia River basalt. Contains no glacial erratics. If Madras and The Dalles fms. are equiv. in time, both may represent aggradational activity during first glacial stage.

E. T. Hodge, 1932 (Univ. Oreg. Pub., Suppl. to Geol. ser., vol. 1, No. 5). *Madras fm.* was suggested in 1928 as a substitute for Russell's Deschutes sands, so as to give a specific location and truly formational name to a fm. that, except along Deschutes River, has been mistaken for Columbia River basalt, and because near town of Madras all the various features of this fm. are excellently displayed. Includes beds that farther N. have been variously known as *The Dalles beds* and *Satsop fm.* Accumulated rapidly. Not older than Plio. and may be Pleist. Rests uncon. on Columbia River basalt and older fms. Overlain by Cascade fm., which tentatively includes all lavas younger than Madras fm. and older than Recent.

†Madrid formation.

Upper Cretaceous: Central northern New Mexico (Santa Fe County).

D. W. Johnson, 1903 (School Mines Quart., vol. 24, p. 338). *Madrid coal group.*—Coal series, of Fox Hills age, 1,000 ft. thick in Cerrillos Hills, N. Mex. Upper 25 ft. consists of massive yellow and white ss.; lower 300 ft. contains several coal seams and some sh. beds. Underlies Galisteo sand group of Hayden and overlies Fort Pierre group.

Same or approx. same as Mesaverde fm., the older name.

Named for Madrid, Santa Fe Co.

Madruga chalk.

Cretaceous: Cuba.

J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, No. 6, p. 539).

Madson basalt.

Pleistocene: Southern Idaho (Gooding County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Madson basalt.*—Diabasic black basalt, in most places regularly jointed, and filling a former canyon of Snake River carved in Hagerman lake beds. Exposed thickness 200 ft. Older than Malad basalt and younger than American Falls lake beds. Madson Spring, Gooding Co., issues from this basalt.

Magallanes rhyolite.

Age (?): Mexico (Sonora).

N. L. Taliaferro, 1933 (Jour. Geol., vol. 41, No. 1, p. 34).

Magdalena group (also **Magdalena limestone**).

Pennsylvanian (lower): New Mexico (widespread) and western Texas.

C. H. Gordon, 1907 (Jour. Geol., vol. 15, pp. 807–816). *Magdalena group.*—Divided into (descending) Madera ls. (300 to 700 ft. of dark-blue ls.) and Sandia fm. (500 to 700 ft. of alternating beds of blue and black clay sh., compact earthy ls. and cgl., vitreous ss. or qtzite; sh. and ls. predominate). In Magdalena Mtns overlies Kelly ls. (Miss.).

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–798), extended *Magdalena ls.* into Tex. (where he identified the fm. in Hueco and Franklin Mtns and in a small area in Sierra Diablo) and restricted Hueco ls. to beds, of Perm.(?) age, uncon. overlying the Magdalena.

Named for development in Magdalena Mtns, N. Mex.

Magnolia member (of Platteville limestone).

Middle Ordovician (Black River): Southwestern Wisconsin, southeastern Minnesota, northeastern Iowa and northwestern Illinois.

C. A. Bays and G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 297–300). Kay's definition of McGregor memb. includes Lower Blue beds of Chamberlin and overlying beds which authors here name *Magnolia memb.*, *restricting McGregor memb.* to Lower Blue beds alone. Introduction of *Magnolia* is necessary because of somewhat inconsistent use of "Upper Buff," although in the main the Magnolia memb. is coincident with latter. However, in south-central Wis. (type area of Upper Buff) the Spechts Ferry and Magnolia are included in "Upper Buff," but in Lead Region the Magnolia is rather generally included in underlying "Blue Beds." There is extant no term which universally and specifically refers to the dolomites for which we are proposing *Magnolia*. Type exposure is on and near highways 13 and 14, 1 mi. S. of Magnolia, in NW¼ sec. 26, T. 3 N., R. 10 E., Rock Co., Wis., where the beds are 39 ft. thick. The beds are light-buff, moderately thick-bedded dol., with conspicuous fucoidal markings on bedding planes, at least in upper part of the memb. Lower down the bedding planes in many places bear great numbers of ostracod *Leperditia fabulites*. The Magnolia rests on dolomitic facies of Blue memb. and is overlain by 8 ft. of cherty Spechts Ferry beds with Hounsfield metabentonite [type in N. Y.] 17 inches above base. Fauna remarkably similar to that of Lower Buff or Pecatonica memb. In W. Wis.

Magnolia memb. is thinner and less conspicuous. In Lead Region it is more limy and more thinly bedded. Fossils listed. The *Vanuxemia* bed of Minn. is clearly = Magnolia memb.

Magoffin beds.

Pennsylvanian: Eastern Kentucky (Magoffin, Knott, and Breathitt Counties).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 296, 301). *Magoffin beds* proposed for the shales and lss. so extensively developed in southern Magoffin Co.; not limited to that county, but probably have their most typical development there. In section at head of Sycamore Branch of Oakley Creek at home of Mrs. Sarah Salyers they consist of (descending): (1) Shales, blue, black, clayey, and carbonaceous, 3½ ft.; (2) dove-colored ls., 1 ft.; (3) shales, upper part calc. and very fossiliferous, 1½ ft.; (4) impure sandy ls., fossiliferous, 0.4 ft.; (5) shales, soft, blue, clayey, filled with plant fossils, 3 ft. This is perhaps an average section. Overlie Middle, "Taylor," or Copland coal; lie 35 ft. below Saltlick beds and 220 or 230 ft. above Kendrick shales. Can be traced from type loc. through Knott and Breathitt Counties to North Fork of Kentucky River at Copland, where they form roof of coal mined there.

Magog formation.

Ordovician: Quebec.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 200). *Magog fm.*, Ord., Canada.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11). *Magog slates*, Ord., Quebec.

Magog conglomerate.

Lower Ordovician: Quebec and northeastern Vermont.

J. A. Dresser, 1925 (Roy. Soc. Canada Proc. and Trans., 3d ser., vol. 19, sec. 4, p. 116). *Magog cgl.*, Ord., Quebec. Included in Quebec group.

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 107–110). *Magog phase of Irasburg cgl.* was discovered by Dresser, 1925. Its pebbles are pre-Ord. and its matrix is Ord. It lies at base of my Memphremagog slates. In this respect it conforms to Northfield phase of the Irasburg, which is more than 100 mi. farther S.

Magothy formation.

Upper Cretaceous: Maryland, New Jersey, Delaware, Long Island and other islands of New England coast.

N. H. Darton, 1893 (Am. Jour. Sci., 3d, vol. 45, pp. 407–419). *Magothy fm.*—Mainly white and buff sands with local beds of brown ss. and limonitic streaking in plates and discolorations. To SW. becomes gravelly for some distance, and some portions are locally lithified into loose cgls. or more or less pebbly brown sss. I formerly supposed these beds to be a local upper memb. of Potomac fm., but find they are separated from Potomac by a continuous erosion plane and that they constitute a distinct fm. 0 to 30 ft. thick in upper Chesapeake Bay region. Uncon. underlies Severn fm. Excellently exposed on Magothy River [Anne Arundel Co., Md.].

For further explanation of *Magothy fm.* see under *Raritan fm.*, 1904 and subsequent entries.

Magpie dolomite member (of Blaine gypsum).

Permian: Western Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 48). *Magpie dol. memb. of Blaine div.*—Hard fossiliferous aren. dol., 1 to 12 ft. thick, overlain by Medicine Lodge gyp. memb. and separated from underlying Ferguson gyp. memb. by a stratum of red sh. All included in Blaine div.

Later abandoned by Gould. See 1906 and 1927 entries under *Altona dol. memb.*

Creek, Blaine Co., just below the ledge.

Named for permanent camp of an Arapahoe chief of that name on Bitter

Magrath sandstone. (In Bearpaw shale.)

Upper Cretaceous: Southern Alberta (near Lethbridge).

T. A. Link and A. J. Childerhose, 1931 (A. A. P. G. Bull., vol. 15, No. 10, pp. 1232, 1235). *Magrath ss.* (*Arctica zone*).—A distinctly sandy zone, consisting of several members having aggregate thickness of 62 ft., present in top part of lower third of Bearpaw sh. Top lies 272 ft. above base of Bearpaw and 100± ft. below Kipp ss. Type section is on S. bank of St. Mary River ½ mi. downstream from mouth of Magrath Coulee, Lethbridge area.

Mahanoy black shale member.

Middle Devonian: Central Pennsylvania (Northumberland County).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, Proc. Pal. Soc. Feb. 28, pp. 202–203). *Mahanoy black sh. memb.*—Top memb. of Marcellus fm. in central Pa. Is fissile, nearly barren, black sh.; 200 ft. thick SW. of Mexico, Juniata Co. Named for Mahanoy Twp, SW. Northumberland Co., where well exposed. Overlies Mexico ss. memb.

Mahantango formation.

Middle Devonian: Central Pennsylvania (Allegheny Front).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, Proc. Pal. Soc., Feb. 28, pp. 202, 205–223). *Mahantango fm.*—Introduced to include all beds btw. Marcellus black sh. and base of Portage. It is=Hamilton as formerly in general use. As Hamilton is now rated in N. Y. and Pa. as a group term, and because the post-Marcellus beds in central Pa. are lithologically inseparable into fms., it is necessary to employ some new title for these strata. Named for North Branch of Mahantango Creek, in whose valley and in adjacent parts of Snyder and Juniata Counties are excellent exposures. The fm. is exposed throughout central Pa. except in a few sections in south-central Juniata Co. Thickness varies from max. of 1,100 ft. in Northumberland Co. to minimum of 500 ft. in western Juniata. With exception of the prominent Montebello ss. the fm. throughout is of nearly uniform lithology. In south-central Pa. contains coarse heavy ss. lenses. The fm. is chiefly uniformly dark gray or brown, usually clayey or finely aren. sh. to fine-grained, dark, shaly ss. that may become platy or flaggy locally. Very fossiliferous. Fossils listed. In central Pa. it is divided into (descending) Moscow faunal facies, Ludlowville faunal facies, and Skaneateles faunal facies. In eastern Pa. it is represented by Moscow fm., Ludlowville fm., and Skaneateles fm.

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, June 1935, p. 361). Hamilton group along Allegheny Front divided into *Mahantango fm.* above (including, descending order, Frame sh. memb., Cheneysville ss. memb., and Gander Run sh. memb.), and Marcellus fm. below.

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, Aug. 31, pp. 1276–1290). Hamilton group of eastern Pa. divided into 4 fms. (Moscow, Ludlowville, Skaneateles, and Marcellus), which maintain their identity btw. Susquehanna and Delaware Valleys. In more easterly sections the characters are obscured except for the Marcellus, which is the one fm. of the group recognizable throughout the Hamilton in Pa. In central Pa. Hamilton group is divided into Mahantango fm. (including Moscow faunal facies, Ludlowville faunal facies, and Skaneateles faunal facies) and Marcellus fm. (divided into, descending, Mahanoy black sh. memb., Mexico ss. memb., Turkey Ridge ss. memb., and Shamokin black sh. memb.). In Bedford Co., near Chaneysville, Mahantango fm. is divided into (descending) Frame sh. memb., Chaneysville ss. memb., and Gander Run sh. memb., aggregating 1,375 ft. In Huntingdon Co. the thickness is 1,065 ft. [Long description.]

Mahaska till.

Mahaskan glacial epoch.

Terms employed by C. [R.] Keyes to designate the Pleist. deposits in Iowa now called *Kansan*. (In his opinion the deposits called *Kansan* in Iowa are in truth pre-Kansan and correspond to the Nebraskan or oldest Pleist. stage. See Pan-Am. Geol., vol. 55, p. 145, 1931, and vol. 58, p. 203, 1932.)

Mahomet beds.

Pleistocene: Central eastern Illinois (Champaign County).

E. J. Cable, 1921 (Iowa Univ., Some phases of Pleistocene in Iowa, pp. 59–60). *Mahomet beds* are located near Mahomet [Champaign Co.], Ill., and belong to Sangamon interglacial epoch. [Discusses fossils—insects.]

Mahoning sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania, eastern Ohio, West Virginia, and western Maryland and Virginia.

J. P. Lesley, 1856 (Manual of Coal, pp. 94, 97–98). *Mahoning ss.*—Underlies coal F of Barren Measures and overlies the Lower series, which includes coal E (Upper Freeport) about 50 ft. beneath top. The Mahoning consists of 2 sss., each 35 ft. thick, separated by 25 ft. of sh. Rests on 2 to 50 ft. of brown and blackish sh.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 477, 493). *Mahoning massive bed of ss.*, 50 to 75 ft. thick, underlies Lower Barren Measures and overlies Freeport group. Becomes a true cgl. along the Mahoning Creeks.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 33). The *Mahoning ss. of Rogers* extended from top of Buffalo ss. to base of Lower Mahoning ss. Name here restricted to lower ss., which is 40 to 80 ft. thick, and consists of (descending): Flaggy ss., 28 ft.; fire clay and argill. sh., 35 ft.; ls., 5 ft.; shaly ss., 10 ft. When massive it is usually a coarse-grained yellowish white rock and frequently contains small pebbles of quartz. The term Mahoning has always been applied to this lower ss. The Buffalo ss. and Mahoning ss. never merge. Both sss. are present on Mahoning Creek [Indiana and Jefferson Counties, Pa.]. Lies lower than Brush Creek coal and rests on Upper Freeport coal.

W. G. Platt, 1880 (2d Pa. Geol. Surv. Rept. H_5), recognized in Armstrong Co., Pa.: (1) An Upper Mahoning ss. 160 ft. thick (which J. P. Lesley on p. 312 proposed to change to *Saltsburg ss.*); (2) a *Middle Mahoning ss.*, 15 ft. thick [probably Buffalo ss.], overlying the Gallitzin coal; and (3) a *Lower Mahoning ss.*, 20 ft. thick, separated by a short interval from underlying Upper Freeport coal.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 95–98). *Mahoning ss.*—In places one rock; in other places it subdivides, is complex, and 100 to 150 ft. thick, consisting of (descending): Upper Mahoning sss., 40 to 50 ft.; Mahoning coal, 0 to 17 ft.; *Mahoning ls.*, 0 to 20 ft. (in Beaver Co., Pa., locally termed "Summit" ls.); Upper Cannelton coal, 0 to 5 ft.; thin red or variegated sh.; Middle Cannelton coal, 0 to 3 ft.; thin red or variegated sh.; Lower Mahoning ss., 30 to 100 ft. (generally bluish-gray sss. and shales).

C. Butts, 1906 (U. S. G. S. Bull. 279, pp. 39–40). For reasons fully stated in Kittanning folio (No. 115, 1904) writer has decided to apply *Mahoning ss.* to only sss. lying btw. Upper Freeport and Brush Creek coals, an interval of 70 to 100 ft. This ss. usually lies at base of Conemaugh fm. and closely overlies Upper Freeport coal. It may, however, occupy a higher position and be separated from the coal by a sh. bed of variable thickness. [This is definition followed by U. S. Geol. Survey.]

Mahoning limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 477, 489). *Mahoning ls.*, 2 ft. thick, is top memb. of Tionesta group and in neighborhood of Newcastle, Pa., it immediately underlies Tionesta [Homewood] ss.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). The Mahoning ls. of Rogers is here renamed *Upper Mercer ls.* [See quotation under *Upper Mercer ls.*]

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3). The Mahoning ss. having been named during the First Survey from Mahoning Creek, in Indiana and Jefferson Counties, it was confusing to have a Mahoning ls. much lower in the series, named from Mahoning River in Lawrence Co., and it is therefore replaced by *Upper Mercer ls.*

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 95–98), recognized *Mahoning ls.* as a bed in midst of Mahoning ss. memb. (See quotation under *Mahoning ss. memb.*) The application of the name to this ls. bed has had considerable usage.

Mahoning red bed. (In Conemaugh formation.)

Pennsylvanian: Western Maryland, western Pennsylvania, and northern West Virginia.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 57, pl. 6), applied *Mahoning red bed* and *Mahoning red sh.* to beds both overlying and underlying Mahoning ls. in Pa. and western Md. On p. 57 he stated: A bed of red sh. has been observed at several localities in Upper Potomac Basin beneath Brush Creek coal, for which the name *Mahoning red sh.* is here proposed. Red sh. appears at this horizon in Conemaugh fm. at widely separated points, having been observed in well at Glenova, W. Va., in various wells in vicinity of Pittsburgh, and more recently by Dr. Harvey Bassler and writer at Freeport, Pa. This bed may be divided into 2 benches btw. which the Gallitzin coal may lie. [The chart, pl. 6, applied *Mahoning red bed* and *Mahoning red sh.* to beds both overlying and underlying Mahoning ls. in Pa. and western Md., and also to beds both overlying and underlying Gallitzin coal.]

Mahoning fire clay. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia, western Pennsylvania, and western Maryland.

See under *Thornton fire clay*. In Pa. the name *Mahoning flint clay* has been applied to 0 to 15 ft. of clay underlying Mahoning coal and overlying Mahoning ls.

Mahoning formation.

Pennsylvanian: Southwestern Pennsylvania.

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas No. 65, Punxsutawney quad., pl. 4, pp. 25–26). *Mahoning fm.* includes beds btw. top of Upper Freeport coal and top of Brush Creek coal.

Includes Mahoning ss. memb. of Conemaugh fm. and some overlying and underlying beds.

Mahopac granite.

Pre-Cambrian: West Point quadrangle, southeastern New York.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225–226, pp. 54–56). *Mahopac granite*.—Medium-grained pinkish gneissoid granite, distinctly but not strongly foliated. Composed of colorless quartz, slightly pink feldspar, and dark biotite. Mapped with Reservoir granite, but it can be mapped separately. Is an intrusive rock. Type loc. along road running from Kent Cliffs to Mahopac mines, especially on fault scarp N. of latter mines, in Putnam Co.

Mahto sandstones.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll. vol. 57, No. 12, pp. 335, 339).

Maidment formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Maidment fm.*—Shales carrying *Niobe howelli*; underlying Riders Brook fm. and overlying Apsey fm. Included in Clarenville series. [Derivation of name not stated.]

Main Street limestone member (of Denison formation).

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 302, 303, 317, 328–331). *Main Street ls.*—Fossiliferous coarse-grained ls., of irregular hardness, composed of minute shell fragments, and separated by thin beds of clay. Of dull yellow color on weathering, white on fracture. Thickness not over 30 ft. Top memb. of Denison beds and of Washita div. Overlies Pawpaw clays and uncon. underlies Dakota ss. [As thus defined included Grayson marl memb.]

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 114–115, 121–124, 245, 246–249, 266–271, pls. 7, 18). *Main Street ls.*—Impure, hard, yellow or yellowish white ls. with marl layers, underlying Main St. at Denison, Tex. Thickness 15 to 22 ft. Underlies Grayson marl (grayish marl, lighter colored than Main Street ls., and 60 ft. thick) and overlies Pawpaw fm., all of which are included in Denison beds. [This is generally approved definition, and it displaces "Choctaw ls."]

Maissade tongue (of Thomonde formation).

Miocene: Haiti.

W. F. Jones, 1918 (Jour. Geol., vol. 26, p. 739). [Assigned to Tert., and called *Maissade beds.*]

W. P. Woodring, 1922 (Haiti Geol. Surv., Stratigraphy, structure [etc.], of central plain, p. 7). *Maissade tongue of Thomonde fm.* assigned to Mio.

Major sand.

A subsurface sand in St. Louis ls. of western Ky.

Makalapa tuff.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Makalapa tuff.*—Erupted from Makalapa Crater. Included in middle part of Honolulu volcanic series [q. v.].

Makanda sandstone member. (In Pottsville formation.)

Pennsylvanian: Southwestern Illinois.

S. St. Clair, 1917 (Ill. Geol. Surv. Bull. 35, p. 48, pl. 4). *Makanda ss. memb.*—Heavy cliff-making ss., 100+ ft. thick, exposed near Makanda. Lies 100 to 150 ft. above base of Pottsville fm. and top lies 400 to 460 ft. below top of Pottsville fm. (base of No. 2 coal) of Williamson, Union, and Jackson Counties, Ill.

J. E. Lamar, 1925 (Ill. Geol. Surv. Bull. 48, pp. 23, 95–100, and map). In general *Makanda ss. memb.* may be divided into a basal massive ss. 80 to 120 ft. thick and an upper part, of about same thickness, composed of medium and thin bedded sss. interbedded with sh. Cross bedding and ripple marks are common. Lenses of coal occur at many horizons. Locally its upper part includes beds of massive ss. and two beds of black sh., which may or may not be same. Thickness 250 ft. in E. part of Carbondale quad. and 300 ft. in W. part. Is top memb. of Pottsville fm. Rests conformably on Drury sh. and ss. memb., and is overlain conformably by Murphysboro (No. 2) coal, the basal memb. of Carbondale fm. Named for town of Makanda, Jackson Co., near which it forms prominent bluffs.

Makasin Hill zone. (In Negaunee formation.)

Pre-Cambrian (middle Huronian): Northern Michigan (Marquette County).

J. L. Adler, 1935 (Jour. Geol., vol. 43, No. 2, pp. 113–132). *Makasin Hill zone of Negaunee fm.*—Chiefly straight, medium to thin bedded, dense chert, hematite, and limonite. Grades laterally into ore bodies. Martitic portion near base grades down into Siamo sl. The Makasin Hill zone grades up into North Lake zone. Thickness 310 ft. Type area, Makasin Hills.

Makawao breccia.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Makawao breccia.*—Included in lower part of Honolulu volcanic series [q. v.]. Exposed 2½ mi. S. and a little W. of Olomana Peak, in Maunawili ranch, also at an altitude of 600± ft. in the bed of Makawao Stream.

Malad basalt.

Pleistocene: Southern Idaho (Gooding County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Malad basalt.*—Black feldspar pahoehoe basalt filling a deep ancient canyon of Snake River N. of present canyon. In places well covered with loess. Thickness 400+ ft. Older than Thousand Springs basalt and younger than Madson basalt. Exposed in Malad Canyon, Gooding Co. Near Malad power plant it forms cliff 400+ ft. high.

Malade Valley group.

Pliocene (?): Northeastern Utah and southeastern Idaho (Malade River valley).

A. C. Peale, 1879 (U. S. Geol. and Geog. Surv. Terr. 11th Ann. Rept., p. 641). *Malade Valley group.*—The soft sss. and marls of Malade Valley containing forms of fresh-water shells are probably more modern than same beds in Cache Valley.

Now considered probably of same age as beds in Cache Valley (NE. Utah and SE. Idaho) and as Salt Lake fm.

Malaga mudstone member (of Monterey shale).

Miocene (upper): Southern California (Palos Verdes Hills).

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 146). *Malaga mudstone memb.*—Radiolarian mudstone forming top memb. of Monterey sh. in Palos Verdes Hills. Thickness 300 to 600 ft. Overlies Valmonte diatomite memb. and underlies Repetto siltstone (Plio.). Is upper Mio. Type region at Malaga Cove, Palos Verdes region [Los Angeles Co.].

Malahat volcanics.

Carboniferous (?): British Columbia.

C. H. Clapp, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 46; Canada Geol. Surv. Summ. Rept. 1913, p. 90); and 1917 (Canada Geol. Surv. Mem. 96, p. 72). *Malahat volcanics*, Carbf. (?), B. C.

Malbaie conglomerate.

Devonian: Quebec (Gaspe Peninsula).

C. H. Kindle, 1936 (Eastern Geol., No. 1, April 1936, pp. 3–5). Gaspe ss. may be divided into a lower memb. (called by Williams *York River ss.*), 7,000 ft. thick, and an upper memb. (consisting of 3,000 ft. of ls. cgls. and sss.), which may be called *Malbaie cgl.* Assigned to Dev. The fossils of York River beds are probably Middle Dev. [Mapped along shores of Mal Baie.]

Malden sandstones. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, pp. 271, 425). *Malden ss.*—Dull gray or dove-colored, micaceous, sometimes massive but usually flaggy, always making steep bluffs. Thickness 200 to 350 ft. Overlies Cedar Grove coal and underlies fire clay beneath Chilton coal. Is conspicuous on both banks of Great Kanawha River in vicinity of Malden, Kanawha Co.

R. V. Hennen, 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., pp. xxvi–xxviii). *Malden ss.*, 15 to 25 ft. thick, underlies fire clay beneath Little Alma coal and lies 0 to 5 ft. above Campbells Creek ls.

C. E. Krebs and D. D. Teets, Jr., 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., p. 279). *Malden ss.*, gray, dove-colored, micaceous, and often flaggy ss., 60 ft. thick; lies 5 to 10 ft. above Cedar Grove coal and lies lower than Thacker coal.

C. E. Krebs and D. D. Teets, Jr., 1915 (W. Va. Geol. Surv. Rept. Boone Co., p. 46). *Malden ss.*, 5 to 50 ft. of massive grayish-blue micaceous ss., often with layers of slate; underlies Little Alma coal and lies 1 to 5 ft. above Campbell Creek ls. *Lower Malden ss.*, 8 to 30 ft. of massive ss., lies 1 to 3 ft. below upper bench Campbell Creek (No. 2 Gas) coal and 1 to 5 ft. above lower bench of Campbell Creek (No. 2 Gas) coal.

Malheur formation.

Recent: Northeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Review, vol. 8, pp. 207–214). *Malheur fm.*—Loose sands, 10 to 200 ft. thick, occurring as dunes. Type loc., Malheur, Harney Co.

Malignant Cove formation.

Ordovician: Nova Scotia.

M. Y. Williams, 1912 (Am. Jour. Sci., 4th, vol. 34, pp. 245, 246).

Mallett dolomite.

Lower Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 110). *Mallett dol.*—Practically all of fm. is massive light- and dark-gray dol. Beginning 100 ft. above base there are 2 or 3 beds of fine white qtzite, cross-bedded and ripple-marked, and sandy dolomites are numerous, in many places grading into dolomitic ss. Between St. Albans and Canada border a few beds of sh. occur btw. the dolomites. Bedding is usually plain and even; most layers are less than 1 ft. thick. Secondary quartz in geodes is common in the dolomites. A few beds of pink dol. occur here and there, apparently in lower part of fm., but these may be repetitions of underlying Winooski marble by faulting. The beds are hard and tough and make ridges. Lower Camb. fossils in upper part in towns of Georgia and Highgate. Thickness 50 to 800 ft. Named for fine exposures on shores of Mallett Bay [Milton quad.], 5 mi. N. of Burlington. Grades into overlying Colchester fm. [Parker sl.], and overlies Winooski marble with abrupt change.

Mallorytown granite.

Pre-Cambrian: Ontario.

J. F. Wright, 1923 (Canada Geol. Surv. Mem. 134, p. 26).

Malone formation.

Upper Jurassic: Western Texas (Hudspeth County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 720–721, 736). *Malone bed.*—In descending order: Gyp., 110 ft.; massive blue granular ls., 170 ft.; white fissile granular gyp., 45 ft.; pale-yellow flaggy ls., 25 ft. Underlies Etholen bed. Included in Washita div. of Cret.

F. W. Cragin, 1897 (Jour. Geol., vol. 5, pp. 817–819). *Malone beds or Malone fm.*—Fossiliferous sss. and lss., gypsums, massive calcite-seamed lss., and any other rocks included among these of Malone Mtn and hills N. and E. of Malone Station. The Malone fm. thus assumes wider limits, a different age significance, and far greater importance than were assigned to it by Mr. Taff. Contains Jurassic fossils. [These fossils are now considered to be Upper Jurassic.]

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 254–257). *Malone fm.* of Cragin included rocks of both upper Jurassic and lowermost Cret. age, which outcrop near Malone (now Torcer) Station on Southern Pacific Ry, SW. of Hudspeth Co. The name *Malone*, in accordance with Cragin's apparent intention, is here restricted to that portion of these rocks which is of Jurassic age. These beds are only a small terminal residue of Jurassic strata of much greater extent which were deposited in a northwardly narrowing arm of Kimmeridge sea in north-central Mexico. They are mostly of Kimmeridge age. The Malone beds rest uncon. on Perm. strata and are overlain, by an inferred uncon., by Valanginian Cret. The Malone Jurassic is mostly cgls., brown sss., and lss., the sss. in part conglomeratic with well rounded ls. and chert pebbles. Some lss. contain chert pebbles. Lithology and position indicate near-shore facies. The Cret. part of Malone fm. is here named *Torcer fm.* [This restricted definition has not been considered by U. S. Geol. Survey for its publications.]

Maloney metamorphic series.

Ordovician: Central Washington (Skykomish Basin).

W. S. Smith, 1916 (Jour. Geol., vol. 24, pp. 559–570). *Maloney metamorphic series.*—Qtzites, schists, and crystalline lss., with associated greenstones. Thickness 4,000 ft. Weaver correlates this series with Cache Creek series of Dawson. On lithologic grounds formerly believed=[G. O.] Smith's Peshastin series of Snoqualmie area, but fossils identify it as Ord., instead of Carbf., as the Peshastin is called by [G. O.] Smith and the Gunn Peak by Weaver. Younger than Easton schist. [On p. 560 he uses *Maloney (Gunn Peak) metamorphic series*. Type loc. not given, and compiler has been unable to locate it.]

Maloney sand.

A subsurface sand, of Penn (?) age, in Stephens Co., southern Okla.; lying at 2,600 ft. depth in Empire pool, the Kagey sand lying at 2,300 ft.

Mal Pais gravel.

Age (?): Cuba.

C. W. Hayes, 1901 (Rept. geol. reconn. Cuba, p. 114).

Malpais basalt.

Tertiary (Pliocene?): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 72, etc.). *Malpais basalt.*—Flow or flows, with a few small intrusions. Dark olivinitic basalt, of a holocrystalline variety that is properly designated dolerite. Caps Malpais Mesa, SW. part of Goldfield dist. Thickness 100 to 200 ft.

Maltrata division.

Cretaceous: Mexico.

J. D. Villarello and E. Böse, 1902 (Mexico Inst. Geol. Bull. 16, p. 16).

Mamacoke gneiss.

Pre-Cambrian: Southeastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 150–152, and map). *Mamacoke gneiss.*—Larger area decidedly gneissic, containing much biotite and more rarely hornblende, but elsewhere the rocks are very granitic in appearance. These different types of rock are probably of different age and possibly of different origin. Much field work is needed. Exposures on Mamacoke Island are typical of large part of area. The eastern part consists of many alternating bands, usually less than 2 ft. thick, of black biotite and white feldspar and quartz; the western is a normal reddish-gray granitic gneiss. Probably igneous and pre-Camb.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 38). *Mamacoke gneiss* is of igneous origin.

Mamainse diabase.

Pre-Cambrian: Ontario.

E. S. Moore, 1926 (Ont. Dept. Mines 35th Ann. Rept., vol. 35, pt. 2, p. 60).

†Mammoth limestone.

Lower Ordovician and Upper, Middle, and Lower Cambrian: Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 620, footnote). In Tintic folio the Eureka ls. of this rept. will be named *Mammoth fm.*, to avoid duplication of names. [For description see †*Eureka ls.* The accompanying map shows the fm. well exposed at and around Mammoth, Juab Co. In Tintic folio, No. 65, 1900, the †Eureka ls. was renamed †Mammoth ls. In detailed rept. on Tintic dist. (U. S. G. S. P. P. 107, 1919) it was subdivided by G. F. Loughlin and W. Lindgren into 9 fms. (of Lower Ord. and Upper, Middle, and Lower Camb. age), and †Mammoth ls. was abandoned.]

Mammoth andesite.

Tertiary: Central Nevada (Cedar Mountains).

A. Knopf, 1921 (U. S. G. S. Bull. 725H). *Mammoth andesite* is well exposed on Mammoth claim, Cedar Mtns. Probably not younger than middle Mio.

Mammoth Cave series.

Mississippian: Western central Kentucky.

A. M. Miller, 1919 (Table of geological formations of Ky., p. 3). *Mammoth Cave series.*—Best developed in western Ky. Includes Newman [ls.] in part in eastern Ky. Includes St. Louis ls., Ste. Genevieve ls., Bethel ss., and Gasper [oolite].

A. M. Miller, 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 2, p. 103). *Mammoth Cave ls. series.*—This name is proposed for the almost uninterrupted deposit of relatively pure ls. which has as a highly conspicuous feature the presence in it of caverns of considerable extent. Greatest development in State is in region surrounding the Western coal fields, where it may reach max. thickness of 600 ft. Is generally less than 100 ft. Includes Ste. Genevieve and St. Louis stages. Underlies Bethel ss. and overlies [discon., p. 250] Warsaw stage. Is closely=Maxville, Greenbrier, and Newman lss.

Apparently named for Mammoth Cave, Edmonson Co.

Mammoth Mountain rhyolite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). A single thick flow, of rather uniform character, at base of Piedra group of Potosi volcanic series in NE. part of Creede area and in mtns to E. and NE. Has been followed to E. as far as Bellows Creek, but not recognized to W., S., or N. of Creede area. Wedges out in upper drainage basin of Nelson Creek. Thickness 0 to 1,000 ft. Named for Mammoth Mtn. Overlain by rhyolite tuff.

Manana tuff.

Latest Pleistocene or Recent: Hawaii (Manana Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Manana tuff.*—Pelagonitized gray to brown lithic tuff, erupted from 2 vents. Composes Manana Island, 1½ mi. NW. of E. point of Oahu. Included in upper part of Honolulu volcanic series [q. v.].

Manasquan marl.

Eocene (lower): New Jersey.

W. B. Clark, 1893 (N. J. Geol. Surv. Ann. Rept. 1892, pp. 205–208). *Manasquan marl.*—Greensand throughout. Highly quartzose in lower 40 ft. The upper more glauconitic memb., 25 ft. thick, is known as the "ash marl." Underlies [uncon.] Shark River marl, and conformably overlies Middle Marl bed [Rancocas group]. Named for excellent section of strata on Manasquan River.

C. W. Cooke and L. W. Stephenson, 1928 (Jour. Geol., vol. 36, No. 2, p. 145), transferred this fm. from Upper Cret. to Eo., based upon contained fauna.

Manassas sandstone. (In Newark group.)

Upper Triassic: Northeastern Virginia.

J. K. Roberts, 1923 (Pan-Am. Geol., vol. 39, pp. 185–200). *Manassas ss.*—Sss. forming intermediate fm. of Triassic sediments of northern Va. Older than Bull Run shales and younger than Border cgls. The red sandstones are limited chiefly to W. side of Triassic basin typically developed around Manassas.

J. K. Roberts, 1928 (Va. Geol. Surv. Bull. 29, pp. 24–25). *Manassas ss.* is for most part intercalated with Bull Run shales, and extends in very broken belts from a few mi. S. of Potomac River over all areas to Carolina border. Where not disturbed by faulting and not covered by Recent material or soil the Border cgls. underlie Manassas ss. and the Bull Run shales overlie it.

Manastash formation.

Eocene: Central Washington (Mount Stuart and Snoqualmie quadrangles).

G. O. Smith, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, pp. 485–486). *Manastash fm.*—Carbonaceous beds of different character from preceding Roslyn fm. (Eo.).

G. O. Smith, 1903 (U. S. G. S. P. P. 19; and U. S. G. S. Ellensburg folio, No. 86). So far as known *Manastash fm.* is limited to SW. part of Mount Stuart quad. and adjacent part of Snoqualmie quad. Consists of ss., sh., and cgl. beds with some seams of carbonaceous material. Uncon. underlies Yakima basalt (Mio.). Although somewhat younger than Roslyn fm., which occurs a few mi. to N., the Manastash rests upon Easton schist (Carbf.?). This relation is believed to indicate nondeposition of the earlier Eo. sediments in this area.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Manastash fm.* is 1,000 ft. thick. Occurs on headwaters of Manastash Creek.

E. J. Saunders, 1914 (Wash. Geol. Surv. Bull. 9), gave thickness of Manastash fm. as 1,900 ft.

†Manatee River marl.

Miocene (lower or later Miocene): Western part of peninsular Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 125–126). *Manatee River marl.*—Basal white marl and yellowish ss. at Rocky Bluff, on right bank of Manatee River, a few mi. above Braidentown, Manatee Co. The marl is "densely charged" with organic remains. [Mentions fossils and briefly discusses probable relations to other fms.] These imperfect data indicate most southern extension of Chesapeake group which has yet been determined on W. edge of Floridian peninsula.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept.). "Manatee River marl" is a part of Oak Grove sand memb. of Alum Bluff fm., and name is abandoned.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). "Manatee River marl" is here included in Hawthorn fm.

†Manayunk mica schists and gneisses.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6, map and pp. 27–28). *Manayunk mica schists and gneisses* [on map]; *Manayunk group* [in text].—Crosses the Schuylkill at Manayunk. Extends along Schuylkill River from S. of Mill Creek to mouth of Wissahickon Creek.

Replaced in part by Wissahickon fm.

Manchester shale.

Eocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 52, 188). *Manchester shales.*—Very dark blue or, when wet, dense-black clay shales, 5 ft. thick. Exposed at Manchester Landing, on Ouachita River, where they underlie 3 ft. of blue and drab finely laminated micaceous sands. Included in Camden series. Same as shales at mouth of L'Eau Frais. [On pp. 56, 211, and elsewhere in this rept. these shales are called *L'Eau Frais shales.*]

Probably belong to Wilcox fm.

Named for exposures at Manchester Landing, near mouth of L'Eau Frais, Clark Co.

Manchester group. (In Newark group.)

Upper Triassic: Central southern Pennsylvania (Dauphin and York Counties).

G. H. Ashley, 1931 (Topog. and Geol. Surv. Pa. Bull. G1, p. 77). *Manchester group.*—Coarse-grained, highly micaceous greenish-gray, relatively soft ss. with interbedded red feldspathic ss. and sh., 7,000 to 8,000 ft. thick, composing basal fm. of Upper Triassic in Dauphin and York Counties. Underlies Conewago group. [Credited to [M. H.] Bissell. When the Triassic of New Cumberland and Middletown quads. (in which occurs Manchester Twp) was differentiated for 1931 geol. map of Pa. these rocks were mapped as New Oxford fm., of which they are a western extension, and the overlying Conewago of Bissell was included in Gettysburg sh.]

Manchioneal formation.

Pliocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 86).

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 419).

Mancos shale.

Upper Cretaceous (of Montana and Colorado age): Western Colorado, northwestern New Mexico, eastern Utah, southern and central Wyoming.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). *Mancos sh.*—Dark-gray or lead-colored shales, nearly always somewhat sandy. Contains thin calc. layers which in places become almost lss. and are usually rich in fossils. Sand locally increases to form ss., but no ls. or ss. layer is persistent and prominent enough to be traced far. Thickness 2,000 ft. Overlies Dakota fm. and in Telluride quad. is overlain by Eocene San Miguel fm. Named for characteristic occurrence in Mancos Valley and about town of Mancos, btw. La Plata Mtns and the Mesa Verde.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60). *Mancos sh.*—So named in Telluride folio. Throughout its thickness of 1,200± ft. in La Plata quad. it is an almost homogeneous body of soft, dark-gray or nearly black, carbonaceous clay sh., varied only by few thin fossiliferous bands or concretions of impure ls., which are too few and too discontinuous to serve as practical guides in subdivision of the great sh. series. Is limited below by Dakota ss. and above by lowest ss. of Mesaverde fm., which consists of alternating sss. and shales. The whole fm. is well exposed along N. face of the Mesa Verde near Mancos, below the scarp of ss. Fossils, identified by T. W. Stanton, are of Benton and Pierre age, but no distinctive fauna of Niobrara age has yet been found in it.

N. M. Fenneman and H. S. Gale, 1906 (U. S. G. S. Bull. 297). The 2,000 to 2,500 ft. of dark sh., containing ls. and ss. layers, which lies above Dakota ss. in Yampa coal field, NW. Colo., is here called *Mancos sh.* because it closely resembles typical

Mancos sh. of SW. Colo. and occupies a similar position above the Dakota. It is also overlain by beds which are apparently analogous to typical Mesaverde fm., which overlies the Mancos in SW. Colo. Fossils 200 ft. above Dakota ss. are pronounced by T. W. Stanton to be of Benton age, and fossils 600 ft. higher are pronounced by him to be of Niobrara age. Approx. upper half of the Mancos is of Montana age.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, p. 10). The marine *Mancos sh.* of SW. Colo. and NW. N. Mex. has yielded faunas of, in ascending order, Greenhorn, Carlile, Niobrara, and Pierre age. It grades into underlying Dakota ss., and into overlying Mesaverde group, the bdy with which is arbitrarily fixed. Writer believes lower part of Mesaverde group on the San Juan represents time interval of part of Mancos sh. of Animas River section. Thickness at type loc. is 1,200 ft. It varies in thickness in SW. Colo., up to a max. of 2,000 ft. near Telluride.

Mancos sandstone.

Upper Cretaceous: Northwestern Colorado (Routt County).

R. D. Crawford, 1920 (Colo. Geol. Surv. Bull. 23, pp. 11–15, map). *Mancos ss.*—Seen in only 3 exposures. Near S. border of Williams Park the exposed part of this memb. consists of alternating sss., shales, and lss., dominantly ss. with some fossiliferous ls. and numerous sh. partings; the ls. has strong bituminous odor. Thickness 20 to 40 ft. Lies 350 to 400 ft. above base of Mancos sh., of which it is a memb.

K. M. Willson, 1920 (Colo. Geol. Surv. Bull. 23, pp. 30–39). *Mancos ss.* consists of porous calc. ss. with numerous thin sh. partings. Is 25 to 35 ft. thick in Tow Creek anticline, and lies 460± ft. above base of Mancos sh.

Mancosian series.

A term applied by C. R. Keyes to the rocks underlying his Foxian series and overlying his Pierrean series.

Mandan amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 177, 205, 206, 248, 409, 490, 491, etc., figs. 23, 24, 25, 29, 34). *Mandan ophite*, 250 ft. thick. Usually comes not over 300 ft. below the Greenstone. [This rock has for many years been called *Mandan amygdaloid.*]

Belongs in Central Mine group. Older than Manitou amygdaloid and younger than Houghton cgl. The mineralized part is the Mandan lode.

Named for occurrence in Mandan mine, Keweenaw Co.

Mandan flow.

Includes Mandan amygdaloid and the underlying trap.

Mandanan series.

Tertiary (?): Western North Dakota and South Dakota.

C. [R.] Keyes, 1925 (Pan-Am. Geol. vol. 43, p. 135). The Cannonball shale is evidently not the sole member of the sedimental province in which it is found. So, while retaining the title for the member best known at present the provincial unit may well be designated the *Mandanan series*. Of Tertic age.

Probably named for development of Cannonball marine memb. of Lance fm. at and around village of Mandan, Morton Co., N. Dak.

Manele basalt.

Age (?): Lanai, Hawaiian Islands.

C. K. Wentworth, 1925 (Bernice P. Bishop Mus. Bull. 24, p. 39).

Mangas quartzite.

Upper Cambrian: Southwestern New Mexico (Silver City region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 9). *Mangas qtzite.*—Basal siliceous memb. 100 ft. thick, of Mid Cambric section exposed near Silver City. [Derivation of name not stated. According to E. Kirk and others the Middle Camb. is absent in N. Mex. This probably refers to Bliss ss., Upper Camb.]

Mangum dolomite member (of Blaine gypsum).

Permian: Southwestern Oklahoma, Texas Panhandle, and central northern Texas.

C. N. Gould, 1905 (U. S. G. S. W. S. P. 148, p. 71). *Mangum dol. memb.*—White, drab or yellowish dolomitic ls., 1 to 5 ft. thick, in places true dol., in places mag. ls.; in places aren. and soft, in other localities cavernous and honeycombed; often firm and solid. Top memb. of Greer fm.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 9). *Mangum dol.* lies 64 ft. below Acme dol., and in midst of Blaine fm. of western Tex.

Named for Mangum, Greer Co., Okla.

Manhasset formation.

Pleistocene: Southeastern New York (Long and Fishers Islands), and southern New England islands.

J. B. Woodworth, 1901 (N. Y. State Mus. Bull. 48, pl. 1 and text). *Manhasset gravels and sands* (mapped) underlie Manhasset Neck, Great Neck, and Oyster Bay quad. Are of pre-Wisconsin Pleist. age. Include a local glacial deposit called *Manhasset boulder bed* [either Hempstead gravel memb. or Herod gravel memb. of Manhasset fm.], which is mapped along E. side of Manhasset Neck.

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). *Manhasset (glacial)* seems to represent waterlaid material when the ice was at no very great distance to N. Is younger than Sankaty interglacial beds (correlated with Yarmouth) and was followed by Vineyard interval of uplift and erosion. Is correlated with Iowan stage. Greater part of it is considered=Tisbury of Woodworth. A portion of the folded Manhasset of Woodworth may be referable to the Jameco.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Manhasset fm.* (also *Manhasset stage*, for the time).—Glacial deposits, 150 to 250 ft. thick, correlated with Illinoian stage of Mississippi Valley. Divided into (descending): (1) Hempstead gravel memb., resting uncon. on (2) Montauk till memb., which rests uncon. on Herod gravel memb.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Manhasset fm.* is present on Block, Nantucket, Marthas Vineyard, No Mans Land, and Cape Cod.

F. G. Wells, 1935 (Geol. Soc. Am. Proc. 1934, p. 121), regarded Manhasset fm. as of Wisconsin age.

Manhasset stage.

The time covered by deposition of *Manhasset fm.*

†Manhasset boulder bed.

See under *Manhasset fm.*

†Manhattan group.

Pre-Cambrian: Southeastern New York (Manhattan Island).

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116–120). We have (on New York [Manhattan] Island) four (or six including those under water) beds of ls., with their associated shales and ls.-shales, the former metamorphosed into marble, and the latter into gneiss and calciferous gneiss granite or hornblende. The conclusion which we have arrived at is that the rocks of New York Island are metamorphosed Taconic, and worthy of the name *Manhattan group*.

F. J. H. Merrill, 1890 (Am. Jour. Sci., 3d, vol. 39, pp. 390–392). The name *Manhattan group* was proposed by R. P. Stevens to include the rocks of New York Island, and it seems proper that it should, for the present, be retained, including in it [descending], with the Manhattan schists, the Inwood ls. and the Fordham gneiss, the Yonkers gneiss, which though not found on Manhattan Island, is evidently a part of the same littoral deposit to which the Fordham gneiss belongs. Probably of Paleozoic age.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 210). Above Fordham gneiss is a series of sed. fms. consisting of Lowerre qtzite, Inwood ls., and Manhattan schist. This series has at various times been regarded as Precamb., Camb., or Cambro-Ord., but most recent investigations indicate Precamb. age, and the rocks are regarded as belonging to Grenville time.

†Manhattan gneiss.

D. S. Martin, 1888 (Geol. map of N. Y. City and vicinity). *Atlantic or Manhattan gneiss* (*age disputed*).—Underlies crystalline ls. and overlies *Highland gneiss* (*Laurentian*).

Probably refers to Fordham gneiss.

Manhattan schist.

Pre-Cambrian: Southeastern New York and western Connecticut.

F. J. H. Merrill, 1890 (Am. Jour. Sci., 3d, vol. 39, p. 390). *Manhattan schists*.—Highly schistose rocks, largely mica, with small proportion of quartz and usually little or no feldspar; garnet, staurolite, fibrolite, and cyanite are chief accessories; some small beds of gneiss are present; intercalated at many localities are hornblendic and augitic strata, usually only a few ft. thick, which resemble diorites and diabases and which may have originally been eruptive rocks, but whatever their origin they are now metamorphic rocks and may be called amphibolites and pyroxenites. Thickness probably more than 1,000 ft. Of limited extent in Westchester Co. Well exposed on Manhattan Island, of which they constitute the principal rock fm. Overlie Inwood ls. Form top fm. of Manhattan group.

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). *Manhattan schist* is considered to be of Hudson River age. Assigned to Ord.

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83), used *Hudson schist, of Sil. age*, to replace Manhattan schist (see under †*Hudson schist*); but Manhattan schist is now considered to be pre-Camb.

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). *Manhattan schist* (coarsely crystalline mica schist) assigned to pre-Camb. In Highlands area of SE. N. Y. it uncon. underlies true Poughquag qtzite, which contains Camb. fossils, and conformably overlies Inwood or Sprout Brook ls.

C. P. Berkey, 1909 (Sci., n. s., vol. 30, p. 416). The most constant characters of *Manhattan schist*, in order of importance, are presence of a white pearly mica, coarse foliation, and a crumpled structure.

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, pp. 47–57). *Manhattan schist* consists of nearly black or streaked micaceous, coarsely crystalline, strongly foliated rock, several thousand ft. thick, generally supposed to be=Hudson River slates. Assigned to Ordovicic (?).

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). *Manhattan* (*Hudson*) *schist*.—Primarily a recrystallized sediment which has lost its sed. character from profound metamorphism. Includes gneisses, schists, phyllites, and slates. Several thousand ft. thick. Conformably overlies Inwood ls. Whether Ord., Camb., or pre-Camb. undet. No fossils.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 21). Berkey holds that in all probability these fms. [Lowerre, Inwood, and Manhattan] are pre-Cambric and offers good evidence that they are not metamorphosed Paleozoic sediments.

J. F. Kemp, 1912 (11th Int. Geol. Cong., Stockholm, Compt. rend., pp. 702–711). *Manhattan mica schist* assigned to pre-Camb. and equivalence with Huronian of Lake Superior suggested.

C. R. Fettke, 1914 (N. Y. Acad. Sci., vol. 23, pp. 194–248). The use of *Manhattan schist* has been confined entirely to those schists which make the uppermost or youngest of bedrock fms. in SE. N. Y., Westchester and Putnam Counties. Consists of several thousand ft. of coarsely crystalline mica schist. In Conn. the continuation of these schists has been described by Conn. Geol. Survey as Berkshire. Age still in doubt, and much more detailed study of geology of SE. N. Y. and western Conn. and Mass. will have to be made before definite conclusion can be reached.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225–226). *Manhattan schist* is of doubtful age, but is tentatively correlated with later Grenville sediments (pre-Camb.).

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull 799). *Manhattan schist* assigned to pre-Camb. and correlated with Wissahickon fm. of Glenarm series (Algonkian).

†Manhattan beds.

Permian: Northern Kansas.

Robt. Hay, 1893 (Kans. State Bd. Agric. 8th Bien. Rept., p. 101). *Manhattan beds*.—Series of beds, not worked out in detail, but containing ls. and buffy, limy shales, also the gyp. beds of Marshall Co. and Pottawatomie. Overlain by Fort Riley beds and underlain by upper coal measures. Assigned to Permo-Carbf.

Named for Manhattan, Riley Co.

†Manhattan limestone. (In Council Grove group.)

Permian: Northern Kansas.

C. S. Prosser, 1894 (Geol. Soc. Am. Bull., vol. 6, pp. 37, 40–41). *Manhattan ls.*—Light yellowish-gray massive ls., 5 ft. thick, containing much chert and in upper part great numbers of *Fusulina cylindrica*. Basal memb. of Cottonwood fm. at Manhattan and vicinity. Overlain by Cottonwood shales and underlain by 31 to 36 ft. of shales and marls with thin ls. layers. Is=Cottonwood ls. and Alma ls.

Same as Cottonwood ls.

Named for Manhattan, Riley Co.

Manhattan ridge. (Also Manhattan moraine.)

Pleistocene (late Wisconsin): Northeastern Illinois (Joliet quadrangle). See D. J. Fisher, 1925 (Ill. Geol. Surv. Bull. 51, p. 89, footnote), and M. M. Leighton, 1932 (16th Int. Geol. Cong. Guidebook 26, pp. 16, 51, pl. 2).

Manifold sand.

Name that has been applied by drillers to Big Injun sand.

Manigotagan granite.

Pre-Cambrian: Manitoba.

E. S. Moore, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 265).

Manistee limestone.

Mississippian: Western Michigan.

C. C. Douglass, 1839? (Mich. Leg. H. Doc. 27, btw. pp. 97 and 111). *Manistee ls.* occurs near Manistee River in T. 15 N. Overlies light blue argill. sh. [The 1916 geol. map of Mich. Geol. Surv. maps the rocks of T. 15 N. and surrounding region as Coldwater sh.]

Manistee moraine.

Pleistocene (Wisconsin stage): Northwestern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Belongs to Port Huron morainic system. Named for Manistee.

Manistique series.

Silurian (Niagaran): Michigan (eastern part of Upper Peninsula).

R. A. Smith, 1916 (Mich. Geol. Surv. Pub. 21, p. 152). *Manistique series.*—Succession of high mag. lss. and dolomites, of white, light and dark gray, buff, blue, and brown colors, and ranging in texture from earthy or finely crystalline to coarsely crystalline. Thickness 250+ ft. Underlies Engadine dol. and overlies Fiborn ls.; all included in Niagara. Named for exposures at Manistique, Schoolcraft Co.

Manitoba formation.

Devonian: Manitoba.

A. MacLean and R. C. Wallace, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 167).

Manitoban.

Devonian (Upper?): Manitoba.

J. B. Tyrrell, 1892 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 144E–199E).

†Manitoban substage.

Pleistocene: Great Lakes region.

M. M. Leighton, 1931 (Jour. Geol., vol. 77, pp. 51–53). *Manitoban substage of Wisconsin stage* is the *Iowan*. In view of fact that the Iowan drift is first deposit of last glacial stage, it must either be known as early Wisconsin or else the old terms "early Wisconsin," "middle Wisconsin," and "late Wisconsin" must be dropped. It is nevertheless proposed that the subdivisions of Wisconsin stage be made according to dominance of the ice fields. This has the advantage of recognizing historical chronology, of placing natural boundaries, and of focusing attention on the fact of shifting dominancy of ice centers. It also permits the listing of the moraines under these divisions and the giving of subordinate places to these minor oscillations. The following nomenclature is therefore proposed: *Wisconsin stage*, divided into Hudsonian (late Wisconsin), Quebecan (early and middle Wisconsin), and Manitoban (Iowan). [The Manitoban is shown as older than Peorian loess.] The name *Manitoban* is taken from province of Manitoba, Canada, in which general area the Iowan ice probably had its center of radiation.

M. M. Leighton, 1933 (Sci., vol. 77, p. 168), withdrew "Manitoban substage" and returned to the old name *Iowan*, which, however, he included in Wisconsin stage.

The U. S. Geol. Survey treats Iowan as distinct from and older than Wisconsin stage.

Manitou limestone.

Lower Ordovician (Beekmantown): Eastern Colorado.

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Manitou ls.*—Best seen in upper part of Garden Park, where it consists of fine-grained pink or reddish dol. less than 100 ft. thick and contains same fossils that characterize the fm. at Manitou Springs and in Manitou Park, for which it is named. To E. is wanting at many places. In Garden Park is conformably overlain by Harding ss. Rests on Algonkian granite and gneiss, but probably a small thickness of qtzite and cherty ls. below Manitou ls. are of Camb. age.

Manitou ls. (of Beekmantown age) is now recognized over a large area on both the E. and W. sides of Front Range. It is in places overlain by Harding ss. and Fremont ls., both of Ord. age, and in other places by Parting qtzite memb. of Chaffee fm. (Dev.). It rests on Sawatch qtzite, the transition shaly beds at the top of which are now known as *Peerless sh. memb.*

Manitou amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Is older than Medora amygdaloid and younger than Mandan amygdaloid. The mineralized part is the Manitou lode. Named for occurrence in Manitou mine, Keweenaw Co.

Manitou flow.

Includes Manitou amygdaloid and the underlying trap.

Manitou series.

A time term applied by N. H. Winchell to upper part of Keweenawan series of northern Minn., or to rocks extending from base of a cgl. interpreted by him as corresponding to Puckwunge cgl. up to top of Keweenawan. (See Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, pp. xiv–xx, 295–298, 1899.) Named for exposures on Manitou River, Lake Co. "Intended to cover that part of the eruptive Keweenawan which followed the great gabbro revolution."

Manitou stone.

Trade name for a stone quarried in Fountain fm. (Penn.) near Boulder, Colo.

Manitoulin dolomite member (of Cataract formation).

Silurian (early): Ontario.

M. Y. Williams, 1913 (Ottawa Nat., vol. 27, p. 37). *Manitoulin memb.*—The lower or dol. memb. of Cataract fm. in Georgian Bay region. Thickness 11 or 12 ft. near Collingwood, Ont., and 50 or more ft. on parts of Manitoulin Island. Underlies the upper or Kagawong [Cabot Head sh.] memb. of Cataract fm. and rests on soft green sh. at top of Richmond fm. Named because of its importance on

Manitoulin Island. At Cabot Head 6 ft. or more of soft red sh. intervene btw. the green Richmond sh. and the base of Manitoulin dol.

See also C. Schuchert's 1914 description, under *Cataract fm.* He recognized the Manitoulin in Stony Creek, Hamilton, Dundas, Glenwilliam, Cataract, Collingwood, Owen Sound, Cabots Head, and Manitoulin Island sections, all in Ont.

Later repts by M. Y. Williams and other geologists state that *Manitoulin dol. memb.* of Cataract fm. overlies Whirlpool ss. on Niagara River and at Dundas, Ont.

Manitoulin limestone.

Silurian (pre-Niagaran): Michigan (east end of Northern Peninsula) and Ontario (Manitoulin Island).

J. J. Bigsby, 1824 (Notes on Geog. and Geol. of Lake Huron, pp. 199-204). *Manitouline ls.* is separated on W. and N. from that of St. Joseph by waters, low woods, and morasses, nothing being visible near promontory of True Detour for many mi. around, on shores of main and neighboring islands, but ls. shingle, white, slaty, and devoid of petrifactions. On E. the *Manitouline ls.* is connected by a chain of high and rocky islets with Cabot's Head. I have seen numerous specimens from both extremities of this ridge, but it is with Drummond, Little Manitou, and W. end of Grand Manitou that I am personally conversant. This ls. is distinguished from that of St. Joseph and the N. by its greater compactness and hardness and difference in organic remains and the silicified state in which they are found, all fossils of Drummond being quartzose or chalcedonic, those of Little and Grand Manitou and Cabot's Head and vicinity being less purely ss. The ls. usually rises to 250 ft. above lake level, often in confused stair-like ledges.

A. C. Lane, 1905 (Mich. Geol. Surv. Ann. Rept. 1903, p. 288), used in table of geologic fms. of Mich., *Niagara* (*Manitoulin*). Later repts state that it is pre-Niagara and=part of Albion ss.

See *Manitoulin dol. memb. of Cataract fm.*

Manitouline limestone.

See *Manitoulin ls.*

Manitounuck group.

Cambrian: Canada.

R. Bell, 1879 (Canada Geol. Surv. Rept. 1877-78, pp. 11C-19C).

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 197), assigned these rocks to Camb.

Manix lake beds.

Pleistocene: Southern California (San Bernardino County).

J. P. Buwalda, 1914 (Calif. Univ. Pub., Dept. Geol. Bull. vol. 7, p. 444). *Manix lake beds.*—Lake beds of aren. clays and fine argill. sands, both of light grayish green color; quartz, feldspar, and mica are the abundant coarser constituents. Most notable characteristic is evenness, persistence, and parallelism of individual strata. Thickness about 75 ft., but the beds thin out gradually toward W. Believed to be slightly younger than the Pleist. fangls. Are deposits of an extinct lake named *Manix Lake.* Well exposed along Mohave River 2 mi. SE. of Manix, about 120 mi. NE. of Los Angeles.

Mankato substage.

Pleistocene: Mississippi Valley.

M. M. Leighton, 1931 (Jour. Geol., vol. 39, pp. 51-53), proposed *Hudsonian substage* for late Wisconsin, *Quebecan substage* for middle and early Wisconsin, and *Manitoban substage* for Iowan, and included Peorian loess and Iowan drift in his Wisconsin stage, thus treating the Wisconsin as the 4th glacial stage, instead of the 5th.

M. M. Leighton, 1933 (Sci., vol. 77, p. 168) withdrew his names *Hudsonian, Quebecan,* and *Manitoban,* and divided his Wisconsin "age" into *Mankato* (late Wisconsin), *Cary* (middle Wisconsin), *Tazewell* (early Wisconsin), and *Iowan*. The name *Mankato* was taken from Mankato, Minn., "where the late Wisconsin deposits are excellently displayed;" the name *Cary* was from a town in McHenry Co., NE. Ill., "where the middle Wisconsin deposits are well displayed;" and the name *Tazewell* from Tazewell Co., Ill., "where the early Wisconsin deposits are well shown in their relations to underlying Peorian loess."

F. Leverett, 1933 (Sci., vol. 77, p. 560). In Feb. 10, 1933, issue of Sci., there appears a brief article by Dr. M. M. Leighton on "The naming of the subdivisions of the Wisconsin glacial age," in which he proposes the substitution of certain meaningless terms—Tazewell, Cary, and Mankato—for the significant terms, Early Wisconsin, Middle Wisconsin and Late Wisconsin, which have been in general use for considerable time and are readily understood by anyone reading geological literature, denoting as they do successive parts of the Wisconsin glacial stage. The incentive for suggesting the new names seems to have its basis in a newly acquired view of Dr. Leighton that the deposition of the Iowan drift came only a short time before that of the Early Wisconsin drift, and so it may properly be included in the Wisconsin stage.

Whether Iowan should be so included, if the entire field is taken into account, is far from being clearly established. This has been made forcibly apparent in a recent report by Dr. W. C. Alden on eastern Mont. and adjacent areas (U. S. G. S. P. P. 174, 1932). There are deposits in Mont. and the Dakotas which Dr. Alden is inclined to refer to the Iowan, but he considers them too old to be included in the Wisconsin stage. These are discussed by him under the heading "Illinoian or Iowan." But he thinks they do not appear to be as old as the Illinoian of Illinois.

Inasmuch as the entire series of drifts classed as Illinoian, Iowan, and Wisconsin fall in the last quarter of the Pleist. the distinctions in age aspects are less striking than btw. these drifts and those of middle and early Pleist. age, known as Kansan and Nebraskan. This being the case, it seems advisable to let the terms that are in general use stand, especially where they have significance, and are self-explanatory, and not replace them by a set of meaningless terms.

G. F. Kay and M. M. Leighton have agreed to adopt Tazewell, Cary, and Mankato. See under *Wisconsin stage*.

Mankomen formation.

Permian: Southeastern Alaska (central Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 40, map). *Mankomen fm.*—Interbedded sss., shales, and lss. with intrusive sheets. Thickness 6,700 ft. Fossils referred by Schuchert to Perm. Lies N. of Mankomen Valley and Mankomen Lake.

Manlius limestone. (Of Cayuga group.)

Silurian (late): New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 376). *Manlius water lime group*.—Embraces all beds of water lime S. of Erie Canal which are burnt for lime. Very constant in character. I have traced it from Cayuga Lake to hills in rear of Hudson. Its layers are dark blue and drab. It occupies interval btw. base of *Pentamerus* ls. [Coeymans ls.] (underlying *Delthyris* shaly ls.) and top of Onondaga salt group, which consists of salines and gyp. [As thus defined the unit apparently included Manlius, Rondout, and Cobleskill lss. and also Bertie ls. memb. of Salina fm. In 1839 (3d Ann. Rept. Geol. Surv. 3d dist., N. Y., p. 272) Vanuxem described the *Waterlime group of Manlius* as overlying "saliferous group of *Onondaga*" and underlying Oriskany ss.]

W. W. Mather, 1841 (N. Y. Geol. Surv. 5th Rept., p. 86), applied *Manlius water lss.* to beds btw. *Pentamerus* ls. and Onondaga salt group [the latter described as consisting of gray and porous ls. (pyritous ls.), gyp., red and variegated shales, etc., essentially same as Salina fm. of present terminology].

E. Emmons, 1842 (Geol. N. Y., pt. 2, p. 429), applied *Manlius waterlime* to beds btw. *Pentamerus* ls. above and Onondaga salt and plaster rock below. The same beds (overlain by *Pentamerus* ls. and underlain by Onondaga salt group) were called *Water-lime group* by Vanuxem in 1842, and *Manlius waterlimes and thin shales* by E. Emmons in 1846 (Agric. N. Y.).

For many succeeding years the term "Waterlime group" continued to be applied to the strata btw. "Lower Helderberg group" and "Onondaga salt group." In some repts. however, the unit was included in "Lower

Helderberg group" and in other repts it was included in "Onondaga salt group." The name *Manlius* was dropped for many years.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Manlius ls.* (the Tentaculite ls. of Gebhard, Mather, and later writers) underlies Coeymans ls. (basal fm. of Helderbergian group) and overlies Rondout waterlime. The name here used was introduced by Vanuxem and is entitled to first consideration. Is top fm. of Cayugan group, which includes Salina fm. at base. [In 1900 (Geol. Soc. Am. Bull., vol. 11, p. 251) Schuchert gave thickness of *Manlius or Tentaculite ls.* as 50 to probably 300 ft. or more.]

E. O. Ulrich and Schuchert, 1901 (N. Y. State Mus. Bull. 52, p. 658), classified Decker Ferry [Decker ls.] as occupying position btw. the Manlius and Rondout. The relations of the Decker to the Manlius and Rondout are, however, still in question.

In March 1903 (Am. Geol., vol. 31, pp. 160–175), Schuchert "redefined" Manlius, calling the beds *Manlius fm.*, which he described as 50 to 126 ft. thick, as underlying Coeymans ls. of Helderbergian group, as overlying Bertie fm. (forming top of Salina and formerly called "Lower Waterlime"), and as including Manlius (*Tentaculite*) ls., Rondout ls. (restricted to "Upper Waterlime"), and Cobleskill ls. (new name applied to 7 to 30 or more ft. of strata formerly called "Coralline ls." and included in the Rondout). Schuchert stated: This will be more in harmony with Vanuxem's conclusion, since he included the horizon having the Cobleskill fauna in his Manlius fm. From his definition of this fm. usage long ago excluded the lower Waterlime, and this part is here referred to as the Bertie ls. J. M. Clarke (in his Hdb. published in July 1903), also C. A. Hartnagel (N. Y. State Mus. Bull. 69, 1903), adopted the following classification: Manlius ls., Rondout waterlime, Cobleskill ls., and Salina fm. In 1905 (N. Y. State Mus. Bull. 82) J. M. Clarke and D. D. Luther used *Manlius group* to include *Manlius ls.* (74 ft. thick), Rondout dol. or waterlime (40 ft. thick), and Cobleskill dol. The broad use of Manlius apparently did not find favor with geologists, who, excepting Berkey, 1911, have continued to recognize the three subdivisions Manlius, Rondout, and Cobleskill. Berkey (N. Y. State Mus. Bull. 146) suggested it might be better to group the beds btw. top of the Manlius and base of the Cobleskill into a single unit and call it *Manlius series.*

In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28) E. O. Ulrich placed in Helderberg group of N. Y. a fm. beneath Coeymans ls. which he called *Keyser ls.*, taking the name from a locality in W. Va. The beds beneath the Keyser he designated as "Tentaculite ls.," "Cement rock," and "Cobleskill ls." In 1913 (Md. Geol. Surv. Lower Dev. vol., pp. 115–116) Ulrich stated that the Keyser represents "Manlius of the literature," and rests on the Rondout, beneath which comes the Decker Ferry [Decker]. These three fms. he included in Dev. But he stated that the *typical Manlius* underlies the Decker and overlies the Cobleskill, is of Sil. age, and is absent at Rondout, where the Keyser rests on Rondout and Rondout rests on Decker. In same volume C. K. Swartz, C. Schuchert, and C. S. Prosser classified the Manlius of eastern N. Y. and N. J. as Lower Dev., and Schuchert so classified it in the 1924 ed. of his Textbook of geol.

The relations and age of typical Manlius, typical Rondout, Decker ls., and Cobleskill ls. are matters about which geologists are not yet agreed.

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 25–35). If *Manlius* is to be employed with anything like its original value, the *group* represented comprises 6 strat. units at the very least. These 6 formational members are all present at Manlius, Onondaga Co., and are here given geographic names, as follows (descending):

(1) Bishop Brook ls. (*Helderbergian fauna*), (2) Pools Brook ls., (3) Jamesville ls., (4) Clark Reservation ls., (5) Elmwood beds, and (6) Olney ls. The beds uncon. underlie Oriskany ss. and rest on a sun-cracked waterlime which forms quarry floor at type loc., and is thought to be below or at least near lower limit of *Spirifer vanuxemi* in central Onondaga Co. Without being distinguished, Nos. 3 and 4 have been classed as Helderbergian by some authors, but they are undoubtedly included in Vanuxem's Manlius. One can hardly escape conclusion that upper part of Rondout of Hopkins (1914) and lower part of Hartnagel's 1903 Manlius are identical.

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, p. 27) included all of Manlius in Sil.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 318, 346-347). When Clarke transferred Helderberg lss. to Dev., the Manlius was, because of rather Sil. aspect of its meager fauna, left in Sil., and since then has been subject of much discussion as to age. Some, following Clarke, class entire Manlius as Sil., others would place it in Dev., and a third group place Dev.-Sil. bdy within the Manlius. In eastern Helderberg region a distinct irregular uncon. occurs btw. the Manlius and overlying Coeymans. The *Upper Manlius beds* of western N. Y. are considered as Keyser, and Dev., by Ulrich. [In this 1931 rept the Manlius is described under Sil. heading, and on pp. 191, 317, and 318 it is included in Sil., but in tables on pp. 190 and 192 *Upper Manlius or Keyser* (*in parens*) is included in Dev. It is shown as overlying the Rondout.]

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 68). *Olney ls.* and *Elmwood waterlime* have been very generally assigned to Sil., and there appears to be no good reason for questioning this practice. A system reference for *Clark Reservation and Jamesville lss.* rests perhaps upon less secure ground. Inasmuch, however, as positive Dev. relations have not been proved for these higher units it is deemed best to include them in Sil.

W. Goldring, 1935 (N. Y. State Mus. Bull. 303) assigned *Manlius ls.* to Sil.

†Manlius group.

†Manlius series.

†Manlius waterlime group.

See under *Manlius ls.*

Mann Creek formation.

Tertiary: British Columbia.

J. F. Walker, 1931 (Canada Geol. Surv. Summ. Rept. 1930, pt. A, p. 136).

Mannetto gravel, also **formation.**

Pleistocene: Southeastern New York (Long and Fishers Islands) and southeastern Massachusetts (Marthas Vineyard).

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367-390). *Mannetto gravel*, name proposed in unpublished rept. of A. C. Veatch on geol. of underground waters of Long Island [U. S. G. S. P. P. 44]. Named for Mannetto or High Hill S. of Huntington, L. I. Consists of 500 ft. of gravel composed of quartzose and weathered granitic pebbles. Uncon. underlies Jameco gravel and uncon. overlies Cret. clay.

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). *Mannetto gravel.*—Mostly quartz gravel, but contains some very decayed pebbles and boulders of probable glacial origin. Classified as a glacial deposit uncon. underlying Jameco gravel.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467-469). *Mannetto gravel* believed to be pre-Kansan and to represent outwash of same glacier that farther inland deposited till.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Mannetto gravel* (glacial), the earliest Pleist. deposit of Long Island. Consists of 40 to 330 ft. of stratified and in places cross-bedded gravels, mainly of well-rounded pebbles of quartz, from ½ inch to inch in diam., mixed with coarse yellowish quartz sand, but everywhere carrying a few deeply weathered granitic pebbles and scattered large boulders of crystalline rock deeply weathered or disintegrated. Includes a few thin intercalated beds of yellowish clay. Rests uncon. on Cret. deposits. Time of deposition called *Mannetto stage*. Is correlated with pre-Kansan of Mississippi Valley. Named for exposures on Mannetto Hills (West Hills).

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Mannetto fm.* of Marthas Vineyard consists of a bed of glacial gravel underlain by stony blue clay ice-laid till without boulders. It underlies Jameco fm. and overlies Weyquosque fm. The time of deposition is called *Mannetto stage*, and is correlated with later part of Nebraskan stage of Mississippi Valley and with Jerseyan drift of N. J.

Mannetto stage.

The time covered by deposition of *Mannetto gravel.*

Mannie clay. (In Richmond group.)

Upper Ordovician: Western Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 39, 44). *Mannie sh. or shaly clay.*—Brownish and bluish fossiliferous shaly clays, 16 to 35 ft. thick, forming top of Richmond group in Tenn. River Valley. Overlies Leipers Creek ls.

Is upper part of Fernvale fm.

Named for Mannie or Allens Creek, Lewis Co.

Manning beds.

Eocene: Eastern Texas (Angelina County).

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 462, 463). *Manning beds.*—Light-greenish sands and carbonaceous sandy clays. Top memb. of Jackson beds. Underlie Corrigan sands. Separated from underlying Caddell beds by lignitic or carbonaceous chocolate-colored clays and sands with light-brown sss. and coarse-grained gray sss. Named for exposures at station on St. Louis & Santa Fe Ry.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 685). [See 1933 entry under *McElroy memb. of Fayette ss.*]

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, p. 1307). Stratigraphically above Wellborn sss. occur a series of beds designated *Manning beds*. Dumble [Univ. Tex. Bull. 1869, p. 134, 1920] described a Manning section which included more beds than are referred to as *Manning beds* in this paper, which include all beds stratigraphically above Wellborn sands and below Dilworth sands. They extend from Sabine River to Atascosa River, and consist of lignitic chocolate-brown shales with thin partings of sand; brown carbonaceous sands; tuffaceous sss. and beds of volcanic ash and cross-bedded glass; chocolate-brown diatomaceous shales, and brown bentonitic shales. Essentially nonfossiliferous and essentially nonmarine.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and pp. 32–43, on area btw. Walker and Gonzales Counties). *Manning fm.* is here retained for the beds btw. top of Wellborn fm. (of which Carlos ss. is top memb.) and base of Whitsett fm. It does not seem to be appropriate to use McElroy fm. for these strata, because Miss Ellisor includes Wooley's Bluff clays, Wellborn sands, and Manning beds in the McElroy. Also, in paleontologic repts on wells McElroy has come to be almost synonymous with *Textularia hockleyensis* zone, but, as Miss Ellisor points out, this foraminifer ranges up into uppermost Jackson strata. The Manning is here divided into (descending): (1) Chocolate-colored lignitic clay with interbedded tan sand and ss. and gray tuffaceous ss. and thin beds of lignite, but chiefly nonmarine, 0 to 25 ft.; (2) *Yuma ss.*, 3 to 25 ft.; (3) same as No. 1; (4) *Dilworth ss.*, 2 to 22 ft.; and (5) chocolate-colored lignitic clay with interbedded tan sand and ss. and gray tuffaceous ss., thin beds of lignite; mostly nonmarine [thickness not given]. Thickness of Manning fm. 250 to 350 ft.

Manning Canyon shale.

Pennsylvanian and upper Mississippian: Central northern Utah (Oquirrh Mountain region) and western Utah (Gold Hill district).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Manning Canyon sh.*—Dominantly sh., with some thin beds of ls. and in lower half two fairly persistent qtzite beds. The part above upper qtzite is Penn., that below it is upper Miss. Thickness 1,140± ft. Grades into underlying "Great Blue" ls. and into overlying Oquirrh fm. Where lss. greatly predominate over sh. the beds are assigned to Oquirrh fm. Outcrops in a narrow band from Manning Canyon on SE. to valley of S. Fork of Ophir Creek, in Fairfield quad. [This name first appeared in print in 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, pp. 423, 430), in a paper on the Paleozoics of Gold Hill quad., Utah, by T. B. Nolan, who identified Gilluly's Manning Canyon fm. in Gold Hill quad.]

See also T. B. Nolan, 1934 (U. S. G. S. P. P. 177).

Mannington sandstone. (In Washington formation.)

Permian: West Virginia and eastern Ohio.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties, p. 226). *Mannington ss.*—Massive cliff-forming ss., 25 to 50 ft. thick, underlying Little Washington coal and overlying Waynesburg B coal. Named for Mannington, Marion Co., W. Va.

C. R. Stauffer and C. R. Schroyer, 1920 (Ohio Geol. Surv., 4th ser., Bull. 22), give 5 sections in Ohio showing 8 to 99 ft. of *Mannington ss.* lying 17 ft. below Washington coal and 21 ft. below Lower Marietta ss.

†Mansfield group.

Eocene: Northwestern Louisiana and western Mississippi.

E. W. Hilgard, 1869 (Am. Jour. Sci., 2d, vol. 48, pp. 340–341; see also Prel. rept. geol. reconn. La., pp. 8–9, 1869). It will be extremely difficult to define the portions corresponding to each of the various marine epochs [of the Eocene]; meanwhile I propose to designate as *Mansfield group* that portion which, from its geographical position and general uniformity of materials, seems to be= lower portion of the Vicksburg bluff. It is very characteristically developed near Mansfield, La., and there presents a feature foreign to the other lignitic groups I have investigated, viz, a ledge, ¾ to 2 ft. thick, of an impure laminated ls. with numerous but mostly fragmentary impressions of lignitized stems and leaves. A narrow (¼ to ½ inch wide) band of this rock seems to extend from Mansfield as far as Shreveport, appearing mostly a few ft. below the hilltops. Bluish-gray clayey sands and mouse-colored laminated clays are predominant materials with which lignite beds are frequently associated. Appears to lie stratigraphically higher than Jackson marine and to underlie the marls and lss. at Vicksburg, Miss.

F. V. Hopkins, 1870 (La. Geol. Surv. 1st Ann. Rept., pp. 78, 83). *Mansfield group* of Hilgard is a large mass of lignitic strata which dips under Jackson group. It is probably parallel to Northern Lignitic of Miss.

F. V. Hopkins, 1871 (La. Geol. Surv. 2d Ann. Rept., pp. 3–35). *Jackson group* underlies Vicksburg group and overlies Claiborne group. It consists of marine strata, often containing massive clays, with characteristic fossils; lignitic beds that tell of swamps; nonfossiliferous laminated sands and clays that must have been deposited in brackish water subject to great variations in freshness. Dr. Hilgard named the lignitic beds and laminated sands and clays the "Mansfield group," and in this I followed him last year, but the fossils I have had the good fortune to discover show that the group is parallel in age with the Jackson marine strata. I have submitted my collections to Dr. Hilgard, who has kindly determined them for me, and agreed to retain Mansfield group only as a subdivision of the Jackson.

As used in La. included Claiborne and Wilcox strata as well as Jackson fm. In Miss. the name was applied to Forest Hill sand, now regarded as basal fm. of Vicksburg group.

Named for exposures near Mansfield, DeSoto Co., La.

Mansfield red beds. (In Chemung formation.)

Upper Devonian: Central northern Pennsylvania (Tioga and McKean Counties) and northeastern Pennsylvania (Susquehanna and Wayne Counties).

J. P. Lesley, 1875 (2d Pa. Geol. Surv. Rept. I, pp. 45, 100, 108), mentions (p. 45) red beds which "cannot represent Bedford sh. of Ohio," but which "will perhaps hereafter be identified with the *Mansfield red beds* (of the Survey of 1841) crossing the Tioga River." On p. 100 he mentions "red beds in the top VIII (Chemung) called by me, in my report [published ??] of 1840, the *Red Mansfield Beds* of Tioga County." On p. 101 he says the *Mansfield beds* are best developed in Tioga Co. The compiler is unable, without spending more time than the matter warrants, to find where Lesley in 1840 or 1841 published the name *Mansfield red beds*.

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R, pp. 43, 73). *Mansfield Red Beds.*—Red and gray sl., sh., and ss., 300 ft. thick, lying 350 ft. below top of Chemung in McKean Co., Pa. The red shales are no doubt the representatives of those which are found in the Chemung in vicinity of Mansfield, Tioga Co., and described by Lesley in 1841 [1878], Rept. G, p. 94. Overlain by 350 ft. of gray sl. and ss. and underlain by 650 ft. of gray sl. and ss. all belonging to Upper Chemung.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G5). *Mansfield reds*, 90 ft. thick in Susquehanna and Wayne Counties. Lie 40 ft. below top of Chemung fm. Consist of olive, greenish, and brick-red shales, with 5 ft. of shaly green ss. near middle.

Mansfield sandstone. (In Pottsville group.)

Pennsylvanian: Southwestern Indiana.

T. C. Hopkins, 1896 (Ind. Dept. Geol. and Nat. Res. 20th Ann. Rept., 1895, pp. 186–213). *Mansfield ss. and cgl.*—Coarse-grained massive variegated ss., with some cgl., lying at base of Coal Measures. Thickness few ft. to more than 100 ft. In previous Ind. repts called *Conglomerate*, also *Millstone grit*. Overlain, uncon. in places, by coal-bearing shales and sss.; uncon. underlain by Miss.

For many years this name was applied to all Pottsville rocks of Ind., Ill., and western Ky., but that use of the name has now been discontinued, and in Ind. it is now applied to basal few to 300± ft. of Pottsville group, or to the beds beneath Brazil fm.

Named for Mansfield, Parke Co.

†Mansfield formation.

Pre-Cambrian (middle and lower Huronian): Northwestern Michigan (Felch Mountain district).

H. L. Smyth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 114–115). *Mansfield fm.*—Chiefly fine- to medium-grained soft mica schists which are exposed at only a few places in Felch Mtn range. But a series of phyllites, less metamorphic but otherwise similar and occupying same [?] strat. position immediately above Randville dol., outcrop to NW., at Mansfield mine and N. of it near Michigamme River in T. 43 N., R. 31 W. For these reasons it is convenient to name the fm. from the Mansfield locality. [Thickness not stated.] Overlain by Groveland fm. [Vulcan fm.].

The rocks to which Smyth applied "Mansfield fm." in Felch Mtn dist. were later (U. S. G. S. Mon. 52, p. 303, 1911) named *Felch schist*, being said to be younger than the rocks at Mansfield mine, to which Clements applied the name "Mansfield sl." In 1935, however (U. S. G. S. P. P. 184), C. K. Leith, R. J. Lund, and A. Leith assigned Felch schist to middle and lower Huronian.

†Mansfield formation (also slate).

Pre-Cambrian (*middle* Huronian): Northwestern Michigan (Crystal Falls district).

J. M. Clements, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 36–48, 62, pl. opp. p. 84). *Mansfield fm.* (heading).—Chiefly sl. Includes graywackes, clay slates, phyllites, siderite slates, cherts, ferruginous cherts, and iron ores interbedded. Colors olive green and purplish black to bright red. Max. thickness in Crystal Falls dist. 1,500 to 1,900± ft. Appears to correspond stratigraphically and lithologically to Siamo sl., of Marquette dist. Named "*Mansfield sl.*" because of exposures at Mansfield village and Mansfield mine. Overlies Randville dol. On the whole the Hemlock volcanic fm. is younger than Mansfield sl., but some of lower Hemlock beds are contemp. with some of upper Mansfield beds.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 291–296, 303, 324). One of principal local sed. units within Hemlock fm. was described and mapped in U. S. G. S. Mon. 36, 1899, on Crystal Falls dist. as "*Mansfield sl.*" Is here called *iron-bearing sl. memb.* Is interbedded [p. 291 says *at top*; pp. 295 and 607 say *near top*] of Hemlock fm.

Mansfield beds.

Pennsylvanian: Southeastern Massachusetts.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 188–191). [In table on p. 134 *Mansfield beds* are included in Rhode Island Coal Measures and are placed above Cranston beds and below Tennile River beds. In description of *Mansfield* *area*, Bristol Co., Mass., on pp. 188–191, the name "Mansfield beds" is not employed, but the beds overlying the Wamsutta "series" there are described as quartz pebble and qtzite cgls. and gray sss.]

Mansonville slates.

Upper Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

†Manti beds.

Eocene (middle): Central Utah (Wasatch Plateau region).

E. D. Cope, 1880 (Am. Nat., vol. 14, pp. 303–304). A series of calc. and siliceo-calc. beds which contain the remains of different species of vertebrates from those which have been derived from either the Green River or Amyzon beds. There is nothing to determine to which part of the Eocene this fm. should be referred, but it is tolerably certain that it is to be distinguished from the Amyzon beds. Petrographically it is most like the Green River, as it consists in large part of shales. Until its proper position can be ascertained I propose that the fm. be called *Manti beds*. [Apparently named for Manti, San Pete Co.]

Later work proved these beds to be Green River fm., by which name they are now known.

Manuels formation.

Middle Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Manuels fm.*—Fossiliferous black, brown, and olive shales, thin sss., and Kalkballen, with phosphorite at base. Assigned to Middle Camb. Overlain by Elliott Cove fm. (Upper Camb.) and discon. underlain by Hanford fm. (Lower Camb.). [Derivation of name not stated.]

Manzanan series.

Pennsylvanian: New Mexico.

See under *Mosca ls.*

Manzanilla formation.

Tertiary (Miocene?): Trinidad.

R. J. L. Guppy, 1866 (London Geol. Soc. Quart. Jour., vol. 22, pp. 572–573). *Manzanilla beds*. Assigned to lower Mio.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 344). *Manzanilla beds* of Trinidad Island assigned to middle Eo.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 69). *Manzanilla fm.*, Trinidad, assigned to Mio.

Manzanilla beds.

Oligocene: Costa Rica.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 362) and 1924 (Revista económica San Salvador, año 11, No. 4, p. 175). Assigned to Olig.

Manzanita dacites.

See under *West Prospect basalt*.

Manzano group.

Permian: New Mexico (widespread).

C. L. Herrick, 1900 (Am. Geol., vol. 25, p. 337; Jour. Geol., vol. 8, pp. 112–126; N. Mex. Univ. Bull., vol. 2, pt. 2, fasc. 3, p. 4). *Manzano series*.—Large series of coarse red qtzites and sss. interbedded with dark earthy lss. and shales. Rests on large series of massive gray siliceous lime (which separates it from underlying Coyote ss.) and is overlain by 500 ft. of reddish ls., ss., and gyp. containing Perm. fossils near base. [Derivation of name not stated.]

C. H. Gordon, 1907 (Jour. Geol., vol. 15, pp. 810–816). *Manzano group* divided into (descending): (1) Gray ls., 0 to 500 ft.; (2) alternating yellow, pink, and white sss. and shales, with lenses of gyp. and subordinate ls., 500 to 1,000 ft.; (3) dark-red sss. interstratified with red sandy shales and some thin beds of bluish drab earthy ls., 400 to 800 ft. Overlies, with uncon., Madera ls., top fm. of Magdalena group.

W. T. Lee, 1909 (U. S. G. S. Bull. 389). *Manzano group* is here divided into 3 fms., named (descending) *San Andreas ls.*, 150+ ft.; *Yeso fm.*, 610+ ft.; and *Abo ss.*, 300+ ft. The Abo rests uncon. on Madera ls., the upper fm. of Magdalena group, and the Manzano is separated from overlying fms. by an uncon. It is clear, from Herrick's original definition of *Manzano group* and from his other writings, that he included in his Manzano group only (1) the lower or red ss. here named *Abo ss.*, with which he associated the overlying gyp.; (2) the middle or chocolate-colored sediments; and (3) the upper or vermilion beds. The present writer has combined Nos. 2 and 3 and herein named them *Yeso fm.* The massive upper ls., which overlies the gypsiferous sh. and ss. and which is here named *San Andreas ls.*, is not described in any of the literature of Rio Grande region, although Herrick includes it in his sections. It contains an abundant fauna, which clearly allies it with the red beds in the Penn. [now called Permian], and it is therefore included in Manzano group, although it was not originally so included by Herrick. So far as known the San Andreas ls. is uppermost memb. of Manzano group, but it cannot be asserted at present that there are no younger Penn. beds in Rio Grande region, or that no Triassic occurs there. The red sediments near Carthage, which apparently are above San Andreas ls., are the only ones known that may represent Perm. or Triassic time. They differ considerably in general appearance from known Manzano, and nothing was found to indicate whether they belong in Manzano group or represent a younger fm. [The Manzano group has for several years been classified as Perm.]

Mao clay.

Miocene: Dominican Republic.

T. W. Vaughan et al., 1921 (Dominican Rep. Geol. Surv. Mem. 1, p. 74).

Mao Adentro limestone.

Miocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Maple Green andesite.

Devonian: New Brunswick.

W. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 484).

Maple Hill limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 80). *Maple Hill ls.*—Bluish-gray, somewhat aren. irregular ls., 2 to 4 ft. thick. Forms a small fall in Maple Creek about 2 mi. SW. of Maple Hill, Kans. Is well shown under Pony Creek bridge S. of Falls City and at other places in Nebr., thinning to NE. Overlies Pierson Point sh. and underlies Table Creek sh., all included in McKissick Grove sh. memb. of Wabaunsee fm.

The sh. overlying Maple Hill ls. was, in Aug. to Sept. 3, 1932 chart of R. C. Moore, named *French sh.*, and *Table Creek sh.* was restricted to upper part of the original Table Creek. In Oct. 1932 chart, however, Moore and Condra transposed these names, and described the sh. resting on Maple Hill ls. as *Table Creek sh.* [restricted].

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). *Maple Hill ls.* underlies Table Creek sh. and overlies Pierson Point sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), discarded McKissick Grove sh. and treated its subdivisions as fms. in Wabaunsee group.

Maple Mill shale. (In Kinderhook group.)

Mississippian: Southeastern Iowa and probably western Illinois (Pike County).

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 322). *Maple Mill sh.*—Nonfossiliferous dark green to blue argill. sh., 30 to 200 ft. thick. Underlies English River grits, and is younger than Louisiana ls., which is absent. Basal fm. of Kinderhook in SE. Iowa. [In Iowa Geol. Surv., vol. 5, 1896, Bain gave thickness of Maple Mill sh. in Washington Co., Iowa, as 160 to 290 ft.]

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines, vol. 21, 2d ser., pp. 21–23, chart opp. p. 282). *Maple Mill sh. memb. of Hannibal fm.*—Blue or green, argill. locally calc., drab, sparsely fossiliferous sh. Thickness at Prospect Hill, Burlington, Iowa, 33 ft. (19 ft. exposed and 14± ft. more concealed). Basal memb. of Hannibal fm. at Burlington, where it grades into overlying English River ss. memb. of the Hannibal. At Kinderhook, Pike Co., Ill., 43 ft. of similar sh. is tentatively correlated with Maple Mill memb. Uncon. overlies Sweetland Creek sh.

L. R. Laudon, 1931 (Iowa Geol. Surv., vol. 35, pp. 341–387+). *Maple Mill fm.*, basal fm. of Kinderhook series, rests uncon. on Sheffield fm. and Cedar Valley ls. and is conformably overlain by English River fm.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 40, 245). Fms. equiv. to Hannibal fm. are English River ss. and part or all of underlying *Maple Mill sh.* of SE. Iowa. [In table on p. 245, Moore showed Maple Mill sh. as underlying English River ss. and overlying Sweetland Creek sh.]

Type loc. appears to be at Burlington, Iowa.

Mapleton sandstone.

Devonian: Northeastern Maine (Aroostook County).

H. S. Williams, 1899 (Am. Jour. Sci., 4th, vol. 8, p. 360, footnote). *Mapleton ss.*—A massive and in places coarse red ss., in which plants (*Psilophyton*, etc.) have been found. Is of Dev. age but somewhat younger than Chapman ss.

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 136–137). *Mapleton ss.*—Reddish-brown sss. and coarse cgls., in beds 10± ft. thick, covering nearly all of E. half of Mapleton Twp. Thickness 180 ft. Overlain by fine-grained gray sss. having appearance of Chapman ss. Believed to uncon. overlie Aroostook ls., but contact not seen.

On 1933 geol. map of Maine, by A. Keith, included in Middle and Lower Dev. block.

†Mapleton granite.

Devonian: Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 105–106, 146–148). *Mapleton granite* (*locally known as Munson's granite*).—In parts of field it is almost black; in other places it is of light color. The dark and light areas are not confined to any particular locality, and transition from one to the other may occur within a few inches or be imperceptible for rods. Field relations indicate it is intrusive. Named for occurrence on a low rounded hill in NE. corner of Mapleton Twp, Aroostook River, Aroostook Co. The granite forms part of the hill.

On 1933 geol. map of Maine, by A. Keith, the igneous rocks of Mapleton region are mapped as (1) rhyolite, andesite and trachyte of Dev. age; (2) rhyolite breccia, tuff, and sl. of Dev. age; and (3) diabase and amygdaloid of mainly Sil. age but including some Dev.

F. W. Toppan, 1932 (Geol. of Maine, p. 78), assigned this granite to Dev.

Maplewood shale.

Silurian: Western New York (Rochester region).

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Maplewood sh.*—Basal div. of N. Y. Clinton. Max. exposure in Genesee Gorge at Maplewood Park, Rochester, where 21 ft. of fine-grained unctuous bright-green nonfossiliferous sh. of uniform texture rests on Thorold ss. This is Hall's "lower green sh." and Hartnagel's "Sodus" exclusive of uppermost 3 ft. This sh. probably terminates eastward without reaching Sodus, the true Sodus sh. being a higher memb. Strat. relations of the Maplewood are with the beds below rather than above. Older than Bear Creek sh. and Martville ss.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347, etc.), placed *Maplewood sh.* below Reynales ls. and above Thorold ss. at Rochester and elsewhere. This is position assigned to *Maplewood sh.* by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), who listed it (p. 317) as present in western, west-central, and central N. Y. In central N. Y. she showed it as lying on Oneida cgl., instead of on Thorold ss.

J. T. Sanford, 1935 (Jour. Geol., vol. 43, No. 2, Feb.–Mar., p. 174). *Maplewood sh.* occurs only in vicinity of Rochester.

G. H. Chadwick, 1935 (A. A. P. G. Bull., vol. 19, No. 5, p. 702), stated the ss. beneath Maplewood sh. at Rochester is not Thorold ss., but a younger ss., of Clinton age, which he has named *Kodak white ss.*

Maquay formation.

Oligocene or Miocene: Cuba.

N. H. Darton, 1926 (Wash. Acad. Sci. Jour., vol. 16, p. 331).

Maquereau series.

Ordovician (?): Quebec (Gaspé Peninsula).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, pp. 270-271). *Maquereau series.*—Oldest rocks at Port Daniel, on S. shore of Gaspé Peninsula. Unfossiliferous arkoses. Probably earliest Ord. Underlies Mictaw series (black shales and tuffaceous graywackes of late Trenton to early Eden age).

C. H. Kindle, 1935 (Geol. Soc. Am. Proc. 1934, p. 354). *Maquereau fm.* assigned to pre-Camb.

C. H. Kindle, 1936 (Eastern Geol., No. 1, April 1936, p. 1). *Maquereau fm.* is assigned to pre-Camb. because boulders of its rocks make up basal cgl. of Mictaw fm. (Middle Ord.).

Maquoketa shale. (In Richmond group.)

Upper Ordovician: Iowa, western Illinois, southern Minnesota and Wisconsin, and eastern Missouri.

C. A. White, 1870 (Iowa Geol. Surv. vol. 1, pp. 180-182). *Maquoketa shales.*—Bluish and brownish shales, 80 ft. thick, forming top fm. of Lower Ord. in Iowa. Equiv. to [so-called] Hudson River shales of Hall. Overlain by Niagara ls. and underlain by Galena ls.

Adopted by U. S. Geol. Survey as middle fm. of Richmond group in Lower Miss. Valley, where it is overlain by Girardeau ls. and underlain by Fernvale ls. In Upper Miss. Valley region the Fernvale and Girardeau lss. are absent, and the Maquoketa was for many years considered sole representative of Richmond group, and was there defined as resting on Galena dol. and as overlain by Niagara dol. In eastern Iowa and SW. Wis., however, 10 to 40 ft. of interbedded ls. and sh. at base of Maquoketa were in 1907 named *Dubuque fm.* by Sardeson and excluded from what he called *Maquoketa sh. proper*, but included in his Maquoketa stage. These basal beds are of basal Richmond age, and according to E. O. Ulrich (Wis. Acad. Sci. Trans., vol. 21, pp. 71-93, 1924) they are much older Richmond than Fernvale ls., and therefore are older than true Maquoketa sh. They are present in western Wis. btw. Maquoketa and Galena. The U. S. Geol. Survey has adopted Dubuque fm. as distinct from and as underlying Maquoketa sh. In Iowa and western Ill. a few ft. of pre-Niagara Sil. rocks have been reported as overlying Maquoketa sh., and in western Wis. E. O. Ulrich has reported the discovery of 60 ft. of dol. of late Medina age in rocks heretofore called Niagara dol. He has named these rocks *Burroughs dol.* In that area, therefore, the Maquoketa is uncon. overlain by Burroughs dol. and not by Niagara dol. In NE. Iowa and SW. Wis. the Maquoketa becomes a *group*, divided into fms., which have been named (descending): Brainard sh., 120 ft.; Fort Atkinson ls., 40 ft.; Clermont sh., 10 to 15 ft.; Elgin ls., 50 to 70 ft.

Named for exposures on Little Maquoketa River, Dubuque Co., Iowa.

†Maquoketa series.

A term applied by F. W. Sardeson (Am. Geol., vol. 19, 1897, pp. 330-336) to Ord. beds overlying his Galena series in Upper Miss. Valley States and divided into (descending): Wykoff fm.=Richmond ls.; Maquoketa fm.=Utica sh.; transition fm. (*Triplecia* bed).

Maquoketan series.

A term employed by C. [R.] Keyes instead of *Maquoketa group* or *Maquoketa sh.* of other geologists.

Marac formation.

Eocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in Geol. No. 7, p. 40).

†Marais des Cygnes coal series.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., pp. 22–24). *Marais des Cygnes coal series.*—Series of lss., sss., shales, and coals, 303 ft. thick, including beds Nos. 178 to 202 inclusive of geol. section of eastern Kans. Underlies Well Rock series and overlies Pawnee ls. series.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). Marais des Cygnes coal series abandoned. Included Pleasanton fm. and possibly higher strata.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 63–67, 72). †Marais des Cygnes coal series of Swallow included Bourbon, Memorial, Lenapah, Nowata, Altamont, and Bandera fms.

Named for exposures on Marais des Cygnes River, Kans.

†Marais des Cygnes shales.

Pennsylvanian: Kansas and Missouri.

C. R. Keyes, 1900 (Iowa Acad. Sci. Proc., vol. 7, p. 84). *Marais des Cygnes shales.*—Restriction of G. C. Swallow's name to shales lying btw. Pawnee ls. below and Bethany ls. above, instead of accepting the name *Pleasanton*, introduced in 1895 to cover the strata btw. the lss. mentioned.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). Marais des Cygnes shales of Keyes is same as Pleasanton fm., the upper ls. referred to being Hertha ls., and not Bethany Falls ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 63–67, 73). †Marais des Cygnes shales of Keyes included Bourbon, Memorial, Lenapah, Nowata, Altamont, and Bronson fms.

Named for Marais des Cygnes River, Kans.

Marathon conglomerate.

Pre-Cambrian (upper Huronian): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 362). *Marathon cgl.* (also, in heading, *Marathon City cgl.*).—Mainly a cgl., occurring in and near Marathon, Marathon Co. Probably not more than 100 ft. thick. Appears to be basal cgl. portion of a much thicker sed. fm. which has been eroded away. Rests uncon. on granite. Is of either upper or middle Huronian age.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to *Animikie group* (*upper Huronian*).

†Marathon series.

Ordovician (Middle and Lower) and Upper Cambrian: Western Texas (Marathon region).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, pp. 37–38). *Marathon series.*—Named by Baker. Consists of (descending): (1) Yellowish-brown shales interbedded with thin gray ls., of Middle Ord. age, 375 ft.; (2) 500 ft. of interbedded green, gray, and black shales and thin brown sss., exact age unknown; (3) 130 ft. of dark-gray thin-bedded ls. of Lower Ord. age; (4) 300 ft. of fine-grained, coarse-grained, and conglomeratic sss. interbedded with green or light bluish-gray shales; (5) 300 ft. of interbedded dark-colored sss. and shales, containing Lower Ord. fossils 100 ft. below top. The entire succession has not yet been found at one locality, and it may contain other unknown members. In places one or more of upper members were removed by erosion prior to deposition of Maravillas chert. Overlies Upper Camb. Brewster fm. and is uncon. overlain by Maravillas chert.

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066–1067). "Marathon series" was named for Marathon region, without reference to definite type loc., and included 5 subdivisions, which are here named (descending): Woods Hollow sh. (of Middle Ord., Trenton age), 200 to 500 ft.; Fort Peña fm. (of Black River or Chazy age), 200 ft.; Alsate sh. (of Beekmantown age), 100 ft.; *Marathon ls.* (of Beekmantown age), 850 to 1,000 ft.; and Dagger Flat ss. (of Upper Camb. age).

300+ ft. The term "Marathon series" is therefore too inclusive and indefinite for further use, and it is here proposed to restrict the term to the lss. and associated rocks which actually crop out within town of Marathon, and which are here designated *Marathon ls.*

Marathon limestone.

Lower Ordovician (Beekmantown): Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066–1069, 1079). *Marathon ls.*—Lss. and associated rocks of Lower Ord. (Beekmantown) age, which crop out in streets and vacant lots of town of Marathon. The basal beds, which rest on Dagger Flat ss. (Upper Camb.) crop out 1 mi. SW. of railway station on N. side of old road to Alpine; and the highest beds, which dip beneath Alsate sh., occupy a NE. belt of outcrop which crosses Boquillas road 1¼ mi. S. of station. Thickness of fm. 350 to 1,000 ft. Most conspicuous parts of fm. are beds of flaggy dense gray or black ls., weathering ashen gray or bluish, and breaking with conchoidal fracture; partings of sh. separate most layers and there are a few thick members of greenish clay sh.; the sh. partings and the clay sh. probably comprise ⅙ to ½ of fm.; btw. the lss. are a few layers of ss. and many beds, 1 to 4 ft. thick, of intraformational cgl.; near middle is Monument Spring dol. memb., 75 ft. thick. The Marathon ls. correlates with El Paso ls.

Marathon sandstone member.

Upper Devonian: Southern central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). *Marathon ss. memb.*, 35 ft. thick; underlies Triphammer sh. memb. and overlies Williams Brook coquinite memb.; all included in Ithaca facies subgroup of Ithaca-Enfield group of fms. in Ithaca region. The Marathon and Triphammer probably constitute Oneonta of the East. [Derivation of name and character of ss. not stated.]

Marathon City conglomerate.

See under *Marathon cgl.*, pre-Camb.

Maravilla dolomite.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 65, No. 1, Feb. 1936, pp. 42, 49, 50) to cover Udden's Vidrio dol., Gilliland dol., and upper Tessey dol. of Glass Mtns, Tex. Named for "intermittent stream that flows by Marathon town to Rio Grande but heads in the Glass Range, where it is the drainage channel of the deep Gilliland Canyon."

Maravillas chert.

Ordovician (Upper): Western Texas (Marathon region).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex., Bur. Econ. Geol. and Tech. Bull. 44, pp. 38–39). *Maravillas chert.*—Named by Baker. Lower part is of Middle Ord. age, and consists of 400 ft. (max.) of hard gray ls. with nodules and lenticular masses of dark-colored chert. The upper 300 ft. consists of thin alternating beds of dark-colored chert and gray lss., often conglomeratic, and is of Lower Sil. age. [Upper Ord. in 1919 ed. of book cited.] Uncon. overlies Marathon series and uncon. underlies Caballos novaculite in Marathon region.

C. L. Baker and W. F. Bowman, 1917 (Univ. Tex. Bull. 1753, table opp. p. 78), assigned Maravillas chert to Trenton and Fernvale epochs.

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, p. 1073), assigned entire fm. to Upper Ord. (Trenton is Middle Ord.).

See also under *Solitario fm.*

Named for Maravillas Gap, Brewster Co.

Marble Bay formation.

Jurassic or Triassic: British Columbia.

O. E. LeRoy, 1908 (Canada Dept. Mines, Geol. Survey Branch Pub. 996, p. 16). [Assigned to "Devono-Carbf." More recent Canada repts assign the fm. to Jurassic or Triassic.]

Marble Canon limestone.

Carboniferous: British Columbia.

G. M. Dawson, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 26B, 39B to 40B). [Assigned to Carbf. and all later repts classify it thus.]

Marble Cliff limestone. (In Columbus limestone.)

Middle Devonian: Central Ohio.

C. S. Prosser and W. C. Morse, 1915 (Outlines of field trips in geology in central Ohio, pp. 14, 17). *Marble Cliff ls.* proposed for upper memb. [thickness & character not given] of Columbus ls. on account of excellent exposures in banks of Scioto River and extensive quarries at Marble Cliff [Franklin Co.]. Underlain by Bellepoint ls. memb. of Columbus ls. and overlain by Delaware ls.

†Marbled limestone.

A name applied in early repts on Ariz. to Muav ls. (Middle Camb.) of present nomenclature.

Marble Falls limestone. (Of Bend group.)

Pennsylvanian (Pottsville): Central Texas.

R. T. Hill, 1889 (Am. Geol., vol. 3, p. 289). *Encrinital or Marble Falls ls.*—Basal fm. of Carbf. in Burnet and Travis Counties, Tex. Thickness 500 ft. Overlies Sil. and underlies 300 ft. of Carbf. bituminous shales and sss. at Marble Falls and Smithwick.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 87–96). *Marble Falls ls.*—Shaly fossiliferous ls., 300 ft. thick. Is basement ls. over which the river falls at Marble Falls.

S. Paige, 1912 (U. S. G. S. Llano-Burnet folio, No. 183). *Marble Falls ls.*—Alternating lss. of dark-gray, light-gray, dove, and dark-blue to black color. Many beds contain abundant cherty nodules, largely dark or black. The bottom is in most places marked by a thin ls. cgl. and in one place by a very coarse angular cgl. or breccia, but there are localities where little or no discordance in sedimentation could be observed. At Marble Falls it includes at top 20 ft. of thin-bedded black sh. underlying the soft Smithwick sh. Thickness 250 to 450 ft. Underlies Smithwick sh. and uncon. overlies Ellenburger ls. (Ord. and Camb.). Assigned to Penn. Is younger than the Miss. sh. included in Bend series of Tex. Survey [and later named Barnett sh.].

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 26; Univ. Tex. Bull. 2132). *Marble Falls ls.* overlies Barnett sh. (Miss.). The latter is absent at type loc. of Marble Falls [Burnet Co.].

Marblehead limestone. (In Columbus limestone.)

Middle Devonian: Northwestern Ohio.

E. Orton, 1888 (Ohio Geol. Surv. vol. 6, pp. 75, 746–750, 758). *Marblehead ls.* described by Hawes (10th Census, vol. 10, p. 80) as bituminous dol., but other portions of Corniferous ls. are much more bituminous.

C. K. Swartz, 1907 (Johns Hopkins Univ. Circ. No. 7, p. 62). *Marblehead memb.*—Gray ls., 38 to 41 ft. thick, forming middle memb. of Columbus fm. Overlain by Venice memb. and underlain by Bellepoint memb.

Named for Marblehead Peninsula, near Sandusky.

Marble Hill marble. (In Richmond group.)

Upper Ordovician: Southeastern Indiana.

D. D. Owen, 1859 (Rept. geol. reconn. Ind. made in 1837, pp. 28, 29, et seq). *Marble Hill rock.*—Shell marble, 20 ft. thick, quarried at Deans quarry, Marble Hill. Overlain by dark-colored Ord. marlite and underlain by 177 ft. of alternating blue Ord. ls. and marls.

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., p. 139), described *Marble Hill marble stratum*, 20+ ft. thick, as lying lower in "Cincinnati group" than his Madison rocks.

Named for Marble Hill, near Madison, Jefferson Co.

Marcellon quartz porphyry.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Columbia County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 519). *Marcellon quartz porphyry* [two varieties described], occurs in sec. 7, town of Marcellon, Columbia Co.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). "May be supposed to be pre-Huronian."

Marcellus shale. (In Hamilton group.)

Middle Devonian: New York, eastern and central Pennsylvania, New Jersey, western Maryland and Virginia, and West Virginia.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 295–296). *Marcellus shales.*—Shales uncon. overlying Seneca ls. [upper part of Onondaga ls.] and separated from overlying Ludlowville shales by (ascending) dark slaty fossiliferous sh., compact blue sh., and fissile olive or bluish sh. The lower part of Marcellus mass is black and slaty, with ls. nodules or concretions.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept.). The upper shales of Marcellus are less highly colored than underlying shales and break into small fragments, flat and showing tendency to peculiar concretionary structure. They are overlain by Skaneateles shales and underlain by Marcellus shales (deep black).

J. Hall, 1843 (Geol. N. Y., div. 4, 4th dist., pp. 177–183). *Marcellus sh.*—Overlies Corniferous [Onondaga] ls. and underlies Hamilton group. Admits of two divisions. The lower div. is very black, slaty, and bituminous and contains iron pyrites in great profusion; some portions are calc.; and it is always marked by one or more courses of concretions or septaria which are often very large. This div. terminates upward by a thin band of ls., above which the sh. is more fissile, and gradually passes from black to olive or dark slate color.

E. Emmons, 1846 (Agric. N. Y., vol. 1). The Hamilton and Marcellus shales are difficult to separate except by fossils.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). The *Marcellus beds or stage* as generally applied in N. Y. geology are divided into (descending): Cardiff sh. (="Upper shales of Marcellus" of Vanuxem), 50 to 100 ft.; Stafford ls., 8 inches; and black slaty Marcellus sh., 50 ft. The Marcellus beds or stage underlie Skaneateles sh. and rest on Onondaga ls. Authors recommend restricting Marcellus to basal black sh. At Marcellus village, Onondaga Co., from which place the name is derived, only the lower layers of this black sh. are well exposed, and our observations both in that region and westward indicate desirability of restricting Marcellus to these lower shales. [In subsequent repts Luther dropped Marcellus in broad sense, but some geologists continued to use it. C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19) used the name in both senses.]

In subsequent repts the Cardiff sh. has been both included in and excluded from Marcellus sh. The greatly predominant usage, however, has been to restrict Marcellus to the scantily fossiliferous black shales btw. the Cardiff and the Onondaga ls. These black shales, with the included thin Cherry Valley ls., aggregate 62 to 145 ft. in thickness btw. Unadilla Valley and Seneca Lake region, to W.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 116–134, 214–236), included Cardiff in Marcellus and included Marcellus in his Hamilton group. (See 1930 and subsequent entries under *Cardiff sh. memb.* and under *Hamilton fm.*)

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), included Marcellus in Hamilton.

The following recent repts exclude Marcellus from the Hamilton: R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285); D. H. Newland and C. A. Hartnagel, 1932 (N. Y. State Mus. Bull. 295, p. 106); R. L. Moodie, 1933 (N. Y. State Mus. Hdb. 12, p. 36); W. Goldring, 1933 (N. Y. State Mus. Hdb. 14, p. 37, and 16th Int. Geol. Cong. Guidebook 4, p. 28); C. P. Berkey (?), 1933 (16th Int. Geol. Cong. Guidebook 9, pl. 9).

The following recent repts include Marcellus in the Hamilton: G. H. Chadwick and G. M. Kay, 1933 (16th Int. Geol. Cong. Guidebook 9A); D. H.

Newland, 1933 (16th Int. Geol. Cong. Guidebook 4, table opp. p. 6); B. Willard and A. B. Cleaves, 1933 (Geol. Soc. Am. Bull., vol. 44, pp. 757–782); B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 32–37); W. Goldring, 1935 (N. Y. State Mus. Bull. 303, p. 148); and B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1275–1290). Willard introduced the new name *Mahantango fm.* for the post-Marcellus rocks in Pa. that have for many years been called *Hamilton fm.*

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 34–35). The black sh. above Cherry Valley ls. has been named *Chittenango memb.* of Marcellus by Cooper. This sh. is the Marcellus *par excellence*, which typifies the formational series. But the term "Marcellus" should not be used in a larger sense for the series and in a more restricted sense for the black beds above the Cherry Valley. A separate name for this sh. is justified, although many geologists will probably regret the discontinuance of the older term for this rock. Base of the Chittenango is well defined by top of Cherry Valley ls., but top is impossible of precise delimitation at most localities, because of gradation into overlying Cardiff sh.

W. Goldring, 1936 (letter dated Jan. 17, 1936). Dr. Cooper's definition of the Hamilton as including the Marcellus is accepted by the New York State Survey and will be so used by the staff in future publications. We do not decide such matters for outside geologists temporarily working for the State, though we suggest our preferences and ask them to take recognition of them.

For many years the U. S. Geol. Survey treated *Marcellus sh.* and *Hamilton fm.* as distinct fms. The N. Y. State Survey has now, however, adopted Cooper's 1930 classification, which treats the Hamilton as a *group*, including the Marcellus sh. This is also present classification of U. S. Geol. Survey in N. Y. In south-central Pa., however, it still treats Hamilton and Marcellus as distinct fms.

March Point formation.

Upper Cambrian: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. No. 1, p. 83).

Marcy anorthosite.

Pre-Cambrian: Northern New York (Essex County).

H. P. Cushing, 1899 (N. Y. State Geol. 18th Ann. Rept.). In Essex Co. two types of pre-Camb. anorthosite "have been dubbed by Kemp *Whiteface type* and *Mount Marcy type*." [The compiler has been unable to find where Kemp used *Mount Marcy type*.]

W. J. Miller, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 400–462). *Marcy anorthosite.*—By far the most abundant facies of the anorthosite of the Adirondacks. I shall call it *Marcy anorthosite* because of its great exposures on Mount Marcy [Essex Co.]. The most typical portion is very coarse-grained, light to dark bluish gray, and consists very largely of basic plagioclase feldspar, mainly labradorite, much of it practically devoid of foliation. [See further explanation under *Whiteface anorthosite*.]

J. F. Kemp, 1921 (N. Y. State Mus. Bull. 229–230, p. 33). The *Marcy type* of anorthosite, as named by W. J. Miller, is characterized by blue to very dark, almost black plagioclase. Assigned to Algoman intrusives of pre-Camb.

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 82). [See under *Adirondack anorthosyte*.]

Marengo moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin and northeastern Illinois. See W. C. Alden, 1904 (U. S. G. S. P. P. 34), and M. M. Leighton and G. E. Ekblaw, 1932 (16th Int. Geol. Cong. Guidebook 26, p. 47).

† Mareniscan series.

A term proposed by C. R. Van Hise in 1892 (U. S. G. S. Bull. 86) for the "dark-colored fine-grained schistose part of Archean crystalline complex" of Lake Superior region, and abandoned by him in 1909 (U. S. G. S. Bull. 360, p. 26) in favor of *Keewatin series*, of which it is a synonym. Van

Hise stated (U. S. G. S. Bull. 86, p. 490) that the name was derived "from Marenisco Twp, Mich., S. of Gogebic range, where these rocks have a typical development."

Maria latite.

Age (?): Quebec.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 72).

Marianna limestone. (In Vicksburg group.)

Oligocene (lower): Western Florida and southern Alabama and Mississippi.

L. C. Johnson, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 128–132). *Mariana building stone* is an orbitoidal ls. of Vicksburg type [but he included it in Mio.].

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 51–59). *Marianna ls.*—Soft porous light-gray to white marine lss., containing some marl and more rarely clay beds; layers of chert common. Characterized by abundance of *Orbitoides mantelli* and other Foraminifera associated with many other fossils; *Pecten poulsoni* and *P. perplanus* common. [*P. perplanus* does not occur in Marianna ls. as now defined, but is characteristic of Ocala ls., according to C. W. Cooke.] Lithologically resembles Ocala ls. at Ocala, but differs from it in character of its fauna. Also closely resembles "Peninsular" ls. Thickness approx. 220 ft. It is believed to underlie Ocala ls. In western Fla. is uncon. overlain by beds belonging to Apalachicola group or by post-Plio. fms.

Later work by C. W. Cooke (U. S. G. S. P. P. 95, p. 109, 1915) resulted in showing that Marianna ls. overlies Ocala ls., and (Wash. Acad. Sci. Jour., vol. 8, pp. 187, 195, 1918) in introducing *Glendon ls.* for upper memb. of the Marianna. In 1923 (U. S. G. S. P. P. 133) Cooke elevated Glendon to rank of a fm. and restricted Marianna ls. to the "chimney rock." He later found that in part of western Ala. and Miss. the Marianna overlies Red Bluff clay, which is strat. equiv. of lower part of the Marianna to E. As now defined the Marianna ls. is the white ls. or "chimney rock" that overlies Ocala ls. at Marianna and carries *Lepidocyclina mantelli* and *Pecten poulsoni*. (C. W. Cooke and S. Mossom, 1929, Fla. Geol. Surv. 20th Ann. Rept.) It is basal fm. of Vicksburg group. (See Fla. Geol. Surv. 20th Ann. Rept., 1929.)

Named for exposures at Marianna, Jackson Co., Fla., E. edge of town, where the rock is quarried.

Mariato formation.

Pleistocene: Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 261).

†Maricopa shale.

Miocene (upper and middle): Southern California (Sunset-Midway district).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215, report on Cuyama Valley). The *Maricopa sh.*, which overlies the white ss. of Vaqueros fm. S. of Cuyama Valley and which forms upper part of Monterey group, has been mapped separately only as far E. as Salisbury Canyon [about 25 mi. W. of Maricopa type loc.]. It consists of about 1,700 ft. of brown sh., in which reef-like outcrops of white ss. are locally prominent. The sh. is made up mostly of clastic fragments, locally clayey, and not noticeably diatomaceous. It is uncon. overlain by Santa Margarita fm. The name *Maricopa sh.* is used in rept on Sunset-Midway region [afterward published as U. S. G. S. P. P. 116, 1920], for great thickness of diatomaceous sh. which in prel. rept was mapped as *Monterey sh.* [Above definition of Maricopa sh. (the first in print) applies the name to only lower part of typical Maricopa sh. as defined below by R. W. Pack, and the name *Maricopa* was later discarded for Cuyama Valley region.]

R. W. Pack, 1920 (U. S. G. S. P. P. 116). *Maricopa sh.*—Mainly thin-bedded siliceous, diatomaceous sh., containing numerous thin calc. layers and in lower part a relatively small amount of arkosic ss., but in upper part numerous lenses of arkosic ss. and boulder beds. Typically developed in gulch that drains N. through secs. 13 and 24, T. 11 N., R. 24 W., where exposed thickness is about 4,800 ft. Rests conformably on Vaqueros fm. and is uncon. overlain by beds here tentatively called *Etchegoin fm.*, but which probably include at base a representative of Jacalitos fm. The upper part of the diatomaceous shales included in the Maricopa is = Santa Margarita fm. as mapped in W. part of San Emigdio Mtns, which contains a typical Santa Margarita fauna and overlaps onto Vaqueros and Tejon fms. Named for exposures W. of Maricopa and Maricopa Flat, Kern Co.

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, pp. 125–149). [*Monterey sh.* as defined in this rept applied to a lithologic unit of Mio. age, and replaced *Maricopa sh.* and *Salinas sh.*, both of which are now discarded by U. S. Geol. Survey.]

Marietta sandstone. (In Dunkard group.)

Permian: Ohio, Pennsylvania, West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 35). *Marietta ss.*—In places two or three massive sss., each 25 to 40 ft. thick, separated by thin shales; in other places one ss. 100 ft. thick. Overlies Washington coal in SE. Ohio, western Pa., and W. Va.

Named for Marietta, Washington Co., Ohio.

†Marietta beds.

Lower Cretaceous (Comanche series): Northeastern Texas and southern Oklahoma.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13, pp. 302, 303, 328–337). *Marietta beds.*—Friable brown laminated clays, marked a few ft. above their base by peculiar segregations, pseudoconcretions, in shape of large thin lenses of indurated siliceous ls., often 4 or 5 ft. in diam. and 1 to 2 ft. thick, which split into fissile laminae on weathering. Lowest memb. of Denison beds. Underlies North Denison sands and overlies Fort Worth ls. [As thus defined probably included Denton and part at least of Weno clay members of Denison fm. L. W. Stephenson (U. S. G. S. P. P. 120H, p. 140, 1918) gave thickness of "Marietta beds" as here defined as 160 ft.]

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 115). *Marietta* overlies Denton subgroup (which rests on Fort Worth ls.) and underlies Pawpaw fm. The Denton subgroup is basal div. of Denison beds. [As thus defined is = Weno clay memb. of Denison fm.]

Named for Marietta, Love Co., Okla.

Marietta. (In Carbondale formation.)

Pennsylvanian: Northwestern Illinois (McDonough County).

T. E. Savage, 1930 (Ill. Acad. Sci. Trans., vol. 22, p. 498). Carbondale series of Macomb region divided into (descending): Ipava sh. and ss., Summum or Vergennes ss., Marietta ls. and sh., Francis Creek sh., Colchester (No. 2) coal, and clay or sh. (thin).

Probably named for Marietta, Fulton Co., just E. of McDonough Co. line.

Marigold oolite. (In Chester group.)

Mississippian: Southwestern Illinois (Randolph County).

A. H. Sutton, 1934 (Jour. Geol., vol. 42, No. 6, pp. 626, 627, 628). Impossible to delimit Golconda from the higher Glen Dean with any degree of certainty except in one general locality. This is in *area S. of Marigold* [Randolph Co.], where the two are separated by a thin horizon of chert and cherty ss. from 1–3 ft. thick. Writer believes this zone represents NW. extension of Hardinsburg ss. Beds below sandy zone contain Golconda fossils and those above Glen Dean fossils. This cherty sandy horizon overlies *Marigold oolite*. [This name is not defined, but it is referred to on 2 pages and fossils from it are listed.]

Marilla moraine.

Pleistocene (Wisconsin stage): Western New York. Named for Marilla, Erie Co., N. Y. Is shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Marin sandstone. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Marin ss.*, 1,000 ft. thick, underlies San Miguel cherts and overlies Sausalito cherts. A subdivision of the Franciscan.

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Marin ss.*—Massive dark-gray ss., obscurely stratified. Thickness 1,000 ft. Underlies Ingleside chert and overlies Sausalito chert. Included in Franciscan group. Named for occurrence on Marin Peninsula, Marin Co.

Marino formation.

Incorrect spelling of Moreno.

Marion granite.

Pre-Cambrian (Laurentian): Central southern Wisconsin (Waushara County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 522). *Marion granite.*—Pinkish feldspathic granite mottled with gray and green. Forms 3 low knobs in town of Marion. Closely resembles Montello granite, but is coarser grained, less closely textured, and has marked tendency to decompose. Assigned to Laurentian.

†Marion formation. (In Sumner group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 786–789). Vari-colored shales and marls with lss. and gyp., 400 ft. thick, overlying Chase fm. and underlying Dakota ss. (Cret.) in central Kans. Toward middle of fm. a cgl., named *Abilene cgl.* [The Tert. age of typical Abilene cgl. is now regarded as established.]

F. W. Cragin, 1896 (Colo. Coll. Studies vol. 6, pp. 1–48). Sumner div. of Big Blue series divided into Wellington shales (above) and Geuda salt measures (below). "Prosser's term Marion fm. is equiv. to Geuda salt measures plus lower part of Wellington." Rests on Chase lss.

C. S. Prosser, 1897 (Kans. Univ. Geol. Surv. vol. 2). *Marion fm.* restricted to lower part of Marion fm. as originally defined, and upper part is here called *Wellington fm.* I now agree with Cragin that upper 200 to 445 ft. of bluish gray, greenish, and reddish shales originally included in Marion fm. should be a distinct fm. The div. line is difficult, but absence of lss. and of fossils in the Wellington may serve as means of separation. The Marion as here defined consists of thin buff lss., shales, and marls, with beds of gyp. and salt, and is Geuda salt measures of Cragin. It overlies Chase fm., top memb. of which has been called "Marion concretionary ls.," but is here replaced by *Winfield concretionary ls.*

L. C. Wooster, 1905 (The Carboniferous rock system of eastern Kans.). *Wellington beds* consist of (descending): (1) Varicolored shales and marls; (2) shales and marls alternating with gyp. and thick beds of rock salt; (3) buff lss. and marls. Thickness 400 ft. Overlie Marion beds, top memb. of which is Abilene cgl. [Tert.], which consists of ls. and quartz pebbles. [This was a restriction of Marion fm., which as originally defined included the salt measures.]

J. W. Beede, 1909 (Kans. Acad. Sci. Trans., vol. 22, pp. 248–256). *Marion stage*, limited to following fms. (descending): (1) Abilene cgl. (?), correlation not positive; (2) Pearl shales, 70 ft.; (3) Herington ls.; (4) Enterprise sh., 44 ft.; (5) Luta ls., 0 to 30 ft. Overlies Winfield ls.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3). *Marion fm.*, 150± ft. thick, divided into (descending): Abilene cgl. memb., Pearl sh. memb., Herington ls. memb., Enterprise sh. memb., and Luta ls. memb.

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2, p. 63, footnote). It appears that so-called Abilene cgl., which has previously been referred to uppermost part of Marion fm., is in reality a Tert. deposit. It contains fragments of rock which apparently belong to Dakota ss., and at no point has it been observed in a strat. position beneath Wellington sh.

Subsequent repts treated Pearl sh. as top memb. of Marion fm. and included the salt beds in overlying Wellington fm.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, in cooperation with U. S. Geol. Survey). Wellington fm. redefined so as to include all beds below "Red Beds" and above Herington ls., and "Marion fm." abandoned.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser.), continued to use *Marion fm.* to include Pearl sh. at top and Luta ls. at base, the underlying fm. being called *Winfield.*

R. C. Moore, 1936 (Jour. Geol., vol. 44, No. 1; and Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), did not use *Marion*, but divided the beds extending from top of Herington ls. to top of Luta ls. into 2 fms. named *Nolans ls.* above and *Odell sh.* below.

Typical Abilene cgl. is now generally acknowledged to be of Tert. age.
Named for exposures in Marion Co., Kans.

Marion concretionary limestone. (In Chase group.)
Permian: Central Kansas.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 772, 773, 780, 783, 797). *Marion concretionary ls.*—Massive ls., 10 ft. thick, containing large flint concretions, which weather brown and contain *Productus* and a few other fossils. Composed of two beds of ls. separated by thin sh. Top memb. of Chase fm.

Is upper bed of Winfield ls. of Prosser, 1902, and other geologists, and appears to be Cresswell ls. of Condra and Upp, 1931. (See under *Winfield ls.*)
Named for Marion, Marion Co.

Marion flint. (In Chase group.)
Permian: Central Kansas.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 773, 779–786, 797). *Marion flint.*—Light-gray ls., generally containing flint, 4 ft. thick; near top of Chase fm. Separated from overlying Marion concretionary ls. by 13 ft. of yellowish shales.

This bed was later included in Winfield fm. It appears to be Stovall ls. of Condra and Upp, which they treated as basal bed of Winfield ls. (See Kans. Perm. chart compiled by M. G. Wilmarth, 1936.)
Named for Marion, Marion Co.

Mariposa slate.
Upper Jurassic: Northern California (Mariposa, Calaveras, and neighboring counties).

G. F. Becker, 1885 (U. S. G. S. Bull. 19, pp. 18–23). *Mariposa beds.*—An immense thickness of highly metamorphosed auriferous slates occurring along foothills from Mariposa to Nev., and containing *Aucella, Belemnites*, and other fossils. Thin-bedded strata prevail, and silicification and serpentinization are predominant characteristics. The beds are upturned into a nearly vertical position, and are uncon. overlain by Chico beds. Regarded as identical with Knoxville beds.

Beds of ss. and cgl. are also included in Mariposa sl., and contemp. greenstone is associated and in part interbedded with the fm. In 1910 (Jour. Geol., vol. 18, charts opp. pp. 217 and 221) J. P. Smith restricted *Mariposa* to lower part of Mariposa sl. of previous repts, or to the slates of the Gold Belt carrying *Aucella erringtoni* and *Cardioceras alternans*, and applied the new name *Colfax fm.* to upper part of the Mariposa, or to the "tuffs and shales of the Gold Belt with *Perisphinctes colfaxi.*" The U. S. Geol. Survey uses the original broad definition of Mariposa, and classifies it as older than Knoxville and of Upper Jurassic age.
Named for occurrence on Mariposa estate, in Mariposa Co.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Mariposa group.

Mesozoic: Sierra Nevada, California.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Mariposa group.*—Between Stanislaus River and Mariposa Creek, a distance of 45 mi., the Bedrock Complex is divided into 2 groups, Tuolumne group and Mariposa group. The latter uncon. overlies the former, and consists of over 3,000 ft. of acid and intermediate volcanics, sss., and cherts and 2,000 to 2,500 ft. of slates. On Merced River and southward into Indian Gulch quad. it is divided into *Mariposa slates* above, 2,000± ft. thick, and Indian Gulch aggls., tuffs, sss., and cgls., 3,500 ft. thick below.

Mariquita diabase.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 322).

Maris rhyolite.

Miocene (upper) or later: Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723, pp. 50–51). Intrusive dikes and irregular masses of brecciated rhyolite cutting Round Rock and Bald Mtn lake beds members of Esmeralda fm. Exposed at Maris mine.

Marjum limestone.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll. vol. 53, No. 1804, pp. 9, 10). *Marjum fm.*—Gray to dark, more or less thin-bedded aren. ls., 1,092 ft. thick. Underlies Weeks fm. and overlies Wheeler fm. Type loc. is cliffs on S. side of Marjum Pass.

Markey ground moraine.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).

W. A. Ver Wiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 164). Lies N. of Houghton Lake, in SW. part of T. 23 N., R. 3 W., Markey Twp.

Markham sand.

A subsurface sand, of Penn. age, in Ponca City field, Kay Co., Okla., correlated with upper part of Cherokee sh. Is older than Bixler sand and younger than Barnett sand.

Markley sandstone.

Oligocene and upper Eocene: Western California (San Francisco Bay region).

B. L. Clark, 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, pp. 54–111). *Markley fm.*—Heterogeneous assemblage of beds, mostly of shallow-water origin but possibly in part continental. Thickness 3,300 ft. Lithology very different from that of San Ramon fm. but very probably it is contemp., at least in part, with the San Ramon. The upper 1,300 ft. consists of alternating layers of clay sh., sandy sh., and ss., and contains a meager fauna. The lower 2,000 ft. is predominantly ss. and contains no fossils. In former paper writer included latter beds in the Tejon, but he now believes them to be lower Olig. Discon. underlies Kirker fm. The Kirker and Markley fms. compose San Lorenzo series in this area. Named for exposures in vicinity of Markley Canyon, Mount Diablo region.

T. L. Bailey, 1930 (Calif. Univ., Dept. Geol. Sci. Bull., vol. 19, No. 15, p. 326) and 1931 (Geol. Soc. Am. Bull., vol. 42, No. 1, p. 304) assigned this fm. to Eo.

B. L. Clark, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 1, p. 304). Fossils found in *Markley fm.* by T. Bailey indicate it is probably Eo. and=Tejon fm.

On Dec. 4, 1932, B. L. Clark (unpublished rept) assigned *Markley ss.* to Olig. and Eo.

†Marks Head marl.

Miocene (lower): Southern South Carolina and eastern Georgia.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, 19). *Mark's Head phase.*—Soft blue marls with characteristic bed of shells embedded in a sandy blue mud matrix. Thickness 27 ft. Of Mio. age. Extends from Mark's Head, on scarp of Savannah River Swamp, NW. of Porter's Landing [Effingham Co., Ga.], by Raysor's Bridge, S. C., and thence below Mount Hope on Santee River, S. C. Underlies Edisto phase (also Mio.) and overlies Parachucla phase (Olig.).

O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 60, 363+, map, etc.). *Marks Head marl.*—Very sandy greenish or drab clay, fine gray or brownish phosphatic sand and sandy laminated clays with calc. nodules. Thickness in Ga. 45 ft. Is early Mio. Rests uncon. on Alum Bluff fm. (Olig.). Overlain uncon. by Duplin marl (late Mio.), which Sloan erroneously correlated with Edisto marl of Edisto River, S. C.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). The early Mio. beds in eastern Ga. and S. C. that have heretofore been called "Marks Head marl," "Edisto marl," "Parachucla sh.," "Parachucla marl," and "Combahee sh." are in this rept included in Hawthorn fm., a Florida name that is here extended into eastern Ga. and S. C. In eastern Ga. the Hawthorn is represented by †Marks Head marl and part of Alum Bluff fm. of Veatch and Stephenson, whose Marks Head marl included, although unwittingly, the †Parachucla marl and †Parachucla sh. of Sloan. The Hawthorn is in Ga., and in most places in S. C., overlain by Duplin marl (upper Mio.), but in a small area in NE. part of Colleton Co., S. C., it is locally separated from the Duplin by a deposit of upper Mio. age to which the name *Raysor marl* is here applied. The Hawthorn rests uncon. on Glendon fm. (Olig.) and older fms.; in Ga. and Fla. it rests on Tampa ls. (lower Mio.).

Marks-Mills red beds.

Eocene (upper): Cleveland Co., Arkansas.

G. D. Harris, 1894 (Am. Jour. Sci., 3d, vol. 47, p. 304). *Marks Mills Red Beds (substage).* [No definition except that the beds are included in Jackson "stage" of Ala. and Miss., are older than "Moody's Branch beds" and younger than Claiborne "stage." In Ark. Geol. Surv. Ann. Rept. for 1892 (1894), pp. 98–101, Harris describes fossils collected from the red beds of Marks Mills battlefield, Cleveland Co., Ark., but does not use term "Marks Mills beds." The Jackson fm. of Miss. is now divided into two members, Yazoo clay memb. above and Moodys marl memb. below. The relation of the beds in Cleveland Co. to the members of Jackson fm. in Miss. is undet.]

Mark West andesite.

Pliocene: Northern California (Sonoma County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 58–87). *Mark West andesite.*—Thickness varies up to 1,500 ft. Conformably underlies Sonoma tuff. Is certainly post-San Pablo and probably post-Orindan.

Apparently named for Mark West Springs, Sonoma Co.

Marland sand.

A subsurface sand in Okla., which is said by some geologists to be referable to base of Chattanooga sh. (Dev.?) and by other geologists to correlate with upper part of Tyner fm. (Ord.).

Marlboro clay. (In Nanjemoy formation.)

Eocene: Eastern Maryland and Virginia.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 65). A bed of red clay at base of Potapaco memb. or substage of Nanjemoy fm. is well defined at Upper Marlboro, Md., and has been referred to as *Marlboro clay.*

W. B. Clark and B. L. Miller, 1906 (Va. Geol. Surv. Bull. 2, pt. 1, p. 17). The basal bed of Nanjemoy fm., known as *Marlboro clay*, extends from central Md. across the Potomac into Va., and is well developed btw. Potomac Creek and the Rappahannock. It consists of 25 ft. of compact clay, lower part pink, upper part white.

Marlboro formation.

Pre-Cambrian: Eastern Massachusetts and eastern Rhode Island.

B. K. Emerson and J. K. Perry, 1907 (U. S. G. S. Bull. 311, pp. 7, 8, 11, 13–36 and map). *Marlboro fm.*—As developed in region from Woonsocket to Pawtucket, R. I., it includes a great variety of green schists, amphibolites, steatites, and lss. Also includes Smithfield ls. memb., 0 to 150 ft. thick, which changes into tremolite schist, steatite, and serpentine. Overlies Grafton [Westboro] qtzite. Named for Marlboro, Mass. [where the fm. makes a long vertical wall along Main St.].

See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597), and L. LaForge, 1932 (U. S. G. S. Bull. 839). Seems to underlie Woburn fm.

†Marlborough rock.

See under †*Piscataway sands.*

Marlbrook marl. [Restricted.]

Upper Cretaceous (Gulf series): Southwestern Arkansas, northwestern Louisiana, and northeastern Texas (?).

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 84–86, 188). *Marlbrook-Columbus or Gryphaea vesicularis chalk marls.*—White chalky marl containing large percentage of yellow and pale-blue clays, and decomposing readily under influence of moisture. When freshly exposed and moist the marls have delicate blue tint, but when dry they are pure white. Thickness probably 200 ft. Underlie Big Deciper beds and overlie Brownstown or yellow *Exogyra ponderosa* marls. [According to C. H. Dane and L. W. Stephenson, R. T. Hill's Big Deciper beds are in upper part of Saratoga chalk. See C. H. Dane, Ark. Geol. Surv. Bull. 1, p. 103. 1929.]

A. C. Veatch, 1906 (U. S. G. S. P. P. 46, p. 26). *Marlbrook marl.*—Series of blue chalky, somewhat glauconitic marls in places impure chalk. Thickness 50 to 750 ft. About 200 to 300 ft. above base is very chalky layer which has been called *Saratoga chalk marl* or *Saratoga fm.* Overlies Annona chalk and underlies Nacatoch sand. Probably Marlbrook fm. as here used contains in upper part beds which Hill classed with Washington (Nacatoch) sand.

L. W. Stephenson and C. H. Dane in 1927 (A. A. P. G. Bull., vol. 11, No. 1) and 1929 (Ark. Geol. Surv. Bull. 1) restricted *Marlbrook marl* to beds in SW. Ark. that uncon. underlie Saratoga chalk and conformably overlie Annona chalk. This is present approved definition.

Typically exposed for a little over 1 mi. N. of Saratoga, on road to Mineral Springs, Howard Co. Also exposed along Marlbrook Creek, in T. 10 S., R. 24 W., Hempstead Co., Ark.

†Marlbrook-Columbus marl.

Upper Cretaceous: Southwestern Arkansas.

See *Marlbrook marl.*

Marlette moraine.

Pleistocene (Wisconsin stage): Eastern Michigan (Tuscola Co.). See Mich. Geol. Surv. Rept. 1908, pp. 148–196.

†Marlin chalk member (of Taylor marl).

Upper Cretaceous (Gulf series): Eastern Texas (Limestone, McLennan, and Falls Counties).

C. H. Dane and L. W. Stephenson, 1928 (A. A. P. G. Bull., vol. 12, pp. 51–55). *Marlin chalk memb of Taylor marl.*—In Limestone Co. chalk at approx. position of Pecan Gap chalk reappears in section and has been traced S. through E. corner of McLennan Co. and through Falls Co. to point a few mi. S. of Brazos River. It is a pure-white chalk, in part hard and tough, and in part soft and marly. The granular texture and admixture of sand which is found in places in Pecan Gap chalk has not been observed in Marlin chalk, but essential lithology is similar and fauna in part comparable. Is believed to be of approx. same age as Pecan Gap chalk, but paleontologic evidence is not conclusive. It lies 250 ft. below top of Taylor marl in Falls Co., and about 550 ft. above Durango sand memb. To W. and NW. of Prairie Hill it rests on sandy sh. and calc. sand undoubtedly=upper part of Wolfe City sand memb. Total thickness less than 50 ft. in vicinity of Mart and probably thins to NE. Is typically exposed 0.4 to 0.9 mi. S. of courthouse at Marlin, Falls Co., along edge of bottom lands of Brazos River, in a small scarp facing W.

This chalk is now regarded by Tex. Geol. Survey and U. S. Geol. Survey as same as Pecan Gap chalk memb. of Taylor marl, and Marlin chalk memb. has therefore been discarded.

Marlow formation.

Permian: Southwestern, central southern, and central Oklahoma.

R. W. Sawyer, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 312–320, map). *Marlow fm.*—Brick-red shales and even-bedded brick-red sss. with bands of fine white sand and sandy gypsums. Entire fm. is gypsiferous, many of shales containing veins of satin-spar and the sss. more or less gyp. At top is a thin layer of almost pure gyp. 1± ft. thick. Thickness 120± ft. [Later repts give thickness as 110 to 135 ft.] Underlies Whitehorse ss. as here defined, but is believed to be part of Whitehorse ss. as originally defined. Rests on Dog Creek sh. to W. and on Duncan ss. to E. Named for exposures at Marlow, Stephens Co.

F. C. Greene, 1924 (A. A. P. G. Bull., vol. 8, No. 3, p. 321). I question propriety of establishing the name "Marlow" until it can be shown more definitely that it is not Dog Creek sh.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324–341). The Marlow fm. of Sawyer and other geologists includes Dog Creek sh. and Blaine gyp.

C. D. Stephenson, 1925 (A. A. P. G. Bull., vol. 9, No. 3, pp. 626–631). *Marlow sh.* is correlated with Dog Creek sh. and Blaine gyp., but in Grady, Caddo, and Canadian Counties it has not been deemed advisable to subdivide it. About 35 ft. below its top occurs Verden channel ss., the 35 ft. interval up to base of Whitehorse ss. as here used (=Upper Whitehorse of some authors) being occupied by sh. containing locally some gyp. beds.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 405–432). Base of *Rush Springs memb.* is by definition a gyp. bed. Top of this gyp. is contact btw. Marlow and Rush Springs members of the Whitehorse. There may be some question as to whether this gyp. is in horizon of Upper Relay Creek dol. or of Lower Relay Creek dol. At any rate it seems consensus of opinion is that Marlow-Rush Springs contact should be drawn at top of Upper Relay Creek dol. Base of Marlow is top of Dog Creek sh., and where exposed this is a definite and easily recognized contact. Top of Rush Springs is base of Cloud Chief. In NW. Okla. it is not possible to separate the Marlow from Rush Springs memb. Together they constitute lower 100 ft. or more of Whitehorse as this fm. is exposed in Harper, northern Woodward, and western Woods Counties. The Marlow is entirely ss. with exception that in places a gyp. ledge 2 ft. thick occurs at base, and farther W. a gyp. bed 5 or 6 ft. thick occurs 20 to 35 ft. above base. This ss. is of characteristic Whitehorse color and appearance. The Marlow memb. of central-western Okla. is approx. 100 ft. thick.

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437). Evans' grouping of Marlow, Rush Springs, and Cloud Chief in a single unit is a logical step, but his separation and correlation of the members within that group is open to serious question. [Long discussion.]

F. C. Greene, 1932 (Tulsa Geol. Soc. Summ. and Abstracts, 1932, Tulsa Daily World), stated that *Rush Springs memb. of Whitehorse ss.* overlies Marlow memb. of the Whitehorse and underlies Weatherford dol.

See also D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454–1475).

†Marmaton formation.

†Marmaton group.

Pennsylvanian: Eastern Kansas and western Missouri.

C. R. Keyes, 1897 (Iowa Acad. Sci. Proc., vol. 4, pp. 23–24). *Marmaton fm.*—Sh., 30 to 50 ft. thick, carrying thin beds of ls., forming middle memb. of Henrietta fm. in SW. Mo. and SE. Kans. Underlies Pawnee ls. and overlies Fort Scott ls. [As thus defined is same as Labette sh.]

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 92–94). As Marmaton River crosses this fm. at right angles, and has cut channel in it, the name *Marmaton* *fm.* will be given to it. It includes all beds above Cherokee sh. and below top of Pleasanton shales. [As thus defined it included Henrietta and Pleasanton fms. and extended up to base of a ls. (called Hertha ls.), underlying Ladore sh.]

Haworth continued to use *Marmaton fm.* (1904, 1908, 1913), but other writers used *Pleasanton and Henrietta fms.*, although Beede (1909) called these combined fms. *stage B* of Carbf. of Kans. and Okla. In 1912 the U. S. Geol. Survey discarded *Marmaton* from its classification, using instead (as did Hinds and Greene, 1915) the subdivisions *Pleasanton* and *Henrietta*. R. C. Moore and W. P. Haynes in 1917 revived *Marmaton fm.* (for the beds btw. top of Cherokee sh. and base of Hertha ls.), reduced Pleasanton to rank of memb., and discontinued Henrietta in Kans., treating the subdivisions of latter as members of *Marmaton fm.* The Kans. Geol. Surv. continued to use this classification until 1932; some Okla. geologists also used it; but U. S. Geol. Surv., Nebr. Geol. Surv., Mo. Geol. Surv., and some other geologists continued to use *Pleasanton* and *Henrietta*. In Bull. 5 (1932) of Nebr. Geol. Surv. is a chart (credited to G. E. Condra, R. C. Moore, and C. O. Dunbar) in which the rocks of Nebr. beneath the ls. (called Hertha ls.) underlying Ladore sh. are called *Marmaton group* and divided into *Pleasanton sh.* above and *Henrietta fm.* below.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 89). Strata at top of *Marmaton group* that overlie the uncon. separating Des Moines and Missouri series are removed from Marmaton and included as part of lowermost Missouri beds. [The beds removed by Moore he listed as (ascending): Unnamed sh. and ss.; Uniontown ls. (so-called Hertha of some repts); Ladore sh. [not Ladore sh. of previous repts]; Schubert Creek ls. ("called 'Hertha' by Hinds and Greene"); Tennison Creek sh.; Critizer ls.; and Mound City sh. The ls. overlying the Mound City, which according to Moore had also been called *Hertha ls.* by Hinds and Greene, Moore named *Sniabar ls.* This definition of Marmaton group (in which both *Pleasanton* and *Henrietta* were discarded, their subdivisions being treated as fms. of Marmaton group) was adopted by Moore and G. E. Condra in their Oct. 1932 revised classification of Penn. rocks of Kans. and Nebr., also by Moore in his 1935 classification of Penn. rocks of Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 41–43). Some rocks formerly classed as upper Marmaton are transferred to Missouri series (see fig. 6). [Fig. 6 draws top of *Marmaton group redefined* at discon. at top of Nowata (?) sh. and omits all mention of overlying Lenapah ls. and Memorial sh. (new). Page 58 states:] Subdivisions of Marmaton group (upward order) are Fort Scott ls., Labette sh., Pawnee ls., Bandera sh., Altamont ls., Nowata sh., Lenapah ls., and Memorial sh.; the upper units have not been traced definitely northward from exposures in southern Kans.

Named for exposures on Marmaton River, Vernon Co., Mo., and Bourbon Co., Kans., whose channel, throughout almost its entire length, is within the fm.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Maromas granite gneiss.

Late Carboniferous or post-Carboniferous: Central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 143 and map). *Maromas granite gneiss.*—The rock exposed in Maromas quarries is a biotite gneiss of medium to fine grain, varying in color and in amount of biotite present. Massive in some places, but usually well foliated and jointed. Along NE. border of area it becomes a decided "augen gneiss." A granulitic facies is developed for a mile along W. border. Intrudes Bolton schist.

Maroon conglomerate (also **Maroon formation**).

Permian and Pennsylvanian (?): Western central Colorado.

G. H. Eldridge, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *Maroon cgl.*—Includes all beds above Weber ls. (100 to 550 ft. thick) and uncon. below

Gunnison ss. [Morrison fm.]. Max. observed thickness over 4,500 ft. Lower div. consists of alternating yellowish-gray grits, thin lss., and sh. beds reaching max. observed thickness of 2,000 ft. The upper div. is composed of alternating beds of cgl. and ss., with some shales and occasional ls. beds, and reaches max. observed thickness of 2,500± ft. at Mount Teocalli and Double Top; it is of a peculiar red or chocolate color, except in regions of local metamorphism, where greenish hues occur, arising from development of minerals containing lime and iron silicates. Named for typical developments on Maroon Creek, N. of quad. [In Aspen quad.] [As thus defined includes the so-called "Weber grits" of later repts.]

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48), restricted *Maroon fm.* to beds (1,500 ft. thick) above the so-called "Weber grits."

The present approved definition of Maroon fm. is for the beds above †Weber grits and below Entrada ss. and Morrison fm. However, because of variation in lithology and the difficulty of separating the Maroon strata (which also include grits, especially in their upper part) from the underlying beds, the name *Maroon fm.* has in several areas been used to include the equivalent of †Weber grits.

Marquettan series.

A term applied by C. [R.] Keyes to the Huronian rocks of Lake Superior region.

Marquette quartz porphyry.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Green Lake County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 520). *Marquette quartz porphyry.*—Occurs near village of Marquette, Green Lake Co.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). "May be supposed to be pre-Huronian."

Marquette member.

Lower Cretaceous (Comanche series): Central Kansas.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, pp. 31–32). *Marquette memb.*—Zones 5 to 10 of Natural Corral section, consisting of (descending): (10) 2 ft. of cross-laminated medium-grained friable yellow ss.; (9) 17 ft. of friable fine-grained yellowish ss. with a somewhat compact 6-inch band near middle and a similar 2-in. band about 7 ft. below top; (8) 7 to 8 ft. of compact yellowish-white ss.; (7) 10 ft. of blue paper sh.; (6) 2 ft. of pale-yellow ss.; and (5) 14 ft. of blue gypsiferous sh. Overlies Windom memb. and underlies Mentor memb., all included in Belvidere fm.

Apparently named for exposures near Marquette, McPherson Co.

Marquette rhyolite.

Pre-Cambrian: Southeastern Wisconsin (Green Lake County).

C. C. Wang, 1932 (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428). *Marquette rhyolite* lies 1 mi. SW. of village of Marquette [Green Lake Co.] in a group of knobs rising abruptly 50 to 150 ft. above surrounding sandy and marshy plain. The mass of the rhyolite is dark reddish purple or dark purplish on fresh surface and dull reddish or grayish red on weathered surface. Mainly porphyritic, with pinkish feldspar phenocrysts scattered through the dense dark groundmass, but in some localities it becomes largely felsitic.

Marquette granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated).

†Marquette series.

A term applied in some early repts to the Huronian rocks of Marquette dist., Mich. In many early repts on this dist. the upper Huronian rocks were called "Upper Marquette series" and the middle and lower Huronian rocks were called "Lower Marquette series."

†Marquettian system.

Pre-Cambrian: Northeastern Minnesota (Marquette district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept., p. 365). *Marquettian system.*—Includes Ogishke group (cgls., 10,000 ft.), Tower group (earthy schists, 15,000 ft.), and Graywacke group (2,500 ft.). Thickness 27,500 ft. Overlies Vermilion group. Heretofore called Keewatin.

Marseilles morainic system.

Pleistocene (Wisconsin stage): Northwestern Indiana and northeastern Illinois. Shown on moraine map in U. S. G. S. P. P. 106. Named for Marseilles, Ill. In some earlier repts called "Marseilles-Iroquois moraine."

Marsh shale.

Pre-Cambrian (Belt series): Southern central Montana (Belt Mountains).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Marsh shales.*—Reddish shales and thick-bedded sss., 300 ft. thick, forming top fm. of Belt series in Marysville-Neihart region. Overlies Helena ls. and uncon. underlies Camb.

Named for Marsh Creek, N. of Marysville.

Marsh sand.

A subsurface sand, of probable Dev. age, in western N. Y., lying near horizon of Richburg sand.

Marshall sandstone.

Mississippian (Osage or Kinderhook): Michigan (Southern Peninsula).

A. Winchell, 1861 (Mich. Geol. Surv. 1st Bien. Rept. Prog., pp. 80, 139). *Marshall group.*—Consists of (descending): (1) Reddish, yellowish, and greenish sss., 147 ft. (exposed at Marshall, Pt. aux Barques, etc.); (2) shaly micaceous ss., 10 ft.; (3) cgl., 2 ft. (exposed at Point aux Barques grindstone quarries). Thickness of group 159 ft. Contains Chemung Dev. fossils. Grades into overlying unfossiliferous Napoleon group and rests on Huron group. [Regarding propriety of excluding or including Napoleon, see under *Napoleon ss.*, 1861 entry.]

In 1871 (Mich. Geol. Surv. Rept. Prog., pp. 26–33) A Winchell defined *Marshall group* as overlain by Michigan salt group [Michigan fm.] and underlain by Huron group, thus including in it the beds previously called Napoleon ss.

A. C. Lane, 1893 (as reported by M. E. Wadsworth, Mich. Geol. Surv. Rept. 1891 and 1892, pp. 62–73), applied *Marshall ss.* to beds overlain by Grand Rapids group and underlain by Coldwater shales. This is present accepted definition.

†Marshall shale.

Mississippian: Northwestern Arkansas and northeastern Oklahoma.

J. C. Branner and F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. xiii, 26, 53–54). [According to p. xiii the fm. was named by Branner; the description is by Simonds.] *Marshall sh.*—Black, more or less bituminous sh., 0 to 80 ft. thick, overlying Batesville ss. [not Batesville ss., but the younger Wedington ss.] and underlying Archimedes [Pitkin] ls. [See under *Fayetteville sh.* for explanation of erroneous correlations in above definition.]

Preoccupied. The sh. at Marshall type loc. is same as Fayetteville sh. See under *Fayetteville sh.*

Named for a sh. mtn just E. of Marshall, Searcy Co., Ark.

Marshall granite.

Pre-Cambrian (post-Glenarm series): Western central and northern Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. geol. map of Va.). *Marshall granite.*—Pink to green granite and quartz monzonite. Intrusive into Lynchburg gneiss, Lovingston granite gneiss, and Catoctin greenstone. Assigned to pre-Camb. Mapped at and around Marshall, Fauquier Co.

Marshall moraine (also **morainic system**).

Pleistocene (Wisconsin stage): Southern Minnesota and Grant County, South Dakota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 99–103). In places develops into a system of unnamed moraines. Village of Marshall, Lyons Co., stands on it.

Marshall green-shale zone.

Name applied by drillers and oil geologists to a deposit of green sh., ls., dol. and sand, of Ord. age and 5 to 160 ft. thick, encountered in wells beneath "First Simpson sand" and above "Second Simpson" ("Wilcox") sand, in Lucien field, T. 20 N., R. 2 W., northern Okla. (See B. B. Zavoico, 1935, Tulsa Geol. Soc. Digest 1934, pp. 59–62, and loose plate. Derivation of name not stated.)

Marshall limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois (Clark County).

See 1934 entry under *LaSalle ls. memb.*, the only known use of the name. Derivation unknown.

Marshall Hill conglomerate.

Pre-Cambrian (upper Huronian): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 357). *Marshall Hill cgl.*—Mainly a graywacke grading into cgl. on one hand and into sh. on the other hand. Basal cgl. forms lowest part. Is either upper or middle Huronian. Forms large part of broad upland known as Marshall Hill, about 6 mi. N. of Wausau.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598). *Marshall Hill cgl.* belongs to Animikie group (upper Huronian).

Marshall Lake series.

Pre-Cambrian: Ontario.

P. E. Hopkins, 1917 (Ont. Bur. Mines Ann. Rept., vol. 26, p. 206).

† Marshalltown shale.

Mississippian: Central northern Iowa (Marshall County).

S. W. Beyer, 1897 (Iowa Geol. Surv. vol. 7, pp. 211, 226–227). *Marshalltown shales.*—Nonfossiliferous ash-blue to deep-blue shales interbedded with argill. lss. with chert nodules in upper calc. layers. Exposed near Marshalltown Flouring Mills. Thickness 15 ft. Referred provisionally to Kinderhook. Younger than Le Grand beds.

Only recorded use. Name established for a fm. in N. J.

Marshalltown formation. (In Matawan group.)

Upper Cretaceous: New Jersey.

G. N. Knapp, as reported by R. D. Salisbury, 1899 (N. J. Geol. Surv. Ann. Rept. State Geol. 1898, pp. 35, 36). *Marshalltown bed.*—Marly clay sand underlying Wenonah bed and overlying Columbus bed [Englishtown sand]. Included in Clay Marl series [Matawan group].

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 155). *Marshalltown bed.*—Ranges from sandy clay to clayey marl. Thickness 30 to 40 ft. Underlies Wenonah sand and overlies Columbus sand.

Named for occurrence near Marshalltown, Salem Co.

Marshburg slates.
Marshburg shale. } (In Pottsville formation.)

Pennsylvanian: Northwestern and central northern Pennsylvania (McKean, Elk, and Forest Counties).

C. A. Ashburner, 1885 (2d Pa. Geol. Surv. Rept. R_2, pp. 307, 325). *Marshburg slates*, 2 ft. thick in Forest Co.; contain a coal bed. Included in Pottsville cgl.

Lie btw. Kinzua Creek ss. above and Olean [?] cgl. below. [On pp. 67–119 and 225–241 of same vol. he gives sections in Elk Co. in which he shows 10 ft. of *Marshburg* sh. btw. Kinzua Creek ss. and Olean ss. and cgl. Marshburg is in McKean Co.]

S. H. Cathcart, 1934 (Pa. Topog. and Geol. Surv. Bull. 110, p. 14), states this coal and sh. are same as Sharon.

Marsh Creek group.

Pliocene (?): Southeastern Idaho (Bannock County).

A. C. Peale, 1879 (U. S. Geol. and Geog. Surv. Terr. 11th Ann. Rept., pp. 612, 641, 642). *Marsh Valley group* (p. 612), *Marsh Creek group* (p. 642).—These beds are exposed on Marsh Creek above Red Rock Gap, are very white, friable sss., which dip a degree or two from the mtns. Farther down the valley they are covered by the basalt flow. They are probably older than the deposits I have included under Cache Valley group. Thickness 85 ft.

Probably a part of Salt Lake fm.

Marshfield sandstone.

Lower Ordovician (Beekmantown): Southwestern Missouri.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, pp. 8, 42). *Marshfield ss.*—Ss., 100 ft. thick; equiv. of Bolivar ss., First ss., Pacific ss., and Crystal City ss. Underlies Finley ls. and overlies Jefferson City ls.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 260, p. 234, and Bull. 267, p. 12), correlated *Marshfield ss.* with either Jefferson City ls. or Roubidoux fm., considering it older than St. Peter ss.

E. M. Shepard, 1907 (U. S. G. S. W. S. P. 195). *Marshfield* and Bolivar sss. are commonly believed to represent St. Peter ss., but Ulrich regards them as lenses in Jefferson City ls.

J. Bridge, 1930 (personal communication), stated that this ss. is now definitely known to be a ss. in Cotter dol.

Marshfield moraine.

Pleistocene (Wisconsin stage): North-central Wisconsin.

S. Weidman, 1907 (Wis. Geol. and Nat. Hist. Surv. Bull. 16, p. 452). The town of Marshfield, Wood Co., is located on this moraine.

Mars Hill conglomerate.

Silurian: Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 119, 134–136). *Mars Hill cgl.*—With exception of Mars Hill diabase dikes, Mars Hill is composed of a cgl. which in places becomes quite fine grained. It is quite distinct from all other sss. and cgls. thus far found in NE. Maine. Absence of igneous fragments is noticeable, and great abundance of sl. fragments makes it almost a sl. cgl. The sheared and broken condition of whole mass and of its individual pebbles, and its intimate association with the crumpled and brecciated slates and lss. at its base, indicate an age at least as great as the Aroostook slated ls., and it is considered, on lithologic grounds alone, to belong to that series. Named for development on Mars Hill, on Int. Bdy, Aroostook Co.

Mars Hill diabase.

Age (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 115, 177–179). *Mars Hill diabase* occurs in two dikes situated close together on SW. flank of Mars Hill. The dikes differ widely in appearance and type of structure. The easternmost dike closely resembles Aroostook Falls diabase and is considered as normal for this region. The other dike is exceedingly basic in composition and is microscopically characterized by a glossy base. Named for occurrence on Mars Hill, Aroostook Co.

Marsh Valley group.

See *Marsh Creek group.*

Marsouin series.

Silurian: Canada.

J. W. Dawson, 1896 (Canada Roy. Soc. Proc. and Trans., n. s., vol. 2, sec. 4, p. 93).

†Martha Washington sandstone.

Pennsylvanian: Southwestern Indiana (Spencer County).

E. T. Cox, 1871 (Ind. Geol. Surv. 2nd Ann. Rept., p. 169). *"Martha Washington" ss.* forms the bluff at Rockport [Spencer Co.] and presents a vertical face of 30 to 50 ft. on side fronting the river. I found *Rockport ss.* to be the millstone grit.

Probably same as Mansfield ss. Has also been called †Lady Washington ss. and †Lady Washington Rock.

D. D. Owen (Geol. Surv. of Ind., 2d Rept., 1839, p. 7). Rockport is built on a conspicuous bluff, on Ohio River, 90 to 100 ft. high, which forms a mural escarpment of ss. to height of 70 or 80 ft. known familiarly as "The Lady Washington."

Martin limestone.

Upper and Middle Devonian: Southeastern and central Arizona.

F. L. Ransome, 1904 (U. S. G. S. P. P. 21). *Martin ls.*—Dark-gray, hard, compact, fossiliferous lss.; occasional beds of lighter hue and sometimes calc. shales of decided pinkish tint. The ls. beds are usually less than 4 ft. thick, being thicker than those of Abrigo ls. and thinner than those of Escabrosa ls. Thickness 340 ft. Rests, apparently conformably, on Abrigo ls. (Camb.) and is overlain, apparently conformably, by Escabrosa ls. (Miss.). Upper limit not always sharply defined. Named for Mount Martin, on Escabrosa Ridge, where fm. is typically developed and well exposed.

As thus originally defined, and as used in subsequent repts, *Martin ls.* included all of Dev. of SE. Ariz. In 1936 A. A. Stoyanow restricted Martin ls. to upper 260 ft. of Martin ls. of previous repts, and applied *Picacho de Calera fm.* to lower 73 ft. of the Dev. ls. in Picacho de Calera Hills and Rincon and Whetstone Mtns. In Santa Catalina Mtns he named the upper 150 ft. of the Dev. the *Lower Ouray fm.* (a name transplanted from SW. Colo.) and applied *Martin ls.* to underlying 145 ft. The U. S. Geol. Survey has not yet had occasion to consider these restrictions. (See also *Santa Rita ls.*)

Martin sandy zone.

A subsurface sand in upper part of Colorado sh. of Bowdoin dome, central northern Mont. Lies higher than *Bowdoin sand zone* (25 to 100 ft. thick), which overlies *Phillips sand* (20 to 83 ft. thick).

Martin Bridge formation.

Upper Triassic: Northeastern Oregon (Wallowa Mountains region).

R. W. Chaney, 1932 (16th Int. Geol. Cong. Guidebook 21, p. 4). *Martin Bridge fm.*—Calc. sh., ls., aggl., basalt, andesite, and tuff, of Upper Triassic age. [Named for locally well-known bridge on Eagle Creek, according to C. P. Ross, personal communication.]

J. Gilluly, J. C. Reed, and C. F. Park, Jr., 1934 (U. S. G. S. Bull. 846, p. 12). The Triassic rocks of Wallowa Mtns have been named *Martin Bridge fm.* They consist of 1,000 to 3,000 ft. of ls., limy sh., and interbedded volcanic rocks of Upper Tr. age. A comparable thickness of chiefly andesitic volcanic rock exposed in valley of Cliff River is believed by C. P. Ross to be contemp. with Martin Bridge fm. [C. P. Ross states (personal communication) that latter rocks were probably included in Martin Bridge fm. of Chaney.]

†Martin Canyon beds.

Tertiary (lower Miocene and upper Oligocene): Northeastern Colorado.

W. D. Matthew, 1901 (Am. Mus. Nat. Hist. Mem., vol. 1, pt. 7, pp. 355–374, 444). *Cedar Creek and Martin Canyon beds.*—Upper part of White River fm. and younger than Horsetail Creek beds (*Titanotherium* beds). Fine light-colored, pinkish or buff clays, much softer than underlying Horsetail Creek beds. Include *Leptauchenia* and *Oreodon* clays. Correspond with Darton's Brule clays, though how accurately it is impossible to say in absence of lists of Brule fauna.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65, 106, 112). Martin Canyon beds = lower (or lower Miocene) part of Arikaree and upper (or upper Olig.) part of Brule fm. [Osborn repeated this assignment in 1918 (Am. Mus. Nat. Hist. Mem., vol. 2, pt. 1, pp. 9, 12, 13).]

Named for Martin Canyon of Cedar Creek, Logan Co.

Martinez formation.

Eocene (lower): Western California.

W. M. Gabb, 1869 (Calif. Geol. Surv., Pal., vol. 2, p. xiii, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb on p. 129). The term *Martinez group* is proposed provisionally for upper part of "Div. A" of Calif. repts, to include a series of beds, of small geographical extent, found at Martinez and on N. flank of Monte Diablo. It may eventually prove to be worthy of ranking only as a subdivision of Chico group. Underlies Tejon group and overlies Chico group.

T. W. Stanton, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 1028). The *Martinez group* of Calif. Survey is not a simple fm. that can be considered a mere subdivision of the Chico, but consists of two distinct parts, one of which is Cret. and inseparable from the Chico, while the other is Eo., and is here classed as Lower Tejon.

J. C. Merriam, 1897 (Jour. Geol., vol. 5, pp. 767-775). *Martinez group.*—The name *Martinez* is here applied to that part of Gabb's Martinez group which remains after the removal of the Chico Cret. element. Is the Lower Tejon of Stanton, and consists of sss., shales, and glauconitic sands. At Martinez it appears to be conformably overlain by the Tejon and conformably underlain by the Chico, although an uncon. probably exists at its base. Differs from adjoining fms. in slightly different aspect of its sss. and the presence in them of considerable quantities of glauconite. The sss. of the Martinez are grayish, those of the Chico yellowish or bluish, and those of the Tejon white to dull red. The fauna also differs from the Chico and Tejon faunas, and is a unit, although it grades to some extent into Tejon fauna.

The present generally accepted definition of Martinez fm. is for the beds uncon. underlying Meganos fm., uncon. overlying Chico fm., and varying in thickness up to 3,500 or more ft. The rocks consist of cgl., ss., and sh. characterized by fossils of lower Eo. age. See definition of Meganos fm.

Martinez marine member.

Eocene: Southern California (Ventura County, south of Simi Valley).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 11). On SW. side of the faults the Martinez group has been separated into following lithologic units: Martinez marine memb., Las Virgenes ss., and Simi cgl. These members grade into one another both laterally and vertically, but with sufficient abruptness that their boundaries can be accurately mapped. The fossiliferous *Martinez marine memb.* of Martinez group consists of 800 to 2,400 ft. of beds that may be subdivided into a ss. above and a sh. below but their boundaries are too indefinite to be indicated on map. With exception of about 200 ft. of light-gray sh. at top, the marine memb. of the Martinez consists of medium- to fine-grained sss. with occasional beds of coarse-grained ss. in lower part.

Martinian series.

A term introduced by C. [R.] Keyes in 1915 to cover upper part of Dev. section in N. Mex., the lower part of the Dev. being called *Perchan series*. (See his conspectus of geol. fms. of N. Mex., 1915.) In 1922 he applied *Martinian series* to lower part of Upper Dev. in Ariz. and *Perchan series* to upper part. (See *Martin ls.* and *Percha sh.*)

Martin Lake limestone. (In Palo Pinto formation.)

Pennsylvanian: North-central Texas (Wise County).

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 22). *Martin Lake ls.* lies 20 ft. below Boone Creek ls. and higher than Hudson Bridge ls., all included in Palo Pinto fm. Consists of 4 ft. of reddish brown ls. that is a veritable bed of *Fusulina*. It is lowest of a series of 3 lss. outcropping around S. and W. sides of Martin Lake, 2 mi. S. of Bridgeport. Not found elsewhere in Wise Co.

Martinsburg shale.

Upper and Middle Ordovician: West Virginia, western Virginia and Maryland, southeastern Pennsylvania, and New Jersey.

H. R. Geiger and A. Keith, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 156-163, pl. 4). *Martinsburg sh.*—Sh. [character not described] in Blue Ridge region near Harpers Ferry, W. Va., of small but uniform thickness, overlying Shenandoah ls. and underlying Massanutten ss. Is=Hudson River. [The ss. in this area, as Mr. Keith later discovered, is not Massanutten ss., but a ss. underlying Shenandoah ls., while the Martinsburg is here overlain by Triassic.]

A. Keith, 1894 (U. S. G. S. Harpers Ferry folio, No. 10, p. 3). *Martinsburg sh.*—Black and gray calc. and argill. shales of fine grain. Contain 80 percent of argill. and siliceous matter, remainder being chiefly carbonate of lime. Thickness 700 to 1,000 ft. Overlies Shenandoah ls. and underlies Newark fm. Equiv. to Hudson River and Utica of Rogers. [This folio includes type loc. of fm.]

Is of Maysville, Eden, and Trenton age. The present definition of U. S. Geol. Survey includes in it 300 ft. of shaly lss. of Trenton age that were originally included in underlying Chambersburg ls.

Named for Martinsburg, W. Va.

Martinsburg limestone. (In Washington formation.)

Permian: Southwestern Pennsylvania (Washington County) and eastern Ohio.

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, p. 2579). *Martinsburg ls.*—A fairly local deposit, underlying Waynesburg "A" coal. Burned for lime on Bacon Street Run, Morgan Twp [Washington Co.], and elsewhere. Also frequently found beneath coal XII (Zollarsville, Waynesburg "A") in Ohio.

Martinsville limestone.

Pennsylvanian: Central eastern Illinois (Clark County). See under *Quarry Creek ls.*

Martinsville sand.

A subsurface sand in St. Louis ls. (Miss.) of Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Martinville limestone.

Pennsylvanian: Illinois.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 39, No. 4, p. 320). *Martinville ls.*, 25 ft. thick, underlies Platte (?) sh., 200 ft. thick, and overlies Lawrence (?) sh., 100 ft. thick, in Ill. geol. section. [Probably is a misprint for *Martinsville ls.*]

Martville sandstone.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327-368). *Martville ss.*—Type loc. is Bentley's quarry, intermediate btw. Martville [Cayuga Co.] and Hannibal, where about 10 ft. of thin grayish green ss. and sh., with fossils, are seen at top of quarry resting with a sh. contact on the 4 or 5 ft. of light-gray or slightly mottled ss. considered Oneida (or Thorold) by Vanuxem, below which is the red Medina ss. Lies beneath horizon of Furnaceville ore. Considered younger than Maplewood sh. Belongs in lower part of Clinton fm.

J. T. Sanford, 1935 (Jour. Geol., vol. 43, No. 2, p. 180). Strat. position and lithologic character of Martville ss. of Chadwick indicate the beds are but a sandy, perhaps beach, phase of the Reynales. It is suggested, therefore, if "Martville" is to be retained, it be used to designate a memb. of the Reynales.

Marvel limestone.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930 (Econ. Geol., vol. 25, pp. 309–310 and map). *Marvel dolomitic ls.*—Essentially a light bluish-gray cherty rock, showing frequent irregular mottling due to brecciation. All traces of organic structure destroyed. Age unknown. Complexly folded. From general characteristics a lower Paleozoic age is assumed. Underlies Surprise fm., usually with gradation from a true ls. to a true schist for a distance of 5 to 30 ft. Exposed along Marvel Canyon, S. part of Panamint Range. ["Interbedded schist in Marvel dolomitic ls." is mapped separately.]

F. MacMurphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July-Oct. 1932, pp. 329–356). [Repeats 1930 definition. "Thickness unknown."]

Marvin Creek limestone.

Devonian or Mississippian: Central northern Pennsylvania (McKean County).

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. R, pp. 68–69). *Marvin Creek ls.*—Near bottom of the Pocono a well-defined bed of ls. has been found in every section in McKean Co. where the rocks of this part of section are exposed. Along Shepherd Run, in S. part of Bradford Twp., it consists of a hard bluish-gray fossiliferous ls. 2 ft. thick, and is overlain by 25 ft. of flaggy ss. and sh. and underlain by 50 to 60 ft. of greenish-yellow sandy sl. Greatest development seems to be in Marvin Creek Valley. On W. slope of Chappel Hill, in Sergeant Twp, it consists of hard siliceous and argill. ls. 5 ft. thick, containing fragments of fossils of Chemung type. Is probably same as Lower Meadville ls. of Crawford Co.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Smethport sh.*, basal memb. of Knapp fm. (Miss.) in NW. Pa., includes *Marvin Creek ls.*, *Syringothyris* zone. [In 1934 (Bulls. Am. Pal., vol. 21, No. 71) Caster discarded his Smethport sh. and introduced *Kushequa sh.* for basal memb. of his Cussewago stage, and included Marvin Creek ls. in his Kushequa sh.]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 105–106). The persistent ls. in midst of Kushequa sh. may best be known compositely as *Marvin Creek ls. zone*, because it is utterly impossible to differentiate which one of the many lss. Ashburner saw on Marvin Creek when he denominated it. At least 2 separate lenses of ls. in the Kushequa occur along Marvin Creek. In Warren Co. this zone lies discon. on Oswayo sh. In Marvin Creek Valley and around Kushequa village this zone is composed chiefly of large plates and bones of fishes. Marvin Creek ls. has been traced and extensive collections made over most of McKean, Elk, and Forest Counties, Pa.

†Marylandian.

A term introduced by A. Heilprin (Phila. Acad. Nat. Sci. Proc. 1882, pp. 183–184, 1883; also Phila. Acad. Nat. Sci. Jour., 2d ser., vol. 9, pt. 1, p. 120, 1884) for the "Lower Atlantic Miocene, older deposits of Md. and possibly the lower beds in Va. ('Yorktown' epoch in part, of Dana)." See under †*Carolinian*. Corresponds to an indefinite part of Chesapeake group of present nomenclature.

Mary Lee coal group.

Pennsylvanian: Central Alabama.

A group of coal beds in Pottsville fm. of Warrior coal field, lying 80 to 150 ft. above Black Creek coal group, and the coals occurring within a vertical section of 220± ft. Includes Newcastle (at top), Mary Lee, Blue Creek, Jaggar, and Ream coals and near its base the Lick Creek ss. memb.

†Mary River formation.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). *Mary River fm.*—Sss., of Foxian (?) age, composing uppermost Cretacic fm. in Alberta. [Apparently same as Saint Mary River fm., of Tert. (?) age.]

Marysville sands.

Pleistocene: British Columbia.

S. J. Schofield, 1915 (Canada Geol. Surv. Mem. 76, p. 85).

Marysville formation.

Eocene (middle): Northern California (Sutter County).

Howel Williams, 1929 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 112, 121–124). *Marysville fm.*—Loose buff sands, usually traversed by parallel strings of ferruginous calc. concretions and by thin lenticular masses of compact, green-gray ss. and, more rarely, ls. In many places this sandy facies is associated with a thick development of green-gray glauconitic shales that weather to a deep reddish brown soil. In some places, on W. side of the Buttes, there is a *Melania*-bearing grit at base. Lithology and thickness are very variable over small areas. The ferruginous concretions range in size from a hen's egg to 4 or 5 ft. long. Thickness 300 to 600 ft. Discon. overlies Chico beds, and underlies, with minor discon., White Ione sands. Fauna referred by B. L. Clark to Meganos (middle Eo.). The fm. is present at Marysville and on Marysville Buttes.

Maryville limestone.

Middle Cambrian: Northeastern Tennessee, southeastern Kentucky, southwestern Virginia, and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Maryville ls.*—Massive blue ls., with little change in appearance except frequent earthy, siliceous bands and occasional grayish blue and mottled beds. Thickness 150 to 550 ft. Underlies Nolichucky sh. and overlies Rogersville sh.

Foregoing is original definition of fm. at type loc. The name, however, first appeared in print in 1894, in U. S. G. S. Estillville folio (No. 12), by M. R. Campbell, who accepted Keith's name, correlating the rocks of Estillville quad. with those in Knoxville quad. He described the fm. as consisting of 550 to 650 ft. of comparatively pure heavy-bedded blue ls. carrying large masses of chert in SE. part of quad., "which make it difficult to separate from Knox dol." Underlies Nolichucky sh. and overlies Rogersville sh.

Named for Maryville, Blount Co., Tenn.

Maryville rock.

Carboniferous: Eastern Kansas.

G. C. Broadhead, 1886 (St. Louis Acad. Sci. Trans., vol. 4, p. 489), mentioned a mag. ls. quarried at Maryville, Kans., and casually alluded to it, in one place, as "the Maryville rock."

This name is listed in U. S. G. S. Bull. 191.

Mascall formation.

Miocene (middle): Central northern Oregon (John Day Basin).

J. C. Merriam, 1901 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9, p. 305). *Mascall fm.*—Ashes, tuffs, and possibly gravels. Generally been considered wholly a lake deposit, but doubtful whether it owes its origin solely to this mode of accumulation. Has been called Cottonwood beds, Loup Fork, *Ticholeptus* beds (in part), and *Amyzon* beds. Cottonwood is preoccupied in Kans.; doubtful if true Loup Fork occupies same horizon; *Ticholeptus* beds belong to another horizon; *Amyzon* beds are older and=Clarno fm. (Eocene). Thickness at Rattlesnake Creek, near Cottonwood not less than 800 to 1,000± ft. Uncon. underlies Rattlesnake fm. (Plio.) and [uncon.] overlies Columbia [River] lava. Type exposure near Mascall ranch, 4 mi. below Dayville.

F. C. Calkins, 1902 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 3, No. 5). In John Day Basin Mascall fm. is preserved only in monoclinal trough extending along S. end of Basin from Spanish Gulch to Canon City.

Some geologists assign the flora of this fm. to upper Mio., others assign it to middle Mio., and others to middle or upper Mio. The U. S. Geol. Surv. at present classifies the fm. as middle Mio.

Mascarene series.

Silurian and Devonian (?): New Brunswick, Canada.

L. W. Bailey and G. F. Matthew, 1873 (Canada Geol. Surv. Rept. 1870-71, pp. 148-163), 1876 (Canada Geol. Surv. Rept. 1874-75, p. 85), 1877 (Canada Geol. Surv. Rept. 1875-76, pp. 352-366). [Assigned to upper Sil. in all of these repts, but Ells (Canada Geol. Surv. Summ. Rept. for 1903, p. 154, 1904, and Canada Roy. Soc. Proc. and Trans., 2d, vol. 11, sec. 4, p. 28, 1906) assigned the rocks to Dev.]

†Mason series.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvii, 276-281). *Mason series.*—Sandy shales and schists with mica, forming basal div. of Texan system. Overlies Archean Fernandan system and underlies Llano series [restricted sense].

Is a part of Packsaddle schist.

Probably named for Mason Co.

Mason shale. (In Conemaugh formation.)

Pennsylvanian: Southern West Virginia.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 281). *Mason shales.*—Dark or black sh., 3 ft. thick, immediately underlying Lower Cambridge ls. Frequently contain marine fossils, especially in upper half, in Pa., Md., and northern W. Va. Named for Mason, on Elk River, Kanawha Co., W. Va.

Mason clay. (In Conemaugh formation.)

A name applied to the light-gray to drab, brown, or pink clay, 1 to 10 ft. thick, underlying Mason coal in Ohio.

Mason City limestone or dolomite.

Upper Devonian: Central northern Iowa.

W. H. Norton, 1897 (Iowa Geol. Surv. vol. 6, p. 148). *Mason City substage.* [Only definition is use of name in table for upper part of Cedar Valley ls., overlying Solon substage of Cedar Valley and underlying Lime Creek stage, in which was included the ls. later named Nora ls. by Thomas.]

S. Calvin, 1897 (Iowa Geol. Surv. vol. 7, pp. 145-160). *Mason City substage* of Cerro Gordo Co., is=upper part of Cedar Valley ls. as developed in Johnson and adjacent counties. It consists of (descending): 22 ft. of variable beds, 21 ft. of argill. and argillo-dolomitic beds; 30 ft. of stromatoporoid beds; 14 ft. of regularly bedded white or light-gray fossiliferous ls.; 20 ft. of dol., generally compact and regularly bedded; and 20 ft. of earthy dol., including near top thin calc. bed with peculiar stromatoporoids and *Pachyphyllum woodmani*. Underlies Hackberry substage of Lime Creek sh. or stage.

C. H. Belanski, 1927 (Am. Mid. Nat., vol. 10, No. 10), restricted *Mason City substage* to lower heavily dolomitized part of beds previously included in Mason City, part of the upper beds being named by him *Rock Creek substage* and the uppermost beds (First *Actinostroma* zone) being included in his Nora substage. He defined type exposure of the Mason City as located at Nora Springs, "because the zones there are more distinct and their faunas more readily determined than at Mason City." He divided his Mason City into (descending) *Lepidocentrus* zone, *Trigonotreta* zone, and *Aulopora* zone.

See also under *Shell Rock ls.*

Named for exposures at Mason City, Cerro Gordo Co.

Mass amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Is younger than North Butler amygdaloid and older than Merchants amygdaloid. Belongs to Central Mine group. The mineralized part is the Mass lode. Named for occurrence in Mass mine, Ontonagon Co.

Mass flow.

Includes Mass amygdaloid and the underlying trap.

Massacre volcanics.

Pliocene? (lower Pliocene?): Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Massacre volcanics.*—Well-consolidated red to brown basic cindery tuff, in places containing angular fragments of underlying fms. At many places contains at base a persistent fine-grained blue basalt flow 23± ft. thick. Thickness of fm. 150± ft. The feeder dikes form Massacre Rocks, a group of knobs of diabase, in sec. 6, T. 9 S., R. 30 E., Power Co. Older than Rockland Valley basalt and younger than Eagle Rock tuff.

†Massanutten sandstone.

Silurian and Upper Ordovician: Western Virginia and Maryland and northeastern Virginia.

H. R. Geiger and A. Keith, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 156–163, pl. 4). *Massanutten ss.*—Ss. [character and thickness not described] overlying Martinsburg sh. and underlying the Newark in Blue Ridge near Harpers Ferry, W. Va. Is=Medina. Named for Massanutten Mtn, which is characterized by the ss. [The typical Massanutten ss. overlies Martinsburg sh., but the ss. in the particular area covered by above map was later found by Keith to be an older ss. (the Antietam), faulted over, and to underlie Shenandoah ls., instead of overlying Martinsburg sh. (See Harpers Ferry folio, No. 10).]

N. H. Darton, 1892 (Am. Geol., vol. 10, pp. 13, 14). *Massanutten ss.*—Rocks of Massanutten fm. vary in local characters, mainly in color, thickness of bedding, and degree of silicification, but white and red qtzites prevail. In most sections basal beds are alternating dark sss. and shales, succeeded by white and gray qtzites, which in turn give place to thinner bedded red and brown sss. and shales. Fossils rare. Thickness 600 to 800 ft. Has been called Medina and Clinton. Overlies Martinsburg shales and underlies Lewistown ls. in Staunton quad. and in central Appalachian Virginia region. [As thus defined Massanutten ss. included the overlying Rockwood fm., which is 150 to 200 ft. thick in Staunton quad. and 800 to 1,000 ft. thick in Massanutten Mtn area.]

N. H. Darton, 1894 (U. S. G. S. Staunton folio, No. 14, p. 2). *Massanutten ss.*—Hard ss. and qtzite; most prominent memb. a hard massive qtzite, usually white or gray, which outcrops in high cliffs or steep slopes at crest of the mtns. This memb. is underlain by considerable thickness of red or brown thinner-bedded ss. and qtzite, which merges into sandy beds of underlying Martinsburg sh. Thickness 450 to 700 ft. Merges into overlying Rockwood fm.

Now divided into Tuscarora qtzite (Sil.) and Juniata fm. (Upper Ord.).

Named for Massanutten Mtn, NW. Va. (Rockingham, Shenandoah, and Page Counties).

Masset volcanics.

Tertiary: British Columbia.

J. D. MacKenzie, 1915 (Canada Geol. Surv. Summ. Rept. 1914, pp. 35, 36).

Massie clay.

Silurian (Niagaran): Southwestern Ohio (Clark County).

A. F. Foerste, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 168), applied *Massie clay* to beds underlying his Euphemia dol. and overlying his Laurel ls. in Springfield area. Derivation of name not stated; but in 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 129) he stated it is exposed on Massie Creek, short distance W. of Cedarville, Ohio. On p. 152 he stated *Massie clay sh.* is 5½ ft. thick S. of Yellow Springs, Ohio, and that on Massie Creek, W. of Cedarville, Ohio, it carries a typical Waldron fauna. On p. 153 he gave further details, under heading *Massie clay*, and stated that the Massie Creek locality (N. side of creek, at a well known spring) is only place in Ohio where a fauna (listed) closely resembling Waldron fauna has been found, but that a clay (closely resembling typical Waldron) underlying Euphemia dol. at Bryan Farm State Park, S. of Yellow Springs, 5 mi. NW. of Cedarville, is identified as *Massie or Waldron clay sh.*, although no diagnostic fossils were found there.

†Massillon sandstone. (In Pottsville formation.)

Pennsylvanian: Eastern Ohio.

J. S. Newberry, 1874 (Ohio Geol. Surv., vol. 2, p. 131). *Massillon ss.*, 20 to 80 ft. thick, in Lower Coal Measures. Separated from underlying coal No. 1 by 5 to 40 ft. of gray sh. Overlain by 20 to 50 ft. of sh.

Same as Connoquenessing ss. memb. of Pottsville fm.

Named for Massillon, Stark Co.

Mass Mountain.

Mississippian: Northern California (southern part of Klamath Mountains).

N. E. A. Hinds, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 158), in table divided Mississippian of S. part of Klamath Mtns into *Baird rhyolitic pyroclastics and sediments* (above) and *Mass Mountain basalt flows and pyroclastics* (below). Latter is probably a misprint for *Bass Mtn.*

Masuk sandstone member (of Mesaverde formation).

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology of Henry Mtns, pp. 4+). *Masuk ss.*—Heavy-bedded yellow ss., 500 ft. thick, overlying Masuk sh. in Masuk Plateau, Henry Mtns.

Now treated by U. S. Geol. Survey as basal memb. of Mesaverde fm. in Henry Mtns region.

†Masuk shale. (In Mancos shale.)

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology of Henry Mtns, pp. 4+). *Masuk sh.*—Gray argill. sh., slightly aren. toward top. Thickness 500 ft. Underlies Masuk ss. and overlies Blue Gate ss. in Masuk Plateau, Henry Mtns.

Now treated by U. S. Geol. Survey as top memb. of Mancos sh. in Henry Mtns region. Name conflicts with Masuk ss., the adopted name.

Masukian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 64–65, 280, 303). Shales, 1,600 ft. thick, uncon. underlying Pennell [Masuk] ss. in Utah and uncon. overlying 1,000 ft. of unnamed shales. Same as Gilbert's Masuk shales, and same as Lewis sh. of western Colo., "which should be replaced by Gilbert's earlier name."

Matachewan series.

Pre-Cambrian: Ontario.

D. G. H. Wright, 1922 (Ont. Dept. Mines 31st Ann. Rept., vol. 31, pt. 7, p. 15).

Matagami series.

Pre-Cambrian: Quebec.

J. A. Bancroft, 1913 (Quebec Dept. Colonization, Mines and Fisheries, Mines Branch, Rept. on Mining Operations 1912, pp. 150, 157).

Later writers spell this name *Mattagami.*

†Matanuska series.

Tertiary, Cretaceous, Jurassic: Alaska.

W. C. Mendenhall, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 307–309). *Matanuska series.*—Chiefly shales, red, green, buff, and black especially abundant; many coarser beds, most important of which is heavy bed of cgl., probably not less than 1,000 ft. thick, that makes base of Castle Mtn. Also, near top near Limestone Gap and along upper course of Bubb Creek, a ls. bed, 300 ft. thick, containing Lower Cret. fossils. Matanuska River flows nearly along strike of the series. Probably overlaps Sunrise series (upper Paleozoic?). Assigned tentatively to Lower Cret. or older.

G. C. Martin, 1926 (U. S. G. S. Bull. 776). Matanuska series of Mendenhall included all sed. rocks seen by him, in a rapid reconn., in Matanuska and Nelchina Valleys, and included rocks ranging from Lower Jurassic to late Tert. The larger part of area supposed to be occupied by this "series" contains these Upper Cret. strata, and nearly all exposures on banks of Matanuska River, from source to mouth, consist of these Upper Cret. rocks. Therefore the name *Matanuska fm.* is here adopted, with a different definition.

Matanuska formation.

Upper Cretaceous: Southern Alaska (Matanuska Valley).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 317-327, table opp. p. 474). The Upper Cret. rocks of Matanuska Valley here designated *Matanuska fm.* consist of marine sh. and ss., at least 4,000 ft. thick on Granite Creek, of which lower half is practically all sh. and upper half alternating beds of ss. and sh., the ss. predominating. Cgl. is present but not in thick or numerous beds. Base not seen. Probably rests uncon. on rocks ranging in age from Lower Jurassic to Lower Cret. Is uncon. overlain by Tert. arkose and cgl. Contains Upper Cret. fossils.

Matanzas series.

Pliocene: Cuba.

J. W. W. Spencer, 1894 (Geol. Soc. Am. Bull., vol. 6, p. 124).

Matapedia series.

Ordovician: Quebec.

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, p. 377).

Matawan group (also **formation**).

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

W. B. Clark, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 335-336, and Jour. Geol., vol. 2, pp. 161-177). *Matawan fm.*—Chiefly dark-colored clays with interbedded layers of sand, the latter very pronounced in upper part. At some points greensand beds appear, but greensand is less pronounced than in overlying fms. Thickness 275 ft. Is Clay Marls of previous repts. Conformably underlies Navesink fm. [broad use of Navesink] and overlies Raritan fm. [broad use of Raritan fm., which included Magothy fm. at top], from which its fauna differs greatly. Typically developed on shore of Raritan Bay in vicinity of Matawan Creek and along banks of the creek.

W. B. Clark, R. M. Bagg, and G. B. Shattuck in 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 315-358) redefined *Navesink*, by separating from it the sands at base, under name *Mount Laurel sands*. They also introduced *Monmouth*, to include the Redbank, Navesink, and Mount Laurel deposits. The Matawan group therefore underlies Mount Laurel sand, the basal fm. of Monmouth group. In Md. the subdivisions are not recognized and the Matawan is classified as a *fm.*

Matewan sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 199). *Matewan ss.*—Massive, medium-grained, micaceous, light gray, cliff forming. Thickness 20 to 60 ft. Lies 5 ft. below Matewan coal and overlies Eagle A coal. Named for town in Mingo Co.

Matfield shale. (In Chase group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 714). *Matfield shales.*—Variously colored shales, with some shaly, buff, occasionally cherty lss. and a light-gray ls., 2 ft. or more thick, about 30 ft. below top. Thickness of fm. 60 to 70 ft. Overlies Wreford ls. and underlies Florence flint. Included in Chase stage.

Named for development in Matfield Twp, Chase Co., Kans.

Matilija sandstone member.

Eocene: Southern California (Ventura County).

P. F. Kerr and H. G. Schenck, 1928 (Geol. Soc. Am. Bull., vol. 39, p. 1090). *Matilija ss. memb.*—Basal memb. of Tejon fm. Comprises beds, 2,500± ft. thick, in which ss. predominates over sh. The resistant massive arkose at base forms convenient guide for separating from underlying Chico fm., upon which it rests without apparent angular discordance. Is discon. overlain by Cozy Dell sh. memb. Well exposed at type loc. (in canyon at Matilija Springs), also on top of Topatopa Bluff, and on San Cayetano Mtn. Near the springs is a bed of lignitic facies distinguished by abundant mollusks embedded in a green and purplish sandy sh., and the same bed is found farther E. at same position in geologic column.

†Matinal series.

Nongeographic name introduced by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to include all rocks beneath Medina group of N. Y. and base of †Calciferous ss. [Beekmantown]. Redefined by Rogers in 1858 (Geol. Pa., vol. 1, pp. 105, 124–126, 239, 246, 252, 260+, and vol. 2, p. 752) and restricted to beds btw. base of Trenton ls. and base of Oneida cgl. Divided into (descending): (1) *Matinal shales* (*Hudson River slates of N. Y.*), 1,200± ft. thick in Centre Co., Pa.; (2) *Matinal black sl.* (*Utica sl. of N. Y.*), 300 to 400 ft. thick; and *Matinal argill. ls.* (*Trenton ls. of N. Y.*), 300–350 ft. in Northampton, Mifflin, and Centre Counties, Pa.

Named to indicate "morning period of the great Appalachian Palaeozoic day," according to Rogers 1844 citation above.

†Matinal limestone.
†Matinal shales.
†Matinal slate.

See under *†Matinal series.*

Mattagami series.

Pre-Cambrian: Quebec.

See *Matagami series.*

Mattagami series.

Lower Cretaceous or Upper Jurassic: Ontario.

F. H. McLearn, 1927 (Canada Geol. Surv. Summ. Rept. 1926, pt. C, p. 20).

Mattapan volcanic complex.

Devonian or Carboniferous: Eastern Massachusetts and northeastern Rhode Island.

L. LaForge, 1917 (U. S. G. S. Bull. 597, pp. 200–201 and map). *Mattapan volcanic complex.*—The Carbf. volcanic rocks of Boston dist. and the associated stocks and dikes of granite porphyry, felsite, and other rocks. Comprises an extensive series of flows, volcanic breccias, and accompanying pyroclastic sed. beds, associated with and to some extent cut by intrusive felsites and granophyric rocks. The later flows of Mattapan volcanic complex are at several places interstratified with Brookline and Dorchester members of overlying Roxbury cgl. Named for exposures in Mattapan, Dorchester dist. of Boston. [In U. S. G. S. Bull. 839, 1932, LaForge changed age to Dev. or Carbf., he then being inclined to regard it as early Dev., and separated the so-called "later flows of Mattapan volcanic complex" as a distinct fm. called *Brighton melaphyre.*]

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 100–134). *Mattapan volcanics (restricted).*—The rocks assigned to Mattapan complex in U. S. G. S. Bull. 597 belong to at least 3 distinct strat. horizons. Youngest of all are the basic lavas interbedded with Roxbury cgl., which are considered to be of Perm. age. Writer prefers to restrict *Mattapan* to the group of volcanics which underlie Roxbury cgl.—in some places with slight angular uncon.—but which rest on eroded surface of Dedham granodiorite and contain pebbles of it. They are here tentatively considered to be of Penn. age. Oldest of all the extrusive volcanic rocks are certain felsites, tuffs, and breccias which are intruded by Dedham granodiorite and are thus of pre-Camb. age. The Mattapan volcanics do not contain fossils, and are difficult to date, for New England was seat of volcanic activity throughout most of Paleozoic. Thickness varies from 0 to 2,000 ft. On accompanying map and structure sections the Mattapan volcanics have not been separated from Basement Complex.

L. LaForge, 1932 (U. S. G. S. Bull. 839). The Dev. or Carbf. igneous rocks of Boston area can be divided into 2 general groups—an older group, composed chiefly of volcanic rocks, forming the Lynn and Mattapan volcanic complexes, and a younger group of intrusive rocks comprising Quincy granite and associated rocks. Some or all may be Dev. or part of them may be Carbf. The subdivision of the volcanic rocks is difficult problem. The division into 2 fms. (Lynn and Mattapan volcanic complexes) herein adopted is based partly on lithologic character and partly on structural relations, but there is considerable probability the two are contemp., and their separation may therefore be invalid. Hence the fm. names must be regarded as adopted only tentatively, chiefly as most convenient way of expressing facts whose relations are not yet fully understood. The Mattapan volcanic complex comprises the late Paleozoic volcanic rocks in and adjoining S. part of Boston Basin. The Brighton melaphyre may represent final eruptions of Mattapan time and hence be a part of Mattapan complex, but it is here treated as younger than Mattapan. Most of Mattapan rocks are of same types as those of Lynn complex. Thick beds of volcanic ash and of coarse tuff, mud flows, and water-laid sediments composed of reworked tuff with some extraneous pebbles are perhaps more abundant in the Mattapan. The sed. rocks are tuffs, tuff breccias, and mud flows composed largely of andesitic material; in places they are associated with aggls. Near top are some interbedded lenses of cgl., ss., and sl. The cgl. and ss. lenses have been confused with lower part of Roxbury cgl., with which, in fact, the Mattapan may be in part contemp. The Mattapan contains some dikes and larger intrusive masses.

Matteawan granite.

Pre-Cambrian: Southeastern New York (Poughkeepsie quadrangle).

W. W. Mather, 1843 (Geol. N. Y., vol. 1, pl. 18). [This geol. cross section shows *Matteawan granite* exposed btw. Fishkill Landing and New Beacon Mtn.]

C. E. Gordon, 1910 (N. Y. State Mus. Bull. 140, pp. 16–20). Greenish granitic rocks of Poughkeepsie quad., identical with gneisses of Fishkill Mtns. "This strip, which will be referred to as the Glenham belt, was described by Mather as the 'Matteawan granite.' "

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148, pp. 11, 18, 25–27, 33, 34, 78, 79, 85, 104). The *Glenham belt* is an inlier of pre-Camb. gneisses. Extends as a narrow strip from point just N. of carpet mill at Glenham, Dutchess Co., northeastward to Vly Mtn. South of Glenham belt, in town of Matteawan, are two small inliers of the gneisses connecting the Glenham belt with the Highlands. [On p. 18, immediately following the heading *Glenham gneiss*, is following statement:] "The prevailing and characteristic rock of the Glenham belt is a granitic gneiss. It appears to be an altered derivative of other gneisses. Is usually red, from disseminated iron stains, and over much of the belt is deeply chloritized." Is "Matteawan granite" of Mather.

†Matthews Landing group.
†Matthews Landing series. } (In Midway group.)

Eocene (lower): Southwestern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 57–60).

For definition, see *Naheola fm.*, which replaces it.

Named for exposures at Matthews Landing, on Alabama River, in Wilcox Co.

Matthews Landing marl. (In Midway group.)

Eocene (lower): Southwestern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 57–60).

For definition, see under *Naheola fm.*, of which this bed is basal memb.

Named for exposures at Matthews Landing, on Alabama River, in Wilcox Co.

Matura formation.

Pliocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 84).

Mauch Chunk shale.

Mississippian (Chester): Pennsylvania, western Maryland, and northern West Virginia.

J. P. Lesley, 1876 (2d Pa. Geol. Surv. Rept. L, App. E, pp. 221, 222, chart opp. p. 224). *Mauch Chunk Umbral Red sh.*, No. XI, 100 ft. thick in Boyd's Hill gas well at Pittsburgh, Pa. Underlies Pottsville Seral cgl. and overlies Umbral or Mountain ls. (24 ft. thick), which rests on Pocono (No. X, Upper (gray) Catskill, Vespertine of Rogers). [Type loc. not stated.]

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, pp. 521, 536). *Mauch Chunk (Umbral) Red sh.*—New name proposed by present State Geologist [J. P. Lesley]. Underlies Pottsville (Seral) cgl. and overlies Pocono (Vespertine) Gray ss. Is No. XI of repts. Thickness 1,100 ft. Upper memb. consists of 910 ft. of red and gray sss. and shales. Middle memb. is Mountain ls., 49 ft. thick, which in Greenbrier Mtn, Pocahontas Co., W. Va., attains thickness of 822 ft. and is known as *Lewisburg ls.* [Greenbrier ls. of later repts]. The lower memb., of reddish and greenish sss. and shales, is 141 ft. thick.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii–xxx). *Mauch Chunk Red sh.*—New name proposed by State Geologist [J. P. Lesley] of Pa. for Rogers's Umbral, No. XI. "Thickest, most solid, and best exposed at Mauch Chunk [Carbon Co., eastern], Pa." Thickness 3,000 ft. Underlies Pottsville cgl. and overlies Mountain ls. [Greenbrier ls.]. Included in Kenawha River system.

J. Barrell, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 450+), stated that max. thickness of 3,000 ft. is at Pottsville, Pa. J. P. Lesley (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 1, pp. 1815, 1895) gave a detailed section of the Mauch Chunk at Mauch Chunk, Carbon Co., Pa., that footed 2,168 ft.

Maude argillites.

Jurassic: British Columbia.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 40).

Mauldin beds.

Permian: Central southern Oklahoma (Garvin County).

A. R. Denison, 1923 (A. A. P. G. Bull., vol. 7, No. 6, pp. 627–644). *Mauldin beds.*—Subsurface Perm. deposits, 200 ft. thick, lying at depth of 1,200 to 1,400 ft., consisting of a series of gas sands alternating with red and blue shales, called Mauldin producing horizon, after original large gas well. The sands appear to be lenticular. Underlies Garvin beds (also a subsurface Perm. fm.) and rests on strata ranging in age from Perm. to possible Camb. Lies above Newberry sands (Perm.).

Maumee.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Maunawili volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii; Div. Hydrog. Bull. 1). *Maunawili volcanics.*—Basalt and cinders. Exposed on Maunawili ranch, 2 mi. W. of Waimanalo. Included in middle part of Honolulu volcanic series [q. v.].

Maury glauconitic member (of Ridgetop shale).

Mississippian (lower): Western and central Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 141, 143). *Maury green shale (Ball or Kidney phosphate).*—Green or greenish sh., few in. to 5 ft. thick, with embedded roundish concretions of calcium phosphate from size of marbles to that of a man's head, and in kidneylike, cakelike, and gourdlike forms of various sizes. Underlies Tullahoma fm. and overlies [uncon.] Chattanooga black sh. (Dev.).

Because of fossils, thinness, and structural relations is now treated as basal memb. of Ridgetop sh. (See N. F. Drake, 1914, Tenn. Geol. Surv. Res. of Tenn., vol. 4, No. 3, p. 105.) But according to J. H. Swartz, 1924 (Am.

Jour. Sci., 5th, vol. 7, pp. 28, 30), the Maury sh. of western Tenn. carries a much younger fauna than Maury sh. of central Tenn. According to G. H. Girty (personal communication) the Maury sh. of Waynesville quad. contains fossils of basal Miss. (probably basal Kinderhook) age, and he has no fossils from typical Maury sh.

Named for Maury Co., central Tenn.

Mauumae volcanics.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 42, 45). *Mauumae volcanics.*—Materials ranging from medium-textured black ash through coarser aggl. and rhyoclastic lava to flow lava. Erupted from Mauumae.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Mauumae volcanics.*—Pyro-explosion deposits and basalt composing Mauumae cinder cone. Included in middle part of Honolulu volcanic series [q. v.]. Assigned to late Pleist.

Maverick limestone.

Miners' local name for an ore-bearing ls., 0 to 5 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 230 ft. below South Ada ls. of miners and 40 ft. above their Honerine ls. Is a stray ls. found in workings of Honerine mine, "Maverick" being a Western word meaning unbranded. (See U. S. G. S. P. P. 173, 1932.)

Maxfield limestone.

Upper Cambrian: Central northern Utah (central Wasatch Mountains).

F. F. Hintze, Jr., 1913 (N. Y. Acad. Sci. Annals, vol. 23, p. 107). *Maxfield fm.*—Alternating lss. and shales, 481 ft. thick, uncon. overlying Alta sh. (Lower Camb.) and uncon. underlying Benson ls. [Detailed section of beds given.] Contains largest ore deposits in region, including the rich galena bedded vein of Maxfield Mine at Argenta [mail Salt Lake City]; for which the fm. is named. No fossils, but tentatively assigned to Ord.

L. D. Burling, 1914 (Canada Geol. Surv. Mus. Bull. No. 2, pp. 100-102). Hintze's Maxfield ls. at type loc. contains Middle Camb. fossils.

Fossils from base of Maxfield ls. are assigned by C. D. Walcott, E. Kirk, and C. E. Resser to Upper Camb. and fossils from upper part have been assigned by E. O. Ulrich to Upper Camb. The fm. overlying Maxfield ls. is now tentatively called *Jefferson (?) ls.* and the fm. underlying it is the Ophir sh.

Maxinkuckee moraine.

Pleistocene (Wisconsin stage): Northern Indiana. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Maxinkuckee Lake, Marshall Co.

Maxner limestone.

Mississippian: Nova Scotia.

W. A. Bell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 166).

Maxon sandstone. (In Trinity group.)

Comanche series (Lower Cretaceous): Western Texas (Glass Mountains).

P. B. King, 1930 (Univ. Tex. Bull. 3038, pp. 91-93, map). *Maxon ss.*—Outcrops in prominent ledge midway up scarps along E. side of Marathon Basin. Extends S. from vicinity of Gap Tank at least as far as SE. corner of Marathon Basin. Southernmost observed outcrop is 1 mi. N. of Jones ranch house. First described by Baker and Bowman, but age not discussed. Later mentioned by T. W. Stanton (Am. Jour. Sci., 5th, vol. 16, p. 404, 1928), who noted that it has much same age and relationships as Paluxy sand of north-central Tex. These sands are but part of a transgressive series of basal sands of indefinite strat. position. For this reason, within area of this rept (Glass Mtns), the basal sands in the N.

are termed Basement sands; those to S. occur at definite level btw. rocks of Fredericksburg and Trinity ages and are deserving of a formational name. Paluxy cannot appropriately be applied here because the two sands are now widely separated and probably were never a continuous deposit. A new name (Maxon) is thus necessary. Type loc. is Maxon Station, near point where the Southern Pacific leaves Marathon Basin. It outcrops in rather prominent ledges about 100 ft. above valley level E. of station and caps several buttes of Glen Rose fm. to W. of it. It is a brown, well indurated, coarse to medium-grained ss. with prominent cross bedding. In places there are one or more thin shaly layers. It is 90 ft. thick 1½ mi. S. of Gap Tank, sec. 61. According to Stanton it is 145 ft. thick in scarps immediately N. of Tesnus Station. Near the tank it loses its massive character and is interbedded with cgl. and sandy marl. Passes out by overlap about 1 mi. N. of this place. In Mesas 5 to 8 mi. E. of Gap Tank it can be traced N., overlapping beyond point of disappearance of Glen Rose fm., to form Basement sands of that area. No fossils found. Stanton writes: "Whether it should be classified as Trinity or Fredericksburg is largely a matter of personal preference. Following the precedent established in classifying Paluxy sand of north central Tex., which is in approx. same strat. position, it would be placed in Trinity, but it may well be in part at least of Fredericksburg age."

Maxon sand.

The *Maxton* sand (Miss., subsurface) of Appalachian region has been incorrectly spelled *Maxon* in many repts.

Max Patch granite.

Pre-Cambrian: Western North Carolina (Madison County) and eastern Tennessee.

A. Keith, 1904 (U. S. G. S. Asheville folio, No. 116). *Max Patch granite.*—Almost wholly coarse granite, in places porphyritic and in places of uniform grain. The minerals are orthoclase, and plagioclase feldspar, quartz, biotite, and a little muscovite. The porphyritic varieties are light gray or dull white. Another variety of great extent is a coarse red granite, which appears to be a modification of the usual massive rock. Intrudes Cranberry granite and the older gneisses. Surrounds Max Patch Mtn, Madison Co., N. C.

Maxton sand.

A name that has been applied to subsurface sands of different ages. In northern Ky. and Ohio to a sand in Pottsville fm. (Penn.). In western Pa. to a sand that probably corresponds to basal memb. of Pottsville fm., also to an older sand (of Miss. age) that lies at horizon of Mauch Chunk fm., above the †Pencil Cave. In W. Va. it has also been applied to two sands, both of Mauch Chunk age, the upper one said to probably correspond to the bed called by W. Va. Survey *Princeton cgl. or ss. memb. of the Mauch Chunk*, and the lower one said to probably correspond to the bed called *Droop ss. memb.* by that Survey. According to I. C. White (1919) the sand was first discovered near Sistersville, Tyler Co., W. Va., and named for its discovery on land of a farmer named *Maxton* (not Maxon). According to Hennen (Fayette Co., W. Va. Rept., p. 338) the higher of the sands in W. Va. is the true Maxton; according to D. B. Reger the lower sand in W. Va. is the true Maxton sand. (See W. Va. Geol. Surv., vol. 1A, pp. 176–180; also W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, p. 418.) According to W. Stout et al, 1935 (Geol. of nat. gas, A. A. P. G., pp. 902-903), Maxton sand of Sistersville pool is correlated with some certainty with Sharon cgl., basal memb. of Pottsville fm.

Maxville limestone.

Mississippian: Ohio and northeastern Kentucky.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 80, 84). There is, above Logan ss. group, a ls. horizon, although the ls. is not everywhere persistent, It often gives place to ss. of the usual coal measure grit. But as these lss. group themselves upon one geological horizon, and always rest upon Logan ss. group, I have no doubt that they have the same age and were formed at same time. I have called it *Maxville ls.*, from village of that name in Perry Co., Ohio, where it has been extensively burned into quicklime.

The commonly accepted definition of Maxville ls. is that it underlies Pottsville fm. (Penn.) and overlies Logan fm. It ranges in thickness up to 110 ft.

Maxville block ore. (In Pottsville formation.)

An ore bed which in early repts was included in Maxville ls. In 1922 (Ohio Geol. Surv., 4th ser., Bull. 25) Helen Morningstar called the bed *Harrison ore*, gave its thickness as 6 in. in Scioto Co. and 4 ft. in Jackson Co., and included it in base of Pottsville fm. "Is patchy, but has been traced from Scioto Co. to Muskingum Co." "Formerly included in Maxville ls., but Morse in 1910 proved it is Penn."

Maxwell limestone. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois (Peoria County).

E. F. Lines, 1912 (Ill. Geol. Surv. Bull. 17, pp. 89, 90). *Maxwell ls.*—Ls., 13½ ft. thick, forming top part of McLeansboro fm. where it outcrops. Upper 12 ft. fine-grained argill. and siliceous ls. in ½-in. layers at top and 4-in. layers at bottom; basal 4 to 5 ft. coarse-grained grayish ls. containing calcite crystals and fossils. Underlain by clay sh. containing thin coal; overlain by soil. [Probably named for occurrence at or near Maxwell, Peoria Co.]

Maxwell terrane.

A name applied by C. [R.] Keyes to 800 ft. of sh. in his Ratonan series (early Eocene and probably same as Raton fm. of SE. Colo.). Derivation of name not stated. Uncon. undelies Denver fm. and overlies Houten ss. "The Maxwell, Houten, and underlying Maya cgl. taken together probably correspond to Eldridge's Arapahoe fm. farther N." (See Iowa Acad. Sci. Proc., vol. 22, 1915, p. 257.)

Maya conglomerate.

Name applied by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 22, p. 257, 1915, and Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 9) to basal memb. of Tert. section in NE. N. Mex. Thickness 100 ft. Derivation of name not given. Underlies Houten ss. [See under *Maxwell*.]

Mayaguez shales.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

Maybelle limestone.

Permian: Central northern Texas (Baylor County).

A. S. Romer, 1928 (Univ. Tex. Bull. 2801, p. 74). In Baylor and Archer Counties, Tex., the Wichita group (Clyde fm.?) is topped by a scarp-forming ls. known locally as *Maybelle ls.* This and lower members of the ls. belt are continuous with Lueders ls.

M. M. Garrett, A. M. Lloyd, and G. E. Laskey, 1930 (Tex. Bur. Econ. Geol. geol. map of Baylor Co.). *Maybelle ls.*, a memb. of Lueders fm., lies 45 ft. below Lake Kemp ls., the top memb. of Lueders fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 174). *Maybelle ls.* is a memb. of Lueders fm., E. of Lake Kemp, Baylor Co.

Derivation of name unknown.

May Creek formation.

Devonian (?): Southwestern Oregon (Riddle quadrangle).

J. S. Diller and G. F. Kay, 1924 (U. S. G. S. Riddle folio, No. 218). *May Creek fm.*—Mica schist and mica slates, 1,000+ ft. thick. Thrust fault contact with Galice fm. (Jurassic). No fossils in Riddle quad., but to SW., in similar rocks, fossils in ls. lentils have been identified as Dev., hence May Creek fm. is classified as Dev. (?). Exposed for 3 mi. along May Creek and to beyond mouth of May Creek.

In other parts of SW. Oreg. this fm. is chiefly schist, and is there called *May Creek schist*.

†Mayes formation.

Mississippian: Northeastern and central eastern Oklahoma.

C. W. Shannon and L. E. Trout, 1915 (Okla. Geol. Surv. Bull. 19, pt. 1, pp. 127–130). *Mayes fm.*—Dark-gray to black ls. separated by thin bands of black sh. Thickness thin to 100 ft. Of Chester age. Conformably underlies Fayetteville sh. Uncon. overlies Boone fm. Usually a thin sh. memb. separates Boone and Mayes.

L. C. Snider, 1915 (Okla. Geol. Surv. Bull. 24, pp. 27–35, 47). *Mayes fm.*—Dark-gray to black ls., locally argill., weathering drab or light gray, the ls. beds separated by thin bands of black sh. In some places 4 or 5 ft. of sh. at base and 3 or 4 ft. of sh. at top. Thickness 8 to 100 ft. Uncon. overlies Boone fm. Conformably underlies thick bed of black sh. forming basal memb. of Fayetteville fm. Is basal fm. of Chester group. In Tahlequah quad. includes lss. mapped by Taff as upper part of Boone, but described as lower ls. bed of the Fayetteville. In Muskogee quad. includes equiv. beds mapped by Taff with Fayetteville and described as lower ls. bed of that fm.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, pp. 59–60). *Mayes fm.—Named by L. C. Snider, 1915.* Consists of dark-gray to black ls., locally argill., separated by thin beds of black sh. Thickness 3 to 100 ft., averaging 40 ft. Occurs around margin of Boone ls., on which it usually rests discon. Is of Chester or older Mississippian age. *Is composed of beds that are assigned by some geologists to Moorefield sh., Batesville ss., and lower part of Fayetteville sh.* Fossils listed.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 30). *Mayes fm.* is of middle Chester age.

G. S. Buchanan, 1927 (A. A. P. G. Bull., vol. 11, No. 12), R. Roth, 1928 (Econ. Geol., vol. 23, pp. 48–51), E. G. Woodruff and C. L. Cooper, 1928 (Okla. Geol. Surv. Bull. 40U). *Mayes fm.* assigned to Meramec epoch.

E. Bloesch, 1928 (Okla. Geol. Surv. Bull. 40EE, pp. 24–30). *Mayes fm.* is of lower Chester and upper Meramecian age.

H. A. Ireland, 1930 (Okla. Geol. Surv. Bull. 40NN). *Mayes ls.* is of Chester age.

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ). *Mayes fm.* is here *restricted* to beds containing "Spring Creek" fauna, of Meramecian age. In Cherokee and Adair Counties [central eastern Okla.] these beds are 0 to 70 ft. thick. The Mayes fm. as heretofore used in Okla. included these beds and lower part of overlying Fayetteville sh. as here defined. In Batesville region, northern Ark., the upper Boone contains this fauna, but these beds are believed not to be present in typical Boone of Boone Co., Ark., where upper beds are of Warsaw age and uncon. overlain by Hindsville ls. memb. of Batesville ss., of Chester age. Rests on Boone without evidence of uncon.

The U. S. Geol. Survey discarded this name from its classification in 1925. Named for Mayes Co.

Mayflower amygdaloids.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belong to Central Mine group. The Old Mayflower amygdaloid is younger than Isle Royale amygdaloid and older than Old Colony ss. Its mineralized part is the Old Mayflower lode. The New Mayflower amygdaloid is older than Isle Royale amygdaloid and younger than New Arcadian amygdaloid, and its mineralized part is the New Mayflower lode. Named for occurrence in Mayflower mine, Houghton Co.

Mayflower flows.

The Old Mayflower flow includes Old Mayflower amygdaloid and the underlying trap. The New Mayflower flow includes New Mayflower amygdaloid and underlying trap.

Mayflower schist.

Ordovician (?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Mayflower schist.*—Chloritic "knotted" or spotted schist and schistose sl., prevailingly dark, with commonly a greenish tinge; more aluminous than schists of underlying Gold Hill fm.; for most part without admixture of other rocks, but in some sections outcrops of a dark-gray ls. similar to overlying Zanzibar ls. were seen, and seem to be interbedded with the schist, but may represent infolded parts of Zanzibar ls. Exposed thickness 800 ft.; maximum probably not much greater. In fault contact with Gold Hill fm. Exposed in Mayflower Gulch.

Maynardville limestone.

Upper Cambrian: Eastern Tennessee.

C. R. L. Oder, 1934 (Jour. Geol., vol. 42, No. 5, pp. 474–476, 494, 497). *Maynardville ls.*—Thin-bedded to massive, light-bluish gray to dark-gray, fine to coarse-grained, more or less laminated ls., with dark-gray dol. forming upper third of fm. Basal third carries ls. cgl. in which small black clay balls suggest oolitic textures. Sometimes thin bluish-green calc. sh. occurs in lower part and dark-gray chert occurs sparingly in upper beds. On W. side of valley top is usually marked by 2 ft. of dark-gray shaly dol. with undulating upper contact. On E. side of valley upper limit is formed by 5 to 10 ft. of ss. Thin aren. zones occur. Thickness 60 to 250 ft. In places formerly mapped with underlying Nolichucky sh., but on older geol. maps of Claiborne and Union Counties it was included in Knox dol. Its known fossils consist of problematical cystid plates and an unidentified sp. of *Cryptozoon*. Croixan trilobites occur in the Nolichucky up to base of Maynardville, but they have not been discovered within the latter. In lithology it compares with lower Knox beds. Hence it seems well to consider it, at least tentatively, as basal memb. of Knox dol. and as marking beginning of deposition of Ozarkian series of Camb. system in east Tenn. Uncon. underlies Conococheague-Copper Ridge fm. Named for Maynardville, Union Co.; well exposed along State Highway 33, about 5½ mi. NE. of town.

Mayne Creek formation.

Mississippian: Central northern Iowa.

F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, pp. 52, 92, 105, 108). *Mayne Creek fm.*—Chiefly soft brownish dolomitic ls., aren. at several horizons; occasionally chert nodules yield well-preserved fossils. Thickness about 68 ft. Underlies Eagle City beds and overlies Chapin beds. Is a fm. in Kinderhook group. Named for exposures in N. bluff of Mayne Creek, NE¼ sec. 21, Reeve Twp., Franklin Co.

L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, pp. 388–396), stated that he had made slight change in basal bdy of *Maynes Creek memb. of Hampton fm.*, as he called the beds. See under *Chapin beds.*

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 242, 245). I regard *Maynes Creek ls.* as = part of Fern Glen [of Osage group].

May Pen beds.

Pleistocene or Pliocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 84).

Maysville group.

Upper Ordovician: Northern Kentucky, southwestern Ohio, and southern Indiana.

A. F. Foerste, 1905 (Sci., n. s., vol. 22, p. 150). *Maysville div.*—Hitherto identified as Lorraine, but fauna is so different from typical Lorraine as to warrant another name. Includes (descending) Arnheim, Mount Auburn, Corryville, Bellevue, Fairmount, and Mount Hope beds, all of which are exposed along railroad S. of Maysville, Ky.

The Arnheim was many years ago transferred to Richmond group. The Mount Hope sh. and Fairmount ls. are now treated as members of Fairview fm. and the Bellevue ls., Corryville sh., and Mount Auburn (concretionary strata) as members of McMillan fm.

Mayville limestone.

Silurian: Southeastern Wisconsin.

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, pp. 336–345). *Mayville beds*.—Usually a rough, coarse, gray, mag. ls., with considerable difference in the layers. Max. thickness 100 ft.; average 60 ft. Is lowest memb. of Niagara series. Underlies Waukesha beds and overlies Cincinnati [Maquoketa] sh. In Sheboygan region it underlies Byron beds (considered=basal beds of Waukesha ls.). Fossils [listed]. Named for max. development and finest exposure S. of Mayville, Dodge Co.

T. E. Savage, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 305–324), correlated *Mayville ls.* with his Kankakee and Edgewood lss. of Ill.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93), stated that *Mayville dol.*, as he called it, is of middle Clinton age.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 278). Mayville is pre-Niagaran and correlates with Edgewood of Ill.

Mayville ore bed.

See under *Neda fm.*

Mayville moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Mayville, Tuscola Co.

Maywood formation.

Silurian (?): Central western Montana (Philipsburg region).

F. C. Calkins and W. H. Emmons, 1913 (U. S. G. S. P. P. 78). *Maywood fm.*—Flaggy reddish, gray, and whitish mag. lss. and gray, whitish, and olive-green calc. sh., with beds of light-colored calc. ss. about 40 ft. above base. Thickness 200–300 ft. Of marine origin. No fossils. May be Lower Dev., Sil., Ord., or Upper Camb. Overlies Red Lion fm., possibly uncon. Underlies Jefferson ls. conformably. Named for Maywood Ridge, W. of Princeton, on whose NE. face, 2 mi. above mouth of South Boulder Creek, the best exposure occurs.

Maywood clay.

Pleistocene: British Columbia.

C. H. Clapp, 1913 (Canada Geol. Surv. Mem. 36, p. 109).

Mazarn shale.

Lower Ordovician (Beekmantown): Southwestern Arkansas and southeastern Oklahoma (McCurtain County).

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 68). *Mazarn sh.*—Sh. with small amounts of ls. and ss. The sh. is ribboned, consisting of alternating black and green layers that split at an angle with the bedding. Thickness 1,000 ft. in Caddo Gap and De Queen quads., Ark.-Okla. The name is applied to the part of "Ouachita sh." lying below Blakely ss. Named for Mazarn Creek [eastern Montgomery Co., Ark.]. Overlies Crystal Mtn ss. and underlies Blakely ss.

Mazatzal quartzite.

Pre-Cambrian: Central Arizona.

E. D. Wilson, 1922 (Pan-Am. Geol., vol. 38, pp. 299–312). The massif of Mazatzal Range is composed almost entirely of schists, slates, and qtzites of pre-Camb. age, the sedimentaries being usually disposed at high angles. The great succession of indurated sss. to which the title *Mazatzal qtzite* is here applied, constitutes main part of the mtns from central Mazatzal Peak northward. There are, however, four separate and distinct areas of the qtzite, which is a hard, vitreous rock, light-brown to gray in color, fine-grained, and often cross-bedded, but possessing at various levels also many phases of cgl. the subangular to rounded pebbles of which vary from very coarse sand to small boulders one-half foot or more in diam. Occasionally there are lenticular layers (up to 150 ft. in thickness) of maroon-colored, gray-spotted, hard aren. shales which frequently display ripple marks and sun cracks.

N. H. Darton, 1925 (Univ. Ariz. Bull. 119, pp. 234–235), reported uncon. btw. Mazatzal qtzite and overlying Apache group (pre-Camb.) on Haigler Creek, near Payson.

Named for development in Mazatzal Range.

Mazomanie sandstone.

Upper Cambrian: Central southern Wisconsin (Dane County).

E. O. Ulrich, 1920 (Wash. Acad. Sci. Jour., vol. 10, pp. 73–78). *Mazomanie ss.*—A more or less decidedly calc. fm.; a magnesian ss.; contains considerable disseminated glauconite. Approx. thickness 10 to 100 ft. Rests on Franconia ss. and underlies St. Lawrence fm.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 548). *Mazomanie fm.*—Fine to medium-grained gray to dark-red ss. irregularly cemented by dol.; locally beds of red, green, and gray calc. sh.; base consists of gray dol. with purple spots very similar to St. Lawrence or Black Earth memb. of Trempealeau fm.; entire fm. contains more or less dol. Max. thickness 165 ft.; average 100 ft. Thins out to W. and overlaps Franconia for distance of 10 to 20 mi. Is known from far NE. Wis. to near Spring Green, Wis. In northern Ill. it was formerly correlated with the Madison and Mendota of Wis., but it bears no resemblance to those fms. Underlies Trempealeau fm. [St. Lawrence fm.] and overlies Franconia fm.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 21–79). *Mazomanie ss.* is same as Franconia ss., and not younger, as Ulrich claims.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 13). Formerly it was rather generally believed Mazomanie fm. of Ulrich was=the Franconia. Ulrich then advanced the view that there are 2 distinct fms., the Mazomanie representing an invasion from the E. and the Franconia from the W., and the former overlapping the latter. Little evidence was advanced to support this view. Recent studies have shown that Mazomanie faunas extend W. beyond the Miss. and that Franconia faunas underlie those of the Mazomanie wherever lower part of the succession is fossiliferous. Also, Pentland's study of the Franconia and Mazomanie shows a homogeneity of mineral content which could hardly have been possible had the materials been derived from different regions. As *Franconia* has priority it is here used, and it is recommended that *Mazomanie* be abandoned or given rank as a memb.

A. C. Trowbridge et al., Sept. 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 116–117). The strata designated "Mazomanie" by Ulrich in 1920 are now known to be a part of Franconia fm., from which they differ in being somewhat coarser-grained and more dolomitic. Ulrich at first supposed Franconia is confined to W. side of Wisconsin arch and the Mazomanie to the east. Later studies showed this is error, and most geologists have abandoned *Mazomanie* as a synonym, although it has been given wide currency among well drillers in E. Wis. and in Ill. [Type section by F. T. Thwaites, on p. 116, calls the beds *Franconia*.]

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, Nov. 30, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, p. 1702). Upper beds of Hudson memb. of Franconia fm. in various parts of Wis., notably central area, contain fauna Ulrich assigned to his proposed Mazomanie fm., but which writers designate *Prosaukia* subfaunal zone. Lower part of Hudson memb. contains *Ptychaspis* subfauna. Ulrich named his Mazomanie fm. from Mazomanie village, on Wisconsin River, near which the strata are exposed in conspicuous cliff. [Summarize parts of Ulrich's definition.] Nothing of kind described by Ulrich exists. His Mazomanie continues westward to Miss. River and beyond, and his Franconia continues E. over the arch with undiminished thickness. Writers do not consider the Mazomanie to merit rank of a fm. but to be little more than a minor subdivision of Franconia fm.

E. O. Ulrich, 1936 (Geol. Soc. Am. Proc. 1935, p. 113). *Mazomanie ss.* is quite distinct from "Franconia," both faunally and lithologically, and is younger.

Mazourka formation.

Lower Ordovician: Central eastern California (Inyo Range).

F. B. Phleger, Jr., 1933 (Southern Calif. Acad. Sci. Bull., vol. 32, pt. 1, pp. 1–6). *Mazourka fm.*—A succession of argill. shales and lss. 675 ft. thick. Lower 125 ft. consists of calc. sh. interbedded at irregular intervals with thin-bedded lenses of dark-gray argill. ls. Rest of fm. consists of argill. ls. interbedded at infrequent intervals with a few thin sh. layers. Typically exposed in Mazourka Canyon btw. Barrel Spring Canyon and Lead Canyon trail. Conformably underlies Barrel Spring fm. and conformably overlies ls. that Kirk considers to be of Beekmantown age. Fossils (identified by Kirk) listed. The fm. is faunally a unit and undoubtedly of Chazy age.

Meade gravel.

Pleistocene: Southwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 52). *Meade gravels.*—Highly fossiliferous gravels and sands, mostly unconsolidated, 10 to 40 ft. thick, laid down in deep and broad valleys. Overlain by Pearlette ash, into which they frequently grade. Supposed to be late Plio. and to belong to Tule div. of Cummins (*Equus* beds of Cope). Named for Meade Center, Meade Co.

Meadow limestone.

Pennsylvanian: Southeastern Nebraska, eastern Kansas, and northwestern Missouri.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 13, 22, 37). *Meadow ls.*—First distinct ls. memb. of Braddyville fm. above Forbes ls. Has wide distribution in Nebr. and apparently in Kans. and Mo. Is usually in one bed, but in places is in 2 beds. Light bluish gray, massive, hard, semicrystalline; upper part weathers light-colored and basal part buff. Lies 6 to 10 ft. above Forbes ls. and 5 to 6 ft. below Union ls. Thickness 2 ft. 7 in. to 4 ft. Outcrops W. of Meadow, Nebr., and at other places.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 43, 51), named the sh. overlying Meadow ls. the *Iowa Point sh.* and the sh. underlying it the *Jones Point sh.*, and assigned all 3 to Calhoun sh. memb. He also renamed *Union ls.* (preoccupied) the *Coal Creek ls.*

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 12, 26, 28, 31, 47). It has been found that *Meadow ls.* as originally defined should be extended to include a sh. and a ls. next above; that (by tracing) the true Meadow ls. is basal bed of Stanton ls. memb., instead of in Calhoun sh. memb.; that the sh. underlying the Meadow is not the Jones Point sh. but Vilas sh. memb; that the true Jones Point sh. is basal bed of Calhoun sh. memb. and Iowa Point sh. is top bed of Calhoun sh. memb. The ls. separating Jones Point sh. and Iowa Point sh. not being the ls. that outcrops W. of Meadow it is here named *Sheldon ls.* and the sh. overlying Meadow ls. is here named *Eudora sh.* The Meadow ls. as here redefined is 10½ ft. thick, and consists of (descending): ls., 4 ft.; sh. 3 ft.; ls. 3½ ft.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), reported 2 units btw. Meadow ls. and underlying Vilas sh., and applied *Linwood sh. memb.* to the upper one (1 to 2½ ft. thick) and *Naish ls. memb.* (also Naish *ss.*) to the lower one (1 to 1.8 ft. thick). He included both of these newly named units in Stanton ls. Whether his Linwood and Naish had previously been included in Meadow ls. or in Vilas sh. was not explained. This classification was adopted by Moore and Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pt. 1, pp. 76–79), introduced *Captain Creek ls.* for basal memb. of Stanton ls., underlying Eudora sh. memb. and overlying Vilas sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 132, 191), discarded *Meadow ls.*, applying *Captain Creek ls.* to typical Meadow ls., which is said to be basal memb. of Stanton ls., and *Sheldon ls.* to the bed in Calhoun sh. that was originally but erroneously named *Meadow ls.* He did not explain fate of Linwood sh. and Naish ls.

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser., pp. 48–49). *Meadow* was originally assigned by Condra and Bengston to what has later been correlated as lower ls. memb. of Plattsburg ls. fm. at Meadow Station, N. of Louisville, Nebr.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Meadow marble member (of Sevier shale).

Lower Ordovician (Chazy): Central Tennessee.

C. H. Gordon, 1924 (Tenn. Dept. Ed., Div. Geol. Bull. 28, pp. 39–40, 63–65, and map). The marble here called *Meadow marble* has not been mapped hitherto. Its outcrop makes its appearance about 2 mi. SW. of Meadow Station and ends near Miser, 2¾ mi. NE. of Friendsville. It consists of light gray and pink marble, identical in appearance with corresponding variety of Holston marble fm. It has its best development from Meadow Station to point SE. of Kiser, a distance of about 2½ mi. Thickness roughly estimated at 200 to 300 ft. Difference of opinion exists as to strat. position of this marble, some, including writer, holding it to constitute a lentil near middle of Tellico fm., while others consider it to be at base of overlying Ottosee (Sevier). The latter view makes it correspond in position with the variegated marble at Vestal, whereas marble identical with the latter outcrops ¾ mi. E. of the Meadow with several hundred ft. of typical Tellico intervening btw. the two marble fms.

Adopted by U. S. Geol. Survey as a local basal memb. of Sevier sh. in E. part of Loudon Co. and W. part of Blount Co.

Named for exposures near Meadow Station, Loudon Co.

Meadow Creek trachyte.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Fine-grained volcanic flow, with fairly large but ill-defined phenocrysts of sanidine, nearly identical with Flag Spring trachyte, which it overlaps slightly in position. Occurs on N. side of Meadow Creek.

Meadow Creek limestone.

A name erroneously credited to Condra and Bengston (1915) in Kans. Geol. Surv. Bull. 22, 1936, pp. 132, 191. Condra and Bengston named the ls. *Meadow ls.*, and did not use *Meadow Creek ls.*

Meadows sand.

A subsurface sand, of probable early Penn. (Cherokee) age, in Kay Co., central northern Okla., lying lower than Bartlesville sand. L. C. Snider (1913) says it is same as Tucker sand.

Meadowvale member.

Upper Ordovician (Richmond): Ontario.

W. S. Dyer, 1925 (Ont. Dept. Mines 32d Ann. Rept., vol. 32, pt. 7, p. 124).

†Meadville Upper limestone. (In Cuyahoga formation.)

Mississippian: Northwestern Pennsylvania.

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3). *Meadville Upper ls.*—A remarkable shell bed in upper part of Crawford shales. At Meadville it lies about 25 ft. beneath Shenango ss.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4). *Meadville Upper ls.* might at many places be called a fishbone cgl.

This is a ls. bed in midst of Meadville sh. memb. of Cuyahoga fm. of present nomenclature. The U. S. Geol. Survey does not apply same name to a unit and to a part of that unit. Caster proposed (1934) it be renamed *French Creek ls.*

†Meadville group. (In Pocono group.)

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q4, pp. 83–90). *Meadville group.*—Consists of (descending): (1) *Meadville Upper sh.*, 25 ft. (bluish-gray or ashen-gray sh., argill. at top, sandy lower down, sometimes flaggy, never massive); (2) *Meadville Upper ls.*, 1 ft.; (3) *Meadville Lower sh.*, 40 ft. (generally ash gray sh. with sandy flags, which increase in number toward bottom; (4) *Sharpsville Upper ss.*, 50 ft. (layers of fine bluish-gray or grayish-brown flagstone 1 to 2 ft. thick, alternating with thin layers of grayish sh.); (5) *Meadville Lower ls.*, 1 to 2 ft. (impure, hard, flinty, persistent); (6) *Sharpsville Lower ss.*, 10 to 30 ft. (series of flags 6 in. to 2 ft. thick, exactly like Upper Sharpsville ss.; and (7) Orangeville sh., 100 ft. Underlies Shenango group [Burgoon ss.] and overlies Corry ss.

Replaced by Cuyahoga fm. Nos. 1, 2, and 3 of above description correspond to *Meadville sh. memb.* of present nomenclature, and Nos. 4, 5, and 6 correspond to Sharpsville ss. memb. In NE. Ohio the Cuyahoga is treated as a *group* and the Meadville, Sharpsville, and Orangeville as *fms.*

Named for Meadville, Crawford Co., Pa.

Meadville shale member (of Cuyahoga formation).

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

See under †*Meadville group*.

†Meadville Lower shale. (In Cuyahoga formation.)

A name applied in early Pa. repts to lower part of Meadville sh. memb. of Cuyahoga fm. of present nomenclature. See original description under †*Meadville group*, 1881. See also *Harvest Home sh. memb.* and *Bykam ls. memb.*

†Meadville Lower limestone. (In Cuyahoga formation.)

A name applied in early Pa. repts to a thin ls. in middle of Sharpsville ss. memb. of Cuyahoga fm. See original description under †*Meadville group*, 1881. Also see *West Mead ls. memb.*

†Meadville Upper shale. (In Cuyahoga formation.)

A name applied in early Pa. repts to upper part of Meadville sh. memb. of Cuyahoga fm. of present nomenclature. See original description under †*Meadville group*, 1881. See also *Custards sh. memb.*

Meadville monothem.

Meadville stage.

Names applied by K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 129), to the rocks designated "Meadville group" by I. C. White (1881), which were later proved to be same as Cuyahoga fm. of Ohio, by which name they have been called in many repts, and divided into (descending) Meadville sh. memb., Sharpsville ss. memb., and Orangeville sh. memb. Caster discarded Meadville sh. memb., dividing it into several newly named units, and reverted to an old and conflicting usage of "Meadville."

Meaford member.

Upper Ordovician: Manitoulin Island and southern shore of Georgian Bay.

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, pp. 7, 51, 53). *Meaford memb.*, of Waynesville age, is lower memb. of Richmond fm. Underlies Kagawong memb. of Richmond fm. Intended to include all those strata which contain a fauna suggesting their Waynesville age. Thickness probably reaches 90 ft. at Streetsville. [Also calls it Meaford *fm.*] Named for exposures near Meaford, Ontario, although better exposed on Manitoulin Island.

Meagher limestone.

Middle Cambrian: Central Montana (Little Belt Mountains and Fort Benton quadrangles).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). Wolsey sh. is succeeded by the thin-bedded *Meagher lss.*, 110 ft. thick, which are overlain by several hundred ft. of Park shales and ls. cgls. All are included in Barker fm.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Meagher ls.* is a thin-bedded ls., often formed mainly of flat ls. pebbles, and carries Middle Camb. fossils. It rests on Wolsey sh. and underlies Park sh., all included in Barker fm. [Derivation of name not stated, but Barker fm. is mapped over large areas in Meagher and other counties of this quad.]

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 285). *Meagher ls.* caps summits of Belt Park buttes. It consists of thinly and irregularly bedded pure lss., gray, mottled with patches of buff aren., clayey matter. The exposed edges of the beds show wavy, almost crinkled bedding planes. Over 60 ft. exposed on Keegan Butte. Lower strata carry no distinguishable fossils and weather into very small irregular gravelly debris. Upper beds spotted with green glauconite grains and contain numerous fossil fragments.

Meakin sand.

Upper Cretaceous: Southwestern Arkansas (Smackover oil field, Ouachita and Union Counties).

H. G. Schneider, 1924 (Am. Inst. Min. and Met. Engrs. Trans., vol. 70, pp. 1078–1099). *Meakin oil and gas sand.*—Fine-grained sand, 18 ft. thick, forming basal part of Marlbrook fm. Named for Meakin farm, on which first producing well was drilled.

H. G. Schneider, 1925 (A. A. P. G. Bull., vol. 9, No. 7, pp. 1116–1117), gave 55 ft. as thickness of *Meakin sand* in Smackover field, and stated that it is also known as *Louann sand* and, in E. part of field, as *Primm gas zone.*

Meander shales.

Devonian: Northwest Territory.

A. E. Cameron, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. B, pp. 13, 29).

Mecca oil rock.

A subsurface sand in Ohio that lies at horizon of Berea ss. or Bedford sh.

Mechunck limestone.

Cambrian: Central Virginia.

W. A. Lambeth, 1901 (thesis presented to Univ. Va., p. 14). *Mechunck ls.*—Lss. interbedded or wrapped up in the mica slates. They vary in thickness and physical condition, the bed in Monticello area, Albemarle Co., showing no crystallization, while one near Lynchburg has been worked for marble. Are generally schistose or slaty, with seams filled with calcite. Assigned to Camb.

Meda rhyolite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 65, etc.). *Meda rhyolite.*—A flow of light-gray to pink rhyolite, which rests on Milltown andesite and on the overlying dacite and dacite vitrophyre. Overlain by andesite breccia. Probably varies much in thickness. Exposed in vicinity of Meda Pass and close to road S. of Myers Mtn.

Medford diabase.

Upper Triassic: Northeastern Massachusetts.

A. W. G. Wilson, 1901 (Boston Soc. Nat. Hist. Proc., vol. 30, No. 2, pp. 353–374 and map). [See also U. S. G. S. Bull. 839, 1932, by L. LaForge.]

Named for occurrence in Medford, Mass.

Medford "granite."

Quarrymen's term for Medford diabase.

Medford black granite.

Commercial name of Medford diabase.

Medford gravel.

Commercial term for the coarsely granular residual material from the weathering of Medford diabase. Is used for road material.

Media shale.

Miocene: Central California (San Joaquin Valley).

G. M. Cunningham and W. F. Barbat, 1932 (A. A. P. G. Bull., vol. 16, No. 4, pp. 419–421). *Media sh.*—Sh., with some ss. and characteristic sh. pelecypod fauna; in lower part of Temblor fm. Thickness 450 to 490 ft. Overlies Carneros ss. memb. of Temblor, 168 ft. thick, and at Devils Den is separated from overlying beds by an angular uncon. [Derivation of name not stated.]

G. C. Gester, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169). *Temblor sh.* in McKittrick-Midway-San Emigdio region divided into (descending) Gould sh., Button bed ss., Media sh., Carneros ss., Santos sh., and *Phacoides* reef.

†Medicine beds.

Cretaceous (Upper and Lower): Central southern Kansas.

C. N. Gould, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 169–174). *Medicine beds.*—Deep-sea to fresh-water transition beds from Kiowa shales (top fm. of Comanche series) below to Dakota leaf-bearing ss. above. Includes (descending) Reeder ss., Kirby clays, Greenleaf ss., and Spring Creek clays.

C. N. Gould, 1901 (Kans. Acad. Sci. Trans., vol. 17, p. 133), suggested discarding term and "classing all the strata in either Comanche or Dakota, although exact line of demarcation can scarcely be drawn."

This name was discarded by U. S. Geol. Survey in 1921. The †Reeder ss. is Upper Cret. Dakota ss., the †Kirby clay, †Greenleaf ss., and †Spring Creek clay are regarded as local facies of Cheyenne ss. without strat. value. The name has since been discarded by Kans. Geol. Survey. (See their Bull. 9, 1924, by W. H. Twenhofel, although Twenhofel revived *Belvidere* to include part of these beds, as explained in 1924 entry under *Belvidere sh.*)

Named for upper Medicine River, W. of Belvidere, Kiowa Co.

Medicine Bow formation.

Upper Cretaceous: Southern Wyoming (Hanna Basin, Carbon County).

C. F. Bowen, 1918 (U. S. G. S. P. P. 108, pp. 228, 229, etc). *Medicine Bow fm.*—Alternating beds of light-colored to gray carbonaceous sh., gray to brown ss. showing cross-bedding, ripple marks, and other features of irregular deposition, and thin irregular beds of coal. Fresh- and brackish-water invertebrates, land plants, and vertebrate bones. Thickness 6,200± ft. Underlies fresh-water Ferris fm. (Tert.?), without proof of uncon., and conformably overlies Lewis sh. (marine). Best exposed along both sides of North Platte River at mouth of the Medicine Bow. Assigned to Upper Cret. Is="Lower Laramie" of Veatch.

Medicine Lodge gypsum. (In Cimarron group, in Kansas.)

Medicine Lodge gypsum member (of Blaine gypsum in Oklahoma).

Permian: Southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 27–39). *Medicine Lodge gyp.*—Persistent bed of massive gyp., 12 to 30 ft. thick, usually of grayish white color, forming basal memb. of Cave Creek fm. Separated from overlying Shimer gyp. memb. of Cave Creek fm. by 7 to 10 ft. of Jenkins clay. Underlain by Flower-pot shales.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., p. 48). *Medicine Lodge gyp. memb. of Blaine div.* is 18 to 24 ft. thick. Is separated from overlying Shimer gyp. memb. by red sh. that corresponds to Jenkins clay of Cragin, which is overlain by Altona dol. memb. Overlies Magpie dol. memb. of Blaine.

Gould later abandoned Altona dol. and Magpie dol., and defined Medicine Lodge as overlain and underlain by red shales (see 1906 and 1927 entries under *Altona dol. memb.*), but he did not explain to what his Altona dol. and Magpie dol. were equivalent.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, p. 405). Nearly all geologists who have traced the Blaine think Medicine Lodge memb. of Blaine of Kans. is=Ferguson memb. of Okla. section. It is suggested that, at least for NW. Okla., Medicine Lodge memb. should be made name of lowest massive gyp. ledge of Blaine and that very probably the term *Ferguson* should be dropped. E. C. Parker, Robt. McNeely, I. H. Stein, and writer are agreed that base of Medicine Lodge gyp. of Kans. can be correlated with base of Ferguson gyp. of Okla. But as writer has not personally traced base of Blaine S. of Fairview, Okla., he makes no positive statement in regard to the Ferguson. [In table on p. 408 Shimer gyp. memb. is placed below Lovedale gyp. memb. and above Medicine Lodge gyp. memb., all included in Blaine fm. On p. 410 Evans states: Shimer gyp. is in every way similar to the Medicine Lodge, from which it is separated by 20± ft. of red sh. The Shimer is 13± ft. thick and has a dol. bed at base very similar to dol. bed at base of the Medicine

Lodge. The Shimer is well exposed in all of NE¼ T. 26 N., R. 21 W., showing its relationship to both the Medicine Lodge and Lovedale members.]

Named for Medicine Lodge River and town of Medicine Lodge, Barber Co., Kans.

†Medicine Lodge beds. (In Cimarron group.)

Permian: Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of Kans.). *Medicine Lodge beds*.—Include (descending): Medicine Lodge (Cave Creek) gyp. (29 ft. thick); Flowerpot shales (170 ft. thick); Cedar Hills sss. (150 ft. thick); and Salt Plain shales (150 ft. thick). Overlies Harper beds and underlies Dog Creek shales.

Medicine Peak metaquartzite.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 632). *Medicine Peak metaqtzite*.—Lower memb. a very massive, violet-gray metaqtzite about 1,700 ft. thick; certain beds dark steel gray; is generally cross-bedded. Upper memb. is unusually pure and uniform metaqtzite nearly 4,000 ft. thick, generally not quite so coarse as lower memb. and cross bedding not conspicuous. Conformably underlies Lookout schist and conformably overlies Heart metagraywacke. Forms S. end of Medicine Bow Peak Ridge. Assigned to early Algonkian.

†Medidial series.

Nongeographic name applied by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to the rocks of Appalachian region btw. base of Marcellus sh. and base of Schoharie grit or top of Oriskany ss. Rogers abandoned this name in his 1858 classification (Geol. Pa., vol. 1, pp. 59, 104–109; vol. 2, pt. 2, pp. 751–775).

Named to indicate "afternoon period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

Medina group.

Silurian (early) and Upper Ordovician: New York and Michigan.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 374, on 3d dist.). *Medina ss*.—In former repts called *red ss. of Oswego*. Predominant color red, more rarely whitish and greenish. Confined to Oswego Co., to high grounds of Oneida at Florence village and other parts of town of Florence, and to extreme N. parts of Onondaga and Cayuga Counties. Occupies strat. position btw. Oneida cgl. above and Salmon River ss. below.

J. Hall, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 453–455, on 4th dist., western N. Y.), gave following rock succession for N. Y. (descending) Rochester sh., 2d Green sh., Pentamerus ls., Green sh. and iron ore, and Medina ss.; and stated: *The Medina ss., red marl and sh.*, is lowest rock in 4th dist., being found bordering shore of Lake Ontario, from Niagara river to E. limits of Wayne Co. The Salmon River group, however, forms bed of the lake, and in some places is probably at no great distance from shore, as boulders and pebbles containing the peculiar fossils of that group are found on the lake beach in Niagara Co. and other places. The Medina consists of upper gray portions, and below of red and variegated beds [marl and sh.] [In 1862 Hall gave thickness as 1,000± ft.]

L. Vanuxem, 1842 (Geol. N. Y., pt. 3), stated that Medina ss. is overlain by Oneida cgl. and rests on Grey ss. of falls of Salmon River and Oswego [Oswego ss.], which in turn rests on Hudson River group.

J. Hall, 1843 (N. Y. Nat. Hist., Geol. 4th dist., quarto, pp. 31, 34–57). *Medina ss*.—Usually a red or slightly variegated ss., solid and coherent in E. extremity of dist., becoming friable and marly in W. extension, and admitting an intercalated mass of gray quartzose ss. containing marine shells, while in red portions are rarely found other than marine vegetables and fucoids. The locality which gives the name exhibits the rock best developed, and with its characteristic fossils. The rock is the lowest of 4th dist. In Oswego Co. it rests on the Gray ss. that overlies Hudson River group. It is overlain by Clinton group and sh. of the Niagara. At Albion there is a low fall on Sandy Creek over the same ss. At Medina, on Oak-orchard

Creek, this rock forms the beautiful little cascade pictured on preceding page. The deep gorge and high cliffs on either side of the Niagara at Lewiston are more than half excavated in this rock; and the partial obstruction of the water at the whirlpool is caused by a part of same mass. Its alternations of harder and softer masses produce cliffs or cascades along its whole extent. Where best developed the rock consists of (descending): (1) The gray or greenish-gray argill. ss. forming terminal part, which in 3d dist. is considered a distinct rock forming the Oneida or Shawangunk cgl.; in 4th dist. it always appears more or less as a part of Medina ss., possessing the same lithological features. Thickness at Medina 4 ft. (2) A repetition of No. 4, gradually passing into a more sandy form in W. part of dist., but in E. part of dist. the whole div. is more siliceous, and No. 3 does not appear. (3) Gray quartzose ss., 25 ft. thick on Niagara River, entirely distinct from mass below. (4) Red marl and marly or shaly ss., sometimes banded and spotted with green, the bands being both horizontal and vertical.

In succeeding years some N. Y. geologists placed Oneida cgl. beneath Medina ss. (see details under *Oneida cgl.*), and the upper gray portion of the Medina came to be known as "Medina gray ss.," "Upper Medina," and "White Medina;" while the lower red portion was called "Medina red ss.," "Medina red sss. and shales," "Red Medina," and "Lower Medina." The use of the name *Medina* was also extended to Canada, Pa., N. J., Md., Va., W. Va., Ky., Ga., Ohio, and Ind., for rocks believed to correspond to all or some part of typical Medina of N. Y.

In 1891 (Smithsonian Inst. 45th Ann. Rept. Bd. Regents, pp. 252–253) G. K. Gilbert stated that at Niagara Falls, beneath Clinton group and extending downward for several hundred ft., is a great bed of soft sandy sh., interrupted, so far as we know, by a single hard layer, a ss. ledge 10 to 20 ft. thick.

In 1893 (Geol. Soc. Am. Bull., vol. 4, pp. 116–117) C. S. Prosser gave strat. position of the Medina btw. Clinton above and "Oswego ss. or Oneida cgl." below, and gave its thicknesses, in different parts of the State, as 400 (central N. Y.) to 1,075 (western N. Y.).

In 1899 (N. Y. State Geol. 16th Ann. Rept., pp. 199–226) D. D. Luther used *Medina group* to include *Medina ss.* (740 ft. at Syracuse) and "underlying" Oneida cgl. (25–100 ft.); and F. J. H. Merrill (N. Y. State Mus. Bull., vol. 4, No. 91) also used Medina in these two senses. The same year (Sci., n. s., vol. 10, pp. 874–878) J. M. Clarke and C. Schuchert stated that *Medina ss.* underlies Clinton and overlies Oneida cgl., and that "it is= Oswego ss. of Vanuxem" [Vanuxem used *Grey ss. of Oswego*]. They also introduced *Oswegan period or group* to include Medina ss. and Oneida cgl. In 1899 (Geol. Soc. Am. Bull., vol. 10, p. 135) G. K. Gilbert stated that in type dist., about Medina, N. Y., *Medina fm.* is 800 ft. thick, and consists chiefly of red sh. with beds of soft argill. sss., usually white or gray, in upper 100 ft.

In 1901 (N. Y. State Mus. Bull. 45) A. W. Grabau applied *Medina series* to the beds btw. Clinton above and Oswego ss. below, and gave their thickness as 1,200 ft. at Niagara Falls and vicinity. In Buffalo Soc. Nat. Hist. Bull. 6, No. 1, pp. 20–21, 1901, he called the same rocks *Medina ss.* and gave 1,266± ft. as thickness in Niagara region; and he used *Oswegan group* to include Medina ss. and underlying Oswego ss. or Oneida cgl.

In 1902 (N. Y. State Mus. Bull. 52, table opp. p. 658) E. O. Ulrich and C. Schuchert gave position of *Medina* as btw. Clinton above and Oneida below, as did several other geologists in succeeding years. In 1905 (Sci., n. s., vol. 22, pp. 528–535) A. W. Grabau stated that lower 1,100 ft. of the Medina represents Richmond time, and he assigned these beds to Ord. In 1906 (N. Y. State Mus. Bull. 92, pp. 120–124) Grabau applied

Medina sss. to upper 125 ft. of Medina rocks and *Medina shales and sss.* to underlying 1,140 ft., and again expressed opinion that latter beds are of Richmond [Ord.] age. In 1907 (N. Y. State Mus. Bull. 114) C. A. Hartnagel stated "there is evidence which may show that all the Oswego and probably part of the [overlying] Medina could with propriety be included with the Lower Siluric" [Ord.].

In 1908 (Sci., n. s., vol. 27, pp. 622–623) A. W. Grabau restricted *Medina ss.* to "Upper Medina or Medina proper" of previous usage, and introduced *Queenston shales* for the 1,100 ft. of *red Medina shales* of previous usage, which he stated are of Richmond age and which he assigned to Ord. (The Queenston is unfossiliferous in western N. Y., but is now generally conceded to be=beds not far distant in Ontario that carry a Richmond fauna.) He also included Medina ss. as thus restricted and Oneida cgl. in the Clinton. The same year (Sci., n. s., vol. 28, p. 347) G. H. Chadwick proposed *Lewiston sh.* for the same sh. that Grabau named *Queenston*, and he also assigned it to Ord., and restricted Medina to post-Queenston beds, which he included in the Niagaran. (Because of priority of publication *Queenston* is name now used by geologists.) In 1909 (Jour. Geol., vol. 17, p. 238) A. W. Grabau applied *Whirlpool ss.* to the 25 ft. of white quartzose ss. forming basal memb. of "true or Upper Medina" and resting on the beds of Richmond age.

In 1911 (Geol. Soc. Am. Bull., vol. 22) E. O. Ulrich applied *Medina ss.* to the post-Queenston part of the original Medina (which he included in Sil. and correlated with Oneida cgl.), and assigned the older and uncon. *Lewiston (Queenston) sh.* and the underlying Oswego ss. to Ord.

In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel included *Queenston (Lewiston) sh.* in *Medina beds*, and assigned all to Sil.

In 1913 the term *Albion* was suggested by J. M. Clarke as a name for the post-Queenston part of the Medina, to which Grabau and Chadwick were restricting the name *Medina ss.* (See *Albion ss.*) The same year E. O. Ulrich (Geol. Soc. Am. Bull., vol. 24, pp. 107–108) recommended that *Medina* "be retained in its original significance," and that it be called *Medina series*, a "term equivalent in rank to Niagaran;" also that "Lower Medina" be called *Juniata* (a well-established Pa. name), instead of *Queenston sh.*, more recently proposed; and he transferred the Richmond (and the Queenston) to Sil. In 1913 (12th Int. Geol. Cong., Canada) Ulrich used *Medinan* as a series term to cover *Albion ss.* and Richmond (Queenston sh.), both of which he assigned to Sil. In Niagara folio of U. S. Geol. Survey, No. 190, 1913 (Paleozoic geology by E. M. Kindle), *Medina group* was used to include *Albion ss.* (Sil.) and *Queenston sh.* (*Sil. or Ord.*), the latter fm. not having yielded fossils, and its age being questioned by some geologists. The same year (Canada Geol. Surv. Guidebook 4, pp. 127–140) W. A. Parks proposed that Medina be still further restricted, by removal of Whirlpool ss. and some 80± ft. of overlying red and gray shales included in Albion ss. as defined, but to which Schuchert in 1913 applied name *Cataract fm.* Parks stated that Cataract fm. of Schuchert represents an invasion from N. and W. at commencement of Sil. time. In Geol. Soc. Am. Bull., vol. 24, pp. 461–463, 1913, A. W. Grabau included in top of the Medina of Niagara Gorge 6 ft. of beds which he designated as *Sodus sh.*, a memb. that had previously been assigned to the Clinton.

In 1914 (Sci., n. s., vol. 39, June 19, pp. 915–918) E. M. Kindle disclaimed responsibility for use of names *Albion ss.* and *Medina group* in Niagara folio, and expressed opinion that Grabau's application of *Medina* to beds above base of Whirlpool ss. "is the usage which the writer believes should and will prevail," and that Albion ss. should be dropped. Kindle proposed that these beds be called *Medina fm.* He included Thorold ss. in his *Medina fm.* This usage was followed by M. Y. Williams (1914 and later repts), who also referred Queenston sh. to Ord., and stated that Whirlpool ss. overlapped it; and by C. Schuchert, 1914 (Geol. Soc. Am. Bull., vol. 25, Sept., pp. 277–320), although some of Schuchert's sections restricted *Medina ss.* to beds above his Cataract fm. [now said to correspond to lower part of Albion ss.]. Schuchert stated that Grabau's restriction of Medina to beds above the [unfossiliferous] Queenston sh. was "altogether correct," for "at Medina along Oak Orchard Creek one practically sees only these red and white sss. characterized by the well-known fauna."

In 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368) G. H. Chadwick still further restricted *Medina* at top, by removing Thorold ss. member (5 ft. thick), and applying *Medina* to the beds btw. base of Thorold ss. and base of Whirlpool ss.

In 1923 (Md. Geol. Surv. Sil. vol., pp. 244, 267, 347, etc.) E. O. Ulrich and R. S. Bassler transferred top memb. (Thorold ss.) of Albion ss. and of Medina group to Clinton fm., and used *Medinan* to include this restricted Albion ss. and the uncon. underlying Queenston sh., both of which they assigned to Sil. They proposed that Albion be retained for the "sandy facies that prevails in N. Y. and rather generally in Appalachian Valley," and used *Alexandria group* to cover Albion ss. and contemp. deposits. In same vol. C. K. Swartz used *Medinan series* to cover only Tuscarora fm. (=Albion ss.), and assigned the underlying Juniata ss. (=Queenston sh.) to Ord. In Denison Univ. Bull., Jour. Sci. Lab., vol. 20, pp. 50–51, 1923, A. F. Foerste included in *Medinan* only the rocks to base of Whirlpool ss., or those equiv. to Albion ss.

The 1924 ed. of Schuchert's Textbook of geology used *Alexandrian* as time term for post-Richmond part of the original Medina. Two repts of W. Va. Geol. Surv. (Rept. on Mineral and Grant Counties, 1924, and Rept. on Mercer, Monroe, and Summers Counties, 1926, both by D. B. Reger) used *Medina White ss.* (instead of Tuscarora ss.), *Red Medina series* (instead of Juniata fm.), and *Grey Medina ss.* (basal 250 to 300 ft. of Sil. system and said to be=Oswego ss. of N. Y.), because *Medina* has long priority. I. C. White, then State Geologist of W. Va., used same classification in 1926 (Geol. Soc. Am. Bull., vol. 37, p. 509). A 1924 rept of Ohio Geol. Surv. (4th ser., Bull. 28, by W. Stout and R. E. Lamborn, chart opp. p. 358 and elsewhere) included in *Medina beds* all rocks btw. base of Sodus sh. and base of Queenston sh. The Pa. Geol. Surv. included in *Medina period-series* the Tuscarora ss. (=Albion ss.), the Juniata fm. (=Queenston sh.), and the Oswego ss., according to Pa. Geol. Surv., 4th ser., Bull. M₇, by B. L. Miller, pp. 57–60, 1925, and G. H. Ashley, State Geologist, Geol. Soc. Am. Bull., vol. 37, p. 510, 1926. The 1916 geol. map of Va. applied *Medina* to Tuscarora ss. (=Albion ss.) and placed Juniata fm. in Ord. E. O. Ulrich, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 279–348) used *Medinan* to include all beds btw. base of Clinton and base of Richmond. The 1928 geol. map of Va. used *Tuscarora ss.* and *Juniata fm.*, and included both in Sil.

C. A. Hartnagel and W. L. Russell, 1929 (A. A. P. G. Structure of No. Am. oil fields, Symposium, vol. 2, pp. 274–278), used *Medina series* to include both the white and the red beds, or all beds below the Clinton and above the so-called "Hudson River." W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), used *Medinan* to include Albion ss. and Queenston sh., but included Thorold ss. and Oneida cgl. in the Clinton. J. T. Sanford, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 194), stated that Thorold ss. is a transition phase composed of Medina sediments reworked by Clinton seas, included it in the Clinton, and applied *Medina ss.* to underlying rocks. G. H. Ashley and J. D. Sisler, 1933 (Pa. Topog. and Geol. Surv., 4th ser., Bull. M19), stated *Medina series* of central Pa. includes Tuscarora (=Albion), Juniata (=Queenston), and Oswego (=Oneida). C. R. Fettke, 1935 (Pa. State Coll. Bull., Min. Industries Exp. Sta. Bull. 19), stated: *Medina group* has been restricted to beds below Thorold ss. and above Queenston sh.

The U. S. Geological Survey has not yet formally discarded the original and long-established definition of *Medina group*, to include the gray Albion ss. (Sil.) and the red Queenston sh. (Ord.). But it avoids the use of the name in its publications, a group name to include fms. belonging to 2 systems being contrary to its practice; and the several modern restricted definitions of the name, to various portions of the upper (and very minor) part of the assemblage to which *Medina* was originally and for many years applied, tending to confuse, rather than clarify, the nomenclature.

Medina sandstone.

See under *Medina group*, 1840 and later.

Medina shales.

See under *Medina group*, G. K. Gilbert, 1891, and A. W. Grabau, 1906.

Medina "series."

Same as *Medina group*. See under *Medina group*, A. W. Grabau, 1901, and E. O. Ulrich, 1913. Other writers also have used this form of the name.

Medinan.

A time term that has been used in several senses: (1) to include Albion ss. and Queenston sh. and contemp. deposits (see under *Medina group*, E. O. Ulrich, 1913); (2) Albion ss. only (see under *Medina group*, E. R. Cumings, 1922, A. F. Foerste, 1923, and C. K. Swartz, 1923); (3) Albion ss. restricted to beds beneath Thorold ss. memb. at top and Queenston sh. (see under *Medina group*, E. O. Ulrich and R. S. Bassler, 1923, and E. O. Ulrich, 1926).

Medora amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name in use locally many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Is older than Allouez cgl. and younger than Manitou amygdaloid. The mineralized part is the Medora lode. Named for occurrence in Medora mine, Keweenaw Co.

Medora flow.

Includes Medora amygdaloid and underlying trap.

Medora coal group.

A term applied to a group of strata forming upper part of Tongue River memb. of Fort Union fm. in SW. N. Dak., and including coals B to E, both inclusive. (See A. G. Leonard, 1908, N. Dak. Geol. Surv. 5th Bien. Rept.)

Medora Knob facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons. Div. Geol. Pub. 98, pp. 76, 237, etc., 1931) to a lithologic development of his Edwardsville fm. in a part of southern Ind.

Meek Bend limestone. (In Millsap Lake formation.)

Pennsylvanian: North-central Texas (Parker County).

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept., by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See 1933 entry under *Millsap Lake fm.*) Type loc. not stated.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15, 16). *Meek Bend ls.*, 20 ft. thick, is included in Lazy Bend memb. of Millsap Lake fm. by Scott and Armstrong (unpublished ms.). Is typically exposed in Parker Co.

†Meekoceras beds.

A term that has had considerable usage in SE. Idaho and northern Utah, for the basal 50 ft. of Thaynes group (Lower Triassic), which is characterized by genus *Meekoceras*. The *Meekoceras* zone (as the U. S. Geol. Survey designates the beds) has also been recognized (by J. P. Smith and others) in Nev. and Calif. So far as known it is confined to those areas in the United States, but it occurs in other parts of the world.

Meers quartzite.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

M. G. Hoffman, 1930 (Okla. Geol. Surv. Bull. 52, pp. 26, 31, 45). *Meers qtzite.*—Oldest rock in Wichita Mtns. Outcrops at N. base of Mount Sheridan along Medicine Bluff Creek, and ¼ mi. SW. of old Meers townsite, where it covers an area ¼ mi. wide. This outcrop was first described by Taylor in 1915. A small exposure (200 ft. long by 50 ft. wide) of qtzite not previously described was found at top of hill in SW¼SE¼ sec. 34, T. 4 N., R. 14 W. Another small mass cuts across the road immediately S. of Meers townsite. These 3 exposures of metamorphosed sedimentary rock are here named Meers qtzite. They all occur in north-central part of the Wichitas.

Meeteetse formation.

Upper Cretaceous: Northern Wyoming (Bighorn Basin).

D. F. Hewett, 1914 (U. S. G. S. Bull. 541, pp. 91, 102). *Meeteetse fm.*—Argill. ss. and sandy sh. with many beds of brown carbonaceous sh. and lenticular coal near top. Thickness 1,110 ft. in Shoshone River region. Poorly exposed along the river, and therefore more thoroughly studied in region S. of it, where it contains a Montana flora. Overlies Gebo [Mesaverde] fm. and underlies Ilo [Lance] fm. Named for town of Meeteetse, on Greybull River.

Later work proved that this fm. includes equivalents of Bearpaw sh. and upper part of Judith River fm.

Megalonyx beds.

A paleontologic name applied by E. D. Cope to strata containing fossil remains of *Megalonyx*. According to H. F. Osborn (U. S. G. S. Bull. 361, 1909, pp. 82, 83, 87, 88) this genus occurs in strata ranging in age from middle Plio. to middle Pleist.

Meganos formation.

Eocene (lower): Western California.

B. L. Clark, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 94, 281–296). The name *Meganos group* is given to the new group situated btw. typical Martinez and typical Tejon. It is believed that deposits of this group have wide distribution throughout Coast Ranges of Calif. In certain localities they have been referred to Martinez group and at other places to the Tejon. Uncon. underlies typical Tejon and contains a faunal representative differing considerably from that of typical Tejon and also differing from typical Martinez fauna of the lower Eo. Uncon. overlies typical Martinez group. Includes *Turritella andersoni* beds.

B. L. Clark and R. B. Stewart, 1925 (Geol. Soc. Am. Bull., vol. 36, p. 227), and B. L. Clark, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull. vol. 16, No. 5), *restricted* Meganos to lower part of Meganos as above defined, and applied *Domengine* to the beds btw. typical Tejon and Meganos restricted. (See under *Domengine fm.*) The U. S. Geol. Survey has accepted this restricted definition of Meganos.

Named for exposures on Meganos ranch or land grant, SE. of Martinez, Contra Costa Co. In 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, p. 71) B. L. Clark and A. O. Woodford stated that type section of Meganos restricted is a strip beginning about 1½ mi. E. and a little N. of Clayton and ending in vicinity of Byron Hot Springs.

Meguma series.

Pre-Cambrian: Nova Scotia.

J. E. Woodman, 1904 (Am. Geol., vol. 33, p. 368, and vol. 34, p. 13).
C. W. Knight, 1911 (Min. Soc. Nova Scotia Jour., vol. 16, p. 94). *Meguma series* assigned to Algonkian.

Mehama volcanics.

Oligocene: Central northern Oregon (Cascade Mountains region).

T. P. Thayer, 1933 (Pan-Am. Geol., vol. 59, No. 4, p. 317). *Mehama volcanics*, subaerial, uncon. underlie Stayton lavas (Mio.) in Cascades. Probably grade westward into Illahe fm., which contains lower-middle Olig. fossils. [Derivation of name not stated.]

Mehrten formation.

Miocene and Pliocene (?): Northern California (Mokelumne River Basin).

A. M. Piper, H. S. Gale, and H. E. Thomas (U. S. G. S. W. S. P. 780, in press). *Mehrten fm.*—Fluviatile ss., siltstone, and cgl., commonly well assorted and well stratified; incloses layers of coarse aggl. of mud-flow origin; dominantly of andesitic detritus associated with andesitic eruptions in High Sierra Nevada. Thickness 75 to 400 ft. Underlies Laguna fm. (Plio.?) and uncon. overlies Valley Springs fm. (Mio.). Exposed near Mehrten dam site, 3½ mi. upstream from Clements bridge. Is believed to be of Mio. and Plio. (?) age.

†Meigs Creek white limestone. (In Monongahela formation.)

A name applied by W. T. Griswold (U. S. G. S. Bull. 198, pp. 17–19, 1902) to ls. later named *Dinsmore ls. bed*. Probably named for association with Meigs Creek coal.

Meiocene.

An early spelling of Miocene.

Meisner sand. See *Miscner sand*.

Melbourne bone bed.

Pleistocene: Florida (east coast, central part; west coast; and interior).

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *Melbourne bone bed.*—Disconnected patches of sand and other materials (clay, carbonaceous matter, cavity fillings) which at Melbourne and elsewhere contain a large and characteristic vertebrate fauna and heretofore have been called "No. 2 bed" and "bone bed." Max. known thickness 10 ft. Wherever examined the bed lies uncon. on coquina or shell marl of Anastasia fm., but in interior of State it rests on older fms. Where the bone bed does not lie at surface of ground it is overlain by wind-blown sand, or, more commonly, by muck, peat, or alluvium. At Melbourne, Brevard Co., it consists chiefly of sand that appears to be wind blown. Farther inland, where wind action was less effective, the Melbourne bone bed is to be looked for in old lake beds, in flood plains, in accumulations of residual sands and clay, and in sinks and caverns. Has been found at intervals along the 100-mile stretch btw. Vero and New Smyrna, and probably occurs along east coast both N. and S. of those towns. On west coast it has been explored on Pinellas Peninsula near Seminole and near Sarasota. The Melbourne fauna has been found also in caverns or sinks near Lecanto, Citrus Co., and at Ocala.

Mellen or High Bridge granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated).

†Mellenia series.

Miocene (upper): Southern California.

O. H. Hershey, April 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [On legend of map of part of southern Calif. *Mellenia series* appears btw. San Pablo series below and upper Plio. above.]

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349–372). *Mellenia series.*—Fresh-water sediments, 1,700 ft. thick, composed of cgls., shales, and sss., uncon. underlying Lang div. and believed to be younger than San Pablo fm.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753, p. 52). As "Mellenia," so far as could be ascertained, is not a place name, and its origin is doubtful, this series of strata is here renamed, to correspond to rule of nomenclature of U. S. Geol. Survey, *Mint Canyon fm.*, the beds being particularly well developed in Mint Canyon region.

Melmont.

Eocene: Western Washington (Puget Sound region).

W. F. Jones, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 122), divided the Eocene coal-bearing rocks of Pierce Co. into (descending): (1) Burnett, 8,000 ft.; (2) Wilkeson, 950 ft.; (3) Carbonado, 2,300 ft.; (4) *Melmont*, 1,400 ft.; and (5) *Fairfax*, 2,000 ft. Melmont and Fairfax are apparently named for towns in N. part of Pierce Co., but they are not defined.

Melozi formation.

Upper Cretaceous: Southwestern Alaska (Nulato-Norton Bay district, Lower Yukon River region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 395–412, chart opp. p. 474). Upper Cret. of lower Yukon region divided into 4 conformable fms. (descending) Kaltag fm., Nulato fm., *Melozi fm.*, and Ungalik cgl. The 3 first are contemp. with Shaktolik group. The Melozi consists of 1,000+ (possibly several thousand) ft. of fresh-water sh. and ss., containing fossil plants and fresh-water invertebrates. Named for exposures on N. bank of Yukon River from 8 to 20 mi. below Melozi telegraph station.

See under *Shaktolik group*. Also see U. S. G. S. P. P. 159, 1930.

Melrose.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to 25 ft. of Carbf. qtzite in Mont. Derivation of name not stated.

Melrose granite facies (of Columbia granite).

Pre-Cambrian: Central Virginia (Campbell County).

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 22–23, map). *Melrose granite facies of Columbia granite.*—Is much coarser-grained and darker-colored than Columbia granite. In area E. of McKeever Ferry the Melrose granite (pre-Camb.) has been converted into augen gneiss. Intrudes Wissahickon fm. [Mapped at and around Melrose, Campbell Co.]

Memorial shale.

Pennsylvanian: Eastern Kansas.

R. H. Dott, 1936 (see Kans. Geol. Surv. Bull. 22, by R. C. Moore, pp. 58, 67). Moore stated: *Memorial sh.* (mss. by R. S. Dott) is name applied to beds of undet. thickness btw. top of "Eleventh St." ls. [Lenapah] and uncon. at top of Marmaton group, top of Des Moines series. [The brackets around *Lenapah* are Moore's. This new name replaces Dudley sh. as restricted by Moore in 1932. Derivation of name not stated.]

Memphis loess.

Pleistocene: Southwestern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 162). *Memphis loam.*—Bluff loam. The fm. upon which most of city of Memphis stands

Fine siliceous earth or loam, more or less calc. and of light ashen, yellowish, or buff color. Quite compact.

†Memphis sandstone. (In Peacock formation.)

Permian: Central northern Texas (Hall County to Motley County).

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, p. 953, pl. 10). A fossiliferous limy pink to red ss. is present in Hall Co. approx. 250 ft. above base of Whitehorse ss. Although similar in appearance to Verden "channel" ss. of Okla., the authors have called this bed *Memphis ss.*, from buttes formed by it near Memphis, the county seat of Hall Co. Is 3 to 10 ft. thick and similar in general characteristics to Verden ss. except that it crops out in belt 10 or 12 mi. wide, and is much higher in geologic section, the Okla. memb. being in upper part of Dog Creek sh. Most southerly outcrop of this bed is in northern Motley Co., near town of Northfield.

Replaced by Dozier ss. memb. of Peacock fm., q. v.

R. Roth, 1932 (Jour. Geol., vol. 40, No. 8, p. 703), believes Memphis ss. is a continuation of Dozier Hills, which are channel deposits, and that it marks base of his Custer fm., which he assigned to Lower Triassic.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 167). The name *Memphis ss.* has been abandoned by U. S. Geol. Survey and Dozier ss. substituted for it.

Memphremagog slate.

Ordovician: Northeastern and southeastern Vermont.

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 115, footnote). U. S. G. S. has adopted *Memphremagog sl.* instead of *Montpelier sl.*, preoccupied. [For definition see 1906 entry under †*Montpelier sl.*]

C. H. Richardson, 1908 (6th Rept. Vt. State Geol., p. 276). *Memphremagog slates.*—Black, carbonaceous, highly fissile sl. Youngest memb. of Lower Trenton series in Vt. Consists of: (1) shallow sea deposits; (2) Coventry ls., deposited in deepening sea; (3) muds and silts laid down near the shore; (4) ls. deposited in subsiding sea; (5) finely triturated clays in shallow, quiet sea. Named for Lake Memphremagog.

G. H. Perkins, 1912 (8th Rept. Vt. State Geol., pp. 21–56). Reference of *Memphremagog sl. to* Trenton is to be regarded as probable, not certain.

C. H. Richardson, 1912 (8th Rept. Vt. State Geol.). *Memphremagog sl.* extends from Lowell Mtn to Lake Memphremagog. Is definitely Lower Trenton.

C. H. Richardson and H. G. Turner, 1914 (9th Rept. Vt. State Geol., pp. 283–293). *Memphremagog sl.* has now been carried southward in somewhat broken belt to S. bdy of Greensboro. In its northern extension into Canada it bears abundant Lower Trenton graptolites.

C. H. Richardson, 1916 (10th Rept. Vt. State Geol., pp. 120–146). Western memb. of *Memphremagog slates* of previous repts was broken in Craftsbury, reappears in Hardwick, also in Woodbury, and continues into Northfield. The black or bluish-black slates and associated shales were named by this author *Memphremagog slates*, because of fact that in their northern extension in Vt. they dip under Lake Memphremagog and appear on E. side of lake, where they contain graptolites. This name is retained for the slates and shales in their southern extension as far S. as writer's work has extended, approx. 100 mi. The Memphremagog sl. and Waits River ls. range from Lower Trenton to Deepkill [Beekmantown].

C. H. Richardson, 1919 (11th Rept. Vt. State Geol.). *Memphremagog sl.*—In N. part of State is represented by 3 belts, roughly parallel, and separated from each other by belts of Waits River ls. Each sl. belt passes under Lake Memphremagog and reappears on E. side of lake in Canada. The E. belt in its more northerly extension is a black carbonaceous, often pyritiferous sl., which to S. becomes phyllite schist. Central belt is black clay sl. with perfect cleavage, occasionally pyritiferous. Western belt is black carbonaceous, highly fissile sl. These slates may represent 3 different noncalc. beds of Ord. sediments or one bed that has been repeated by a fan fold. All 3 belts contain graptolites, those found in Roxbury and Northfield proving the southern extension of the slates are of Deepkill (Beekmantown) age, according to Ruedemann.

C. H. Richardson, 1924 (14th Rept. Vt. State Geol.). *Memphremagog group.*—Slates and phyllites; in Bethel phyllites predominate. The slates extend unbroken from Lake Memphremagog S. for 100 mi. The phyllites have been more or less broken in their continuity by lss. The slaty characters were so pronounced in Newport and

Coventry that the terranes were named *Memphremagog slates*. In southerly extension the 2 easternmost members soon lose their slaty characteristics and become phyllites. In Bethel westernmost belt is nearly all phyllite. It has been obvious for long time these phyllites should receive a more definite name, and therefore *Randolph phyllite* has been selected for them. [See *Randolph phyllite*.]

C. H. Richardson, 1927 (15th Rept. Vt. State Geol., p. 150). *Memphremagog group* of slates and phyllites divided into *Randolph phyllite* and *Memphremagog sl.*

E. L. Perry, 1929 (16th Rept. Vt. State Geol.). *Memphremagog group of slates and phyllites* occurs in and near base of Waits River ls. in northern section.

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., pp. 192–211). *Memphremagog group* of slates and phyllites in SE. Vt. includes sl., *Brattleboro phyllite*, and Waits River ls., which usually is interbedded with the phyllite.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 13, p. 360), showed that in central Green Mtns, Vt., the Ord. consists of Randolph phyllite (correlated with Black River ls. of N. Y.), Waits River ls. (Chazy fossils), and Memphremagog sl. (Beekmantown fossils).

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., pp. 316–347). *Memphremagog group* (Ord.) consists of slates, phyllites, and qtzites. In N. half of State the sl. appears as a continuous belt from Northfield to Int. Bdy. On E. side of the Ord. the belt is more or less broken, but beds of sl. appear in nearly every twp southward from Waterford to Mass. line. Includes Brattleboro phyllite.

Menard limestone. (Of Chester group.)

Mississippian: Southern Illinois and western Kentucky.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 128). *Menard fm.*—Upper part, thin-and moderately thick-bedded close-textured fine-grained lss., with shaly partings and with some sh. beds 5 or more ft. thick; basal 35 ft. or more fine blue clay sh. Thickness 80 ft. Uncon. underlies Palestine ss. and overlies Okaw fm.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4 and No. 5, also Ill. Geol. Surv. Bull. 41, pp. 202–205, and Sci., n. s., vol. 51, p. 494) reported three fms. (Waltersburg ss., Vienna ls., and Tar Springs ss.) in southern Ill. btw. *Menard ls.* [restricted] and horizon of underlying Okaw fm., which are absent in Randolph Co. (See *Okaw fm.*) On p. 202 he stated: When these units (Waltersburg ss., Vienna ls., and Tar Springs ss.) were first observed they were considered as subordinate members of Menard fm., but as field studies have been carried to W. they have proved to be—in importance and magnitude with other Chester units and have come to be recognized as full fms. [In the three 1920 repts cited above Weller restricted *Menard* to beds above Waltersburg ss. This is present commonly approved definition.]

Named for Menard, Randolph Co., Ill., where it is well exposed immediately SE. of hospital for criminal insane.

Mendenhall sand.

A subsurface sand in Rico fm. (Perm.) of southern San Juan Co., SE. Utah.

Mendez formation.

Upper Cretaceous and Eocene(?): Mexico.

I. C. White, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 255).

Has been assigned to Upper Cret., to Eo., and to both.

Mendha limestone.

Upper Cambrian: Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Engrs. Trans., No. 1647, p. 7) and 1932 (U. S. G. S. P. P. 171). *Mendha ls.*—Descending: (1) Blue-gray thick and thin ls., somewhat cherty, with layers of flat ls. cgl., 450 ft.; (2) dark-gray to black dolomitic ls., cherty, 350 ft.; (3) gray heavy-bedded crystalline ls., 300 ft.; (4) gray ls., thin- to thick-bedded, much oolitic and conglomeratic material, 800 ft. Conformably overlies Highland Peak ls. In fault contact with overlying Yellow Hill ls. (Lower Ord.). Named for Mendha mine, on W. side of Arizona Peak, which is entirely composed of these rocks. Larger areas are in Highland quad. Absent in Ely Range. Present in Bristol Range quad. Fossils basal Upper Camb. according to C. E. Resser.

Mendon schist.

Pre-Cambrian; Southwestern Vermont (Rutland County) and northwestern Vermont (Addison County).

C. L. Whittle, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 347–355). [See 1st entry under *Mount Holly gneiss.*]

C. L. Whittle, 1894 (Jour. Geol., vol. 2, pp. 396–429). *Mendon series.*—A series, 200 to 2,000 ft. thick, of more or less metamorphosed clastic rocks of sed. origin. Referred to Algonkian. Overlies Mount Holly gneiss and underlies (uncon.?) Lower Camb. qtzite. So far as known best section occurs in town of Mendon, 1 mi. S. of Mendon village.

W. G. Foye, 1919 (11th Rept. Vt. State Geol., pp. 82–98). *Mendon series.*—Cgls., arkoses, qtzites, calcite marbles, dolomites, calc. schists, biotite schists, chlorite schists, actinolite schists, tourmalinized schists, and gneisses. Ripton cgl. is basal layer of Mendon series. Overlies Mount Holly gneiss. Is later Algonkian.

E. L. Perry, 1929 (16th Rept. Vt. State Geol., pp. 1–61), states there is erosion interval btw. *Mendon series* and Mount Holly series.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 284). In town of Mendon Cheshire qtzite is in contact with the dol. series. As we go up the hill from this quartz we go down through Mendon series, according to Whittle. Next outcrop to E. is shaly ls. 800 ft. thick. Next outcrop is impure qtzite, 500 ft. thick, which has been injected by volcanic material. Going up higher we find 50 ft. of the fine-grained dol. marble known as *Mendon dol.* It contains quartz grains. Highest outcrop reported is 350 ft. of green mica-quartz-actinolite schist, undoubtedly sedimentary and possibly injected by volcanic material. It could have been derived from Canajoharie sh. The *Mendon dol.* in Whittle's type loc. overlies, apparently conformably, the Camb. qtzite, which may be seen in bed of brook beside the dol. outcrop. The Mendon series as seen in Brandon is not strictly = the series in town of Mendon, and there is some doubt that the two sections are comparable as a series. Upon the basis of these meager facts the suggestion is offered that *Mendon series* may at present be assigned to Camb. and that there is no pre-Camb. along Green Mtn front. [In correlation table accompanying this rept. *"Mendon" dol.(?)* is assigned to Beekmantown D, and *Mendon series* to Lower Camb., Upper Camb., and Beekmantown.]

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, p. 265). Over Mount Holly gneiss lies a succession of mica schist and qtzite, including some ls. or dol. with a prominent structure that strikes nearly due N. This assemblage was called *Mendon "series"* by Whittle. Being chiefly schists, it is here called *Mendon schist.* It is of younger pre-Camb. age, and uncon. underlies qtzite containing Lower Camb. fossils.

E. J. Foyles, 1933 (18th Rept. Vt. State Geol., pp. 366–367). The establishment of *"Mendon series"* has hampered clear understanding of geol. history of W. side of Green Mtns. Has never been proved to be pre-Camb., and yet its records have often been used by authors as an infallible classic. Many series of somewhat similar nature but in no way exactly comparable have been correlated with it. For several years I have been unable to reconcile Mendon series with the fms. of the region. In summer of 1931 side trips from beaten path were made, and nothing unusual was encountered until the well-known dol. outcrop of type section was reached at 1,240 ft. above sea level. The dol. is large block 15 ft. long by 10 ft. wide, surrounded by glacial till and without recognizable bedding planes. It is concluded that *"Mendon dol."* is really Rutland dol., which arrived in its present position through faulting or glaciation. Although Whittle (Jour. Geol., vol. 2, 1894, pp. 396–429) thought "Mendon series" in Blue Ridge Mtn was completely overturned, there is no field evidence to prove it. "Mendon series" may prove to be Paleozoic.

Mendon dolomite.

Pre-Cambrian: Southwestern Vermont (Rutland County) and northwestern Vermont (Addison County).

See E. J. Foyles, 1929 and 1933 entries under *Mendon schist.* If this dol. belongs to Mendon schist, it is of pre-Camb. age, according to Prindle and Knopf (1932). But Foyles (1933) thinks it is Rutland dol. (Lower Camb.) faulted. (See under *Mendon schist.*)

Mendota dolomite member (of St. Lawrence formation).

Upper Cambrian: Southern Wisconsin.

R. D. Irving, 1875 (Am. Jour. Sci., 3d, vol. 9, pp. 441–442). *Mendota ls.* of south-central Wis., 30 ft. thick, underlies Madison ss. and rests on Lower or Potsdam ss.

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, p. 260). *Mendota ls.*—Alternating mag. ls., sandy calc. shales, and shaly and calc. sss.; the lss. soft, granular, porous, friable, rather thin-bedded, buff-colored, and frequently contain greensand; shales variegated with yellow, red, and purple; two kinds of ss. Thickness of fm. 60 ft. Should be included in Potsdam ss. series and not with Lower Mag. series. Base of Lower Mag. should be placed at top of Madison ss. Paleontology corroborates this view. Named by Prof. Irving from its occurrence on Lake Mendota, near Madison. Grades into underlying calc. ss. (155 ft. thick), which, with underlying sh. and sss., is also included in Potsdam ss. Also grades into overlying Madison ss.

R. D. Irving, 1877 (Geol. Wis., vol. 2, pp. 525, 577, 583–584, 590–592, 602, 603). Underlying Madison ss. and overlying Potsdam ss. proper is a well-marked and very persistent yellow ls. layer to which I have given specific name of *Mendota ls.*, from a large exposure at MacBride's Point [now known as Maple Bluff] on N. shore of Lake Mendota. Only intended as local name in central Wis.

In many subsequent repts this dol. was correlated with St. Lawrence fm. by several authors, including E. O. Ulrich; but later work led Ulrich to belief that it is younger than St. Lawrence fm. and younger than Jordan ss.

E. O. Ulrich, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 477–478). *Mendota dol.* is 25 ft. thick on Lake Mendota and at other points in area btw. the two cuts. It overlies Jordan ss. and underlies Madison ss. At Madison the Mendota is absent and the Madison rests on Jordan ss. All of 8 known outcrops of true Mendota are practically identical in lithologic character and contained fossils, and they arrange themselves in a narrow NW-SE belt (probably an erosion valley) some 50 mi. long and 4 or 5 mi. wide, that passes btw. the localities of the 2 cuts in which the true Mendota type of rock is absent. Hotchkiss, Weidman, and I agree that the beds immediately underlying these Mendota outcrops vary decidedly in age from place to place, hence contact is uncon., and that differential movement, emergence, and locally varying amounts of surface erosion occurred before deposition of the Mendota began.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93), defined *Mendota dol.* as underlying Madison ss. and overlying Devils Lake ss., and he assigned all three to his "Lower Ozarkian," and assigned the Jordan ss. and underlying St. Lawrence fm. to Upper Camb.

F. T. Thwaites, 1927 (Ill. Geol. Surv. Rept. Invest. No. 13, table 1, footnote). Writer is of opinion the Mendota is=lower part of Trempealeau fm., the original St. Lawrence.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 51, 55). There can be no doubt the Mendota of Irving directly overlies the greensand beds here called *Franconia*, directly underlies Madison ss., and includes not only the dol. but the overlying beds now called *Lodi*. Ulrich's chief basis for considering the Mendota younger than the St. Lawrence is paleontological. Ulrich, however, points out that Black Earth dol. contains 13 sp. of fossils, 10 of which are identical with sp. that occur commonly in the Mendota, but he interprets this as a preoccurrence of Mendota fauna in the St. Lawrence. We are of opinion that St. Lawrence, Black Earth, and Mendota dolomites represent same strat. unit and are of same age.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 21–23). Trempealeau fm. [redefined] is here divided into (descending) Jordan ss. memb., Mendota dol. memb., Lodi sh. memb., and basal greensand and greensand cgl. memb. All evidence indicates that the Black Earth, Mendota, and St. Lawrence [restricted] are different expressions of same dol. Writers prefer to wait for better evidence than has yet been presented before they can give serious consideration to Ulrich's interpretation of Mendota dol. [The Lodi sh. *overlies* Mendota, instead of underlies it, according to C. E. Resser and J. Bridge (personal communication, 1935).]

F. T. Thwaites, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 118). At close of 1914 field season writer and S. Weidman (then of Wis. Geol. Surv.) made an intensive study of Black Earth Valley. They discovered fossils in both Lodi siltstone and underlying dol. The rock is exactly like original Mendota in lithology, and most critical study by Ulrich failed to discern more than minute differences in fossils. Ulrich named the dol. "Black Earth" in 1916. Later students of this controversy, with aid of more fossils, insoluble residues, and heavy minerals, have confirmed conclusion of Weidman and writer. In 1933 Ulrich (in letter to G. O. Raasch) stated he had abandoned his former contention. [On pp. 129–130 Thwaites said: Type section of Mendota was what is now known as Maple Bluff (Macbrides Point in Irving's day). Irving correctly correlated Mendota with St. Lawrence [restricted] and Lodi members of what is now called Trempealeau fm. Ulrich, on basis of fossils collected by Alden, assumed that Mendota is much younger and lies in narrow erosional trough extending NW. to Baraboo region.]

The U. S. Geol. Survey now considers Mendota dol. and Black Earth dol. as synonyms. *Mendota* has long priority, and therefore *Black Earth dol.* has been discarded.

Menefee formation. (In Mesaverde group.)

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

A. J. Collier, 1919 (U. S. G. S. Bull. 691K). *Menefee fm.*—Middle fm. of Mesaverde group in SW. Colo. Approx. 400 ft. thick. Consists of ss., sh., and coal beds. Is "Middle Coal Group" of W. H. Holmes' subdivisions of Mesaverde group. Named for Menefee Mtn [Montezuma Co., Colo.], in which coal in it is being actively mined. Underlies Cliff House ss. and overlies Point Lookout ss.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, p. 5). *Menefee fm.* consists of rocks of fresh- and brackish-water origin with only a few marine beds.

†Menevian.

A term used in some early repts as synonymous with Acadian (Middle Cambrian). It is of British origin (Hicks and Salter, 1865).

Menifee sand.

A subsurface sand, of Dev. age, in eastern Ky.

†Meniscus limestone.

Nongeographic name applied by J. M. Safford to ls. of late Sil. (Cayugan) age in Tenn., which was later named †Sneedville ls. by Safford and Hancock ls. by A. Keith. Named for abundance of fossil sponge shaped like the glass lens called meniscus.

†Menominee series.

A term applied in some early repts to the Huronian rocks of Menominee dist., Mich. In many early repts on this dist. the upper Huronian rocks were called "Upper Menominee series" and the middle and lower Huronian rocks were called "Lower Menominee series."

Mentasta schist.

Paleozoic (pre-Devonian): Southeastern Alaska (Upper Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 26, in column of table credited to "Schrader, geologic reconn. of headwater region of Copper and Tanana Rivers, Alaska, Prof. Paper, in preparation"), showed *Mentasta schist* opp. *Pre-Sil. sediments.* A. H. Brooks, 1911 (U. S. G. S. P. P. 45, table opp. p. 206) also referred to *Mentasta schist* of Schrader's rept in preparation, and placed it tentatively opp. *Early Paleozoic (Sil., Ord., Camb.).* These are only recorded uses of *Mentasta schist.* Schrader's rept referred to was not published, and his subsequent duties called him to the States.

Menteth limestone member (of Moscow shale).

Middle Devonian: West-central New York.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, p. 22). *Menteth ls.*—Compact layer, usually very pure, but in places quite argill. and nodular. Thickness 1 ft. Is a well-defined bench mark in Moscow shales [of the Hamilton]. Lies 75 ft. above Tichenor ls. Very fossiliferous. Forms first falls in ravines at Tichenor Point and Menteth Point, on Canandaigua Lake, Ontario Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 68). *Menteth ls. lentil.*—Is a lentil in Moscow sh., 75 ft. above its base. Noted for fine replacement of its fossils by silica.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 229–230). *Menteth ls.* is basal bed of Moscow fm. as here redefined. It is a crinoidal ls. 1 ft. thick, and is here included, with 8½ ft. of overlying beds of alternating lss. and shales, in *Portland Point memb.* of Moscow fm. It lies 55 ft. higher than true Tichenor ls. at Canandaigua Lake, but traced westward it approximates stratigraphically the Tichenor horizon. [See further explanation under *Portland Point memb.* and *Moscow sh. memb.*]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 394). *Menteth ls.* is basal bed of Moscow sh., and lies 50 to 75 ft. above Tichenor ls. in Ontario Co. In Erie Co. it rests on Tichenor ls. through overlap, but thins out and disappears before reaching the lake, according to Cooper, 1930.

The U. S. Geol. Survey treats *Menteth ls. memb.* as basal div. of Moscow sh.

Mentor formation.

Lower Cretaceous (Comanche series): Central Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, p. 162). *Mentor fm.*—Fossiliferous, variegated, earthy mixtured, marine shales, with thin beds of brown ss. Thickness 50 to 60 ft. Formerly thought to belong to Dakota group, but now known to belong to upper part of Comanche series. Whether they overlie all of Kiowa sh., or only lower part of it, or whether they merge southward into upper part of Kiowa remains undet.

C. N. Gould, 1901 (Kans. Acad. Sci. Trans., vol. 17, pp. 132–167). "Mentor beds" of central Kans. same as Kiowa sh.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3, p. 123). Age and general character of so-called Mentor beds not satisfactorily determined.

I. Perrine, 1918 (A. A. P. G. Bull., vol. 2, p. 79). Type exposure of *Mentor beds* is on E. side of Smoky Hill River about 3 mi. E. of Mentor. They outcrop in Saline, McPherson, Ellsworth, Lincoln, Ottawa, and Clay Counties. Conformably overlie Kiowa shales and underlie Dakota ss.

W. H. Twenhofel, 1918 (Kans. Acad. Sci. Trans., vol. 28, pp. 213–222). Comanchean of central Kans. divided into (descending): (1) Some beds that have been called Dakota; (2) *Mentor beds* [restricted]; (3) unfossiliferous beds, 65±ft. thick, that are quite probably nonmarine; and (4) Kiowa sh. In Mentor beds it is proposed to include only the fossiliferous sss. and such associated beds as can be proven to be marine. These beds total 10±ft. in thickness. Are variable locally. At type loc. they consist of dark-brown friable fine-grained ss.; at Natural Corral the rock is heavy-bedded brown ss., coarser-grained than at Mentor, and in places carries many ferruginous concretions that are characteristic of Dakota.

W. H. Twenhofel, 1920 (Am. Jour. Sci., 4th, vol. 49, p. 291), correlated *Mentor marine ss.* with middle part of Kiowa sh.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, pp. 31–32). It is here proposed to include in Belvidere fm. all strata from top of Mentor horizon down to Permian, and those above the Mentor in "Dakota." The Mentor beds drop out to N. The Belvidere [in McPherson Co.] divided into (descending): Mentor memb.; Marquette memb., 53 ft.; Windom memb., 3 ft.; Natural Corral memb., 30±ft. These memb. names are used only for convenience to designate occurrence of fossils and strat. position; the divisions are shown in few natural exposures. [This classification was followed by W. H. Twenhofel and A. C. Tester in 1926 (A. A. P. G. Bull., vol. 10, No. 6, pp. 553–561).]

Considered to be of Washita age, and to correspond to Kiowa sh. of southern Kans.

Meramec group.

Mississippian: Mississippi Valley region.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Meramec group* proposed to include (descending) St. Louis ls., Spergen Hill ls., and Warsaw fm. Replaces broad usage of "St. Louis ls." and "St. Louis group." Overlain by Ste. Genevieve ls., basal fm. of Chester group.

S. Weller, 1907 (Ill. Geol. Surv. Bull. 6), excluded Ste. Genevieve ls. from Chester group, and subsequently continued to exclude it, but did not definitely place it in Meramec group until 1920 (Ill. Geol. Surv. Bull. 41) and 1921 (Ky. Geol. Surv., ser. 6, vol. 4), when he drew top of *Meramec group* at base of his Shetlerville fm., or in midst of Ohara ls. memb. of Ste. Genevieve ls. of Ulrich, stating that original Ste. Genevieve ls. of Shumard did not include Shetlerville fm. of Weller, and that it does not belong to Chester group, as contended by Ulrich, but to Meramec group.

For many years the U. S. Geol. Survey did not (because of divergent views of geologists who had made a special study of the problem) definitely assign Ste. Genevieve ls. to either Meramec group or Chester group. (See under *Ste. Genevieve ls.*) In May 1937, however, it was decided by the Federal Survey to include this fm. in Meramec group (which is the definition for some time followed by Ill. Geol. Survey), and to recognize the "Upper Ohara" of repts as a part of Renault fm., instead of the upper div. of Ste. Genevieve ls. The Ill. Geol. Survey at present includes the Warsaw in Osage group; the U. S. Geol. Survey has for many years included it in Meramec group.

Named for Meramec Highlands and Meramec River, W. of St. Louis, Mo.

Meramecian.

A time term used by some geologists to cover the epoch during which the Meramec group was deposited.

Merced formation.

Pliocene: Western California (San Francisco Bay region).

A. C. Lawson, 1893 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 1, pp. 142–151). For convenience the Plio. rocks here referred to will be designated *Merced series*, from Lake Merced, which lies in a structural or synclinal depression of the Plio. terrane, to S. of the city. The base of the series is observable at Mussel Rock. Basal bed is a stratum of partially carbonized forest material. Is a local or delta accumulation. Very fossiliferous. The delta gravels on the San Benito [on p. 153 casually called *San Benito gravels*] are direct equiv. of Merced series.

The Merced fm. (marine) in San Francisco region rests uncon. on Franciscan rocks or on an ancient alluvium of post-Franciscan and pre-Merced age. Is considered=nonmarine Orinda fm., which lies conformably on Pinole tuff. In Santa Cruz region the Merced rests on Purisima fm. It is considered older than Berkeley group. (See U. S. G. S. San Francisco folio, No. 193.)

This fm. is now being assigned to middle Plio. by Calif. geologists. (See E. Dorf, Carnegie Inst. Wash. Pub. 412, p. 7, 1933.)

Mercer limestone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477). *Mercer ls.*, 2 ft. thick, included near base of Tionesta group [=Mercer sh. memb. of present nomenclature].

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Mercer ls.* (*Lower Wurtemburg ls.*).—Tolerably compact dark-bluish ls. filled with fossils. Thickness 8 to 12 in. Persistent from Old Homewood furnace up the Beaver and Connoquenessing to Wurtemburg [Lawrence Co.], where it is *Lower Wurtemburg ls.* in Prof. Lesley's Slippery Rock section, in Rept. J.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). Rogers' name *Mercer ls.* here changed to *Lower Mercer ls.*, which is same as "Lower Wurtemburg" ls. of Lesley. The *Upper Mercer ls.* (here introduced to replace Mahoning ls. of Rogers) is same as Upper Wurtemburg ls. of Lesley. Named for Mercer, Pa. [See quotation under *Upper Mercer ls.*]

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M_7, pp. 280, 281, 332). [See under *Wurtemburg ls.*]

Mercer shale member (of Pottsville formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, pp. xxi–xxxvi, 319–333). *Mercer group.*—Middle part of Pottsville cgl. Underlies Tionesta (Homewood) ss. and overlies Connoquenessing ss. [Corresponds to *Mercer sh. memb. of Pottsville fm.*, the name in general use for many years.]

H. M. Chance, 1880 (2d Pa. Geol. Surv. Rept. G4). *Mercer coal group* underlies Homewood ss. and overlies Connoquenessing sss.

Mercer "formation."

Same as Mercer sh. memb.

Mercer "group."

See under *Mercer sh. memb.*

Mercer coal group.

See under *Mercer sh. memb.*

Merchants amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Is younger than Mass amygdaloid and older than Knowlton amygdaloid. The mineralized part is the Merchants lode. Named for occurrence in old Merchants mine, Ontonagon Co.

Merchants flow.

Includes Merchants amygdaloid and underlying trap.

Merchantville clay. (In Matawan group.)

Upper Cretaceous: New Jersey.

G. N. Knapp, as reported by R. D. Salisbury, 1899 (N. J. Geol. Surv. Ann. Rept. State Geol. 1898, p. 35). *Merchantville bed.*—Marly clay underlying Woodbury bed and overlying Raritan fm. [original broad usage of Raritan, which included Magothy fm. at top]. Basal bed of Clay Marl series [Matawan group].

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 159). *Merchantville clay.*—Black marly clay, glauconitic and micaceous; weathers rusty brown. Thickness 35 to 60 ft. Underlies Woodbury clay and overlies Raritan clay series [upper part of which is now called Magothy fm.].

Basal fm. of Matawan group.

Named for fact Merchantville, Camden Co., rests on this fm.

Meredith granite.

Late Devonian (?): Eastern New Hampshire (Lake Winnipesaukee region).

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, map, p. 83). *Meredith granite.*—Porphyritic granite. One of most striking rocks in N. H. Inasmuch as other porphyritic granites are present in State, it is proposed that this particular type be designated *Meredith granite*, from typical exposures in Meredith Twp [Belknap Co.]. Was called *porphyritic gneiss* by Hitchcock. Is closely related to Chatham granite in chronology and mineralogy. Intrudes Montalban schist [of Billings].

M. Billings, 1935 (letter dated Aug. 27). *Meredith granite* is lithologically precisely like the porphyritic phases of Kinsman quartz monzonite, and there is no doubt they should be correlated. This means the Meredith is definitely younger than Lower Dev. My guess is that it is late Dev.

Meriden ash bed.

Meriden type.

Upper Triassic: Central Connecticut.

B. K. Emerson, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 66–67, 72–77). *Meriden "ash bed."*—The bed at base of trap sheet W. of Lamentation Mtn, on Berlin turnpike, 1 mi. N. of Meriden, Conn. Differs from Greenfield bed only in much greater quantity of glass and in being only half as thick. Rests in places on unbaked ss.

B. K. Emerson, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 91–130). *Meriden type.*—Blending of mud and lava at base of Holyoke trap.

†Meridian series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 107, 137–138, 273+, and vol. 2, p. 755). Divided into *Meridian ss.* (*Oriskany ss. of N. Y.*), 150 ft. thick on Juniata River, underlain by Meridian sl., 170 ft. thick on Upper Juniata near Frankstown. The latter rests on *Pre-Meridian ls.* (*Lower Helderberg ls. of N. Y.*).

†Meridian sandstone.

†Meridian slate.

See under †*Meridian series.*

†Meridian formation.

†Meridian buhrstone.

Eocene (middle): Southeastern Mississippi and southern Alabama.

W J McGee, 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, pp. 413–415, 491+). The most distinctive rock mass of Mississippi embayment. It is as characteristic and distinctive as ls., ss., sh., or marble; but by reason of its confinement to a comparatively restricted region it has never received the coordinate appellation it deserves. Is typically displayed in vicinity of Meridian; from these exposures it seems appropriate to designate the deposit *Meridian fm.*; or, if the general though unsatisfactory lithologic term be retained, *Meridian buhrstone*. Here it comprises hard siliceous ledges, with intercalated beds of imperfectly indurated siliceous clay or marl, the mass displaying moderately regular bedding; yet despite a high degree of uniformity in composition and structure there is wide diversity in texture, owing to variable degree of lithification. There is commonly a rude nodulation or segregation of materials in plates and lenses, variously disposed in attitude; the nodules, plates, and lenses are generally hard, brittle, refractory under the hammer, clinking sharply and breaking with conchoidal or splintery fracture, while intervening mass is less perfectly lithified, and sometimes quite friable. Sometimes nodules are an inch or less in diam., the plates and lenses but hand specimens; again the harder aggregations measure feet or yards, the nodules running into lenses which expand into ridges. Is middle Eocene. Underlies calcareous Claiborne.

Replaced by Tallahatta fm., a later but better-established name. Preoccupied by Rogers' †Meridian series of Pa. See additional explanation under †*Choctaw buhrstone*.

Named for development in vicinity of Meridian, Lauderdale Co., Miss.

Meridian sand member.

Eocene (middle): Southeastern Mississippi.

E. N. Lowe, 1933 (Miss. Geol. Surv. Bull. 25). [On p. 1 Lowe states that Claiborne group of Miss. includes *Meridian sand memb.* and Tallahatta, Winona, Lisbon, and Yegua (or "Cockfield") fms. On pp. 105–106 he gives sections around Meridian, Miss., where he shows basal memb. of Tallahatta fm. to consist of 75 ft. of sand, but he does not on those pp. use *Meridian sand memb.*]

Merigomish formation.

Carboniferous: Canada.

H. M. Ami, 1900 (Canadian Rec. Sci., vol. 8, pp. 162–163).

POLITECHNIKA ... ZAKŁAD GEOLOGII

Merkel dolomite member (of Clear Fork formation).

Permian: Central northern Texas.

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull., vol. 1, pl., pp. 95, 96, 97). *Merkel dol.*—Dol. with clay parting 3 to 4 ft. thick. Is characteristically ripple marked and weathers in thin plates like cross-bedded sss. Thickness of fm. 5 to 8 ft. Top memb. of Clear Fork beds. Named for exposures just W. of Merkel [Taylor Co.]. Traced across country to Abilene-Sweetwater section and to Double Mtn section.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, p. 49). *Merkel dol.* is highest dol. of Choza fm. of Clear Fork, lying 270 ft. below top of Choza.

J. W. Beede and W. P. Bentley, 1921 (Univ. Tex. Bull. 1850). *Merkel dol.* is 20 ft. thick in Coke Co.

J. W. Beede and D. D. Christner, 1926. [See 1926 entry under *Choza fm.*]

W. Kramer, 1934 (Jour. Geol., vol. 42, p. 193). *Merkel dol.*, top memb. of Clear Fork fm. of north-central Tex., may be traced as a continuous ledge-maker from NW. Taylor Co. northward for 50 mi. into NE. Stonewall Co. To N. of this continuous outcrop the horizon of the Merkel contains thin, apparently discontinuous dol. beds having many ripple-marked surfaces, and can be identified by its position a few ft. below San Angelo ss.

Some geologists spell this name *Merkle*, but P. O. Guide spells the town for which the dol. was named *Merkel*.

Merom sandstone.

Pennsylvanian: Southwestern Indiana and probably eastern Illinois.

J. Collett, 1871 (Ind. Geol. Surv. 2d Rept., p. 199). *Merom ss.*—Lower 10 to 25 ft. massive ss., with ferruginous seams and veins (called Anvil Rock ss.); upper 20 to 25 ft., soft ss. Overlain by loess and drift; underlain by thin bed of calc. cgl. succeeded below by Productal ls. Included in Coal Measures.

Probably=Inglefield ss., and possibly=in whole or in part Anvil Rock ss. of western Ky.

Named for Merom, Sullivan Co., Ind.

†Merom group.

Pennsylvanian: Southwestern Indiana.

G. H. Ashley, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, pp. 273–277). *Merom group.*—Upper or barren measures, 400 ft. thick, overlying Wabash group.

Preoccupied. Includes Merom ss., Wabash fm., and Inglefield ss.

Named for Merom, Sullivan Co.

Merriam limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 97). Members of Plattsburg ls. that are readily identified in many Kans. sections are, in upward order: *Merriam ls.*; "middle," *Hickory Creek sh.*; and *Spring Hill ls.* ("upper"). [Derivation of names not stated. On p. 46 *Merriam ls.* is described as consisting of 2 to 5 ft. of gray to buff massive ls.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 71–73). Basal memb. of Plattsburg ls., and perhaps most characteristic part of Plattsburg, is here termed *Merriam ls. memb.* In many places consists of 2 divisions, the lower a blocky, even layer, less commonly cross-bedded ls., drab to light gray, generally weathering white, often highly fossiliferous, up to 5 ft. thick, locally absent. The upper div., generally 1 ft. thick, is fine-grained dense gray massive blocky ls., in one layer, seldom fossiliferous, but contains in upper part numerous irregularly disposed hollow tubes. Underlies Hickory Creek sh. memb. Named for exposures at town of Merriam, Johnson Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

KANSAS

Merrimac rhyolite.

Pre-Cambrian (pre-middle Huronian): South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121, 130). *Merrimac rhyolite.*—Flow rhyolite in Merrimac Twp, on S. flank of syncline near Merrimac, sec. 32, T. 11 N., R. 7 E. Assigned to pre-middle Huronian.

Merrimack quartzite.

Carboniferous (probably Pennsylvanian): Northeastern Massachusetts (Merrimack River region).

C. H. Hitchcock, 1870 (2d Ann. Rept. Geol. and Min. N. H., geol. map and p. 34). *Merrimack group.*—This name was informally applied by my father [where?] to the mica schists, slates, and qtzites contained in valley of Merrimack River in Mass. They skirt Exeter syenites in N. H., lying in troughs on the flanks of an anticlinal. Probably belong to the earliest Sil. series. [This "group" was in this rept mapped over a large area in SE. N. H., on both sides of Merrimack River and near town of Merrimack.]

C. H. Hitchcock, 1871 (Official Topog. Atlas Mass.). *Merrimac schists* belong to Eozoic.

C. H. Hitchcock, 1873 (Proc. Boston Soc. Nat. Hist., vol. 15, pp. 304–309). *Merrimack group.*—A convenient term to represent the qtzites and fine-grained mica schist following Merrimac River below Lowell, Mass.

C. H. Hitchcock, 1873 (Geol. Surv. N. H. Rept. 1872, p. 14). The *Merrimack group* seems to be distinct from the mica schist, though the two have heretofore been confounded.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545). *Merrimack group.*—Micaceous qtzite not yet separated from Rockingham schist group. The occurrence in it of large beds of soapstone suggests Huronian age. It abounds in beds of coarse indigenous granite, which predominate in certain parts of Strafford Co., N. H.

C. H. Hitchcock, 1877 (Geol. N. H. pt. 2, pp. 588–591, 621, and btw. pp. 658 and 675). *Merrimack group.*—Ferruginous and mica schists and micaceous qtzite, varying to argill. schist; includes a little clay sl. Occupies principal area btw. Exeter and Newburyport ranges of sienite, as well as that btw. the 2 great gneiss areas of Pelham and Andover, Mass. This is typical area of this group, from which the name was derived. Thickness 4,300 ft. Older than Rockingham mica schist.

C. H. Hitchcock, 1879 (Macfarlane's Geol. Ry. Guide, pp. 56–59), assigned his *Merrimac qtzite and schist* of N. H. to Huronian, and gave thickness of 4,300 ft.

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers No. 3). "*Merrimac schists*" of Hitchcock's 1871 atlas of Mass. belong to Montalban system.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.). *Merrimac schists.*—Phyllites, mica schists, and qtzites, of Miss. age. Probably younger than subalkaline rocks, although separated from them by faults. Intruded by Andover granite.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 58, correlation table, map). The rocks of that part of Merrimack trough that lies btw. Lowell and Mass.-N. H. line are fairly homogeneous, and for present it seems best to map and describe them under one fm. name—*Merrimack qtzite*. The fm. was named by C. H. Hitchcock (Geol. N. H., vol. 2, p. 621, 1877) from Merrimack River, along which it causes the falls at both Lowell and Lawrence, Mass. It is typically shown in gorge of the river below Pawtucket Falls at Lowell, [etc.]. Consists chiefly of thin-bedded qtzite or quartz schist, as a rule somewhat actinolitic, generally gray or greenish gray, but at many places made chocolate-colored by red biotite, which is disseminated in it in small amount, and at other places stained rusty brown by oxidation of pyrite. At many places there are thin intercalated beds of sl. or slaty quartz schist, and at others thin lenses and roundish nodules of greenish calc. or epidotic rock, exactly as in Oakdale qtzite of Worcester trough, to which it is probably equivalent. [Mapped by Emerson up to N. H. line over a broad area in NE. Mass.; but F. J. Katz (U. S. G. S. P. P. 108–I, 1917) adopted local names for equiv. rocks a little farther N. in SE. N. H. and SW. Me. He stated that *Merrimack slates* of Hitchcock *in N. H.* included Eliot sl. and Kittery qtzite (both of Penn. (?) age), some unnamed pre-Carbf. (Algonkian?) slates, schists, and qtzites, and Berwick gneiss of Katz's classification. At present the name *Merrimack qtzite* is not used by U. S. Geol. Survey in N. H. D. White considered the fm. to be "probably Pennsylvanian."]

E. E. Fairbanks, 1927 (Boston Soc. Nat. Hist. vol. 38, No. 8, p. 405). *Merrimack qtzite* near Lowell, Mass., consists of well-bedded grayish to greenish qtzites containing interbedded phyllite members. Is probably Camb.

Merrimack group.

See under *Merrimack qtzite*.

Merriman limestone member (of Graford formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. Reeves, 1922 (U. S. G. S. Bull. 736E, p. 120). *Merriman ls. memb. of Brad fm.*—Fine-textured yellow ls., very hard, usually weathering into rectangular blocks. Thickness 4± ft. Lies 84± ft. below Ranger ls. memb. and 67 ft. above Adams Branch ls. (top memb. of underlying Graford fm.). Crops out near Merriman Church, S. of Ranger, Eastland Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 111), extended Graford fm. up to top of Merriman ls., and restricted Brad fm. to Placid sh. memb. and Ranger ls. member. He also applied the name *Merriman ls.* to the lss. formerly called *Clear Creek ls.* (preoccupied); but the Merriman ls. of Reeves corresponds to only the upper of the 2 lss. that were included in Clear Creek ls. of Drake and of Plummer and Moore. (See Wallace Lee and C. O. Nickell, Univ. Tex. Bull. soon to be published.)

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), divided Brad fm. of McCulloch Co., Colorado River region, into following members (descending): Ranger ls., Placid sh., Clear Creek ls., and Cedarton sh., and stated (p. 205): Clear Creek ls. is also known as Merriman ls.

The U. S. Geol. Survey still uses Merriman ls. as defined by Reeves, that is, for a bed in Brazos River region which lies in lower part of Winchell memb. of Lee, Nickell, et al., which is top memb. of Graford fm. as redefined by Sellards and later delimited by Wallace Lee and C. O. Nickell, in publication cited above.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 24), showed Merriman ls. of Brazos River Valley as older than Clear Creek ls. of Colorado River Valley, and included Merriman ls. and some older rocks in Brad fm. On pp. 47–48 they define Merriman as top memb. of Graford fm. in Palo Pinto Co.; as consisting of 20 to 75 ft. of gray, massive, jointed, resistant, fossiliferous ls. ("previously mapped by Plummer and Moore as Adams Branch ls."); and as resting on Wolf Mtn sh. memb. of the Graford. On p. 50 they state that Merriman ls. varies in thickness from 175 ft. or more at Possum Kingdom Bend on the Brazos to 20 ft. or less on Keechi Creek near N. bdy of Palo Pinto Co.

Merritt sand.

Pleistocene: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Merritt sand.*—Marine sand, 30 ft. thick, uncon. overlying San Antonio fm. and uncon. underlying Temescal fm. Forms the sand underlying cities of Oakland and Alameda. Named for occurrence on Lake Merritt, in city of Oakland. Thickness 44 ft.

Mervine sand.

A subsurface sand, of Penn. age, in central northern Okla. In Mervine pool, Kay Co., it is 25 ft. thick, lies at depth of 1,000 ft., the Hoover sand lying at 1,250 ft. Is said to be same as Newkirk sand.

Mesa sandstones.

Cretaceous: Mexico (Baja California).

W. M. Gabb, 1867 (Calif. Acad. Sci. Proc., 2d ser., vol. 1, p. 175). [Assigned to Cret., but C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 206), assigned *Mesa ss.*, divided into 3 members, to late Plio.]

Mesa formation.

A term applied by W. P. Blake, 1899 (Rept. Governor Ariz. to Secy Interior of U. S., p. 143) to deposits of wash, gravel, and sand, derived from breaking down of granite and gneissic rocks and forming the mesa upon which Univ. of Ariz. at Tucson is located.

Mesa basalt.

Tertiary (late): Northwestern Nevada.

J. C. Merriam, 1910 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 6, No. 2, pp. 21–53). *Mesa basalt*.—Widely spread over region of Virgin Valley and Thousand Creek. Consists of several fairly distinct layers. Thickness 25 ft. Appears to be last fm. laid down before present valley was excavated. So far as known not distinctly uncon. with underlying Virgin Valley beds.

†Mesabi moraine.

Pleistocene (Wisconsin stage): Northern Minnesota.

W. Upham, 1894 (Minn. Geol. and Nat. Hist. Surv. 22d Ann. Rept., pl. 1, p. 50). Forms a hilly belt along Mesabi range.

This name is no longer used, because detailed mapping by F. Leverett has shown that the morainal belt in region described follows a different course from that indicated by Upham.

†Mesabi gabbro.

A name applied by N. H. Winchell (Am. Geol., vol. 16, p. 333, 1895) to Duluth gabbro in Mesabi dist., NE. Minn.

†Mesabi series.

Pre-Cambrian (Huronian): Northeastern Minnesota (Mesabi district).

C. R. Van Hise and C. K. Leith, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 351–361). *Upper Huronian (Mesabi series)*.—Includes, in Mesabi dist., Virginia sl., Biwabik fm., and Pokegama fm. (descending).

C. K. Leith, 1933 (16th Int. Geol. Cong. Guidebook 27, p. 9), assigned Biwabik and Pokegama fms. to middle Huronian.

Mesa Negra beds.

See *Negra clays*.

Mesaverde group (also **formation**).

Upper Cretaceous (of Montana age): Western Colorado, northwestern New Mexico, eastern Utah, southern, central and northern Wyoming.

W. H. Holmes, 1877 (U. S. Geol. and Geog. Surv. Terr. 9th Ann. Rept., for 1875, pp. 245, 248, pl. 35). *Mesa Verde group*.—Divided into (descending): (1) Upper escarpment ss. or group, consisting of 190 ft. of massive ss.; (2) middle coal group, consisting of 800 to 900 ft. of ss., sh., marl, and lignite; (3) lower escarpment ss. or group, consisting of 120 ft. of massive ss. Underlies Sand Shale group [later named Lewis sh.] and overlies Colorado dark shales and ls. [later named Mancos sh.], which are 1,200 to 1,500 ft. thick in valley of Rio San Juan, SW. Colo. and NW. N. Mex.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60). *Mesaverde fm.* is a succession of alternating sss. and shales, with occasional marls or thin lss. and a number of coal seams, some of which are of excellent quality. Max. thickness in La Plata quad. 1,000 ft. It overlies Mancos sh. and underlies Lewis sh. Its fossils have been identified by T. W. Stanton as of Pierre age.

N. M. Fenneman and H. S. Gale, 1906 (U. S. G. S. Bull. 297). The beds in Yampa coal field of NW. Colo. herein designated *Mesaverde fm.* are apparently analogous in character of constituent members, in position btw. two great clay-sh. groups, and in contained fossils, to typical Mesaverde fm. of SW. Colo. In Yampa field, however, they attain thickness of 2,500 to 3,500 ft., while in SW. Colo. their max. development is 1,000± ft. In Yampa field they consist of ss., sh., and coal beds, the sss. and coals occurring in groups. They grade, through rapid transition, into overlying sh. here identified as Lewis sh., and rest on dark sh. here identified as

Mancos sh. The fm. is of Pierre and Fox Hills age, the fauna of the shales resembling Pierre fauna, the fauna of the sss. being more like Fox Hills fauna.

Subsequently the Meșaverde fm. was identified and mapped across central Wyo.

A. J. Collier, 1919 (U. S. G. S. Bull. 691, p. 296), replaced Holmes' descriptive terms in SW. Colo. with following geographic names (descending) Cliff House ss., Menefee fm., and Point Lookout ss., derived from localities on or near Mesa Verde, SW. Colo. According to J. B. Reeside, Jr. (1924, below), the Cliff House and Point Lookout sss. are both of marine origin; the Menefee fm. is of fresh-water and brackish water origin, but contains a few marine beds.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). The 3 fms. into which Holmes and Collier divided *Mesaverde group* in SW. Colo. are not distinguished at many localities, but the name Mesaverde as a designation for a coal-bearing series in upper part of Upper Cret. has been very widely used—as far away from type region as northern Wyo. The Mesaverde of SW. Colo. grades into marine Mancos sh. below and into marine Lewis sh. above, and the boundaries are arbitrarily fixed. Writer believes Mesaverde group on the San Juan represents time interval of part of Mancos sh., the Mesaverde group, and much of Lewis sh. of Animas River section. To S. of San Juan River, where Lewis sh. becomes much thinner even than on San Juan River, the top of Cliff House ss. may represent practically same time of deposition as very top of Lewis sh. along N. side of San Juan Basin. It seems very probable Point Lookout ss. and Cliff House ss. are really aggregates of successively overlapping beds which as a whole, with reference to a given chronologic plane, change their positions in strat. column from place to place. The Point Lookout ss. in its northern exposures is younger than in its southern exposures; the Cliff House ss. in its northern exposures is older than in its southern exposures. Writer has not noted any locality where such an overlap and passage from one lithologic phase to another is observable, but exposures are in general inadequate. That such a phenomenon can be shown in other and more favorable regions is well known, and it is almost certain something of the sort occurs here. In some areas in SW. Colo. top of Mesaverde may include beds as young as Fruitland and Kirtland fms. of San Juan Basin. The relations of Mesaverde group of SW. Colo. to beds similarly named in northern Colo., Utah, and Wyo. are not at all clear. In some parts of Wyo. the base of Montana group is definitely known and general relations of Mesaverde group of those regions to typical Mesaverde can be deduced, but not enough is yet known to make detailed comparisons possible. At some places there are no marine beds above basal part of Mesaverde, and most of Mesaverde and the later beds are fresh-water deposits. It is quite likely that the Mesaverde at some of these localities is really nearer to Fruitland and Kirtland fms. in age than to typical Mesaverde. The typical Mesaverde is wholly of Pierre age.

The Mesaverde group of Axial, Monument Butte, and Meeker quads, of NW. Colo. has been divided into Williams Fork fm. above and Iles fm. below; in Yampa coal field into (descending) Holderness fm., Twentymile ss., Mount Harris fm., Trout Creek ss., Milner fm., and Haybro fm. The Mesaverde group of Baxter Basin, Sweetwater Co., SW. Wyo., has been divided into (descending) Almond fm., Ericson ss., Rock Springs fm., and Blair fm. In Wasatch Plateau, Utah, it has been divided into (descending) Price River fm., Blackhawk fm., and Star Point ss.

Mescal limestone. (Of Apache group.)

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380–385). *Mescal ls.*—Cherty thin beds of varied color, generally gray or white, but some yellow, buff, and rusty brown beds. Most of ls. is mag., and some of it is dol. Thickness 225 ft. Rests conformably on Dripping Spring qtzite. Is separated from overlying Troy qtzite by 75 to 100 ft. of vesicular basalt, which is apparently coextensive with it, and is not separated from it on the map.

Named for exposures in Mescal Range, Ray quad.

Mescalero Sands.

According to N. H. Darton "Mescalero Sands" is a geographic name applied to a large area in SE. N. Mex. that is covered with dune sands. The Mescalero Valley runs through the area.

W. G. Blanchard, Jr., and M. J. Davis, 1929 (A. A. P. G. Bull., vol. 13, pp. 987-988). Mescalero sands and caliche, 0 to 250 ft. thick, are of Quaternary age, and throughout Llano Estacado overlie Dockum group (Triassic).

Meshik formation.

Miocene or Oligocene: Southwestern Alaska (Alaska Peninsula).

R. S. Knappen, 1929 (U. S. G. S. Bull. 797, pp. 198-201, map). *Meshik fm.*—Interbedded purple and green andesitic aggl., varicolored volcanic ash, and bentonitic clay (black, brown, and yellow), and black soil, all poorly stratified, and of fluviatile and eolian origin; some andesite flows. In general is finer grained in lower part, becoming much coarser above, until it consists entirely of coarse volcanic material and includes numerous lava flows. Typically developed along sides of valley of Meshik River and Meshik Lake. Thickness probably 2,000 to 4,000 ft. Rests on Eo. wherever base is exposed. No evidence of erosion preceding the fm. In absence of fossil evidence the Meshik is referred to Mio. or Olig.

†Mesnard formation.

Pre-Cambrian (Huronian): Northwestern Michigan (Marquette district).

M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, pp. 63-66). *Mesnard fm.*—Qtzite, argillites, and dol. Uncon. underlies Holyoke fm. and is believed to uncon. overlie Republic fm., but may prove to be same as Republic fm. Named for exposures at Mount Mesnard. [As defined is a broader unit than Mesnard qtzite of established usage.]

Mesnard quartzite.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 517+). *Mesnard qtzite.*—Chiefly qtzite, but includes cgls., graywackes, and graywacke slates, with all gradations; cgl. at base. Thickness 150 to 670 ft. Grades into overlying Kona dol. Rests uncon. on Basement Complex. Composes larger part of mass of Mount Mesnard, S. of Marquette.

†Mesnard epidote.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, p. 680). At top [of Central Mine group] is "Mesnard epidote," and just beneath it the heaviest flow, over 1,000 ft. thick at times, known as the Greenstone.

Basal fm. of Ashbed group, according to present classification, the Greenstone now being treated as top fm. of Central Mine group. Is same as †St. Mary's epidote.

Named for fact it occurs in old Mesnard mine, Houghton Co.

Meson beds.

Oligocene: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, p. 147).

Mesozoic era.

A major time term, meaning middle life, based on the life (zoic) contents of the rocks. It includes the Cretaceous, Jurassic, and Triassic periods. For definition see U. S. G. S. Bull. 769, 1925, pp. 9-10.

Messines formation.

Devonian: British Columbia.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, p. 50).

†Metamynodon sandstone.

A paleontologic name that has been applied by paleontologists to basal sss. of Brule clay (Olig.) in S. Dak. The U. S. Geol. Survey does not apply paleontologic names to lithologic units, and would use "*Metamynodon*-bearing sss." or "*Metamynodon* zone."

Metapán formation:

Lower Cretaceous: Guatemala, Honduras, and Salvador.

C. Schuchert, 1935 (Hist. geol. of Antillean-Caribbean region, pp. 337, 355, 359).

Metchosin volcanics.

Eocene: British Columbia.

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 89). [In his early repts Clapp assigned these rocks to Jurassic (?) and to Jurassic. Since 1913, however, Clapp and others have assigned them to Eo.]

Meteor granodiorite.

Jurassic (?): Northeastern Washington.

C. E. Weaver, 1913 (Wash. Geol. Surv. Bull. 16, pp. 20–30). *Meteor granodiorite.*—Very variable in appearance; in many cases a distinctly plutonic rock passing into a porphyritic condition. Jurassic (?). Named for Meteor, Ferry Co.

Methow physiographic stage.

Pliocene: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. P. 19, p. 70). Pre-Glacial, Pliocene. Characteristic feature, the Methow plain. Type loc. of the stage, generally throughout the broad mtn dist. and specifically in Yakima Valley.

Mettawee slate.

Lower Cambrian: Eastern New York (Washington County) and southwestern Vermont (Rutland County).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 67–70). *Mettawee sl.*—Grayish green, purple, or mixed green and purple, alternating with beds of calc. qtzite up to 5 ft. and ls. breccia up to 40 ft. Is the Cambric roofing slate of [T. N.] Dale. Extends typically from Pawlet, Vt., and Granville, N. Y., to Fairhaven, Vt. Named for Mettawee River, which drains the region [rising in Pawlet quad., in SW. part of Rutland Co., Vt., and flowing NW. into N. Y.]. Underlies Eddy Hill grit and overlies Bomoseen grit—all Lower Camb.

Mexia member (of Wills Point formation).

Eocene: Northeastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 535, 559, 562). *Mexia memb.*—Dark, thinly laminated or compact fossiliferous clays, 50 to 75 ft. thick, of a fairly deep-water marine facies, with a thin glauconitic sand layer (*Venericardia bulla* zone) at base. [On p. 535 thickness of Mexia memb. is given as 215 ft.] Is lower memb. of Wills Point fm. Rests on Kincaid fm. and underlies Wortham aragonite lentil. Type loc. is clay pit at the brickyard in W. edge of Mexia, Limestone Co.

The U. S. Geol. Survey includes in Kerens memb. the 8 to 10-inch bed called *Wortham aragonite lentil* by Plummer. The Mexia as thus defined is overlain by Kerens memb.

Mexican sandstone.

Lower Cretaceous: Southeastern Arizona.

C. [R.] Keyes, 1935 (Pan-Am. Geol., vol. 64, No. 2, pp. 129, 138, 139). *Mexican ss.*—Medial ss. of Cinturan section (Cintura fm. of Ransome) in SE. Ariz. Underlies Dixie sh. and overlies Forrest sh. Thickness fully 500 ft. Named for Mexican gulch, E. of Bisbee. Was formerly thought to be W. extension of Muleros ss. of El Paso section, but of this there is now considerable doubt.

Mexico sandstone member.

Middle Devonian (Marcellus): Central Pennsylvania (Juniata County).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, Proc. Pal. Soc. Feb. 28, pp. 202–203). *Mexico ss. memb.*—Fine ss., light gray to whitish, platy; bedded surfaces weather brown. Underlies Mahanoy black-sh. memb. and overlies Turkey Ridge ss. memb., all belonging to Marcellus fm. Usually barren. Well exposed in hill E. of Mexico, Juniata Co., also at Blue Springs, SW. of Mexico. Max. thickness 275 ft., in McCoysville section. Thins out in W. part of Juniata Co. Is 100 ft. thick to E., through Dalmatia, then disappears.

Meyer oil zone.

Name applied to the lower oil horizons (consisting of 850 or 860 ft. of Tert. brown sh. and sandy brown sh.) in Santa Fe Springs field, Los Angeles Co., Calif. Contains three distinct oil horizons. Is capped by Bell oil zone.

Meyersdale red shale. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties) and northern West Virginia; also Somerset County, southern Pennsylvania.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 574). *Meyersdale red sh.*—Underlies Thomas coal and overlies Buffalo ss.; all included in Conemaugh fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 59, 98, pl. 6), shows *Meyersdale red bed* as everywhere lying a short distance below Lower Bakerstown (Thomas) coal, and in some places resting on Buffalo ss. and in other places included in Buffalo ss. On p. 59 he states that it is deep red, soft, breaks in small fragments, and may form 2 benches, one above and one below Meyersdale ls. On p. 98: "The Meyersdale red beds occur at horizon of upper part of Buffalo ss., which they replace locally." Are finely exhibited in cut of Western Maryland Ry E. of Meyersdale, Pa.

Meyersdale limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 59, 95, 110). *Meyersdale ls.*—Thin impure marine ls., associated with Meyersdale red sh. in Lower Youghiogheny Basin. It may lie above, below, or within Meyersdale red sh. Thickness 1 ft. [In strat. chart, pl. 6, he calls the ls. in midst of Meyersdale red sh. in Lower Youghiogheny Basin the *Pine Creek ls. and fauna,* and does not show any Meyersdale ls.]

Miami oolite.

Pleistocene: Southern Florida.

S. Sanford, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 209, 211–214). *Miami oolite.*—Soft white oolitic ls., containing streaks or thin irregular layers of calcite separating less crystalline streaks. Breaks with irregular fracture. At Miami it is plainly stratified and cross bedded. Thickness probably 12 to 50 ft. Is of marine origin. Is perhaps younger than Palm Beach ls. and is younger than lower part of Key Largo ls. All exposures of oolitic ls. on mainland of SE. Fla. are included under designation *Miami oolite.*

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). *Miami oolite* as here defined includes all oolitic ls. of southern Fla., including that on the keys. It includes the "Key West" oolite and part of "Lostmans River ls.," the rest of the latter being a part of Caloosahatchee marl. The only difference btw. Miami oolite and "Key West" oolite is that the Miami contains a little more sand than the "Key West."

†Michigamme jasper.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Menominee district).

H. L. Smyth, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 219–223). *Michigamme jasper.*—Greatly altered ferruginous rock apparently carrying fragmental quartz grains. Top memb. of Lower Menominee of Menominee dist. Overlies principal iron fm. [Negaunee fm.? or Traders memb.?], which consists of red, black, and green slates.

H. L. Smyth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 137). The Groveland fm. was originally named by me *Michigamme jasper*. The name Michigamme was subsequently used for one of the Upper Marquette fms. in prel. rept. on Marquette dist. (15th Ann. Rept. U. S. G. S.), distributed in 1896. I now abandon the old name, although it is entitled to stand by rules of priority, in order to avoid confusion which would necessarily arise from its retention. It outcrops in vicinity of Michigamme Mtn, in sec. 33, T. 44 N., R. 31 W., and sec. 3, T. 43 N., R. 31 W.

Michigamme slate.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Upper Peninsula) and northeastern Wisconsin (Florence district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 598). *Michigamme fm.*—Sl. and mica schist, 1,000 to 2,000 ft. thick. Top fm. of Upper Marquette series in Marquette dist. Overlies Ishpeming fm. [Ishpeming fm. was later divided into Bijiki schist above and Goodrich qtzite below and was discarded.]

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52), treated the Vulcan rocks of Crystal Falls dist. as a memb. of Michigamme sl., and Bijiki schist of Swanzy dist. as a memb. of the Michigamme.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), showed Michigamme sl. as overlying Clarksburg volcanics in Marquette dist. and overlying Quinnesec greenstone in Menominee dist.; called the included iron-fm. the *Bijiki iron-fm. memb.* in Marquette dist. and *Iron River iron-fm. memb.* in Iron River, Florence, and Crystal Falls dists.; transferred Vulcan iron-fm. to middle Huronian; and placed Goodrich qtzite as older than Greenwood iron-fm., which underlies Clarksburg volcanics, according to present interpretation.

Named for exposures on islands of Lake Michigamme, Marquette dist.

Michigan formation.

Mississippian: Michigan (Southern Peninsula).

W. H. Taylor, chairman, 1839 (Mich. Geol. Surv. Rept. State Geol. in re improvement of State salt springs, Mich. Leg. H. R. Doc. 2, p. 3). *Michigan salt group*, "so called by Prof. Winchell, see rept of last geological survey by Prof. A. Winchell." [Where?]

A. Winchell, 1861 (Mich. Geol. Surv. 1st Bien. Rept. Prog., pp. 91, 139). *Michigan salt group.*—Consists of (descending): (1) Carbonaceous and argill. sh., gypseous and pyritous marls; (2) shales, marl, mag. and siliceous lss., and thick beds of gyp.; (3) saliferous shales and alternating lss. Thickness 184 ft. Underlies the Carbf. ls. [Bayport ls.] and overlies Napoleon group, which may properly constitute upper part of Marshall group.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, pp. 1–31). Lower part of Grand Rapids group was called *Michigan salt group* by Winchell.

A. C. Lane, 1900 (Mich. Geol. Surv. vol. 7, pt. 2, btw. pp. 1 and 30). *Michigan series.*—Consists of (descending): (1) Light-gray sh. with gyp. and pyrite, salty bluish shales, argill. hydraulic lss.; (2) blue to black micaceous shales; (3) ls. at Oak Point. Thickness 232 ft. Underlies Bayport ls. and overlies Napoleon ss. or Upper Marshall.

Michigan conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name in local use many years. According to B. S. Butler the cgl. may be same as Kearsarge cgl. of Central Mine group, or may be same as Bohemia cgl. (No. 8), top fm. of Bohemian Range group. Named for occurrence in old Michigan mine, in Ontonagon Co.

†Michigan period.

Term proposed by M. E. Wadsworth (Mich. Geol. Surv. Rept. 1891 and 1892, pp. 63–66, 1893) to cover Negaunee [middle Huronian] and †Holyoke [upper Huronian] fms. of the Huronian of Mich.

Michigan "salt group."

Same as *Michigan fm.*, which does not contain salt.

Michigan "series."

See *Michigan fm.*

Michipicoten schists.

Age (?): Ontario.

J. M. Bell, 1905 (Ont. Bur. Mines Rept. 1905, vol. 14, pt. 1, p. 300).

Mictaw series.

Middle and Upper Ordovician: Quebec (Gaspé Peninsula).

W. A. Parks, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 788). *Mictaw*, Ordovician, Quebec.

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, pp. 270–271). The newly named *Mictaw series*, of black shales and tuffaceous graywackes, the age of which has been for first time determined to be late Trenton-early Eden, overlies Maquereau series (probably earliest Ord.) and uncon. underlies Chaleur series (middle Sil.).

†Middendorf formation.

Upper Cretaceous: Coastal Plain of South Carolina and of Georgia east of Flint River.

E. Sloan, 1904 (S. C. Geol. Surv., ser. 4, Bull. 1, pp. 68, 72, 75–81). *Middendorf*—white sands (25 ft.), bed of dense white and drab kaolin with waxy luster (fossiliferous),—harsh sands; varicolored cross-bedded fine-grained sands; thin seams of colored clay interlaminated with sands; gravel. Uncon. overlies Hamburg beds. Thickness at Aiken, S. C., 93 ft. [Detailed section given.]

E. Sloan, 1907 (Summary of mineral resources of S. C., pp. 12, 13, 14). *Middendorf clays, etc.*, underlie Black Creek sh. and overlie Upper Hamburg clays. Consist of white sands (25 ft.), bed of dense white and drab kaolin with waxy luster (fossiliferous); harsh sands, varicolored cross-bedded fine-grained sands; thin seams of colored clay interlaminated with sands; gravel. The Lower Hamburg and Upper Hamburg and the Middendorf phases comprise sands, clays, and arkose which are exposed in upper three-fourths of Aiken Co., S. C., in greater part of Lexington Co., in lower part of Richland Co., in body of Kershaw Co., in lower part of Lancaster Co., and in northerly part of Chesterfield Co., S. C.

Later, for several years the †Middendorf deposits (100 to 200 ft. thick) were included in Black Creek fm., as its basal memb., under the name *Middendorf arkose memb.* (See additional explanation under *Black Creek fm.*) Still later they were treated as a distinct fm. uncon. below Black Creek fm. and uncon. above the crystalline rocks, the Hamburg clays of western S. C. having been found to be same as Middendorf deposits of eastern S. C. Still later the Middendorf and Hamburg deposits were proved to be same as Tuscaloosa fm., and both *Middendorf* and *Hamburg* were abandoned. (See C. W. Cooke, U. S. G. S. Bull. 867, 1936. Cooke considers it possible that further work in S. C. and N. C. may result in differentiating some older deposits from those now called *Tuscaloosa fm.* in those States.)

Named for exposures near Middendorf, Chesterfield Co., S. C.

†Middle Barren Measures.

A term applied in some early repts to Conemaugh fm. exclusive of Mahoning ss. memb.

Middleboro clay.

Middleboro moraine.

Pleistocene: Southeastern Massachusetts (Plymouth County).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 985). *Middleboro moraine*.—A tolerably well-defined moraine on E. side of town of Middleboro [Plymouth Co.]. The brick clays worked in 1895 about 1½ mi. NE. of Middleboro are clearly the outwash from the ice sheet at time the moraine was deposited. [*Middleboro clays* is used in heading.]

Middleborough member.

Carboniferous: Nova Scotia.

W. A. Bell, 1926 (Canada Geol. Surv. Summ. Rept. 1924, pt. C, p. 159).

Middle Bridge formation.

Carboniferous (Pennsylvanian?): Nova Scotia (Cape Breton Island).

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 323).

Middleburg limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., pp. 20, 25). *Middleburg ls.*—New name for middle part of Easly Creek sh. of Condra, 1927. Thickness btw. 4 and 9 ft., increasing southward to vicinity of Hooser and Dexter, Kans. Type loc. on Easly Creek, 1½ mi. S. of Middleburg School, in E.¼ of sec. 36, T. 1 N., R. 13 E., in SW. part of Richardson Co., Nebr., where it consists of (descending): (1) Gray ls., massive, granular, dense, weathers buff-gray, 1'4"; (2) ls., variegated light to dark gray, massive, tough, with many small dark-colored high-spired gastropods, 1'6"; (3) olive sh., 6" to 1 ft.; (4) ls., dark gray, blocky, dense, 2" to 3". Underlies Easly Creek sh. restricted and overlies Hooser sh.

G. E. Condra, 1935. (See under *Bader ls.*)

Middlebury moraine.

Pleistocene (Wisconsin stage): Northeastern Indiana. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Middlebury, Elkhart Co.

Middle Cambrian series.

Same as *Acadian series.* (See U. S. G. S. Bull. 769.)

Middle Creek limestone.

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 90, 97). [See under *Swope fm.*] Named by Newell.

J. M. Jewett, 1932 (pp. 99, 101, 103 of book cited above). *Middle Creek ls.* will be proposed by Newell to designate a persistent bed of bluish-gray ls. which he has traced from Kansas City to southern Linn Co. line and has been traced by writer from Linn Co. line to where it pinches out near Erie, Neosho Co. Thickness varies up to 5 ft. Underlies Hushpuckney sh. and overlies Elm Branch sh., all members of Swope fm. [Derivation of name not stated.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 26–27). *Middle Creek ls.*—Lowest memb. of Swope ls. Very uniform throughout Kans. and Mo. Named for exposures on E. side of Middle Creek at highway 3 mi. E. of LaCygne, Linn Co., Kans. In Miami Co. generally consists of 2 even layers of dark bluish gray, dense, and brittle ls., only locally separated by sh. Thickness 1' 4" to 2' 3". Underlies Hushpuckney sh. memb. and overlies Ladore sh. [restricted].

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 82–83). [See 1936 entry under *Ladore sh.*]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Middle Devonian series.

The commonly accepted definition includes Hamilton group, Onondaga ls., and Schoharie grit, and their time equivalents. Based on fossil content.

Middlefield granite.

Late Carboniferous or post-Carboniferous: Western Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pl. 34). [*Middlefield granitite* in folio; *Middlefield granite* on pl. 34.] Porphyritic muscovite biotite epidote granite. [A small N.-S. mass in Middlefield Twp, W. part of Hampshire Co. See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 258–259, map, and correlation chart).]

†Middle Freeport limestone.

See under *Freeport ls. memb.*, F. Platt, 1877. Same as *Lower Freeport ls.*

Middle Kittanning clay. (In Allegheny formation.)

A clay bed, 3 to 15 ft. thick, underlying Middle Kittanning coal, in western Pa.

†Middle Mahoning sandstone. (In Conemaugh formation.)

A name applied by W. G. Platt (2d Pa. Geol. Surv. Rept. H4, 1878) to 15 ft. of ss. in Indiana Co., Pa., overlying Philson coal and separated from an overlying 20- to 50-foot ss. (identified by him as "Upper Mahoning ss.") by 10 ft. of thin ss. and sh. The "Upper Mahoning ss." of this rept appears to be Buffalo ss. and the "Middle Mahoning ss." appears to be "Upper Mahoning" of other repts.

†Middle Mercer shales. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Middle (Mercer) shales* underlie Upper Connoquenessing ss. [?] and overlie Quakertown coal. Included in Connoquenessing ss.

Middle Ordovician series.

The commonly accepted definition includes Trenton and Black River groups and their time equivalents. *Mohawkian series* is used provincially for these rocks.

Middle Park formation.

Upper Cretaceous and Eocene (?): Middle Park, Colorado.

W. B. Clark, 1891 (U. S. G. S. Bull. 83, p. 137). *Middle Park beds* in many particulars similar to Denver fm. Upper part consists of sandy shales, sss., and grits chiefly of granitic origin; contains lignitic material and many fossil leaves. Lower part consists of 800 to 900 ft. of andesitic breccias and cgls. with interstratified sands bearing fossil plants; contains seams of lignitic material and many fossil leaves. Rests uncon. on Cret.

W. Cross, 1893 (Colo. Sci. Soc. Proc., vol. 4, pp. 192–214), gave thickness of Middle Park fm. as 5,500 ft. and correlated it with Denver fm. "Was called Laramie or 'Lignitic' fm. by Marvine," but it is of post-Laramie age.

F. H. Knowlton, 1930 (U. S. G. S. P. P. 155, pp. 5–6). Fossil plants from *Middle Park fm.* correlate it with Denver fm.

The age of Denver fm. was in 1935 changed from *Eocene* to *Cret. and Eo. (?)*.

Middle Park formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Derivation of name not stated.]

F. MacMurphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July-Oct., 1932, pp. 329–356). *Middle Park fm.*—Fine-textured dark-gray quartz-biotite schist, spotted schist, green ottrelite schist, and dark-gray impure metamorphosed qtzitic rocks, 300± ft. thick, conformably overlying Sour Dough ls. and discon. (?) underlying Mountain Girl cgl.-qtzite—all fms. of Telescope group (lower Paleozoic?). [Probably named for Middle Park Canyon, shown on his map of S. part of Panamint Range.]

Middle River formation.

Carboniferous: Nova Scotia.

W. A. Bell, 1925 (Canadian Inst. Min. and Met. Bull. 158, p. 618).

Middlesex shale.

Upper Devonian: Western and west-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 23 and chart). *Middlesex black sh.*, basal part of Naples beds in Ontario Co. Overlain by Cashaqua sh. and rests on Genesee sh. Is "Lower black band" of repts. [See also N. Y. State Mus. Mem. 6, 1904.]

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1000–1029). *Middlesex black sh.*, 32 ft. thick in gorge of Genesee River; 6 to 10 ft. in Lake Erie section. Above this horizon there is no recurrence of Genesee fauna. The bottom of the passage beds [described as shales 3 ft. thick] immediately below the black band is therefore taken as base of Portage fm., and the stratum of black shales above has been designated by State paleontologist *Middlesex shales.* Overlain by Cashaqua sh. The passage shales rest on Genesee sh.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). *Middlesex black sh.* consists of very black sh. somewhat slaty, with thin aren. gray flags in upper and lower portions. The affinity of the meager fauna with that of Cashaqua shales is evident. Basal fm. of Portage.

J. M. Clarke and D. D. Luther, 1908 (N. Y. State Mus. Bull. 118). In early repts *Middlesex black sh.* was considered upper part of Genesee black sl. In 1885 (U. S. G. S. Bull. 16) Clarke separated it from Genesee sl. and called it "Lower black band" of Portage group. Named for abundant exposures in town of Middlesex [and in Middlesex Valley, Yates Co.], from which locality it is continuous westward to Lake Erie, maintaining its general characteristics but diminishing in thickness to 6 ft.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), included Middlesex in Portage group.

G. H. Chadwick, 1920 (Geol. Soc. Am. Bull., vol. 31, No. 1, p. 118), 1923 (idem, vol. 34, p. 69), 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96–100, 193), and 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 857–862) included Middlesex sh. in his Naples group (=Portage).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10. p. 369), included Middlesex sh. and underlying West River sh. and Genundewa ls. in Portage group, restricting Genesee to the basal black sh. (Geneseo of Chadwick).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, pp. 201–202), included Middlesex in the Genesee.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included *Middlesex sh.* in his Naples group.

The U. S. Geol. Survey treats *Middlesex sh.* as a fm. underlying Cashaqua sh. and overlying Genesee group (the top fm. of which in south-central N. Y. is Standish flagstone).

†Middleton formation.

Eocene (lower): Western Tennessee, Mississippi, and southern Alabama.

J. M. Safford, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 511–512; Am. Geol., vol. 9, pp. 63–64). The "clay ss." division No. 2 of section on p. 112 of Hilgard's "Agriculture and Geology of Miss." is same as the rock in Hardeman Co., Tenn., which for years I have spoken of as *Middleton bed,* and according to Dr. E. A. Smith the same fm. occurs in Ala. The particular and characteristic rock referred to is rarely more than 3 ft. thick, but it has associated with it a group of layers of much greater thickness. The group has importance in fact that it is lowest Eocene in Tenn., Miss., and Ala. With concurrence of Dr. Hilgard and Dr. Smith I propose for it the name *Middleton fm.* Immediately to E. of the fm. in Tenn. lie the Cret. (Ripley) beds, while to W. are the Flatwoods (Porter's Creek) clays. [As thus defined applies to Clayton fm. of present nomenclature, and apparently was included in Ripley fm. of Safford's previous repts.]

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 158, 159). *Middleton fm.*—Laminated sands and clays, 400 to 500 ft. thick. Basal Eocene. Is=Clayton, Porter's Creek, Midway, Flatwoods, Ripley in part. Underlies La Grange. Overlies 400 ft. of beds much like Coffee sand, which may prove to belong to Middleton but which are called Ripley (?). These Ripley (?) beds [true Ripley] overlie McNairy Shell bed [Selma chalk]. [As thus defined is essentially=Midway group.]

G. D. Harris, 1896 (Bulls. Am. Pal., vol. 1, pp. 18–22), established the Midway age of Porters Creek clay and Middleton fm., and latter name has been discontinued.

Named for exposures at and near Middleton, Hardeman Co., Tenn.

Middletown gneiss.

Carboniferous (?): Central southern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 143, and map). Between Bolton schist and Haddam gneiss is an irregular band of rock which should be separated petrographically from Haddam granite gneiss, which it almost surrounds. This is *Middletown gneiss.* It consists of a variety of rocks.

One general characteristic is presence of hornblende in small grains or, more usually, in long prisms or stellar aggregates of prisms. Many of the rocks possess granulitic structure. The dominant type is hornblende gneiss thoroughly injected with amphibolite and granitic seams and lenses. Where least injected with granite and amphibolite the rock is a fine-grained light-gray to greenish thin-bedded gneiss. It seems probable this heterogeneous group of rock types represents the contact zone btw. Haddam granite gneiss and surrounding fms. Crosses SE. part of Middletown Twp.

Middletown clay.

Name applied by R. F. Flint (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 965-987, 1933) to a late Pleist. clay that underlies parts of northern Middletown Twp, Conn.

Middle Washington limestone member (of Washington formation).

Permian: Southwestern Pennsylvania.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Middle Washington ls.*—Thickness 15 ft. Included in Washington County group [Washington fm.]. Lies 40 ft. below Jollytown coal and about 89 ft. above Lower Washington ls.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 35). *Middle Washington ls.*—Buffish ls., persistent; 3 to 20 ft. thick. Occurs in interval btw. Upper Washington ls. and Washington "A" coal.

Midland sand.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54). *Midland sands.*—Delta deposits of sands and sandy loams with occasional deposits of diatomaceous earth. Since these several deltas are scattered over a large area they must represent deposition at different stages in the glacial retreat, yet they all belong to same epoch and have resulted from similar conditions. Village of Midland is located on western area of these sands.

†Midway series. } (Narrow sense.)
†Midway limestone. }

Eocene (lower): Southern Alabama.

E. A. Smith, 1886 (Ala. Geol. Surv. Bull. 1, p. 14). *Midway or Pine Barren section.*—Thickness 25 ft. [Same description as in 1887 rept below.]

T. H. Aldrich, 1886 (Ala. Geol. Surv. Bull. 1, p. 60). *Midway group.*—A few ft. of material at base of Tert.; a bed containing a species of *Turritella* being immediately contiguous to the Cret. [Lists fossils from "1st Midway bed, consisting of a hard siliceous ls.," and "2d Turritella Rock."]

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 62-68, 70). *Midway series.*—Thickness 25 ft. White, argill. ls. holding a large nautilus, which is characteristic of the horizon, 10 ft.; calc. sands and a yellowish crystalline ls. with Turritellas, Carditas, and corals, the sands 6 ft. thick, the ls. 8 or 9 ft. thick. This section is best seen in eastern Wilcox Co., on Pine Barren Creek, but upper or Nautilus rock occurs at Midway, on Alabama River, and westward across Marengo Co. Overlies Cret. Ripley fm. and underlies Black Bluff series [Sucarnoochee clay].

These original uses apply *Midway* to basal fm. of Midway group of modern usage, or to the rocks now known as *Clayton fm.* This restricted application of name continued until 1892, when E. A. Smith (Sketch of geol. of Ala., Roberts and Son, Birmingham, Ala., pam. of 36 pp.) introduced *Clayton or Rutledge ls.* "for the impure ls. formerly known as Midway group," 200 ft. thick on Chattahoochee River, but thin to W., and underlying Sucarnoochee clay and overlying Ripley fm. The detailed paleontologic studies of G. D. Harris led, in 1894, to the broader use of *Midway* explained under *Midway group* (*broad sense*).

Named for exposures at Midway Landing and plantation, on W. side of Alabama River (about 5 mi. below Prairie Bluff), in Wilcox Co., Ala.

Midway formation } (Broad sense.)
Midway group.

Eocene (lower): Western Georgia to southern Texas, Arkansas, western Tennessee and Kentucky, southeastern Missouri, and southwestern Illinois.

G. D. Harris, 1894 and 1896 (Am. Jour. Sci., 3d, vol. 47, pp. 303–304, 1894; Bulls. Am. Pal. vol. 1, No. 4, pp. 10–38, 1896). *Midway stage.*—Basal Eocene. Includes Matthew's Landing marl (substage), Black Bluff clays (substage), and Midway clay and ls. (substage). Is a strat. and paleontologic unit.

The foregoing double use of *Midway* was employed in several subsequent publications by different authors, but since 1906 the name has been universally used in Harris's broad or group sense, the name *Clayton* being employed to designate the basal fm. of the group. In present usage the Midway is a group in Ala., Miss., SW. Tenn., and eastern Tex., divided into (descending) the following fms., all of marine origin:

Ala.	*Miss. and SW. Tenn.*	*Tex.*
Nāheola fm. [†Matthews Landing.]		Wills Point fm.
Sucarnoochee (Porters Creek) clay.	Porters Creek clay.	[restricted].
[†Black Bluff clays.]		Kincaid fm.
Clayton fm. [†Midway clay and ls.]	Clayton fm.	

It underlies Wilcox group and overlies the Cret. The Porters Creek clay of Midway group extends into western Ky., SE. Mo., and SW. Ills. In NE. La., NW. La., SE. Ark., SW. Ark., and parts of eastern Tex. the Midway deposits are called *Midway fm.*

Named for exposures at Midway Landing and plantation, on W. side of Alabama River (about 5 mi. below Prairie Bluff), in Wilcox Co., Ala.

†Midway andesite.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1911 (Min. and Sci. Press, vol. 102, pp. 560–561; also "Rept on geol. of property of Montana-Tonopah Mining Co., Tonopah, Nev.," published privately), applied *Midway andesite* to the "Later andesite" of his 1905 rept on Tonopah dist., Nev. (U. S. G. S. P. P. 42). Thickness 0 to 500 ft. Named for Midway mine.

T. B. Nolan, August 1, 1930 (Univ. Nev. Bull., vol. 24, No. 4, pp. 16, 21). So far as writer's observations in mines of W. part of Tonopah dist. show, the rocks assigned to "Midway andesite" or "later andesite" by Spurr and J. A. Burgess cannot be separated from Mizpah trachyte by reason of any original differences in composition or texture, nor has he seen any examples of this rock capping any of the veins, or found in the literature references to any specific example of it (p. 16). All examples of "Midway andesite" cappings of veins that were seen by writer proved to be basal part of Fraction breccia.

C. V. Averill, Nov. 24, 1930 (Eng. and Min. Jour., vol. 130, No. 10, p. 532). [Refers to Nolan's rept.] I think the Midway andesite actually exists; but there has been endless confusion btw. it and Mizpah trachyte. The Midway andesite probably does not reach depths of more than a few hundred ft. in W. part of Tonopah dist. There was a flow of andesite (Midway andesite) of much later age than Mizpah trachyte, and it contains pebbles of the Mizpah. It is of purplish color, and is nearly fresh, solid, unbrecciated andesite.

T. B. Nolan, 1935 (Univ. Nev. Bull., vol. 29, No. 5, p. 20). All exposures of supposed "Midway andesite" that were accessible at time of this survey have yielded convincing evidence that the rock is identical with Mizpah trachyte. Averill, however, has recorded occurrence of an andesitic rock overlying Mizpah trachyte which he considers to represent uncon. overlap of "Midway andesite." This exposure was not seen by writer, but it may well be that at shallow depths in certain parts of Tonopah dist. there is an overlying flow, related to post-Esmeralda andesites or latites of Divide dist., although it is most improbable this rock is of any great extent or of econ. importance in productive part of Tonopah dist.

Midway volcanic group.

Miocene and Oligocene: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 10, 118°30′ to 119°). *Midway volcanic group.*—Lower part, Olig. andesites and basalt, flows and pyroclastic deposits; upper part, Mio. (?) trachyte and analcitic rhomb porphyry, flows and pyroclastic deposits.

C. W. Drysdale, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 136). *Midway volcanic group* assigned to Mio.

O. E. Le Roy, 1912 (Canada Geol. Surv. Mem. 21, p. 44).

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 398). *Midway volcanic group*, Mio. and Olig. Covers area about town of Midway, B. C., near Int. Bdy.

Midwayan.

Term used by some authors to cover the time of deposition of Midway group.

Mier sandstone member (of Yegua formation).

Eocene (middle): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1374, 1384). Basal 114 ft. of Yegua fm. of this region is characterized by a series of gray and red clay shales with a very heavy oyster bed (*Ostrea georgiana*) beneath a prominent bench-forming massive soft gray ss., 125 ft. thick, which is referred to in this rept as *Mier ss.* A typical exposure of this ss. can be seen in town of Ciudad Mier, Tamaulipas. Immediately above Mier ss. is a similar series of beds, 58 ft. thick, with almost identical sequence of gray and red clay shales, overlain by a heavy bed of oysters (28 ft.), and this in turn by another massive coarse-grained ridge-forming ss., 100 ft. thick, which is referred to in this rept as *Alamo ss.* A typical exposure of latter ss. can be seen along E. bank of Rio Alamo downstream from Ciudad Mier. Both of these sss. have been traced more than 50 mi. in Mexico and brought up to Rio Grande and traced into Tex. as far as Arroyo Tigre, in Zapata Co. The Alamo ss. lies 132 ft. below Alberca ss. and 86 ft. above Mier ss.

Miette formation.

Pre-Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll. vol. 57, No. 12, pp. 335, 340). *Miette sss.*, pre-Camb., B. C. and Alberta.

C. D. Walcott, 1915 (Problems Am. Geol., p. 179). *Miette fm.*, pre-Camb., Alberta.

C. D. Walcott, 1928 (Smithsonian Misc. Coll. vol. 75, p. 258). *Miette fm.*, Algonkian (Belt series), B. C.

Mifflintown limestone.

Silurian: Central Pennsylvania.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, pp. xxv–xxvi). *Mifflintown ls.*—Near bottom of upper red sh. memb. of Clinton fm. lie 6 ft. of hard calc. ss. layers, each 2, 3, or 4 inches thick, separated by very thin layers of calc. ss. mottled with red. This peculiar group is recognizable at distant localities and sometimes becomes a ls., as near Mifflintown [Juniata Co.], on W. bank of Juniata River, where some beds of very hard comparatively pure ls. 3 or 4 ft. thick crop out.

Miguel formation.

Upper Cretaceous: Southwestern New Mexico (Alamosa Creek Valley, Socorro County).

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A). *Miguel fm.*—Yellow sss., massive and persistent, also soft sss., drab and yellow sandy shales, a few beds of clay, and several beds of coal in upper half. Abundant invertebrate fossils and a few plant remains. Contains 4 persistent massive yellow ss. members, 2 of which are here named, *Bell Mtn ss. memb.* being applied to the one at top and *Gallego ss. memb.* to the one near middle. The 2 lower sss. may represent Tres Hermanos ss. memb. of Lee. Thickness 2,080 ft. Underlies Chamiso fm. and overlies Dakota ss. Named for Miguel Creek, which crosses the beds in NW. part of area (Alamosa Creek Valley). Benton fauna abundant. Is not exactly=Mancos sh., hence local name.

Milams member (of Cook Mountain formation).

Eocene (middle): Eastern Texas (Angelina and Sabine Counties) and northwestern Louisiana.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Milams memb. of Claiborne fm.*—Name proposed for that memb. of the Claiborne occurring below Saline Bayou memb. and above Crockett memb. Type loc. is in NE¼ sec. 17, T. 13, R. 3 W., Winn Parish, La., which is ½ to ¾ mi. SW. of Milams, on Ark. Southern Ry. The section is (descending): (1) Red clay, weathering orange, 6 ft.; (2) gray plastic calc., fossiliferous, somewhat glauconitic clay with many corals, weathers dull orange red, with a few small lime nodules, 6 ft.; (3) gray calc., very glauconitic fossiliferous clay, weathering orange red, with numerous small calc. nodules, 10 ft.; (4) zone of calc. glauconitic concretions with fossil casts, 6 in.; (5) dark yellowish-gray, very glauconitic plastic fossiliferous clay, 3 ft.; (6) badly weathered orange-red, very glauconitic fossiliferous clay, 3 ft.; (6) badly weathered orange-red, very glauconitic fossiliferous sandy clay, many oysters, 10 ft., the upper 4 ft. very ferruginous and indurated.

Milan loam.

Pleistocene: Northwestern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 163). *Milan loam.*—Mellow clay, without laminar structure, of light-yellow or pale-reddish color, containing more or less fine sand. Thickness few in. to 15 ft., averaging 3± ft. Covers very generally the sands of the Lafayette and is basis of best subsoils and soils of upland parts of many counties in W. Tenn.

Named for Milan, Gibson Co.

Milburn shale. (In Canyon group.)

Pennsylvanian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvi). *Milburn-Strawn series.*—Alternating clays and shales and thin-bedded lss., with fire clay and coal, overlying Richland-Gordon sss. and underlying Brownwood-Ranger series.

R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 205–206). *Milburn shales.*—Shaly ss., argill. sh., clay, with some gyp. and coal, overlying Richland ss. and underlying Brownwood div. Thickness 100 to 150 (?) ft.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 98). *Milburn div.* as originally defined by Tarr consists of local impure deposits which are now included with Brownwood div. At close of preceding Richland subepoch, as shown by clays of Milburn beds, there was slight subsidence of sea floor, so that deeper sea deposits were laid down.

C. H. Gordon, 1911 (Jour. Geol., vol. 19, p. 117). *Brownwood div.* now includes Brownwood and Milburn of Tarr, and is=Canyon div.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, p. 13). Brownwood and Milburn of Tarr=Canyon group.

Named for Milburn, McCulloch Co.

Miles limestone member.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 5, 9). *Miles ls.*—Basal memb. of Falls City ls. fm. Is blue gray; locally weathers brownish and porous; 1+ ft. thick. Underlies Reserve sh. memb. and overlies Hawxby sh. fm. Type loc. in high hill W. of Miles ranch, 2± mi. SW. of Falls City [Richardson Co., Nebr.].

Milesburg formation.

Lower Devonian: Central Pennsylvania (Blair County).

C. Schuchert, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 552). *Milesburg fm. or Lower Oriskany.*—Thickness 130 ft. in Tyrone Gap, Bald Eagle Mtn. Consists of thin-bedded siliceous lss., of dark-blue to black color, underlain by black siliceous shales. Is=Shriver fm. of Md. Uncon. overlies Keyser fm. or Lower Helderbergian, and is overlain by Oriskany [Ridgeley] ss.

The U. S. Geol. Survey now uses *Oriskany group* in Blair Co., Pa., to include Ridgeley ss. above and Shriver ls. below.

†Milford chlorite schist.

Pre-Cambrian: Central and western Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, p. 100, and map). *Milford chlorite schist.*—Prevailing rock is greenish chlorite schist, varying in thickness and hardness. In places evenly foliated; elsewhere highly contorted. Quartz is important constituent and occurs in seams, lenses, and veins, and also distributed in minute particles throughout the schist. Small bands of impure serpentine occur at several localities. In places the rock is massive, with the schistose structure hardly at all developed, and consists largely of hornblende and feldspar. Occasionally this more massive variety is porphyritic from presence of crystals of labradorite. Believed to have been originally a diorite or similar basic igneous rock with intrusions in form of dikes. [Mapped over large area in Milford Twp.]

In 1909 (U. S. G. S. W. S. P. 232) Gregory assigned this schist to pre-Camb. Conflicts with *Milford granite*, a name of considerable commercial importance, which cannot be as easily replaced as the name for this schist.

Milford granite.

Devonian (?): Eastern Massachusetts and northeastern Rhode Island.

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, pp. 26–33, 45–47, 66, and map). *Milford granite.*—Compact, massive rock, somewhat above medium grain, and of light color. Its two especially characteristic constituents constantly present are blue quartz and a microcline microperthite. Forms a great granite batholith that extends across Mass. and R. I. Is of post-Camb. and pre-Carbf. age Named for well-known quarries in Milford, Mass.

See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597), when **Milford granite** was assigned to Dev. (?).

Milford group.

Carboniferous and Triassic: British Columbia.

M. F. Bancroft, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 43), and J. F. Walker and M. F. Bancroft, 1929 (Canada Geol. Surv. Mem. 161, p. 12).

†Miliolitic limestone.

A name, of paleontologic derivation, applied in some early repts to Ocala ls. Based upon presence of miliolitic fossils.

Milk River sandstone.

Upper Cretaceous: Southern Alberta, Canada.

D. B. Dowling, 1917 (Canada Geol. Surv. Mem. 93, p. 47). *Milk River ss.*—Shales, sss., and coal beds, underlying Pakowki fm. (Claggett sh.) and overlying Colorado sh. in southern Alberta. Upper part consists of a series of green shales, carbonaceous shales, thin coal seams, and thin sss., overlain in places by a thick cross-bedded ss. capped by a black-chert pebble bed 1 to 6 in. thick. Lower part is composed of Virgelle ss. memb.

Is considered same as Eagle ss. of Mont.

Millbury ls.

Late Carboniferous or post-Carboniferous: Eastern Massachusetts (Worcester County).

B. K. Emerson and J. H. Perry, 1903 (Geol. of Worcester, with map). *Millbury ls.* is a narrow band or thin layer in Bolton gneiss. Occurs at Millbury, Worcester Co.

Mill Creek limestone.

Pennsylvanian: Northeastern Pennsylvania (Luzerne County).

C. A. Ashburner, 1886 (2d Pa. Geol. Surv. Ann. Rept. 1885, pp. 443+). *Mill Creek ls.*—Siliceous, ferruginous, and extremely hard ls., 12 to 15 inches thick. Very fossiliferous. Outcrops along N. side of Mill Creek, near Wilkes Barre, near breast of old Hallenback Dam, and about midway btw. River Street bridge and a bridge of Lehigh Valley R. R. which crosses the creek at its mouth. Lies 25 to 30 ft. higher than Canal ls. and 30 ft. below Joe Gibbs coal, the separating beds in both cases being ss.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 259). There can be little doubt that Mill Creek ls., near summit of Pa. anthracite coal series in Wilkesbarre basin, represents same geol. plane as Ames ls., since nearly every species described from it by A. Heilprin is found in Ames ls. [memb. of Conemaugh fm.] of vicinity of Morgantown, W. Va.

Mill Creek.

A plant-bearing series near base of Upper Cret. of Canada. (See J. W. Dawson, Roy. Soc. Canada Trans., vol. 3, 1886, sec. 4, p. 2.)

Mill Creek series.

Cretaceous: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 218).

Mill Creek moraine.

Pleistocene (Wisconsin stage): Northern Pennsylvania.

See U. S. G. S. Elkland-Tioga folio, No. 93, 1903. Begins at junction of Mill and Bailey Creeks, at E. edge of Tioga quad.

Mille Lacs moraine (also **morainic system**).

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154), and 1932 (U. S. G. S. P. P. 161, pp. 48–51). Named for Mille Lacs Lake, Aitkin Co.

Miller fire clay.

Pennsylvanian: Northern Missouri (Macon County).

H. A. Wheeler, 1893 (Mo. Geol. Surv. Sheet Rept. No. 2 (vol. 9), pp. 60–65). *Miller fire clay* underlies Lower Ardmore coal.

Named for Miller farm, 2½ mi. S. of Bevier, Macon Co.

Miller sand.

A subsurface sand in Empire pool, Stephens Co., southern Okla., lying at 1,500 ft. depth, the Nigh sand lying at 1,600 ft. and the Gas sand at 1,000 ft. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 179, this sand is Perm.; according to Okla. Geol. Surv. Bull. 40E, 1926, it is Penn. The name has also been applied to a sand in Archer Co., Tex., that is considered to be same as Gose sand.

Miller limestone.

Mississippian: Nova Scotia.

W. A. Bell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 166).

Miller Peak formation.

Pre-Cambrian (Belt series): Central western Montana (Missouri to Helena region).

C. H. Clapp and C. F. Deiss, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 677–678, figs. 2, 3). *Miller Peak fm.*—On Miller Peak consists of (descending): (1) Purple massive to thin-bedded argillitic ss., some gray argillite, 235 ft.; (2) red and purple sandy argillite, with some thin beds of green and gray argillite intercalated with argillitic ss., 1,440 ft.; (3) pale green-gray argillitic ss., 85 ft.; (4) purple and green-gray sandy micaceous argillite weathering to rusty buff on joint faces, 590 ft.; (5) purple sandy thin-bedded mud-cracked siliceous argillite, with some beds of finely micaceous argillite and gray sandy argillite, 550 ft. Underlies (uncon.?) Hellgate fm. Type section is upper part of S. flank of Miller Peak, where it rests conformably on Wallace (Siyeh) ls. Is Lower Camp Creek series of Walcott.

Millers sandstone.

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 457–464). [See definition under *Woodcock ss.*] Fossiliferous on Mill Creek below Dorset. Included in Bradfordian and also treated as memb. of Chagrin fm. [which U. S. Geol. Survey classifies as Upper Dev.].

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Millers ss. memb.* (*Venango 2d oil, "B"*) included in Cattaraugus fm., of Dev. age. [U. S. G. S. classifies Cattaraugus fm. as Dev. or Carbf.] Underlies Saegerstown sh. memb. and overlies North Warren sh. memb. [This is a restriction of Chadwick's Millers ss.]

Derivation of name not stated.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 89). *Millers ss.* of Chadwick is same as Pope Hollow cgl., Wrightsville cgl. of Warren Co., Pa., and Salamanca cgl. of Butts's Warren, Pa., folio, and of Glenn (N. Y. State Mus. Bull. 69, pp. 974–978, 1903). [Millers ss. of Chadwick included all beds btw. Saegerstown sh. and Amity sh., and would therefore be=Pope Hollow cgl., North Warren sh., and Bimber Run cgl. of Caster.]

Millersburg formation.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84, p. 2). *Millersburg fm.*—Sss. and shales, 150 ft. thick, btw. base of Millersburg coal below and base of Somerville fm. above.

This name was dropped by Ind. Geol. Survey in 1922, the lowermost bed (Millersburg coal) being thrown into upper part of their redefined Petersburg fm., and the rest of the fm. into their overlying Shelburn fm. (new name). (See E. R. Cumings, Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, 1922.) Named for Millersburg, Elkhart Co.

Millersburg limestone member (of Cynthiana formation).

Middle Ordovician: Central Kentucky.

A. F. Foerste, 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, No. 4, p. 112). *Millersburg. ls. memb. or Orthorhynchula phase of Cynthiana fm.*—Richly fossiliferous argill., irregularly bedded lss., frequently weathering into irregular fragments called rubble, in basal part of Cynthiana fm. Base is formed by *Allonychia* horizon btw. Flanagan and Millersburg. Overlain by coarse-grained Nicholas ls. S. of Pleasant Valley and by coarse-grained ls. containing *Clitambonites* S. of Carlisle. The Greendale memb. as developed near Lexington is regarded as approx.=the much more richly fossiliferous Millersburg ls. farther E.

Named for Millersburg, Bourbon Co.

Miller's Cliff conglomerate.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 1489–1536). Sub-Olean cgl. is equiv. to *Miller's Cliff cgl.*, whose purely ss. character at Garland merely tells the common story of all pebble deposits. The *Miller's Cliff cgl.*, 20(?) ft. thick, consists of thin-bedded sss. It lies 200 ft. below Olean cgl. [Miller's Cliff is halfway btw. Lottsville and Wrightsville, Warren Co.]

†Millers River conglomerate.

Carboniferous: Northeastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 140, 156). *Millers River cgls.*—A broad exposure of cgl. beds underlying the red Wamsutta series in valley of Millers River, in Cumberland, R. I. In this gray series there are three or four thick beds of cgl. with small quartz and qtzite pebbles. Best exposed on farm of J. A. Miller, where thickness is unusually great, being 300 to 400 ft. Included in Pondville group.

Mapped as Pondville cgl. by B. K. Emerson, U. S. G. S. Bull 597, 1917.

Millersview limestone member (of Grape Creek formation).

Permian: Central Texas (Concho County).

W. Kramer, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1579, 1581). *Millersview ls memb.* is 2-foot gray bed lying 730 ft. above Coleman Junction ls. Crops out (in W ½ T. F. Benge survey No. 100) 4.5 mi. S.-SW. of Millersview on road having that bearing from the village. Has been traced across SE. part of Runnels Co. to point 4.5 mi. N. of SE. corner of that Co. As it is persistent ledge maker it is considered top memb. of Grape Creek fm.

Millerton formation.

Lower and middle Pleistocene: Western California (north of San Francisco Bay region).

R. E. Dickerson, 1922 (Calif. Acad. Sci. Proc., 4th ser., vol. 11, No. 19, with maps). *Millerton fm.*—Fossiliferous marine deposits, uncon. underlying Tomales fm. and overlying Merced group and its correlative the Sonoma group. Best strat. section seen (in headland 1½ mi. NW. of Millerton Station) consisted of (descending): (1) 23 ft. of carbonaceous tan-colored ss. and dark-gray sh.; (2) prominent cgl. 2 ft. thick; (3) 85 ft. of carbonaceous tan-colored ss. and dark-gray sh. with marine fossils in middle part; and (4) 50 to 65 ft. of cgl. at base.

Named for exposures in headland near Millerton Station, Marin Co.

Millerville green schist.

Post-Carboniferous (?): Eastern Alabama.

See under *Hillabee chlorite schist*, Smith 1896 entry. The 1926 geol. map of Ala. shows *Hillabee chlorite schist* at and around Millerville, Clay Co. Is intrusive.

Millett clay.

Southeastern California (Inyo County) and southwestern Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 61, 79). *Millett clays.*—Named for old Millett borax camp, in Furnace Canyon [E. of Death Valley, Inyo Co., Calif.], which was situated directly upon the principal borate-bearing beds, which appear to be Mio., and separated from higher clays of similar character by marked uncon. Thickness 1,000 ft. Uncon. below Negra clays and above Redhill sss. Top fm. of Furnacian series in Nev.

†Milliard limestone.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 79). "*Milliard lss.* is name suggested for Walcott's Cambric Dome ls. of House Range, Utah, which term is preoccupied by Hague." [There is no record of Hague having introduced the name *Dome*. Keyes applied *Milliard lss.* in Nev. section also. Walcott in 1912 replaced his *Dome ls.* with *Dome Canyon ls.*, the present approved name.]

Derivation of Milliard and type loc. not stated.

Millican formation.

Pre-Cambrian: Western Texas (Sierra Diablo region).

G. B. Richardson, 1914 (U. S. G. S. Van Horn folio, No. 194). *Millican fm.*—Fine-grained red ss., cherty ls., and cgl. Uncon. underlies Van Horn ss. and overlies (relations concealed) Carrizo fm.

Named for Millican's ranch, 10 mi. NW. of Van Horn.

Milligen formation.

Mississippian and Devonian (?): Southern central Idaho (Custer County).

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10, 24–29, map). The fine-grained argill. rocks that underlie Wood River fm. as here restricted are named *Milligen fm.*, from Milligen Creek, near center of largest exposure of fm. 6 mi. E. of Ketchum. Thickness several thousand ft.; at least 3,000. Included in Wood River fm. of Lindgren. Varies considerably in lithologic character, but most of it is black carbonaceous argillite; some beds are dominantly qtzitic and others calc. Some rocks are more or less distinctly laminated. In a few places beds of coal are intercalated in the argillite, and in places beds of qtzite, ls., and dolomitic ls. are intercalated. Also includes some beds of thick-bedded dark-blue impure dolomitic ls. as much as 4 or 5 ft. thick. Grades into overlying Wood River fm. restricted. Considered to be chiefly of Miss. age, but basal part may be Dev. Uncon. overlies Trail Creek fm., of Sil. age. Included in Wood River fm. of Lindgren.

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth) and 1934 (Geol. Soc. Am. Bull., vol. 45, No. 5, p. 967 and chart opp. p. 940). *Milligen fm. restricted* to lower 3,000± ft. of Milligen fm. as defined in 1930, above which lies 2,000+ ft. of Brazer (upper Miss.) ls. The Milligen in Custer, Bayhorse, and Sawtooth quads. consists of argillite, argill. qtzite, impure dolomitic beds, and locally beds of coarse grit to fine cgl. It overlies Grand View dol. (Upper Dev.).

Named for exposure on Milligen Creek, Hailey quad., 6 mi. E. of Ketchum.

Milliken sandstone member (of Fox Hills sandstone).

Upper Cretaceous: Northeastern Colorado (Larimer and Weld Counties).

J. Henderson, 1920 (Colo. Geol. Surv. Bull. 19). *Milliken ss. memb. of Fox Hills fm.*—Massive greenish-yellow concretionary ss., almost free from sh. except a few 1-in. bands in lower part. Contains many large brown concretions and bands, more or less ferruginous and calc. and usually highly fossiliferous. Cross bedded in places. Thickness 100 to 150 ft. Is upper massive ss. in Fox Hills of NE. Colo. Well exposed near Milliken Station, W. of La Salle [Weld Co.].

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B). *Milliken ss. memb.* is 39 to 63 ft. thick in NE. Colo., and lies at or near top of Fox Hills ss.

Millington moraine.

Pleistocene (Wisconsin stage): Eastern Michigan (Tuscola County). (See Mich. Geol. Surv. Rept. 1908, pp. 148–196.)

Million shale. (In Eden group.)

Upper Ordovician: Central Kentucky.

J. M. Nickles, 1905 (Ky. Geol. Surv. Bull. 5, p. 25). *Million shales.*—Name suggested by A. F. Foerste for all of Eden, including Utica sh. (Fulton layer of Foerste) at base, below Garrard ss. Underlain by Winchester group.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7), applied *Million bed* to 120 to 200 ft. of beds of Eden age, underlying Paint Lick bed and overlying Utica (Fulton layer), 0 to 3 ft. thick. This restricted definition of Million sh. was adopted by A. M. Miller in 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 651–657) and is the one recognized in later repts of Foerste and Miller.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull., vol. 17). That part of Eden below Paint Lick memb. was [in 1906 rept] grouped under term *Million* on account of its different faunal expression from that exhibited by the Eden at Cincinnati.

Named for Million, Madison Co.

Mill River conglomerate.

Upper Cambrian: Northwestern Vermont (Franklin County).

B. F. Howell, 1929 (16th Rept. Vt. State Geol., pp. 266–268). *Mill River cgl.*—New name, here proposed by writer, after consultation with Dr. Keith, for the conglomeratic ls. which overlies the Middle Camb. *Paradoxides* beds (St. Albans sh.) and underlies Highgate sh. (Upper Camb.). Its fauna has not been carefully studied but it is believed to be Upper Camb. Named for Mill River, just E. of which the fm. is exposed about 2 mi. SW. of St. Albans, ¼ mi. S. of road running W. from western foot of St. Albans Hill.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, p. 374), reported an abundant Upper Camb. fauna from some ls. layers in Mill River cgl., and stated that it rests uncon. on St. Albans sl.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 359, 368, 370–371), reported reworked St. Albans (Middle Camb.) and Lower Camb. fossils in this cgl., which he called a basal cgl., assigned it to base of Upper Camb., correlated it with *typical* Milton dol., and introduced new name *Rugg Brook dol. cgl.* for the so-called Milton dol. of Keith, which underlies St. Albans sl. and uncon. overlies Parker sl. Thickness of his Rugg Brook cgl. 0 to 15 ft.

Mills moraine.

Pleistocene (Wisconsin stage): Northern central Colorado.

W. T. Lee, 1917 (Geologic story of Rocky Mtn Park, Colo., Nat. Park Service, Dept. Int., Wash., D. C., pl. 35).

Lee stated that he named the moraine for Amos Mills, who then owned Longs Peak Inn, at foot of Longs Peak, on side of which lies the moraine.

Mills bed.

Eocene (middle): Southern Texas (Rio Grande embayment).

F. M. Getzendaner, 1930 (A. A. P. G. Bull., vol. 14, No. 11, pp. 1436–1437). A unique bluish-white, very fine-grained noncalc. ss. (younger than Carrizo sand), in Bigford fm., containing imprints of grasslike leaves, was studied and partly mapped by writer, who carried it in his notebooks as "*Mills bed*," because he first studied it on the O. A. Mills ranch in Zavalla Co. It occurs in a long line of disconnected outcrops in Frio and Zavalla Counties and has been traced to eastern Frio Co., where it seems to lens out and the Carrizo sand and Mount Selman become contiguous fms.

†Millsap division. (In Strawn group.)

Pennsylvanian (Allegheny): Central and central northern Texas.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361, 372–374). *Millsap div.*—Mostly blue and black clays, with an occasional ss., hard ls., and bed of sandy sh. Thickness at least 1,000 ft. Found only in N. part of Carbf. area. Includes all Coal Measures strata below top of coal No. 1. Underlies Strawn div.

Later Tex. repts (1893, etc.) dropped *Millsap*, because of conflict with name of a well-established fm. of Miss. age in Colo., and included the beds thus designated in *Strawn fm.* This definition of Strawn was adopted by U. S. Geol. Survey in 1912. F. B. Plummer and R. C. Moore, however, in 1922 (Tex. Univ. Bull. 2132) divided the Strawn deposits into Mineral Wells fm. above and Millsap fm. below. (See under *Strawn fm.*) In 1933 (Univ. Tex. Bull. 3232, pp. 105, 109) E. H. Sellards divided *Strawn group* into (descending) Mineral Wells fm. restricted, Garner fm., and *Millsap Lake fm.*, the latter name being introduced to replace *Millsap fm.*

Named for Millsap, Parker Co.

†Millsap limestone.

Mississippian (lower): Eastern Colorado.

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Millsap ls.*—Remnants of thin-bedded, variegated, dolomitic ls. with a few thin ss. layers. Chert nodules in upper layers carry characteristic Carbf. fossils. Thickness 0 to 30 ft. Uncon. underlies Fountain fm., and uncon. overlies Fremont ls. Named for Millsap Creek, Pikes Peak quad.

G. K. Gilbert, 1897 (U. S. G. S. Pueblo folio, No. 36). *Millsap ls.*—Coarse gray and red ss. (30 ft. thick) underlain by 200 ft. of gray and purple lss. with some sh., especially in lower part. Assigned to Carbf. Underlies Fountain fm. and conformably overlies Harding ss. Like the Harding, the lss. occupy 2 small areas W. of Beulah, separated by St. Charles Canyon. A Carbf. fossil was found near middle of the lss., but nothing was found to mark presence of Fremont ls., which in Pikes Peak dist. separates Millsap and Harding fms. Application of name Millsap to whole ls. series of Pueblo dist. is a somewhat arbitrary procedure and is subject to correction when more facts are available. Use of Millsap in Tex. has priority, and if retained in Tex. another name will have to be selected for this Colo. fm.

A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte in 1933 (A. A. P. G. Bull., vol. 17, No. 4, pp. 381–396) divided the beds beneath Fountain fm. and above Manitou ls. on E. slope of Front Range, Colo. (typical Millsap region) into Madison ls. (Miss.) 100 ft., and Williams Canyon ls. (of supposed Dev. age) 30 ft., and reported an uncon. btw. the two. (See under *Williams Canyon ls.*)

Millsap Lake formation. (In Strawn group.)

Pennsylvanian (Allegheny): North-central Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106–108). To obviate dual usage of *Millsap* (for this Penn. fm. of Tex. and for a Miss. fm. in Colo.) G. Scott and J. M. Armstrong (ms. of rept on geol. of Parker Co., Tex.) used *Millsap Lake* for the Tex. fm., which usage is here adopted. The fm. is largely shales with some cgls. and thin sss.; lss. are present but are thin and usually lenticular in character. Max. thickness 3,000 ft. or more. Type loc., Millsap Lake, Parker Co. Divided by Scott and Armstrong (ms. of Parker Co. rept) into following members (descending): Grindstone Creek beds, Brannon ls., Steussy shales, Meek Bend ls., Hill Creek beds, Dennis Bridge ls., Kickapoo Falls ls., Lazy Bend beds, and Dickerson beds.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15–24). *Millsap Lake fm.* in Parker Co. has been divided by G. Scott and J. M. Armstrong (unpublished mss.) into 3 members (descending), Grindstone Creek memb., Lazy Bend memb., and Dickerson memb., and the Grindstone Creek and Lazy Bend members are divided into several beds [listed under those members]. Is basal fm. of Strawn group. Underlies Garner fm. and uncon. overlies Bend group, which is divided into Smithwick and Marble Falls fms.

Millsdale limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

See under *Aux Sable ls.*

†Millstone grit.

A term applied in early repts to basal cgl. of Penn. series in Eastern and Central States. In Pa. it was applied to Pottsville fm. of present usage; in N. Y. it was applied by Eaton to Shawangunk cgl., according to W. W. Mather (N. Y. Geol. Surv. 4th Rept., 1840), also to Oneida cgl., according to L. Vanuxem (N. Y. Geol. Surv. 4th Rept., p. 374). The name was derived from fact that the conglomeratic beds were quarried for millstones. In western Ky. the name was applied to Caseyville ss. (of Pottsville group).

Millstone grit group.

Carboniferous: New Brunswick.

G. A. Young, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 314).

Millstream series.

Ordovician: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 32).

Millsville member.

Carboniferous: Nova Scotia.

W. A. Bell, 1926 (Canada Geol. Surv. Summ. Rept. 1924, pt. C, p. 160).

Millsville conglomerates.

Pennsylvanian (lower): Nova Scotia.

J. S. Stewart, 1932 (Nova Scotia Dept. Public Works and Mines, Ann. Rept. on Mines 1931, pt. 2, p. 37).

Milltown andesite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 47, etc.). *Milltown andesite.*—Mainly flows, but with some dikes and intrusive masses and with some tuff and breccia. Locally includes some effusive basaltic rocks that are not exposed at surface. Overlies Morena rhyolite, from which it is probably separated by an erosion interval. Where Morena and Sandstorm rhyolites are absent it rests on the latite. Thickness estimated at 700 ft. Named for small settlement of Milltown, about 1 mi. E. of Goldfield.

Millwood formation.

Millwood series.

Millwood shales.

Upper Cretaceous: Manitoba and British Columbia.

J. B. Tyrrell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 83E, 144E, 199E, 212E–215E). *Milwood series*, Cret., B. C. Included in Pierre.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 216). *Millwood fm.*, Cret., Canada.

D. B. Dowling, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 91). *Millwood*, Cret., Manitoba.

W. Malcolm, 1913 (Canada Geol. Surv. Mem. 29, p. 40). *Millwood shales*, Cret., Manitoba.

S. C. Ells, 1923 (Canada Mines Branch Summ. Rept. 1921, p. 36). *Millwood series*. Cret., Manitoba.

R. C. Wallace, 1925 (Geol. fms. of Manitoba, pub. by Nat. Hist. Soc. of Manitoba, p. 28). *Millwood series*, Cret., Manitoba.

M. Y. Williams, 1932 (Jour. Geol., vol. 40, No. 6, p. 561). *Millwood* of Manitoba underlies Odanah and correlates with Judith River, Claggett, and Eagle of Mont.

Milner formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado (Yampa coal field).

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Milner fm.*—Shales, thin-bedded ss., and coal beds underlying Trout Creek ss. and overlying Haybro fm. Included in Mesaverde group. Thickness 600 to 800 ft. The fm. crosses valley of Yampa River in T. 6 N., R. 86 W. and is named for Milner, a small village in this valley.

Milton formation.

Jurassic (?): Northern California (Downieville region).

H. W. Turner, 1894 (Am. Geol., vol. 13, pp. 232–234). *Milton series*.—Comparatively little-altered sediments containing large amount of fragmental diabasic material with some qtzite, fine-grained reddish clastic rocks, a variegated breccia, and a few ls. lenses. Considered older than Mariposa sl. and younger than Sailor Canyon fm.

Named for exposures in neighborhood of Milton, an old stage station on Middle Fork of Yuba River, in Downieville quad.

Milton dolomite.

Upper Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 111–115). *Milton dol.*—Almost entirely massive dol., fine and coarse grained. Most beds 1 to 4 ft. thick, especially in lower part of fm., and bedding usually difficult to determine. Color dark bluish gray or steel gray through light gray to buff, most beds weathering dark. Beds of sandy dol. fairly common, but only a little dolomitic ss., mainly in upper third of fm. One peculiarity is its considerable content of black chert, which occurs in small irregular patches and pockets and very seldom in layers. Another peculiarity is its large content of dolomitic cgl., present at many horizons throughout fm. and almost invariably at top. The cgl. consists mainly of pebbles of dol. and dolomitic ss., the source of which is probably the beds of same character in lower parts of the fm. Upper 80 ft. at Highgate Falls consists of fossiliferous slabby dol. and ls. interbedded with 8 layers of cgl. that resembles tillite, but only one of which (15 ft. below top and 26 ft. thick) contains boulders of foreign origin. Fossils in upper 80 ft. determined by C. Schuchert to be Upper Camb. No fossils in middle and lower parts of fm.; Middle Camb. may be represented in lower part of Milton dol. or in upper part of underlying Colchester fm. Thickness of fm. 800± ft. Underlies Highgate sl. and rests uncon. on Colchester fm. (Lower Camb.). A few mi. SW. and NW. of St. Albans the fm. is cut out by erosion. Extends from Canada to Monkton. Best exposed in wide belt passing through town of Milton, about 3 mi. W. of Milton village.

A. Keith, 1924 (Vt. State Geol. Rept. 1923–4, p. 137, footnote). Later work has shown there was considerable interval btw. deposition of the dol. to which

Milton was applied in my 1923 paper and that of the thinly bedded [strata] there called *upper Milton*. I therefore propose to call the latter *Missisquoi fm.* [This name applied to fossiliferous upper 80 ft. of Milton dol. as originally defined in St. Albans region, and restricted *Milton dol.* to lower or unfossiliferous part.]

B. F. Howell, 1929 (16th Rept. Vt. State Geol., pp. 264–266). Keith stated that Upper Camb. fossils occurred in *Milton dol.*, but this record was based on an error, whereby certain Upper Camb. fossiliferous beds were wrongly correlated with true Milton. No fossils have been found in original Milton, and we do not know certainly whether it is Paradoxidian [Middle Camb.] or older, but as it seems to underlie the *Paradoxides* beds either uncon. or discon., it was probably laid down in late EoCamb. time. The underlying Colchester fm. has yielded many EoCamb. fossils. We now know that the Middle Camb. *Paradoxides* beds form a distinct fm. above the Milton. Keith was not certain to which of his fms. the *Paradoxides* beds at St. Albans (St. Albans sh. of writer) belonged, but later detailed search by Schuchert, Keith, and writer found that they overlie Milton dol. and underlie Highgate sl.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 13, July 19, pp. 372–373), excluded from his Milton dol. the upper 80 ft. of beds containing Upper Camb. fossils (which he in 1924 named *Missisquoi fm.*—preoccupied and now replaced by *Mill River cgl.*), and applied *Milton dol.* to the lithologically similar dol. cgl. underlying St. Albans sl. (Middle Camb.) and overlying Parker sl. (Lower Camb.) in St. Albans region.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 359, 368, 369, etc.). In original account of Milton dol. Keith regarded it Upper Camb., though he had not found fossils in it [in its type area]. Ulrich was first to find these in typical area during summers of 1930 and 1931, and they confirmed Keith's reference. In his later field work Keith continued more detailed mapping N. to Canadian border, and, finding so many similar dolomites, confused some of them, and in his 1932 paper applied "Milton dol." to a much thinner dol. (about 30 ft.) in upper part of Lower Camb. (Parker) [overlying the Parker]. All of these Lower Camb. "Miltons" must be excluded and term be restricted to the original intention, namely, to the dolomites W. of Milton and of Upper Camb. age, and *to their equivalents*. In Milton region the true Milton dol. is 700± ft. thick, is conformably overlain by Highgate sl. and uncon. underlain by Parker sl. In Highgate Falls region the Upper Camb. beds separating Highgate sl. from the uncon. underlying Parker sl. are here given the following names (descending): *Highgate ls.-sl.*, 85 ft.; *Gorge cgl.*, 80 ft.; *Gorge ls.-dol.*, 140 ft. Writer has made 10 trips to region. [The Highgate ls.-sl. of Schuchert was included in Highgate sl. as originally defined by Keith, and the Gorge cgl., and Gorge ls.-dol. of Schuchert were clearly included in original definition of Milton dol., and are shown by Schuchert's diagram on p. 368 to be=typical Milton dol. The name *Gorge* is nongeographic.] At 3 widely spaced localities the Upper Camb. basal *Mill River ls. cgl.* overlies St. Albans sl. with erosion uncon. Its thickness is 5 to 15 ft.

The present definition of Milton dol. approved by U. S. Geol. Survey and A. Keith applies the name to the Upper Camb. strata underlying Highgate sl. and uncon. overlying Parker sl. (originally called *Colchester fm.*).

Milton quartzite.

Cambrian(?): Eastern Massachusetts (Boston region).

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 99, 101–103). *Milton qtzite* is proposed by writer for the coarse granular qtzite exposed just N. of the Quincy granite in town of Milton. It is a greenish, somewhat sheared grit which dips steeply to N. and is 400 to 500 ft. thick. All previous writers have assigned this rock to Roxbury cgl. (Perm.). Its separation from Roxbury cgl. originated with Dr. Kirk Bryan. It is entirely unlike latter fm., however, for it is well sorted and composed almost entirely of rounded quartz grains. Deposited under conditions very different from those which prevailed in Carbf. times in this region. Its close association with Quincy batholith implies a Camb. age, for great quantities of proved Camb. sediments are found as xenoliths in the Quincy granite and doubtless represent fragments of a collapsed roof. Assigned to *Camb.* (?).

E. J. Rhodes and W. H. Graves, Jr., 1931 (Am. Jour. Sci., 5th, vol. 22, p. 371). We visited Milton qtzite locality with Dr. [L.] La Forge and found *Milton fm.* an *arkose* rather than a qtzite. The pebbles of the Milton entirely resemble the matrix and sandy facies of Roxbury cgl. in a nearby outcrop. The Milton is not metamorphosed. Its original clays are still present and the rock has been but slightly altered by shearing. We are of opinion Milton fm. is a fine-grained portion of Roxbury cgl., to which fm. all writers preceding Billings assigned it.

Milton moraine.

Pleistocene (Wisconsin stage): Southern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Milton, Rock Co.

Milverton moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map in Smithsonian Inst. Ann. Rept. 1912, p. 297, 1913.

Milwaukee formation.

Middle Devonian: Southeastern Wisconsin (Milwaukee and vicinity).

W. C. Alden, 1906 (U. S. G. S. Milwaukee folio, No. 140). *Milwaukee fm.*—Only lower 15 to 25 ft. exposed, but following generalized section is based on exposures and well records (descending): Black sh., 15 ft.; soft bluish "soapy clay" or sh., 80 ft.; bluish mag. ls. ("cement rock"), 12 ft.; bluish ls. and softer bluish "soapy clay," 31 ft. Very fossiliferous. Hamilton fauna. Overlies Waubakee fm. Underlies Pleist. drift. Named for exposures near Milwaukee.

Milwood series.

Upper Cretaceous: Manitoba.

See *Millwood*, the correct spelling.

†Mimbres limestone.

Silurian and Ordovician: Southwestern New Mexico.

C. H. Gordon, 1907 (Sci., n. s., vol. 25, pp. 824–825; Jour. Geol., vol. 15, pp. 91–92). *Mimbres ls.*, 900 to 1,200 ft. thick, underlies Dev. Percha sh. and overlies Upper Camb. Shandon qtzite [Bliss ss.]. The greater part of these lss. contains Richmond fauna, but upper 100± ft. have yielded Sil. fauna.

Now separated into Fusselman ls. (Niagaran), Montoya ls. (Richmond), and El Paso ls. (Lower Ord.), and name abandoned.

Named for Mimbres Mtns, W. part of Sierra Co.

Mimbresian series.

A term introduced by C. [R.] Keyes to cover his Cristobal lss. (of Richmond, late Ord. age) of N. Mex. (See Iowa Acad. Sci. Proc., vol. 22, 1915, pp. 257–259.) In his Conspectus of geol. fms. of N. Mex., 1915, p. 9, he defined it as "term restricted to Late Ordovicic section in Mimbres, Caballos, and Franklin Ranges that carries the Richmond fauna." In 1922 (Pan-Am. Geol., vol. 38) he stated this is not Mimbres ls. of Government repts.

Minabariet formation.

Jurassic: British Columbia.

C. H. Crickmay, 1930 (Calif. Univ. Dept. Geol. Sci. Bull., vol. 19, No. 2, p. 33).

†Minden formation. (In Claiborne group.)

Eocene (middle): Northern Louisiana.

J. W. Whittemore, 1927 (La. State Dept. Cons. Bull. 14, pp. 6, 9, map); 1928 (idem. Bull. 16, p. 8); and 1929 (idem. Bull. 19, p. 6). *Minden or St. Maurice fm.* outcrops around Minden. Underlies Cockfield fm. and overlies Sparta sand.

I. Campbell and A. D. Miller, 1928 (A. A. P. G. Bull., vol. 12, No. 10, p. 990). *St. Maurice (Minden).*—Green and brown glauconitic sh., 130 ft. thick in Richland Parish, NE. La., where it underlies Quat. and overlies Sparta sand.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, No. 10, pp. 1339–1346). Those beds in La. which are stratigraphically same as Crockett memb. of Tex. have been locally referred to as *Minden beds*. Town of Minden [Webster Co., NW. La.] is not on so-called Minden beds, but is on Sparta sands. (Oral communication from

L. P. Teas, of Humble Oil & Refining Co.) As it is not advisable to use two names for same memb., the [new] name *Crockett*, which has been used in Tex., is suggested instead of *Minden*. The outcrops of the Crockett in Tex. are better exposures. For these reasons *Minden* is dropped and *Crockett* used instead.

H. K. Shearer, 1930 (A. A. P. G. Bull., vol. 14, No. 4, pp. 433–450). *Mount Lebanon fm.* is here proposed to replace *St. Maurice fm. restricted* of Spooner and Minden fm. The name *Mount Lebanon* has been used by Standard Oil Co. geologists and a few others since 1924, in referring to the upper marine fm. of the Claiborne. Name is taken from old town of Mount Lebanon, in Bienville Parish, which is surrounded by good fossiliferous exposures. Minden is not considered as satisfactory a name, because the typical exposures are several mi. from Minden, and the fm. there is not as characteristic as in Bienville Parish. The fm. generally consists of brown or green sh. and glauconitic sand containing a characteristic fauna. Thickness 350 ft. Underlies nonmarine Cockfield [Yegua] fm. and overlies Sparta fm. Includes Saline Bayou, Milams, and Crockett members of Tex. According to C. L. Moody and others who have done detailed work in Tex., the exposure at Cook Mountain, Houston Co., Tex., is definitely on the same fm. If this is true, *Cook Mountain* should be used as the fm. name, because it has priority over any of other names which have been proposed.

H. V. Howe, 1933 (A. A. P. G. Bull., vol. 17, No. 6, p. 625). The name "Minden" was suggested by writer during a course of lectures he was giving in Shreveport. It was not then known just how the Cook Mtn of Tex. fitted in La. section. As a result the name came into fairly common use by petroleum geologists and has crept into the literature several times without ever having been formally described. Portions of writer's office map of geol. of La., on which *Minden* appeared, were copied by Whittemore [the 3 books listed above] without writer's knowledge during his absence on summer vacation. Acknowledgment was given in later two publications, but writer never sanctioned placing this name in print. Another name for this fm. is *Mount Lebanon* of Shearer, who, when he proposed Mount Lebanon, suggested that Cook Mtn is the proper name if exposure at Cook Mtn definitely proved to be on same fm.

Minden fm. is now replaced by *Cook Mtn fm.*, the older name.

Mineola limestone.

Middle Devonian (Onondaga): North-central Missouri.

E. B. Branson, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 267–276). *Mineola ls.*—Extremely irregular in composition, ranging from very compact fine-grained ls. of high purity to ss. Commonest phase is a porous sandy ls. Occurs in patches. Thickness 0 to 40 ft. Uncon. underlies Callaway ls., and uncon. overlies fms. ranging from Kimmswick ls. to Jefferson City ls. Fauna closely related to Onondaga faunas of Ind. and Ohio. Contemp. with Cooper ls., but deposited in separate sea.

See later entries under *Cooper ls.*

Named for exposures, 4 or 5 mi. in extent, in vicinity of Mineola, Montgomery Co. Good outcrops in secs. 11 and 12, T. 48 N., R. 6 W.

Mineral Creek andesite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). Flows, breccia, and aggl.; predominantly andesitic; thin vesicular flows alternate with breccia and aggl.; some beds of reddish-purple feldspathic ss., of light-gray, dark-red, purple, and nearly black colors. Thickness 0 to 700 ft. Older than Fanney rhyolite and younger than Pacific quartz latite.

Named for exposures in S. walls of Mineral Creek Canyon above Cooney mine.

Mineral King beds.

Triassic (?): Southern California (Tulare County).

H. W. Turner, 1894 (Am. Geol., vol. 13, p. 231, and U. S. G. S. 14th Ann. Rept. pt. 2, p. 451.) *Mineral King beds.*—Clay sl., mica schist, qtzite, and crystalline ls, exposed at old mining camp of Mineral King, about 15 mi. SW. of Mount Whitney, at headwaters of Kaweah River, Tulare Co. Assigned to Triassic (?), on basis of poorly preserved fossils.

Mineral Wells formation. (In Strawn group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, p. 138). Strawn div. overlies Millsap div., and is divided [in table] into (descending) *Gordon, Mineral Wells sss.*, Brazos ss., etc. [Subdivisions not described.]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 32). *Mineral Wells fm.*—Sss. and shales, with coal No. 1 (Thurber coal) at base. Thickness 500 to 800 ft. Top fm. of Strawn group. Underlies Palo Pinto ls. (of Canyon group) and overlies Millsap [Millsap Lake] fm. Named for exposures in vicinity of Mineral Wells, Palo Pinto Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 108). *Mineral Wells fm.* is *restricted* by G. Scott and J. M. Armstrong (ms. on geol. of Parker Co.) to beds above Brazos ss. [Brazos River ss.] and they introduce *Garner fm.* for lower part of original Mineral Wells fm., or to include (descending) Brazos ss., Mingus sh., and Thurber coal members. [Sellards (1933) included in top of Mineral Wells fm. of Colorado River region the Capps ls. memb. This definition is present approved definition of U. S. Geol. Survey, and is the one followed by F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534).]

Mines dolomite.

Cambrian (Upper): Central Pennsylvania (Blair to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 527, 534, 537). *Mines dol.*—Cherty dol., oolitic, yielding much oolitic and platy scoriaceous chert. Thickness 250 ft. Underlies Larke dol. and overlies Gatesburg fm. Named for old mining town of Mines, several mi. SW. of Williamsburg, Blair Co. Best exposed in N. end of long ridge just SE. of Williamsburg.

Minesota conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; see map and p. 20). *Minesota cgl.*—A belt of cgl. and ss. 60 ft. wide. Its southern or lower half is ss.; the upper or northern half is cgl., which is usually highly metamorphosed and breaks with a trappean fracture, its divisional planes and lines of clearage [cleavage] dividing it imperfectly into irregular cubical or prismoidal blocks. Is distinguished by its firm and compact texture, its pebbles of feldspathic and syenitic rock, and the occasional presence of considerable epidote and carbonate of lime. This belt underlies the metalliferous deposits worked at Minesota mine. It is succeeded by the Minesota traps.

According to B. S. Butler (U. S. G. S. P. P. 144, 1929) is probably same as Kearsarge cgl. It belongs to Central Mine group.

Minesota trap.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 20). These traps, 570 feet wide, as stated above, are termed the *Minesota traps*, and with the underlying [Minesota] cgl. generally, the *Minesota belts*. [Shown as underlying National ss. and overlying Minesota cgl.]

Named for occurrence at Minesota mine, Ontonagon Co.

Minford silt.

Pleistocene: Southern Ohio.

W. Stout and D. Schaaf, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, pp. 663-672). *Minford silts.*—Fine, highly laminated silts, composing upper and by far greater part of valley filling of old preglacial valleys of all larger streams in southern Ohio and well toward headwaters of smaller tributaries. In main the evidence favors glacial origin. Rests on the old alluvium, where locally present, and on the still older sands that lie on bed rock. Named for exposure in the cut of Chesapeake & Ohio Ry at Minford, Harrison Twp. Scioto Co.

Mingan formation.

Ordovician: Quebec (Mingan Islands).

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 688).

Mingo formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 33, 38, 207, and pl. XLA). *Mingo fm.*—Shales, sss., and coals, 950 ft. thick, underlying Catron fm. and overlying Hance fm. in Cumberland Gap coal field. Top defined by base of Poplar Creek coal in Log Mtns, and by base of Wallins Creek coal in Black Mtns. Base defined by base of Harlan coal to E., by base of Hance coal in central part of Cumberland Gap coal field, and by base of Bennett Fork coal at W. Correlated with upper part of Kanawha fm. and lower part of Sewell fm.

Named for Mingo Mtn, Claiborne Co., Tenn.

Mingus shale member (of Garner formation).

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, pp. 75, 76, and charts). *Mingus sh. memb. of Mineral Wells fm.*—Gray sandy sh., 250 to 300 ft. thick, overlying Thurber coal, which is basal bed of Mineral Wells fm. (of Strawn group). The sh. is nowhere well exposed in complete section, but is observed in coal mine shafts and well borings. Underlies Brazos River ss. Named for small mining town S. of Mineral Wells.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 108). G. Scott and J. M. Armstrong (ms. on geol. of Parker Co.) restrict Mineral Wells fm. to beds above Brazos ss. memb., and introduce *Garner fm.* to include lower part of Mineral Wells fm., or (descending) Brazos ss., Mingus sh., and Thurber coal members.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 23–30), divided *Garner fm.* into following members (descending): Brazos River ss. (25 to 75 ft. thick), Mingus sh. (145 to 210 ft. thick), and Thurber coal (2 ft. thick), and gave a detailed section of Mingus sh. in Palo Pinto and Parker Co. region.

Minho beds.

Cretaceous: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 24, p. 57).

Minidoka basalt.

Pleistocene: Southern Idaho (Minidoka County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Minidoka basalt.*—Vesicular, blue, pahoehoe basalt containing tiny crystals of olivine and thinly covered with loess. Thickness 30± ft. Overlies conformably the capping gravel memb. of the beds deposited in lake behind the Sand Spring lava dam. Older than Wendell Grade basalt and younger than Barley lake beds. Named for Minidoka Dam. Probably issued from one of cones near Minidoka.

Miniss series.

Pre-Cambrian: Ontario.

W. S. Dyer, 1933 (Canadian Min. Jour., vol. 54, No. 2, p. 72).

Minneapolis limestone.

Middle Ordovician: Southern Minnesota.

F. W. Sardeson, 1907 (Geol. Soc. Am. Bull., vol. 18, p. 185). *Minneapolis ls.*—Basal bed of Beloit fm., and heretofore known as Buff bed and Lower Buff bed. Underlain by St. Peter ss. and overlain by *Bellerophon* bed.

Is basal part of Platteville ls.

Named for Minneapolis.

Minnekahta limestone.

Permian? (may be Triassic): Western South Dakota, eastern Wyoming, northwestern Nebraska.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 514). *Minnekahta ls.*—Thin-bedded gray ls., 30 to 50 ft. thick, underlying Spearfish fm. and overlying Opeche fm. in Black Hills. In previous repts called *Purple ls.* Type loc. is region near the hot springs originally known as "Minnekahta" by Indians.

Minnelusa sandstone.

Pennsylvanian: Western South Dakota and northeastern Wyoming.

N. H. Winchell, 1875 (Black Hills of Dakota, by Wm. Ludlow, U. S. Eng. Dept. U. S. Army, pp. 38, 65, map). *Minne-lusa ss. or Upper ss.*—Nearly white, crystalline, subsaccharoidal ss., coarsely granular when weathered and hard; has somewhat aspect of a crinoidal ls. but without stem sections of crinoids. [In another place he describes it as white ss., locally stained with iron so as to have a brick-red color. Thickness 75 ft. in Black Hills, S. Dak. Underlies Upper ls. and overlies Lower ls. Named for Indian name of valley in which it was discovered.

T. A. Jaggar, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 178–181, and map). *Minnelusa lss. and sss.*—In northern Black Hills consist of (descending): (1) *Minnelusa saccharoidal ss.*, 200 ft.; (2) *Minnelusa "alternate" series*, 300 ft.; (3) *Minnelusa white ss.*, 100 ft. Separated from overlying Minnekahta ls. by 90 ft. of red ss. Rests on 200 to 700 ft. of gray ls. equiv. to Madison ls.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 510). *Minnelusa fm.*—Sss., mainly buff and red, in greater part calc.; some thin lss. Thickness 400 to 450 ft. Minnelusa was applied by N. H. Winchell in 1875 to a portion of the bright-colored sandy members of the Carbf. lying above the Gray or Pahasapa ls. In this rept the name will be employed to designate all sss. and lss. in Black Hills region lying btw. well-defined limits of Pahasapa ls. below and deep-red sss. and shales of Opeche fm. above. Minnelusa is Dakota Indian name for Rapid Creek.

Minnelusa is Sioux Indian name for rapid water. The fm. is exposed on Rapid River 4 or 5 mi. above Rapid City, S. Dak. The fm. possibly includes some Perm. at top and some Miss. at base.

Minnesota trap.

Minnesota conglomerate.

Pre-Cambrian (Keweenawan): Michigan.

See *Minesota trap* and *Minesota cgl.* These units were named for a mine (spelled Minesota) in Ontonagon Co.

Minnesotan series.

A term introduced by C. [R.] Keyes to include Glenwood sh. and St. Peter ss. of Iowa and Minn. (See Iowa Acad. Sci. Proc., vol. 19, pp. 147–151, 1912.) In 1931 (Pan-Am. Geol., vol. 56, pp. 348–349) he restricted the name to St. Peter ss., and assigned Glenwood sh. to Chazy epoch.

†Minnesota River Valley gneiss and granite.

A descriptive term applied by C. D. Walcott (Geol. Soc. Am. Bull., vol. 10, 1899, table on p. 222) to basement rocks in southern Minn., which he assigned to †Archean system.

Minnewanka formation.

Devonian: Alberta.

H. W. Shimer, 1926 (Canada Geol. Surv. Bull. 42, pp. 3, 6, 20).

Minnewaste limestone.

Lower Cretaceous: Western South Dakota (SE. part of Black Hills).

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 529). *Minnewaste ls.*—Nearly pure light-gray ls., 0 to 30 ft. thick, underlying Fuson fm. and overlying Lakota fm. Contains no fossils. Formerly included in Dakota ss. Minnewaste is Dakota Indian name for Cheyenne River. Extensively exposed in anticline 2 mi. E. of Hot Springs, S. Dak.

N. H. Darton and S. Paige, 1925 (U. S. G. S. Central Black Hills folio, No. 219, p. 12). In SE. part of Black Hills uplift the Lakota ss. is overlain by *Minnewaste ls.*, a thin sheet of ls., which terminates btw. Buffalo Gap and Fuson Canyon. This ls. is about 12 ft. thick in Buffalo Gap and 18 ft. thick on plateau S. of Calico Canyon.

Minnith zone. (In Powell limestone.)

Lower Ordovician (Beekmantown): Central eastern Missouri (Ste. Genevieve County).

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines, vol. 22, 2d ser., pp. 86–90). The base of the upper Powell is placed at bottom of zone of cellular ferruginous chert, which may be termed *Minnith zone*, in which there is a prolific fauna in most places where it is found, the distinguishing fossils being Trochonemoid gastropods. The Minnith zone consists of intercalated beds of argill. dol., decomposed dol., and soft, ferruginous chert. Where absent the contact btw. upper and lower Powell is marked by a thin ss. or cgl. or a slight uncon. At Minnith the Minnith zone rests directly on Cotter fm.

Named for exposures at and near Minnith, Ste. Genevieve Co.

Minong breccia.

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).

A. C. Lane, 1898 (Mich. Geol. Surv. vol. 6, pt. 1, pp. 87, 101, 105, and pl. I). Believed to be same as Kearsarge cgl.

Belongs in Central Mine group. Has also been called *Minong cgl.*

Named for occurrence in Minong mine, Isle Royale.

Minong porphyrite.

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).

A. C. Lane, 1898 (Mich. Geol. Surv. vol. 6, pt. 1, pp. 141, 142, 159, 161, 170, 177, 200, 201, 209, 212, and pls. 1 and 2). Shown as younger than Minong trap and older than Minong breccia.

Belongs to Central Mine group.

Named for occurrence in Minong mine, Isle Royale.

Minong trap.

Pre-Cambrian (Keweenawan): Northern Michigan (Isle Royale).

A. C. Lane, 1898 (Mich. Geol. Surv. vol. 6, pt. 1, pp. (see index), pls. 1 and 2). Shown as older than Minong porphyrite.

Belongs to Central Mine group. Is younger than Kearsarge West amygdaloid.

Named for occurrence in Minong mine, Isle Royale.

Minooka moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. Shown on moraine map (pl. 23) in U. S. G. S. P. P. 106. Named for Minooka, Grundy Co.

Minshall sand.

A subsurface sand in Conemaugh fm. (Penn.) of W. Va., that lies at or near horizon of Connellsville ss. memb. Named for F. W. Minshall, geologist, Marietta, Ohio.

Mint Canyon formation.

Miocene (upper): Southern California (Los Angeles County).

W. S. W. Kew, 1923 (A. A. P. G. Bull., vol. 7, pp. 411–420). *Mint Canyon fm.*—Land-laid deposits locally developed in vicinity of Mint Canyon, a branch of upper part of Santa Clara River N. of San Gabriel Mtns. Contains good vertebrate faunas at several horizons. Rests uncon. on beds that are probably = Sespe fm. In places overlain by strata containing an upper Mio. fauna and tentatively correlated with Modelo fm.; and in other places it lies uncon. beneath Pico fm. [In

U. S. G. S. S. Bull. 753, 1924, Kew gives thickness of Mint Canyon fm. as 4,000± ft. and states that the name is substituted for *Mellenia*, because latter is not geographic.]

Mint Spring marl member (of Marianna limestone).

Oligocene (lower): Southern Mississippi.

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, pp. 187, 195–196). *Mint Spring calc. marl memb.* (*of Marianna ls.*).—Sands and shell marls which in western Miss. replace "chimney rock" facies of Marianna ls. Between Vicksburg and Pearl River the Mint Spring marl occupies entire interval btw. Forest Hill sand [below] and Glendon ls. [above], but E. of Pearl River it is overlain by a thickening wedge of Marianna "chimney rock." Has not been recognized E. of Chickasawhay River.

A. R. Mornhinveg and J. B. Garrett, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 11, p. 1659). Writers propose to set upper limit of the Mint Spring at first ls. ledge, and the lower at last fossiliferous bed. Btw. these limits are included 20 to 25 ft. of marine strata, grading from sparingly fossiliferous lignitic sands and clays in lower part to sandy fossiliferous marls in upper part.

Miocene epoch (or **series**).

Next to last epoch of Tertiary period and the rocks formed during that epoch. For definition see U. S. G. S. Bull. 769, p. 53.

Mira series or formation.

Cambrian: Canada and Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 195).

Mira basalt.

Tertiary (upper Miocene): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 69, etc.). *Mira basalt.*—A basalt flow, 100± ft. in greatest thickness, intercalated in Siebert [Esmeralda] fm. Underlies S. part of town of Goldfield. Caps Mira Mtn and some smaller hills in neighborhood. Prevailingly vesicular and characterized megascopically by large phenocrysts of vitreous feldspar disseminated sparingly through the rock.

Miraleste tuff bed. (In Monterey shale.)

Miocene (middle): Southern California (Palos Verdes Hills).

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, pp. 125–149). A distinctive tuff, readily recognized by abundance of pumice lapillae, which lies 125 to 175 ft. below top of middle div. of Altamira sh. memb., is here named *Miraleste tuff bed*, from Miraleste dist. Type region is on W. side of upper Agua Negra Canyon. Thickness of tuff varies from a few inches to 6 ft.

Mirando sand.

A subsurface sand in Fayette ss. (upper Eocene) in southern Tex. Lies lower than Cole sand and 500 ft. higher than Webster sand.

Mirando City sand.

A subsurface sand in the upper Eocene of Driscoll pool, Duval Co., Tex.

Misener sand.

A name that has been applied by drillers and oil geologists to a sand, or sands, encountered in oil and gas wells of many counties of eastern and northern Okla. and Cowley and adjoining counties of southern Kans. The name is said (N. W. Bass) to have been first applied to a sand in an oil pool near town of Beggs, Okmulgee Co., Okla. In that county (according to Okla. Geol. Surv. Bull. 40F, 1926) it lies in top of Viola ls.; it is not a sheet sand, but consists of small lenses; it occurs locally; and it has been correlated with Sylamore ss. The sand, as now commonly interpreted, is a transgressing unit that is treated by U. S. Geol. Survey as basal memb. of Chattanooga sh., and it overlies a widespread uncon. of pre-Chattanooga time. In some parts of Okla. it lies on Siliceous lime (Arbuckle ls.); in other places it lies on rocks as young as Hunton ls. (Dev. and Sil.). It is said (N. W. Bass, letter) to have been named for Fred D. Misener, an oil operator of Tulsa, and to have been found at depths of 3,009 to 3,054 ft. in No. 1 well (drilled btw. Dec. 19, 1919, and March 10, 1920) on McWilliams lease in sec. 23, T. 15 N., R. 10 E. (now included in Wilcox oil pool, Creek Co., Okla.), where it rests on Viola ls.

Misenheimer shale.

Middle Devonian: Southwestern Illinois.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Misenheimer sh.*, 0 to 25 ft. thick, overlaps Grand Tower ls. in a few places, and in these the basal part is dark sh. having greatly disturbed appearance and containing numerous shells of *Leiorhynchus limitare* and a few other fossils. Conformably underlies Lingle ls., Middle Dev. Well exposed in banks of Misenheimer Creek and tributaries in NE¼ sec. 34 and NW¼ sec. 35, Misenheimer Twp, Union Co., where it rests uncon. on Clear Creek chert or Dutch Creek ss. Corresponds to Marcellus and Hamilton of N. Y. Middle Dev.

Misinchinka schists.

Pre-Cambrian: British Columbia.

M. Y. Williams and J. B. Bocock, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 199).

Mispec group.

Mispeck group.

Devonian: New Brunswick.

G. F. Matthew, 1863 (Canadian Nat., vol. 8, p. 244).

Originally spelled *Mispeck;* later repts spell it *Mispec.*

Missi formation.

Pre-Cambrian: Saskatchewan and Manitoba.

E. L. Bruce, 1914 (Canadian Min. Jour., vol. 35, p. 504).

Mission argillite.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 72, map). *Mission argillite.*—Banded and massive argillites, calc. argillites, quartz mica schists, and narrow intercalated bands of qtzite and ls.; argillites and quartz-mica schists predominate. Bands of pure white ls., 2 to 100 ft. thick and traceable several mi., occur interbedded with the argillites. One of these lss., 3,000 ft. thick, has been named *Northport ls.* and mapped as a separate fm., but it is in reality interbedded with Mission argillites. Thickness of Mission argillite 12,000± ft. Rests on Clugston ls. Is top fm. of Stevens series. May possibly constitute several fms., but it would be difficult to map subdivisions, as they are not persistent for any great distances. [Town of Mission seems to be on this fm.]

Mission sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

M. I. Goldman and H. M. Robinson, 1920 (U. S. G. S. Bull. 686Y, pp. 362, 364). *Mission ss.*—Named for prominent occurrence along Mission Creek, especially in secs. 13, 14, 23, 24, and 25, T. 28 N., R. 11 E. Just NW. of center of sec. 23, T. 28 N., R. 11 E., it is conspicuous as the bed forming surface of prairie a few ft. above creek bottom N. of Gordon ranch. In T. 29 N., Rs. 11 and 12 E., it is part of a series of lenticular sss. overlying Possum ss. In T. 28 N., Rs. 11 and 12 E. it is a very constant, conspicuous bed of hard ss., 2 to 4 ft. thick, weathering in slabby blocks, prevailingly of pinkish color, in places carrying fossil shells in top part and forming surface bed over great part of the open country btw. Caney River and Mission Creek. Is generally overlain by sh. In SE. part of area it becomes more or less lost in a series of soft, massive, lenticular sss., and appears in sec. 31, T. 28 N., R. 12 E., as part of a continuous massive bed 20 ft. or more thick. Top lies 60 to 70 ft. below top of Cheshewalla ss. and 30± ft. below base of Hay Hollow ss.

Is=top bed of Revard ss. memb. of Nelagoney fm. (See 1922 entry under *Revard ss. memb.*)

Mission Canyon limestone. (Of Madison group.)

Mississippian (lower): Central northern Montana (Little Rocky Mountain region).

A. J. Collier and S. H. Cathcart, 1922 (U. S. G. S. Bull. 736F, p. 173). In this part of Mont. (Little Rocky Mtn region) the Madison ls. becomes a group divisible into two distinct fms., here named *Mission Canyon ls.* (the upper one) and *Lodgepole ls.* (the lower one). The Mission Canyon ls. is a massive white marine ls. 500 ft. thick, and not so fossiliferous as Lodgepole ls. It is named for exposure in Mission Canyon.

†Mission Creek series.

Tertiary, Cretaceous, Paleozoic: Southwestern Alaska (Yukon gold district).

J. E. Spurr, 1896 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 153–183). *Mission Creek series.*—Cgls., grits, sss., and shaly and coaly beds. Named for Mission Creek, in vicinity of which it is well exposed. Probably in part at least Lower Cret.

According to G. C. Martin this name included rocks of Tert., Lower Cret., and Paleozoic age. On Mission Creek it included Tert. and either Carbf. or Dev.

Mission Creek shale. (In Deer Creek limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northwestern Missouri, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 49, 50). *Mission Creek sh.* overlies Haynies ls. and underlies Ervine Creek ls., all included in Deer Creek ls. It is ½ to 1½ ft. thick in Nebr. and SW. Iowa, 3 to 4 ft. thick in NW. Mo., and 2 to 3 ft. thick in NE. Kans. Named for exposures on Mission Creek, SE. of Iowa Point, Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 185–187). The sh. overlying "middle Deer Creek ls." (Rock Bluff ls.) and underlying Ervine Creek ls. in Kans. contains 2 persistent subdivisions, the lower half consisting of hard black fissile sh. and upper half of gray to yellowish soft clay sh. Because this sh. appears exactly=Larsh sh., Haynies ls., and Mission Creek sh. of Nebr. it is here called *Larsh-Mission Creek sh. memb.* Its thickness is 2½ to 7 ft. [See also 1936 entry under *Haynies ls.*]

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser.), abandoned this name, as explained in 1937 entry under *Burroak sh.*

Missisquoi schist.

Upper Cambrian (?): Northeastern and southeastern Vermont.

C. H. Richardson, 1919 (11th Rept. Vt. State Geol., pp. 120–140, in a description of Roxbury, S. part of Washington Co.). No definite name has been applied hitherto to the sericite schists, save describing them as *sericite schists and quartz sericite schists.* Author proposes *Missisquoi schists* for this terrane, which is prevailing schist in Missisquoi River valley in N. part of State [in Orleans Co.]. It is the schist in which most if not all serpentine and talc beds occur on *east* side of Green Mtns. Is certainly pre-Ord. and tentatively referred to Lower Camb.

C. H. Richardson and C. K. Cabeen, 1921 (Vt. State Geol. Rept. State Geol. 1919–1920, in description of Braintree Twp). The *sericite schist and quartz sericite schist* are known as *Missisquoi schists.* They are continuous from Missisquoi Valley southward for more than 100 mi.

C. H. Richardson and C. K. Cabeen, 1923 (Vt. State Geol. Rept. 1921–22, pp. 109–140, in description of Randolph Twp, SW. part of Orange Co., NE. Vt.). *Missisquoi group* as here used is made to include the sericite schists, qtzite, and the *chlorite* *schists* that are of sed. origin; some of chlorite schists may be igneous. All terranes of the group are Camb., or at least they are pre-Ord.

C. H. Richardson, 1924 (Vt. State Geol. Rept. 1923–24, pp. 77–103, in description of Bethel Twp, NW. part of Windsor Co.). *Missisquoi group.*—No fossils, but unquestionably pre-Ord. Includes hornblende schists that may be of sed. origin; *certain chlorite schists* that seem to be of same age as enclosing sericites and qtzites, i. e., Upper Camb.; sericitic qtzites, regarded as Upper Camb., which grade into sericite schists that are younger than Bethel schist and older than Ord.; and, in places, a cgl. that is regarded as a basal cgl., but if not basal then it is an intraformational cgl. and the Missisquoi group of terranes might then be regarded as Lower Camb. Rests uncon. on Bethel schist (Lower Camb.).

C. H. Richardson, 1927 (15th Rept. Vt. State Geol., pp. 127–158, describing Barnard, Pomfret, and Woodstock Twps, in Windsor Co., SE. Vt.). *Missisquoi group.*—Sericite schists and sericite qtzites, with minor beds of chlorite schists, hornblende schist, and gneiss that may not in all cases be of sed. origin. Is youngest Upper Camb. terrane in eastern Vt. Conformably overlies Bethel group.

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 208–246). *Gassetts schist* is a new, and the oldest, memb. of Missisquoi group, Upper Camb.

E. L. Perry, 1929 (16th Rept. Vt. State Geol., p. 31), stated that this Missisquoi fm. was named for Missisquoi or Missisco River, which rises in town of Lowell [Irasburg quad., Orleans Co.], and flows northward into Canada, then swings S. again into Vt. and empties into Lake Champlain in NW. Vt. The rocks on Missisquoi River in NW. Vt. are not same as Missisquoi schist of Richardson of NE. Vt.

†Missisquoi formation.

Upper Cambrian: Northwestern Vermont (Franklin County).

A. Keith, 1924 (Vt. State Geol. Rept. 1923–24, p. 137, footnote). *Missisquoi fm.* is here applied to thin-bedded upper part of Milton dol. as defined by me in 1923. [See 1924 entry under *Milton dol.*]

P. E. Raymond, 1924 (Vt. State Geol. Rept. 1923–24, pp. 137–138, 197–202). [Describes the Upper Camb. fossils from thinly bedded ls. and conglomeratic strata exposed in gorge of Missisquoi River at Highgate Falls (at Highgate village, St. Albans quad.), which were named *Missisquoi fm.* by Keith.] "Fauna resembles that of Hoyt ls."

B. E. Howell and A. Keith, 1929 (16th Rept. Vt. State Geol., pp. 266–268), introduced *Mill River cgl.* to replace this name, which is preoccupied by Missisquoi schist of Richardson, an Upper Camb. fm. on E. side of Green Mtns, Vt.

Mississagi quartzite.

Pre-Cambrian (Huronian): Western Ontario.

A. Winchell, 1888 (4th Int. Geol. Cong., London, Am. Comm. Repts., p. A14). *Mississaugui (vitreous) qtzite.*

W. H. Collins, 1914 (Canada Geol. Surv. Mus. Bull. 8, p. 26, etc.). [See under *Bruce series.*]

Mississinewa shale.

Silurian (Niagaran): Northeastern Indiana (Wabash County).

E. R. Cumings and R. R. Shrock, 1927 (Ind. Acad. Sci. Proc., vol. 36, pp. 71–84). *Mississinewa sh.*—Drab to bluish-gray calc. sh. underlying Red Bridge ls. and forming basal exposed part of Niagaran in northern Ind. To this fm., from base of the yellow ls. above, downward as far as typical development continues, is given the name *Mississinewa sh.*, from its exposures along the Mississinewa, at or near river level, at Wabash and Lagro. True base of fm. has never been seen by writers. At Wabash 75 ft. is exposed. Elrod and Benedict, on basis of well logs, reported 114 ft. at Lagro, and stated that fm. is probably as much as 250 ft. thick. Includes the "thick-bedded argill. ls." and "hydraulic ls." of Collett (1872) and equiv. fms.; also the "laminated sh.," "cement rock," and probably the "hydraulic ls." of Elrod and Benedict (1892).

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 53, 56–71). *Mississinewa sh.* is lowest known fm. of Niagaran age in northern Ind. Fossils listed. Late Rochester and early Lockport time are represented in it. It includes all strata beneath Red Bridge ls. memb. of Liston Creek fm. and base of Niagaran. Thickness probably 250 ft. Should basal portion prove to be limy, then term *Mississinewa fm.* might be used. We can only conjecture what underlies it. It is conformable with Liston Creek fm., but in places is discon. overlain by younger fms.

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Mississinewa morainic system.

Pleistocene (Wisconsin stage): Western Ohio, northeastern Indiana and southern Michigan. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53. In some earlier repts called *Mississinawa moraine*. Named for river in Ind. *Mississinewa* is spelling adopted by U. S. Geographic Board.

†Mississippi slate series.

A term applied by R. D. Irving (U. S. G. S. 7th Ann. Rept., pp. 440–441, 1888) to the Huronian rocks of Mississippi River region of central and eastern Minn.

†Mississippi clays.

Miocene: Mississippi River basin.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 157, 330). *Mississippi clays.*—Clays developed in basin [embayment] of Mississippi River. Miocene of Grand Gulf petezone.

Replaced by Hattiesburg clay and Pascagoula clay.

Mississippi lime.

Name loosely applied in different parts of the country to rocks encountered in wells, which may or may not be wholly of Mississippian age.

†Mississippi group.

Same as Mississippian series. See U. S. G. S. Bull. 769, p. 73.

Mississippian epoch (or **series**).

The oldest epoch of the Carboniferous period, and the deposits formed during that epoch. For definition see U. S. G. S. Bull. 769, pp. 73–78. Some geologists now treat the Miss. deposits as a system.

Missoula.

Name applied by C. [R.] Keyes (Pan.-Am. Geol., vol. 46, 1926) to 50 ft. of lss. of Carbf. age in Mont. Derivation of name not stated.

Missoula group.

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deiss, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 677, figs. 2, 3). *Missoula group.*—Divided into (descending): Sheep Mtn fm., 1,000 to 2,300 ft.; Garnet Range fm., 7,600 ft.; McNamara fm., 3,000 ft.; Hellgate fm., 2,200 ft.; Miller Peak fm., 2,900 ft. Rests conformably on Wallace (Siyeh) ls. Thickest exposures lie in mtns E. of city of Missoula.

Missouri group.

Pennsylvanian: Northwestern Missouri and Iowa.

C. R. Keyes, 1893 (Iowa Geol. Surv., vol. 1, pp. 114–116). *Missouri fm. or Upper Coal Measures.*—Shales, lss., sss., and clays overlying Des Moines beds, or Lower Coal Measures, and underlying Cret. rocks in Iowa. Thickness 1,200 ft.

In subsequent repts, by Keyes and others, called *Missourian series, Missouri stage, Missourian fm., Missourian stage, Missourian div., Missouri group,* and *Missouri series, with different upper and lower limits.*

Adopted by U. S. Geol. Survey many years ago, as a group name, to include rocks from base of Hertha ls. memb. of Kansas City fm. up to top of Penn. in Iowa and NW. Mo., overlying Des Moines group; well-defined faunal break btw. the two. (See H. Hinds and F. C. Greene, Mo. Bur. Geol. Mines, vol. 13, 1915.) Owing to great number of named subdivisions of Penn. rocks in Kans. and SE. Nebr., the U. S. Geol. Survey has been accustomed to treat the major subdivisions of Des Moines and Missouri age as *groups*, and therefore does not use *Missouri group* and *Des Moines* *group* in its rock classification of those States. These names (*Missouri group* and *Des Moines group*) were not used by Kans. Geol. Surv. in its classification until 1917 (Moore and Haynes).

R. C. Moore (1931 and 1932) proposed to restrict *Missouri series*, as he called it, by removing at top the Wabaunsee, Shawnee, and Douglas fms., which he called *groups* and assembled under the name *Virgil series*. (See under *Virgil series*.) He divided his Missouri series into (descending) Pedee group, Lansing group restricted, Kansas City group restricted, Bronson group, and Bourbon group. In 1936 (Kans. Geol. Surv. Bull. 22, pp. 41–43) Moore included in his *Missouri series* (*redefined*) all rocks above discon. at base of his Bourbon fm. and below discon. at base of his Tonganoxie ss., the overlying beds being assigned to his Virgil series. The U. S. Geol. Survey has not had occasion to consider, for its publications, these modifications.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for development in NW. Mo. and along Missouri River, Iowa.

Missouri series, stage, etc.

See under *Missouri group*.

†Missourian series, formation, division.

Variants of *Missouri group*, employed by some geologists.

Missouri Mountain slate (also **shale**).

Silurian (late): Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Slates of Ark., Ark. Geol. Surv., p. 37). *Missouri Mtn sl.*—Mainly red clay sl., with green sl. in basal portion. Thickness 50 to 300 ft. Underlies Arkansas novaculite and overlies, probably uncon., Blaylock ss. May be Ord., Sil., or Carbf., but scarcely Dev. [As here defined replaces Slatington sh. of Purdue, and is applied to older rocks than those called "Missouri Mtn fm." in his earlier 1909 publication. This is established definition, while "Slatington sh." was never adequately defined and has been discarded.]

E. O. Ulrich tentatively refers this fm. to Cayugan epoch of Sil.

Named for exposures in Missouri Mtns, Polk and Montgomery Counties, Ark.

†Missouri Mountain formation.

Devonian and Pennsylvanian: Southwestern Arkansas.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557). *Missouri Mtn fm.*—Novaculite, ss., and sh. overlying Slatington sh. and composing top fm. of Ouachita Ord. area in Ark. Slatington sh. and Missouri Mtn fm. may possibly be of Sil. age. [As here defined the name was applied to beds which Purdue later in 1909 named *Arkansas novaculite* and *Fork Mountain sl.* The Arkansas novaculite is of Middle and Upper Dev. (?) age; the †Fork Mtn sl. is of Penn. age, and is now included in Stanley sh.]

Mistassini formation.

Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 197).

Mistassini limestone.

Pre-Cambrian: Quebec.

H. C. Cooke, 1919 (Jour. Geol., vol. 27, p. 74).

Mitchell limestone.

Mississippian: Southern Indiana.

C. E. Siebenthal, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., pp. 296, 298). *Mitchell ls.*—Impure lss., calc. shales, and fossiliferous lss., 150 to 250 ft. thick, overlying Bedford oolitic ls. [Spergen ls.] and underlying Chester or Kaskaskia group, although latter rocks are not present at Mitchell.

M. N. Elrod, 1899 (Ind. Acad. Sci. Proc. for 1898, pp. 258–267). Mitchell ls. of Siebenthal appears to extend from top of Bedford oolitic ls. to middle of Paoli ls. of this rept. *Mitchell ls.* is here restricted to 160 ft. of lithographic ls. and calc. sh. with chert inclusions, the lower portion argill. and hydraulic. It thus includes all of St. Louis ls. below Lost River chert (which underlies Paoli ls.), and it overlies Bedford oolitic ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29). *Mitchell ls.* of Ind. includes St. Louis, Ste. Genevieve, Cypress ss., and Tribune ls.

C. A. Malott, 1919 (Ind. Univ. Studies vol. 6, No. 40, pp. 7–20). *Mitchell ls.* extends to top of Beaver Bend ls., and includes St. Louis ls., Fredonia oolite, Gasper oolite, and Sample ss.

C. A. Malott, 1921 (Ind. Acad. Sci. Proc. for 1919, pp. 361–369). *Mitchell ls.*, 350 ft. thick, outcrops in so-called Mitchell Plain. Includes Gasper oolite, Fredonia oolite, and St. Louis ls.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 127). Ashley has estimated thickness of *Mitchell ls.* of Ind. to be btw. 350 and 400 ft. As the Mitchell includes the Ste. Genevieve, which is about 160 ft. thick, it leaves 190 to 240 ft. for the St. Louis.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 507). It would seem best to follow Butts' example, discarding Mitchell and returning to long established names St. Louis and Ste. Genevieve, and the latter procedure is adopted in present revision. *Mitchell* may still be used as a convenient handle for the whole mass of cavernous lss. btw. the Salem [Spergen] and the clastic Chester.

W. N. Logan, 1926 (Ind. Dept. Cons. Div. Geol. Pub. 55, pp. 342–343). *Mitchell ls.* extends from top of Salem ls. to top of Beaver Bend ls.

Named for Mitchell, Lawrence Co.

Mitchell sand.

Subsurface sand that has been said to correspond to Connellsville ss. memb. of Conemaugh fm. in some parts of western Pa. and in Ohio. Is 10 to 50 ft. thick, and lies 90± ft. below Pittsburgh coal. It has also been correlated by some geologists with the older Morgantown ss. memb. of Conemaugh fm. First found on Mitchell farm, sec. 10, Marietta Twp, Washington Co., SE. Ohio.

Mitchell's Ferry beds.

Eocene (upper): Eastern Texas and western Louisiana.

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1317). *Mitchell's Ferry beds.—Massilina pratti* zone in wells. Very fossiliferous, gray, glauconitic, sandy clay, green when wet. Thickness 100 ft. Exposed at Mitchell's Ferry, on Sabine River, Tex., also in Mount Vernon Parish, La., on E. bank of Bayou Toro in SE¼NW¼ sec. 6, T. 3 S., R. 11 W. Belong to Whitsett fm. Are possibly eastern equiv. of lower part of Falls City shales.

Mitten black shale member (of Pierre shale).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Mitten black sh. memb. of Pierre sh.*—Blue-black fissile sh. with few iron-stained calc. concretions. Marine fossils. Forms prominent scarp. Thickness 150 to 200 ft. Overlies Gammon ferruginous memb. of Pierre sh. and top lies 500 to 800 ft. below Monument Hill bentonitic memb. of Pierre. Named for exposures along Mitten Prong in T. 56 N., R. 68 W., Crook Co., Wyo.

Mizpah trachyte.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1911 (Min. and Sci. Press, vol. 102, pp. 560–561; also Rept on geol. of property of Montana-Tonopah Mining Co., Tonopah, Nev., published privately), and 1915 (Econ. Geol., vol. 10, pp. 713–769). *Mizpah trachyte.*—Oldest rock of Tonopah dist. Called "earlier andesite" in U. S. G. S. P. P. 42, 1905. Its lower part is "Glassy trachyte," into which the Mizpah trachyte proper grades. Is intruded by West End rhyolite. Thickness 700+ ft. Named for Mizpah Hill, Tonopah dist.

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, pp. 15–17). The "earlier andesite" of Spurr as originally defined included Sandgrass andesite of Spurr's 1915 rept (Econ. Geol., vol. 10, pp. 713–769). The name *Mizpah trachyte* is retained in present rept, although the rock is in reality a keratophyre or albite trachyte. A thickness of at least 2,000 ft. is indicated by hanging-wall exposures in Sand Grass and Tonopah Extension mines. Top is not known, except where it is uncon. overlain by Fraction breccia. It conformably overlies Tonopah fm. and must therefore be slightly younger. The "glassy trachyte" is here included in Tonopah fm.

Moab sandstone member, also **Moab tongue** (of Entrada sandstone).

Upper Jurassic: Central eastern Utah (Moab region).

J. B. Reeside, Jr., C. E. Dobbin, A. A. Baker, and E. T. McKnight, 1927 (A. A. P. G. Bull., vol. 11, No. 8, pp. 787, 799, 804, 805). *Moab tongue of Entrada ss.*—In unpublished rept by W. T. Lee was called *Moab ss.* Is top part of Entrada ss., and of lighter color than rest of Entrada. Thins out to W. into Summerville fm., with which it intertongues.

C. H. Dane, 1935 (U. S. G. S. Bull. 863). *Moab ss. memb. of Entrada ss.*—White cross-bedded fine-grained quartz ss., massive or in thick beds, with a few red sh. partings. Upper part of Entrada ss.

Named for exposures in Moab Valley, but not at or very near Moab.

Moat volcanics.

Late Devonian or late Carboniferous: Northern New Hampshire (North Conway quadrangle, White Mountains).

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, pp. 89+). In North Conway quad. two large areas of volcanics are exposed, the type loc. on Moat Mtn and a second large area on Mount Kearsarge (Mount Pequawket). These are composed of siliceous flow rocks and interbedded tuffs and breccias. I propose name *Moat volcanics* to include the Pequawket breccia and "quartz porphyry" of Hitchcock. (The "quartz porphyry" is=*South Moat flows* of this paper.) Thickness 8,300 to 11,800+ ft. Rest uncon. on Intervale clay slates. Are intruded by Albany and Conway granites. Type loc. on South Moat Mtn, North Conway quad., where excellent section is exposed from elev. 1,100 ft. upwards on South Moat trail to Red Ridge.

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 12–13, map). Remnants of *Moat volcanics* are present in Franconia quad., where the fm. is uncon. on Talford schist, from which it is separated by long erosion period. It is definitely younger than New Hampshire magma series; can not be older than late Dev., and may be late Carbf. Introductory fm. of White Mtn magma series. Thickness exposed in this quad. is 1,500± ft.; upper part has been cut away.

Moberly channel sandstone.

Pennsylvanian: Northern central Missouri.

C. F. Marbut, 1898 (Mo. Geol. Surv. vol. 12, pt. 2 (Sheet Rept. 12), pp. 323, 324, 331–332, 350). *Moberly ss.*—Sss., shales, and cgls., of unknown thickness, with basal cgl. of waterworn fragments of ls. and sh. Usually more heavily bedded and coarser than underlying Coal Measures sss., and often cross-bedded. Uncon. overlies Middle Coal Measures and underlies Pleist. drift, in Randolph, Howard, Chariton, and Monroe Counties.

Is a channel deposit, 0 to 100 ft. thick, occupying depressions in Pleasanton fm., and probably of Pleasanton age and contemp. with Warrensburg ss. Named for exposures at Moberly, Randolph Co.

†Mobile formation.

†Mobile Bay formation.

Pleistocene: Southwestern Alabama.

E. A. Smith, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 285–296).

E. A. Smith, L. C. Johnson, and D. W. Langdon, Jr., 1894 (Ala. Geol. Surv. Rept. Coastal Plain, pp. 47, 50). *Mobile Bay fm.* (*Mon Louis Island*).—Stump-bearing clay which borders Mobile Bay and extends up larger rivers to inland margin of coastal plain. A phase of Port Hudson which we have called *Mobile or Mon Louis Island Terrace.* [On p. 47 is heading: *Estuarine or transition formations (Mobile).*] We have therefore in Mobile fm. a post-Tert. or Pleist. fm. younger than the Lafayette and older than the "Outside Keys" and older than the first bottoms of the rivers, and formed during the last great depression of the coast, preceding the last considerable elevation and of course preceding the subsidence that is now in progress. The shells which characterize the fm. could not have flourished here except at a time when Mobile estuary was freely open to the deep sea. This would make it contemp. with lower part of the Port Hudson and Biloxi, and it corresponds also with older part of second terrace deposits of the rivers. The Mon Louis or Mobile fm. forms natural connection btw. the marine Pleist. of outer coasts and the fresh-water Pleist. of rivers. Full extent of fm. not definitely known. Thickness undetermined.

Only known uses of names. According to C. W. Cooke (personal communication) the deposits are probably=Pamlico fm. of Atlantic Coast.

Moccasin limestone.

Middle Ordovician (Lowville): Northeastern Tennessee and western Virginia.

M. R. Campbell, 1894 (U. S. G. S. Estillville folio, No. 12, p. 2). *Moccasin ls.*—Red argill. ls., passing into blue flaggy Chickamauga ls. below and into blue and yellow Sevier sh. above, being intermediate btw. the deep-sea deposits of NW. part of quad. and aren. shore deposits of Bays syncline. Max. thickness 500 ft.

G. W. Stose, 1923 (Va. Geol. Surv. Bull. 24). *Moccasin ls. memb. of Lowville ls.*—Reddish argill. ls., 50 ft. thick, composing upper part of Lowville ls. in Wise and Scott Counties, Va. Underlain by fine-grained drab ls. of Lowville age.

According to late studies of C. Butts the Moccasin ls. is a facies of Lowville ls., and the two facies occur in different areas, *Moccasin ls.* being appropriate in SE. belts as far N. in SW. Va. as Roanoke, and *Lowville ls.* being appropriate along NW. side of the valley as far S. as latitude of Morristown, Tenn. These are the definitions at present followed by U. S. Geol. Survey.

Modelo formation.

Miocene (upper): Southern California (Ventura and Los Angeles Counties).

G. H. Eldridge, 1907 (U. S. G. S. Bull. 309). *Modelo fm.*—Consists of 1,700 to 6,000 ft. of strata, divided into a lower ss., massive and heavy-bedded, 200 to 2,000 ft. thick; overlain by 400 to 1,600 ft. of earthy sh., gray to brown, with ls. concretions that weather yellow; succeeded by upper ss. memb., about 900 ft. thick and similar to lower ss. memb. except that it is nonconcretionary and thinner-bedded. Top memb. consists of a body of brown, gray, or yellowish sh. of uncertain thickness (due to erosion uncon. above it) but variously estimated at btw. 200 and 1,500 ft. The upper sh. memb. is indistinguishable from the sh. btw. the two sss.; both vary from granular siliceous to earthy and fissile, and both carry calc. layers and here and there lenticular ls. concretions. Rests on Vaqueros ss. [younger than true Vaqueros, according to Kew] and is uncon. overlain by Fernando fm. The fm. is well developed in Hopper Canyon and at head of Modelo Canyon, Ventura Co.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753). The beds called *Vaqueros ss.* by Eldridge are younger than true Vaqueros ss., and *Modelo fm.* is here redefined to include Modelo fm. and the 2,000 to 3,000 ft. of so-called Vaqueros of Eldridge, all of which are upper Mio. As redefined the Modelo aggregates 9,000 ft. in thickness. It is primarily clay, diatomaceous sh. and fine-grained laminated ss. and cherty beds, and contains two or three large lenses of coarse brown and tan ss. varying in thickness up to about 4,000 ft. It rests uncon. on Topanga fm., and is uncon. overlain by Pico fm., the basal div. of Fernando group.

Later work by Kew and others proved that typical Modelo contains beds=Topanga fm. (middle Mio.), but U. S. Geol. Survey follows Kew's 1924 definition, which restricted Modelo to upper Mio. beds, believing that that usage will be more useful, and that the Topanga may eventually be separated from type Modelo.

Modin formation.

Lower Jurassic: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). An extensive succession of tuffaceous beds, overlain by a greater mass of compact, fine gray shaly sss. and shales, with a few small lenses of ls. At base an extensive bed of volcanic cgl., having max. thickness of about 400 ft. in Bear Mtn. Estimated thickness of fm. 3,000 ft. Rests uncon. on Brock sh. The relation of *Modin fm.* to overlying Potem fm. appears to be one of conformity, though Modin epoch closed at a time of vigorous volcanic activity, especially in vicinity of Bagley Mtn. [See *Bagley andesite.*] Named for exposures on Modin Creek, near mouth of which, in NE. part of Redding quad., the fm. has yielded most of its fossils.

Modoc limestone.

Mississippian (lower): Southeastern Arizona (Clifton-Morenci region).

W. Lindgren, 1905 (U. S. G. S. P. P. 43). *Modoc ls.*—Coarse blue or gray lss., exceptionally pure, with subordinate strata of qtzite and dol.; the gray ls. is characteristic part and recurs at many places. Thickness 170± ft. South of Modoc Mtn the fm. consists of (descending): (1) Coarse blue fossiliferous ls. in benches 2 to 3 ft. thick, 4 to 10 ft.; (2) *"Gray Cliff" ls.*, consisting of 75 to 85 ft. of light-gray coarse ls. with crinoid stems, in 2-ft. benches; (3) light grayish-brown dolomitic ls., 60 ft.; (4) white or reddish calc. qtzite, 15 to 17 ft.; (5) massive bench of gray coralliferous ls., 8 to 10 ft. Rests conformably on Morenci sh. and is uncon. overlain by Pinkard fm. (Cret.).

Modoc quartz monzonite.

Eocene: Central northern Colorado (Boulder County).

P. G. Worcester, 1921 (Colo. Geol. Surv. Bull. 21, pp. 30–31). *Modoc quartz monzonite porphyry.*—Occurs in a single dike, which is found in Modoc mine, about ½ mi. due N. of Ward. The dike extends E. for about a mile.

Modoc lavas.

Tertiary (?): Northwestern Nevada (Washoe County).

R. W. Chaney, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 162–163). *Modoc lavas* overlie Davis Creek beds in Washoe Co., Nev. The Davis Creek beds contain plants that seem to establish their Mio. age. [Derivation of name not stated.]

Modoc basalt.

Recent: Northern California (Modoc lava-bed quadrangle).

H. A. Powers, 1932 (Am. Min., vol. 17, No. 7, pp. 253, 273, map). *Modoc basalt.*—A group of Recent basalt flows and cones the eruption of which began after the glaciation and continued to present time. The youngest of these is certainly not over 500 yrs old. Most of these flows and cinder cones are found in 2 areas, one the Modoc Lava beds on NE. slope of Medicine Lake Highland and the other on southern slope of the Highland. A few flows are scattered along eastern and western flanks of the Highland, and a few eruptions took place at top of the Highland in vicinity of Medicine Lake. Little Mount Hoffman is a Modoc basalt cone containing small irregular intrusives. The rock of most of the flows is dark gray, usually aphanitic, variably vesicular, and rarely visibly porphyritic.

†Modoc porphyry.

Name locally applied to a rhyolite porphyry, of Mio. or Plio. age, in Butte, Mont., dist.

Moduria limestone series.

Misprint (on p. 273 of U. S. G. S. Bull. 191) for *Maclurea ls.*

Moenkopi formation.

Lower Triassic: Arizona, southern Utah, southeastern Nevada.

L. F. Ward, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 401–413). *Moencopie beds.*—Consist of (descending) 200 ft. of dark chocolate-brown argill. and saliferous sh.;

100 ft. of soft dark-brown argill. sss.; 200 ft. of dark-brown argill. sh.; 100 ft. of white calc. sh.; and 100 ft. of saliferous argill. sh. Rest uncon. on Upper Aubrey [Kaibab ls.] (Carbf.) in Little Colorado Valley. Underlie Shinarump cgl.

In some subsequent repts Moenkopi fm. was defined as underlying De Chelly ss. In other repts De Chelly ss. was placed in lower part of Moenkopi. But true De Chelly ss. is now known to be of Perm. age, to be=uppermost part of Coconino ss., and to belong to Cutler fm. At De Chelly Canyon, Ariz., it is top memb. of Cutler fm. (Perm.), and is uncon. overlain by Moenkopi fm. (Triassic). At Fort Defiance, Ariz., some red beds of the Cutler separate the light-colored De Chelly ss. from the uncon. overlying Moenkopi, which is, in turn, uncon. overlain by Shinarump cgl. At places in Ariz. (Grand Canyon, Lees Ferry, Red Canyon, Little Colorado River, etc.) and Utah (Circle Cliffs, San Rafael Swell, etc.) the Moenkopi rests on Kaibab ls. (See A. A. Baker and J. B. Reeside, Jr., A. A. P. G. Bull., vol. 13, No. 11, pp. 1413-1448, 1929.) This is present approved definition of Moenkopi fm.

Named for Moenkopi Wash, Grand Canyon, Ariz.

†Moenkopian series.

A term employed by C. [R.] Keyes to designate the Lower Triassic Moenkopi fm.

Mogollon andesite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). *Mogollon andesite.*—Dominantly andesitic flows, but includes dacite flow near top and possibly other dacite flows. Underlain by a few ft. of red ss. Thickness 250 to 600 ft. Uncon. overlain by Dog Gulch fm.

Named for prominent outcrops near town of Mogollon.

†Mohave formation.

Tertiary (probably Eocene): Southern California (Mohave region).

J. H. Smith, 1900 (Jour. Geol., vol. 8, pp. 455-456). *Mojave fm.*—A fm. in SE. Calif. described [but not named] by H. W. Fairbanks (Am. Geol., vol. 17, 1896, p. 63 [also 67-68]), as consisting of a series of beds of clays, ss., volcanic tuffs, and interbedded lava flows, probably 1,000 ft. or more thick, occurring on N. slope of El Paso Range, btw. Mojave and Owen's Lake, and probably extending over considerable area btw. El Paso Range and Sierra Nevada. Finely exposed in Red Rock Canyon and about Black Mtn; tilted northward at angle of 15-20°. Fossil plants identified by F. H. Knowlton as without doubt Tert. and as probably Eo.

†Mohawk limestone.

Middle Ordovician: Eastern New York.

T. A. Conrad, 1839 (Phila. Acad. Nat. Sci. Jour., vol. 8, pt. 1, pp. 228-235; N. Y. Geol. Surv. 3d Ann. Rept., pp. 57-66). *Mohawk ls.*—Underlies Trenton ls. and overlies Birdseye [Lowville] ls. Characterized by *Orthostonia communis*. Included in Mohawk system. [Applies to post-Lowville part of Black River group, or to beds now called *Amsterdam ls.* Some succeeding early N. Y. repts gave following succession (downward): Trenton ls., Birdseye ls., Mohawk ls., Calciferous sandrock. Other repts state that Mohawk ls. is base of Trenton ls.]

Named for development in Mohawk Valley.

†Mohawk system.

Silurian, Ordovician, and Upper Cambrian: New York.

T. A. Conrad, 1839 (Phila. Acad. Nat. Sci. Jour., vol. 8, pt. 1, pp. 228-235). *Mohawk system or Lower Silurian group.*—Includes (descending) Clinton group [exclusive of Rochester sh.], Niagara ss., shales of Salmon River, unnamed black sh.

that is—Trenton ls., Mohawk ls., Birds-eye ls., Calciferous ss., and Potsdam ss. Is overlain by Niagara [Rochester] sh. "The Cambrian, which was supposed to underlie the Silurian system, having proved to be composed of members of the latter group, I include in our Silurian."

†Mohawk slate group.

Upper Ordovician: Eastern New York.

W. W. Mather, 1841 (N. Y. Geol. Surv. 5th Ann. Rept., pp. 91–94, 98–101, 129). *Mohawk sl. group (Black sl. of Vanuxem)*.—More or less fissile and interstratified with thin layers of ss. and ls. Passes into underlying Trenton ls. by gradual interstratification of thin bands of sl. in the ls. Overlain by Frankfort sl. group.

Now replaced by Utica sl.

†Mohawk group.

Middle and Lower Ordovician: New York (Mohawk Valley).

J. Hall, 1842 (Am. Jour. Sci., 1st, vol. 42, p. 52). The ls. along Mohawk valley, the principal memb. of which is termed by Mr. Vanuxem the "Mohawk ls.," a name which with much propriety might be applied to the whole mass, forming the *Mohawk group*. This would include Mohawk, Birdseye, and Trenton lss.; and calciferous sandrock [Beekmantown] might also be included as lower memb. of the group.

Mohawk lake beds.

Miocene (upper): Northern California (Plumas County).

H. W. Turner, 1891 (Wash. Phil. Soc. Bull. 11, pp. 385–410). *Mohawk lake beds*.—Lake beds of fine stratified material deposited in Mohawk Valley and vicinity, in Plumas Co., during Plio. and Pleist. time. Rest on Tert. igneous rocks (andesites and rhyolites) and are overlain by recent alluvium.

According to J. P. Smith (Calif. State Min. Bur. Bull. 72, p. 37, 1916) these beds are of upper Mio. age.

Mohawkian series (or **epoch**).

Provincial series of Middle Ordovician rocks as developed in Eastern States and the time covered by their formation. Includes Trenton and Black River time. Defined by J. M. Clarke and C. Schuchert (Sci., n. s., vol. 10, pp. 876, 877, 1899). Rocks typically developed in valley and watersheds of Mohawk River, N. Y. For definition see U. S. G. S. Bull. 769, pp. 86–87.

Mohegan granite.

Pre-Cambrian: West Point quadrangle, southeastern New York.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, pp. 29, 35, 40, 42, 43, 64). *Mohegan granite*.—Same as Peekskill granite, which is quarried about 4 mi. E. of Peekskill and also a little E. of road running S. from Mohegan Lake. The product is known in the trade as *Mohegan granite*.

Named for exposures about Mohegan Lake.

†Mohegan Bluff beds.

†Mohegan Bluff series.

Pleistocene: Block Island, Rhode Island.

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 978 and table opp. p. 988). *Mohegan Bluff series*.—At Mohegan Bluffs, on Block Island, consists of blue clays with ice-scratched bowlders above, underlain by sands and gravels, to which succeed clayey beds resting on bluish carbonaceous clays probably of Cret. age. Belongs to Tisbury subepoch. Preceded Vineyard interval.

J. B. Woodworth, 1897 (Geol. Soc. Am. Bull., vol. 8, p. 210). *Mohegan Bluff beds*.—Nearly horizontal sands and clays, with boulders and cobbles. Equiv. to Tisbury beds on Marthas Vineyard. Typically exposed in upper part of Mohegan Bluffs. Uncon. overlain by glacial drift of last glacial stage. Uncon. overlies Sankaty beds.

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52), divided the beds exposed at Mohegan Bluffs, Block Island, that are uncon. overlain by last Wisconsin glacial drift and uncon. underlain by Weyquosque fm. (=Sankaty sand), into (descending): Manhasset fm. (including all 3 of its members—Hempstead gravel memb., Montauk till memb., and Herod gravel memb.), Jacob sand, Gardiners clay, and Jameco gravel.

Moheganter shales and sandstones. (In Hamilton group.)

Middle Devonian: Eastern New York (Schoharie Valley).

A. W. Grabau, 1930 (Sci. Quart. Nat. Univ. of Peking, China, vol. 1, No. 4, p. 14). *Moheganter shales and sss.*—Represent all of Hamilton group in Schoharie Valley, that is the beds which in the section of Ulster Co. are represented by the Ashokan, Mount Marion, and probably part of so-called Marcellus shales. In Schoharie Valley these beds contain typical Hamilton fossils from top to bottom. Thickness 1,500 ft. They are abruptly capped by Sherburn ss., the base of which represents horizon of Tully ls. farther W.

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, p. 551). Grabau proposed *Moheganter shales and sss.* for the fossiliferous Hamilton beds which Prosser and others thought represented all of the Hamilton. It is now known that Prosser failed to recognize the upper Hamilton in Schoharie Valley, and therefore the Moheganter beds do not represent the complete Hamilton but a little more than half of it. The name *Panther Mtn*, here proposed, is preferred to Grabau's name, because Moheganter Mtn does not furnish an adequate type section for interval writer wishes to define, and the limiting Portland Point memb. is not known to occur there.

Mohnian stage.

Tertiary: California.

See under *Zemorrian stage*, R. M. Kleinpell, 1934.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224). *Mohnian stage* includes Briones fm., middle Monterey, Tice, and Rodeo shales, etc.

Moingona till.

A term introduced by C. [R.] Keyes to cover an early Pleist. deposit in Iowa. (See Pan-Am. Geol., vol. 58, p. 203, 1932.)

Moingonan glacial epoch.

A term introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 44, pp. 139–142, 1925) to cover the time of deposition of an old glacial till encountered in deep excavations in city of Des Moines, Iowa, which he considers to be of pre-Nebraskan age. Named after the old pre-glacial Moingona River (Iowa Acad. Sci. Proc., vol. 25, pp. 551–559, 1920), in a tributary deep gorge of which the till remnant is now revealed.

Moira granite.

Pre-Cambrian (Huronian): Western Ontario (Hastings County).

W. G. Miller and C. W. Knight, 1914 (Ontario Bur. Mines Rept., vol. 22, pt. 2, p. 4). Intrusive.

†Mojave formation.

See *Mohave*.

Mokapu basalt.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Mokapu basalt.*—Included in lower part of Honolulu volcanic series [q. v.]. Named for Mokapu Peninsula.

Mokulea basalt.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Mokulea basalt.*—Included in lower part of Honolulu volcanic series [q. v.]. Composes Mokulea Rock, in Kailua Bay.

Moku Manu volcanics.

Pleistocene (late): Hawaii (Moku Manu).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Moku Manu volcanics.*—Lithic tuff, basalt, and cinders composing Moku Manu, which consists of two islands, one 202 ft. and the other 132 ft. high. Included in lower part of Honolulu volcanic series [q. v.].

Molas formation.

Pennsylvanian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120, and Geol. Soc. Am. Bull., vol. 16, pp. 470–496). *Molas fm.*—Red calc. shales and sss. with chert, ls., and qtzite pebbles and thin fossiliferous ls. lenses. The ls. lenses contain Penn. fossils. The chert and ls. pebbles often contain fossils from Miss. part of underlying Ouray ls., with which it is uncon. Thickness 75 ft. Is conformably overlain by Hermosa fm. The Molas is absent in area where Hermosa fm. was first defined, and therefore was not included in original Hermosa.

The Miss. part of Ouray ls. as first defined is now called Leadville ls., and *Ouray ls.* is restricted to the Upper Dev. part.

Named for exposures on Molas Lake, Needle Mtns quad.

Mollie Miller sand.

A subsurface sand in South Ponca field, central eastern Okla., which is reported to correspond to Sylamore ss. memb. of Chattanooga sh. (Dev.?). Named for Mollie Miller lease, where first recognized.

Mollman sand.

A subsurface sand, of Ord. age, in Okla. City oil field, central Okla., that has been correlated with a lower part of Simpson fm. It is said to be basal 30 ft. of *School Land ss.*, q. v.

Momable slates.

Pre-Cambrian: Newfoundland.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 219).

Mona schist.

Pre-Cambrian (Keewatin): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 490+). *Mona schists.*—Nonconglomeratic greenstone schists, many of which are probably altered tuffs, while others are squeezed basic lavas. Some of schists are banded, others aphanitic, others resemble epidiorite, others might be called amphibolites, others strongly resemble true crystalline schists. All are older than the granites of Basement Complex, and of about same age as the conglomeratic Kitchi schist. Exposed on Mona Hills, SW. of Marquette.

Later repts state that Kitchi schist may be younger than Mona or may be of same age.

Mona limestone. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1917 (W. Va. Geol. Surv. Rept. Braxton and Clay Counties, p. 191). The ls. immediately at base of Lower Connellsville ss. in Mona section, as described in Monongalia-Marion-Taylor Co. rept, is not Clarksburg ls., which overlies Lower Connellsville ss., but represents an unclassified ledge which could appropriately be referred to as *Mona ls.*, from Mona, Monongalia Co. [This ls. is described in Monongalia, Marion, and Taylor Co. rept as consisting of 10 to 30 ft. of dark-gray hard ls. with interbedded limy shales.]

Mona shale.

Oligocene: Panama and Costa Rica.

D. F. MacDonald et al., 1919 (A. A. P. G. Bull., vol. 3, p. 364).

†Monarch formation.

Upper and Middle Devonian: Central northern Montana (Fort Benton quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Monarch fm.*—Rocks readily distinguished by color and crystalline granular texture from lss. above and below. Includes both Jefferson and Threeforks fms, to S. Greater part of total thickness of 130 ft. consists of Jefferson lss. (dark-colored, usually chocolate-brown or bluish-black, finely crystalline lss. that weather with pitted surface, carry Dev. fossils, and often show a fine striping, due to slight color variations). The upper 30 ft. consists of reddish shaly lss., also carrying Dev. fossils. Underlies Madison ls. and overlies Barker fm. [Mapped at and around village of Monarch, in SW. corner of Fort Benton quad.]

Monclova sandstone.

Lower Devonian: Northwestern Ohio.

E. Orton, 1888 (Ohio Geol. Surv. vol. 6, p. 20) and 1890 (Ohio Geol. Surv., 3d Organization, 1st Ann. Rept., p. 24). *Monclova or Holland ss.* occupies same position in the series as Sylvania ss.

Named for Monclova, Lucas Co.

Monclova shale.

Cretaceous: Mexico.

E. Ordóñez, 1908 (Min. and Sci. Press, vol. 96, p. 363).

Moneague.

Tertiary: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 75).

Moneta biotite-hornblende gneiss.

Pre-Cambrian: Central western Virginia (Bedford County).

A. A. Pegau, 1932 (Va. Geol. Surv. Bull. 33, pp. 22-26, 83, pl. 4). *Moneta biotite-hornblende gneiss.*—Occurs in area mapped as *Lynchburg gneiss* (*pre-Camb.*) on 1928 map of Va. It is described as mica gneiss and mica schist, in part garnetiferous. The gneiss in Moneta-Bells area differs so much from general character of Lynchburg gneiss that writer has named it *Moneta gneiss*, from Moneta, Bedford Co., where it is best known. It is prevailing type in Moneta-Bells area. Consists of two distinct lithologic types, biotite gneiss and hornblende gneiss, so intimately associated that they cannot be mapped separately. The two types may (1) represent different beds in original sediments, (2) both be of igneous origin, or (3) one may be igneous and the other sedimentary.

Monitor sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1915 (W. Va. Geol. Surv. Rept. Boone Co.). The name of the massive, bluish gray, medium grained, hard, micaceous ss., 20 to 40 ft. thick, lying 0 to 5 ft. below Alma coal and 1 to 5 ft. above Little Alma coal, is now changed from *Logan ss.* (preoccupied) to *Monitor ss.*

Named for exposures at Monitor, Logan Co.

Monitor (Lower) sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., p. 274). The name *Lower Monitor ss.* is suggested for the ledge in Logan and Mingo Counties that was erroneously correlated with Peerless ss. on pp. 103 and 183 of Logan and Mingo Co. rept. [For description see Hennen and Reger, 1914, under *Peerless ss.*]

Monitor Mountain limestone member.

Mississippian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 48 and passim). *Monitor Mtn ls. memb.*—Top memb. of Madison ls. (lower Miss.), nearly every good exposure of which in this area contains typical Madison fauna. Most striking feature of this memb. is its large amount of argill. matter. Lower 26 ft., fine-grained white argill. ls., which breaks with conchoidal fracture and weathers white gray. Near base is 2½ ft. of gray fine-grained sandy qtzite. Overlying 54 ft. is argill. fine-grained cream-colored ls. and some crumbly argill. ls. Overlying this are 182 ft. of white, slightly sandy argill. ragged lss. that weather clayey but of more white-gray color than underlying. Upper 20 ft., very massive thick-bedded pale buff-gray argill. ls., which exhibits an occasional pinkish cast on fresh surfaces and weathers white buff. Thickness of fm. 0 to 282 ft. Only known occurrence is in NE¼ sec. 18, T. 17 N., R. 7 W., on upper ridge and top of Monitor Mtn, where it is 282 ft. thick. Overlies Rooney chert memb.

Monk formation.

Pre-Cambrian: Southeastern British Columbia, northwestern Idaho, and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 6 and 7). *Monk fm.*—Alternating phyllites and metamorphosed (schistose) grits, sss., and cgls., of gray colors.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 147, 178, 194). *Monk fm.*—Qtzite, phyllite, cgl., and schist, 5,500± ft. thick. Conformably underlies Wolf fm. and conformably overlies Irene volcanics—all included in Summit series of Selkirk Mtns at 49th par. Exposed on summits just N. of Monk Creek, B. C., for which it is named.

Monkey Hill formation.

Oligocene: Panama.

E. Howe, 1908 (Am. Jour. Sci., 4th, vol. 26, p. 228).

Monkton quartzite.

Lower Cambrian: Northwestern Vermont (Addison County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 106). *Monkton qtzite.*—Oldest fm. in central sequence. Base not known, because lowest red beds rest on Ord. rocks along a thrust-fault plane. Named for town of Monkton, 20 mi. nearly S. of Burlington, where relations to overlying beds are well shown. Is almost wholly qtzite, in layers from a few inches to 3 ft. thick. A few seams and beds of reddish or purplish sh. most of them only a few inches thick, are interbedded with the qtzite in lower part of fm. The qtzite has a decided reddish color, varying from reddish brown through brick red and purple to light shades of red, pink, buff, and white; the white beds are more numerous at top, especially N. of Burlington, where they are as important as the vari-colored beds. In upper part of fm. a few thin layers of gray or pink dol. form transition to overlying Winooski marble. Quartz cgl. in thin layers has been reported from a few places by several geologists but has not been observed by writer. Full thickness of fm. unknown, but 300 ft. are seen in sections in Colchester Twp. Contains Lower Camb. fossils.

Mon Louis formation.

Pleistocene: Southwestern Alabama.

See description under †*Mobile fm.*

Name derived from Mon Louis Island, on W. coast of Mobile Bay.

Monmouth group (also **formation**).

Upper Cretaceous: New Jersey, Delaware, and northeastern Maryland.

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 315, 331). *Monmouth fm.*—Name is now proposed for first time, from Monmouth Co., N. J. Underlies Rancocas fm. [group] and overlies Matawan fm. Thickness 60 to 150 ft. Divided into (descending) Redbank sands, Navesink marls, and Mount Laurel sands.

The Monmouth is now classified as a group in N. J., and its subdivisions (Redbank sand, Navesink marl, and Mount Laurel sand) as fms. In Md., where the subdivisions are not recognized, it is called *Monmouth fm.*

Mono limestone.

Mississippian (upper): Central northern Utah (Ophir district).

S. G. Olmstead, 1921 (Econ. Geol., vol. 16, pp. 438, 452, 453). Great Blue ls. fm. is locally known as *Mono* in Ophir dist.

Evidently named for Mono mine, which is in Deseret ls., Humbug fm., and †Great Blue ls., according to J. Gilluly (U. S. G. S. P. P. 173, p. 154, 1932).

Mono series (also Monon series).

Terms applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 51, 53, 79), to 2,600 ft. of lss. in Nev. and Calif., said to be of early Camb. age and to be older than Prospect Mtn qtzite. "Term derived from Mono Co., Calif."

Mono shale.

Eocene (?): Southern California (southern part of Santa Ynez quadrangle, Santa Barbara County).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 10, pp. 350, 352, pl. 46, and map). At type loc. the *Mono sh.* consists of a series of sandy gray shales, in beds up to 4 inches thick, interbedded with light-gray, medium fine-grained micaceous sss, varying in thickness from 1 to 4 inches. In lower part some of softer shales are locally contorted. Oval concretions occur locally. Toward top are impure ls. ledges 1 to 2 ft. thick. At base is a rather hard massive coarse-grained ss. about 50 ft. thick. Total thickness of fm. 700 ft. Rests conformably on Indian cgl. and is conformably overlain by Sierra Blanca ls. No fossils, but believed to be of marine origin. Extends from Mono Creek to Santa Cruz Creek; also occurs on SE. side of Big Pine Mtn. Named for exposure in canyon of Mono Creek, at mouth of Roble Creek, Santa Barbara Co.

M. F. Keenan, 1932 (San Diego Soc. Nat. Hist. Trans., vol. 7, No. 8, pp. 53–84). Paleontologic evidence points to Cret. (Chico) age of *Mono sh.* and Indian cgl., instead of Eo.

Monon series.

A term employed by C. [R.] Keyes to cover 2,000 ft. of shales, of early Camb. age, in Utah, to which he has applied name *Timpanogos*.

Monongahela formation.

Pennsylvanian: Western Pennsylvania, eastern Ohio, West Virginia, and western Maryland and Virginia.

H. D. Rogers, 1840 (Pa. Geol. Surv. 4th Ann. Rept., p. 150). *Monongahela series*.—The Upper Coal Measures. Exposed in valley of Monongahela River. Includes the beds entitled Pittsburg series in my last annual rept. and rests on Allegheny series, the bdy btw. the two being marked by final outcrop of the shales which are exposed just above Ohio River at Pittsburg.

J. J. Stevenson, 1873 (Am. Phil. Soc. Trans., vol. 15, n. s., pp. 15–32). *Upper Coal Group* (*Monongahela River series*), extends from top of Waynesburg ss. to base of the 3 ft. of fireclay that underlies Pittsburg coal. [This definition corresponds with current definition of *Monongahela fm.* (the shorter name) except that top of Waynesburg coal has for many years been accepted as top of the Monongahela, the succeeding 1 to 15 ft. of Cassville sh. and overlying Waynesburg ss. being included in Washington fm.]

The present Pa. Geol. Survey classifies the Monongahela as a *group*. The U. S. Geol. Survey classifies it as a *fm.*

Named for exposures along Monongahela River, Pa.

Monongahela group.

Monongahela series.

See under *Monongahela fm.*

Monongahela system.

A term applied by F. Platt (2d Pa. Geol. Surv. Rept. L, 1876) to Monongahela fm. of present nomenclature.

†Monongahela River series.

See J. J. Stevenson, 1873, under *Monongahela fm.*

†Monongahela River coal series.

Permian and Pennsylvanian: Western Pennsylvania and northern West Virginia.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_5, p. xxiii). *Monongahela River coal series* includes Upper Barren Measures (divided into Greene County group above and Washington County group below) and the Upper Productive Coal Measures [Monongahela fm.] overlying the Allegheny River coal series.

W. G. Platt, 1878 (2d Pa. Geol. Surv. Rept. H_4). [Used same definition as above, and stated that base of Monongahela River coal series was base of Pittsburg coal.]

Monroan.

A time term applied by A. W. Grabau, 1909 (Sci., n. s., vol. 29, pp. 351–356), to upper part of Cayuga group (Sil.) of N. Y. and contemp. deposits elsewhere. As defined included (descending) Manlius, Rondout, Cobleskill, and Bertie fms. of N. Y., Sylvania ss. of Mich. and Ohio (now assigned to Lower Dev.), and the so-called "Lower Monroe" of old repts, which is now known as *Bass Islands dol.*

See under †*Monroe group.*

†Monroe beds.

†Monroe formation.

†Monroe group.

Lower Devonian and Silurian: Michigan (Lower Peninsula) and northern Ohio.

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *Monroe beds*, 100 to 220 ft. exposed, underlie Dundee ls. and rest on 600 to 2,000 ft. of dol., salt, and anhydrite.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, p. 26). *Monroe beds.*—Underlie Dundee ls. and overlie Niagara fm. Thickness 650 to 2,000 ft. Only 100 to 120 ft. exposed. Consist of (1) aren., thin argill. dark-colored ls. or dol., 40 to 100 ft. thick; underlain by (2) buff ls., 100 to 220 ft. thick; and (3) thick gyp. deposit.

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30). *Monroe beds* include near top the Sylvania ss., which extends persistently across Monroe Co.

In subsequent repts the beds above Sylvania ss. were called "Upper Monroe" (later named *Detroit River dol.*) and the beds below Sylvania ss. were called "Lower Monroe" (later named *Bass Islands dol.*). The Detroit River dol. and Sylvania ss. were later proved to be Lower Dev. and Bass Islands dol. to be Sil. The names "Monroe fm." and "Monroe group" have therefore been discarded.

Named for exposures in Monroe Co., Mich.

†Monroe shales.

Middle Devonian: Northern New Jersey and southeastern New York.

N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 367, 373). *Monroe shales.*—Dark-gray to black fissile to slaty shales, 200 to 900 ft. thick. Underlie Bellvale flags and overlie Oriskany qtzites or cgl. Contain typical lower Hamilton fossils, according to James Hall. Are 200 ft. thick at Monroe, Orange Co., N. Y.

Replaced in N. Y. by *Cornwall shale* (C. A. Hartnagel, N. Y. State Mus. Bull. 107, 1907), because of preoccupation of Monroe in Mich. Replaced in N. J. by *Pequanac sh.*, in 1908 (U. S. G. S. Franklin Furnace folio, No. 161), but "Pequanac" was discarded in 1914 (U. S. G. S. Raritan folio, No. 191) in favor of prior name *Cornwall sh.*, which is now commonly used in both States.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

†Monroe beds.

†Monroe slates.

Pre-Cambrian(?): Southern central North Carolina (Union County).

H. B. C. Nitze and G. B. Hanna, 1896 (N. C. Geol. Surv. Bull. 3, pp. 36–37). *Monroe slates.*—Bedded but little indurated or metamorphosed slates at Monroe, Union Co., very similar to slates at Parker mine, at town of Albemarle, Stanley Co., and at San Christian mine, Montgomery Co. In fresh condition the sl. is black, weathering to dark and light drab, greenish, and even reddish. At railroad station at Monroe it lies in a low, gently undulating anticlinorium. Of sed. origin and of later age than the slates and schists to W. and N. No fossils. Provisionally placed in Algonkian.

L. C. Graton, 1906 (U. S. G. S. Bull. 293, pp. 23–24, 29, 31), described (under heading "*Monroe*" *beds*) rocks to SW. of Monroe, Union Co., N. C., as consisting of horizontal or slightly tilted beds of fine-grained material, well stratified, considerably decomposed, and having the appearance of a tuff. No fossils. Age uncertain, but pre-Triassic. "It is difficult to believe that these soft rocks could have been present when the metamorphism of the schists took place."

On 1932 geol. map of U. S. these rocks are mapped as pre-Camb.

†Monroe beds.

Pennsylvanian: Central southern Iowa.

S. W. Beyer and L. E. Young, 1903 (Iowa Geol. Surv. vol. 13, p. 366). *Monroe beds.*—Shales and sss., with coal, constituting bulk of Coal Measures in Monroe Co. Overlain by Appanoose beds and underlain by Miss.

Preoccupied. Comprises most of Cherokee sh.

Named for Monroe Co.

†Monroe beds.

An abbreviated form of Monroe Creek beds (Miocene) that has been used by some geologists.

Monroe gas rock.

A subsurface porous sandy ls., thin to 75 ft. thick, in upper part of Upper Cret. of Richland gas field, NE. La. (See D. Gordon, A. A. P. G. Bull., vol. 15, No. 8, 1931.)

Monroe City gas sand.

A subsurface sand in Mansfield ss. (Penn.) of Ind. The Ind. geologists have also applied *Monroe City deep sand* to a sand of early Chester (Miss.) age that has been correlated with Paoli ls. of Cumings.

Monroe Creek beds.

Miocene (lower): Western Nebraska and eastern Wyoming.

J. B. Hatcher, 1902 (Am. Phil. Soc. Proc., vol. 41, p. 116). *Monroe Creek beds.*—Very light-colored fine-grained, not very hard but firm and massive sss., 300 ft. thick. Grade into overlying Harrison beds and overlie Gering sss. Scant fauna. Well shown in N. face of Pine Ridge, at mouth of Monroe Creek Canyon, 5 mi. N. of Harrison, Nebr. Assigned to Mio.

Is a part of Arikaree fm. Assigned to Mio. by most geologists, but H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, p. 44), assigned it to upper Olig.

Mons formation.

Lower Ordovician (Beekmantown): Alberta and British Columbia.

C. D. Walcott, 1920 (Smithsonian Misc. Coll. vol. 72, No. 1, p. 15). *Mons fm.*, Camb., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll. vol. 67, No. 8, pp. 459–460, Mar. 5, 1923, when he assigned it to lower Ozarkian of Ulrich. Thickness 0 to 1,480 ft. Uncon. underlies Sarbach fm. and overlies Lyell fm.]

In 1923, 1924, and 1928 Walcott assigned this fm. to †Lower Ozarkian. In 1924 Kindle assigned it to Camb. In 1930 P. E. Raymond (Am.

Jour. Sci., 5th, vol. 20, pp. 300–307) assigned the Mons "as restricted by Walcott in 1928" to Lower Ord. (Beekmantown) and the underlying Sabine fm. (originally included in Mons) to Upper Camb., and stated that there is no occasion for the use of the term *Ozarkian*.

Monson granodiorite.

Late Carboniferous or post-Carboniferous: Central Massachusetts, southwestern New Hampshire, and northern Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 15, 18, 41–45, 57–65). *Monson gneiss* (also *Monson cgl. gneiss*).—A clear-gray friable biotite gneiss, medium- to fine-grained. Named for occurrence at Monson, Hampden Co., Mass.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 124), called this fm. *Monson granite gneiss*.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 241–243 and map). *Monson granodiorite*.—A clear-gray granite or granite gneiss of rather fine grain, generally purely biotitic but some of it slightly hornblendic or muscovitic. Although wholly massive and granitoid over large areas, it is generally foliated by concentration of biotite in darker bands, many of them rather broad, and tapering or set so as to simulate cross-bedding, faulting, corrugations, or in different complex patterns. In U. S. G. S. Mon. 29, 1898, this rock was believed to be an altered cgl.

W. G. Foye and A. C. Lane, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 137), regard this fm. as "probably Dev."

Montague group.

Devonian or Carboniferous (?): Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 27).

†Montalban.

Name applied in some early repts to a series of pre-Camb. (?) gneisses and mica schists in White Mtn region of N. H. and westward, which were supposed to be younger than Huronian series of Lake Superior region.

According to C. R. Van Hise and C. K. Leith (U. S. G. S. Bull. 360, 1909, pp. 87, 88) T. S. Hunt in 1888 stated that in 1871 [where?] he gave the name *Montalban* to the young gneisses, crystalline lss., and micaceous and amphibolic schists, because of their great development in White Mtns of N. H.

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 178–179, pls. 16, 17). [See 1884 entry under *White Mtn series*, which is essentially the same as Montalban group as first defined.]

This name (derived from the Latin for White Mtn) has been in disuse for many years. On the 1932 geol. map of U. S. these rocks in N. H. are mapped as *pre-Camb.*, but this age is now questioned by M. Billings. (See under *Berlin gneiss*.)

In 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, No. 3) M. Billings applied *Montalban schists* to rocks beneath Chatham granite in North Conway quad., N. H., and correlated the schists and granite with Montalban group of Hitchcock, which he assigned to pre-Camb. (?).

M. Billings, 1935 (letter dated Aug. 27). This summer some of our field parties are struggling with the "Montalban schist." Lithologically most of it is like the katazone facies of Littleton fm., and I believe there is little doubt that the Montalban is Dev. but we have not yet been able to prove this conclusively.

Mont Alto lignite.

Tertiary (?): Central southern Pennsylvania.

J. P. Lesley, 1864 (Mont Alto lignite and Appalachian erosion, 30 pp., 4 pls.). [Describes bed of lignite found recently in southern central Pa. Assigned to Tert. and correlated with Brandon lignite of Vt. See Am. Jour. Sci., 2d, vol. 40, p. 119, 1865.]

Montalto quartzite member (of Harpers schist).

Lower Cambrian: Central southern Pennsylvania.

G. W. Stose, 1906 (Jour. Geol., vol. 14, p. 207). *Montalto qtzite memb. (of Harpers fm.)*.—Hard qtzitic stratum, usually dark gray and veined with quartz. In South Mtn area it occurs near middle of Harpers fm. Forms Montalto Mtn.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170), gave thickness of Montalto qtzite as 20 to 850 ft.

Montana group.

Upper Cretaceous: Montana, Wyoming, Dakotas, Colorado, Utah.

G. H. Eldridge, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, p. 93, footnote). [See under *Fox Hills ss.*]

A more elaborate description of *Montana group* was given by Eldridge in 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 313–321). The original subdivisions of Fox Hills ss. and Pierre sh. are still recognized in the Dakotas, eastern Mont., eastern Wyo., and eastern Colo. In southern Mont. the group is now divided into (descending) Bearpaw sh., Judith River fm., Claggett sh., and Eagle ss. In NW. Mont. it is divided into (descending) Horsethief ss., Bearpaw sh., Two Medicine fm., and Eagle ss. In central and southern Wyo. it is divided into (descending) Lewis sh., Mesaverde fm., and Steele sh. In eastern Colo. the group is overlain by Laramie fm. (Upper Cret.); in central southern Wyo. by Medicine Bow fm. (Upper Cret.); and elsewhere in Wyo. and in Mont. by Lance fm. (Upper Cret.).

Named for extensive development in Montana, especially in Upper Missouri River region.

†Montana breccia.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1911 (Rept. on geol. of property of Montana-Tonopah Min. Co., Tonopah, Nev., published privately). *Montana breccia*.—Intrusive glassy rock that immediately preceded West End rhyolite intrusion. Named for Montana mine.

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, p. 10). Tonopah fm. as here defined (for what has previously been called "Lower rhyolite") includes rocks that have previously been mapped as "Glassy trachyte" and "Montana breccia," but it does not include all exposures that have been so assigned by Spurr, Burgess, and others.

†Montana series.

Name proposed by G. H. Ashley (Eng. and Min. Jour.-Press, vol. 115, No. 25, pp. 1106–1108, 1923) to include Montana group and overlying Laramie fm.

Montanan series.

A term used by C. R. Keyes instead of *Montana group*.

†Montara granite.

Late Jurassic (?): Western California (San Francisco Peninsula and southward).

A. C. Lawson, 1895 (U. S. G. S. 15th Ann. Rept., p. 408, and Am. Geol., vol. 15, pp. 343–346). *Montara granite*, of undet. age, is intrusive into the crystalline ls. [Gabilan ls.] and constitutes the mass of Montara Mtn, San Francisco Peninsula.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193), mapped and described these rocks as *quartz diorite of pre-Franciscan age*, the name "Montara granite" being discarded.

Montauk till member (of Manhasset formation).

Pleistocene: Southeastern New York (Long and Fishers Islands) and islands of southern New England (Block Island, Nantucket, Marthas Vineyard, No Mans Land, and probably Cape Cod).

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367–390). *Montauk drift.*—Overlies Herod gravel (uncon. in places) on Fishers Island, N. Y.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467–469). *Montauk drift.*—Hard, compact dark-gray, often partly cemented till, 75 to 150 ft. thick; on Long Island, Fishers Island, and Cape Cod. Probably of Illinoian age. Overlies Herod gravels and underlies granitic gravels [Hempstead] which resemble Jameco and Herod fms. (See also U. S. G. S. Bull. 285, pp. 432–441.)

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). *Montauk till memb. of Manhasset fm.*—Consists of two beds of till separated by a gravel bed. Thickness 0 to 60 ft. on Long Island. Rests uncon. on Herod gravel memb. and is uncon. overlain by Hempstead gravel memb. of Manhasset fm. Time of deposition called *Montauk substage.*

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Montauk till memb. of Manhasset fm.* present on Block Island, Marthas Vineyard, Nantucket, No Mans Land, and probably on Cape Cod.

F. G. Wells, 1935 (Geol. Soc. Am. Proc. 1934, p. 121), regarded Manhasset fm. as of Wisconsin age.

Named for occurrence at Montauk Point, Long Island.

Montauk substage.

The time covered by deposition of *Montauk till memb.*

Montebello sandstone. (In Hamilton formation.)

Middle Devonian: Central Pennsylvania (Perry County).

E. W. Claypole, 1885 (2d Pa. Geol. Surv. Rept. F_2, pp. 67–68). *Hamilton (Montebello) ss.*—Ss., 500 to 800 ft. thick, separating Hamilton upper sh. from Hamilton lower sh. in Perry Co. Overlain by Montebello fossil ore, 2 ft. thick. The proportion of sand diminishes rapidly to N. and W., until the intermediate sh. becomes so thick that it forms most of fm., but is overlain and underlain by thin sss. Exposed at Montebello Narrows, on Little Juniata River. At its southernmost exposure, near Marysville, it is 800 ft. thick.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2). Selinsgrove upper ss.=Montebello upper ss. of Claypole.

Monte Cristo diorite.

Pre-Permian (?): Southeastern Alaska (Upper Tanana River region).

W. C. Mendenhall and F. C. Schrader, 1903 (U. S. G. S. P. P. 15, pp. 33–37). *Monte Cristo diorite.*—Medium- to coarse-grained granitoid rock belonging to diorite family. Named for exposure on Monte Cristo Creek, Nabesna and Chisana River region.

Monte Cristo limestone.

Mississippian (lower and middle): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 9–10, 17, etc.). *Monte Cristo ls.*—Includes all Miss. rocks in Goodsprings quad. Divided into 5 members (descending): (1) Yellowpine ls. memb., 0 to 120 ft.; (2) Arrowhead ls. memb., 0 to 20 ft.; (3) Bullion dol. memb., 185 to 300 ft.; (4) Anchor ls. memb., 65 to 400 ft.; (5) Dawn ls. memb., 60 to 400 ft. Underlies (probably uncon.) Bird Spring fm. (Penn.) and overlies Sultan ls. (Dev.). Fossils [listed] are lower and middle Miss., according to G. H. Girty. [Mr. Hewett sent an advance copy of his Goodsprings section, and of the names he proposed to apply to the fms., to W. S. Glock, who in 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 326–339) described the *Monte Cristo ls.*, in east-central part of Spring Mtn Range, Goodsprings quad.]

Exposed near Monte Cristo mine, Goodsprings quad., but the mine itself is in Anchor ls. memb.

Monte de Oro formation.

Upper (?) Jurassic: Northern California (Oroville, Butte County).

H. W. Turner, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 548). *Monte de Oro fm.*—Plant-bearing clay sl. with some cgl. The slates are very similar to those of Mariposa fm., from known areas of which they are, however, widely separated. Occur near Oroville, just S. of Monte de Oro, Butte Co.

Local name for sl. whose relations to Mariposa sl. still remain undet.

Montego formation.

Pleistocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 102).

Montell sandstone. (In Allegheny formation.)

Pennsylvanian: Western Maryland and northern West Virginia.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Montell ss.*—Underlies Lower Freeport coal and overlies Montell rider coal; all included in Allegheny fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), showed *Montell* ss. as including, near its top, Montell rider coal, and as overlying Upper Kittanning (Montell) coal. On p. 50 he stated that it is 50 ft. thick, persistent over large areas, frequently forms cliffs, is found above Montell coal, is finer-grained and more argill. than the lower sss. of Allegheny fm. but is conglomeratic W. of Piedmont, W. Va., and that it is named for its position above Montell coal.

Montello granite.

Laurentian: Central southern Wisconsin (Marquette County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 521). *Montello granite.*—Pink granite outcropping in village of Montello. Assigned to Laurentian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). "May be supposed to be pre-Huronian."

This granite is known to the trade as *Montello granite.*

Monterey group (San Francisco region).

Monterey shale.

Miocene (upper, middle, and late lower): Western California.

W. P. Blake, 1856 (Phila. Acad. Nat. Sci. Proc., vol. 7, pp. 328–331). *Monterey fm.*, consisting of regular strata of light-colored, prevailingly white argill. and aren. material, the particles being very fine and firmly impacted, so that in some places the strata break with smooth curved surfaces, and have a semivitreous luster. Top 50 ft. very rich in diatoms, and the underlying beds may be equally rich. Thickness undet. Typical section is about 2 mi. SE. from center of town of Monterey, and it forms a portion of a hill 500 to 600 ft. high, which fronts the bay and rises on E. side of stage road to San Francisco. This hill is separated from bay by a broad sandy plain and a belt of sand hills along the beach. The detailed section approximates 81 ft., exclusive of basal memb., which "extends down for a long distance." The fm. is uncon. overlain by a rudely stratified or assorted mass of boulders and gravel like the accumulation along a beach, and it appears to be conformably underlain by Tert. strata that underlie part of town of Monterey and extend to and beyond the Mission of San Carlos. Is quarried near town of Monterey. [Blake's heading (p. 328) calls the beds *Tert. fm. of Monterey, Calif.* After describing the fm. he called it *Monterey fm.* on p. 331.]

Monterey sh. was approved by U. S. Geol. Survey in 1902, after correspondence with Calif. geologists.

A. C. Lawson, 1893 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 1, p. 7). The [Mio.] series was among the first which attracted attention of earlier writers—Trask (1854) also Blake (1856)—and it has since become famous for "infusorial" remains which it contains, being known to collectors as *Monterey fm.* This name, under form "*Monterey series*," will be adopted as local designation of the series. Thickness 1,000+ ft. around Carmelo Bay. Overlain by "terrace fms.," and rests, with erosion uncon., on Carmelo series (Tejon, Eocene?).

G. H. Ashley, 1895 (Jour. Geol., vol. 3, pp. 439–440). The Monterey series was long ago described and assigned to Mio., and later determinations have not modified that decision.

G. D. Louderback, 1913 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 7, pp. 191–241), proposed *Monterey series* to include all Mio. deposits as well as underlying Sespe fm.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Monterey group* is divided into (descending): Briones ss., 2,300 ft., containing Hercules sh. memb. near middle; Rodeo sh., 670 ft.; Hambre ss., 1,200 ft.; Tice sh., 460 ft.; Oursan ss., 600 ft.; Claremont sh., 800 ft.; and Sobrante ss., 400 ft. [Subsequent studies of B. L. Clark resulted in excluding Briones ss. from Monterey group.]

From 1913 to 1935 the U. S. Geol. Survey included Vaqueros ss. in Monterey group, because it was believed that basal ss. at Monterey (thin to 200 ft. thick) represented that fm. This basal ss. at Monterey, however, is now considered to be younger than Vaqueros. The Vaqueros was, therefore, in 1935 excluded from the Monterey, and *Monterey sh.* was adopted for a lithologic unit of variable Mio. age, consisting predominantly of hard silica-cemented shales and soft shales carrying siliceous micro-fossils. It includes, in different areas, beds of upper, middle, and even late lower Mio. age. In Palos Verdes Hills it ranges from middle Mio. into upper Mio.; in Kettleman Hills it includes only part of upper Mio. In Palos Verdes Hills it is divided into 3 members, named (descending) Malaga mudstone memb. (upper Mio.), Valmonte diatomite memb. (upper Mio.), and Altamira sh. memb. (upper and middle Mio.). As now defined the Monterey sh. is in places underlain by Vaqueros ss. or Temblor fm., and in other places by older rocks. In Palos Verdes Hills it rests uncon. on Franciscan (?) fm. In some regions it is overlain by Santa Margarita ss., and in other areas its upper part grades laterally into Santa Margarita ss. In still other areas it is overlain by San Pablo group, and in other places it includes time equiv. of the San Pablo. In San Francisco region the Monterey deposits (post-Vaqueros) are still called *Monterey group*. For details regarding present interpretation of Monterey sh. see report by W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell (A. A. P. G. Bull., vol. 20, No. 2, pp. 127–146, 1936).

†Monterey sandstone.

Lower Devonian: Northwestern Virginia and western Maryland.

N. H. Darton, 1892 (Am. Geol., vol. 10, pp. 13, 15–16). *Monterey ss.*—Coarse-grained light-colored ss. or moderately silicified qtzite, usually friable in weathered outcrops. Fossils mainly Oriskany forms, but Lower Helderberg and Hamilton fossils are intermingled to greater degree than in N. Y. Oriskany. Beds comprise not only Oriskany but in upper part representatives of the several coordinate members of Corniferous group. Thickness 0 to 300 ft. Uncon. underlies Romney sh. Overlies Lewistown ls.

Preoccupied. Replaced by *Ridgeley ss.*

Named for Monterey, Highland Co., Va.

†Monterey conglomerate.

Pennsylvanian: Northeastern Tennessee (Overton, Fentress, and Putnam Counties).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 276, 277, 369–372, 374). *Monterey cgl.* (also *Monterey or Bonair cgl.*).—The cgl. at Monterey [Putnam Co.] is generally believed to be same as Bonair cgl. memb. of Lee fm. Massive pebble-bearing cgl., varying in thickness from 15 to 40 ft. To northward appears to be cut out or to thin out at Obey City, Overton Co., but is conspicuously developed to E. and across the line into southern Fentress Co. Overlies Whitwell sh. and underlies Vandever sh. A subdivision of Lee fm.

Same as Bonair ss., of Lee group.

†Monte Sano limestone (also †Montesano group).

Mississippian: Northern Alabama, Tennessee, Kentucky, and Illinois.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29). [On pl. 29 *Monte Sana* is used in "General time scale" to include Tribune, Cypress, and Ste. Genevieve. There is no other definition in book cited.]

E. O. Ulrich, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 157), casually referred to the *lower or Montesano group* of the Chester, but did not define term.

E. O. Ulrich, 1917 (Ky. Geol. Surv. Mississippian series in western Ky., pt. 2, pp. 25, 38, 45, 51, 52, 53, 59, 68, 100, 116, 125–141, 197, 199, 200, 206, pls. E and F), used *Montesano ls.* and *Montesano group* to include Gasper oolite, Aux Vases ss., Ste. Genevieve ls., and equiv. fms. in Ky. and Ill. "Underlies Cypress or Hartselle ss. and uncon. overlies St. Louis ls."

Corresponds to lower part of Chester group.

Named for exposures at Monte Sano, Madison Co., Ala. (The town and ridge are spelled with final *o* on U. S. G. S. topog. map.)

Montesano formation.

Miocene (upper): Southwestern and northwestern Washington.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). *Montesano fm.*—Largely massive coarse-grained light-brown sss., with many intercalated lenses of cgl. and grit; shales subordinate in lower part but common in upper part. Thickness 5,000 ft. Upper Mio. fauna. Uncon. overlies Chehalis fm. (Lower Mio.). Named for Montesano, Chehalis [Grays Harbor] Co.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). The upper Mio. marine invertebrate fauna of Wash. is called *Yoldia strigata* zone, from presence of this most characteristic species. Only 1 faunal horizon is recognized in the fm., and it is upper Mio. The strata containing this fauna are termed *Montesano horizon* or, more appropriately, *Montesano fm.* Is confined to 2 widely separated areas, the larger in Grays Harbor region, mostly S. of Chehalis River, and the smaller in SW. Clallam Co., in vicinity of junction of Soleduck and Bogachiel Rivers. Max. thickness 5,400 ft., in Grays Harbor region. Overlies Wahkiakum horizon uncon.

†Montevallo conglomerate.

Pennsylvanian: Northern central Alabama.

J. Squire, 1890 (Ala. Geol. Surv. Rept. Cahaba coal field, pt. 1, passim). *Cgl. group, the great Montevallo cgl.*, the cap rocks of our Alabama Coal Measures. Overlies Montevallo coal. Thickness 500 ft.

Is a cgl. at top of Pottsville fm.

Probably named for exposures at Montevallo, Shelby Co.

†Montevallo formation.

Lower Cambrian: Alabama.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 148 and map). *Montevallo or Choccolocco shales.*—Sandy shales of variegated colors. Original material calc. sh., but at outcrops the calc. matter has been thoroughly leached out and only the more siliceous parts are left. Sometimes the shales are tough and hard and, especially toward E., assume characters of semicrystalline rocks. In upper part are beds of blue ls. and gray dol. which are often difficult to distinguish from similar rocks in overlying Knox dol. Underlies Knox dol. and overlies Coosa shales. Includes Weisner qtzite, usually interbedded in lower part. [Owing to faulting the relations of †Montevallo sh. to †Coosa sh., Conasauga sh., and Rome fm. were misunderstood. Now, however, typical Montevallo sh. is known to be same as Rome fm. (Lower Camb.) and to underlie Conasauga sh., which is same as †Coosa sh. Rome fm. is better established name. (See C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, p. 65, 1926.) As first defined, i. e., including rocks up to base of Knox dol., the Montevallo was of Middle and Lower Camb. age.]

Named for Montevallo, Shelby Co., and for Choccolocco, Calhoun Co.

Montezuma schist.

Pre-Cambrian: Western North Carolina.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 4). *Montezuma schist.*—Fine-grained epidotic and chloritic schists and amygdaloids, of very uniform appearance. Originally probably a basalt. Schists are bluish black, gray, or green when fresh, becoming more green and yellowish green on weathering. The amygdaloid beds occur chiefly along NW. areas of the fm., and consist of bluish-gray groundmass with cavities (the size of a pea) filled with quartz, feldspar, and epidote. Assigned to Algonkian (?).

Named for Montezuma, Cranberry quad., in Mitchell Co.

Montezuma quartz monzonite.

Eocene: Central northern Colorado (Montezuma region, Summit County).

H. B. Patton, 1909 (Colo. Geol. Surv. 1st Rept., pp. 125, 126, 128, map). *Montezuma granite.*—Pinkish-gray biotite granite with large porphyritic feldspar crystals. An intrusive rock, but does not occur in dikes. Town of Montezuma, Summit Co., is built on this rock. Is believed to be younger than Santa Fe granite. Is in contact with Idaho Springs fm. [pre-Camb.].

J. W. Vanderwilt, 1932 (16th Int. Geol. Cong. Colo. Guidebook), stated the *quartz monzonite* porphyries of this region are locally called *Montezuma granite*, and are of Eocene age. According to unpublished ms. by T. S. Lovering the Montezuma "granite" is quartz monzonite. It cuts the thrust fault that was formed during Laramide revolution and is older than Flattop peneplain, of late Eo. age.

Montezuma shales.

Jurassic: Southwestern Colorado and northeastern Arizona.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 65, No. 4, pp. 303, 306). Zunian series divided into (descending) McElmo shales, Lohali ss., Montezuma shales, and Arido sss. Latter 3 correspond to the LaPlata of Cross. For the middle shaly marine beds of the LaPlata the title *Montezuma shales* is suggested, the name being derived from Montezuma Co., in SW. Colo.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 66, No. 1, p. 72, and No. 3, p. 225). *Lohali ss.* is preoccupied and is here replaced with *Tyende ss.*

The Montezuma shales of Keyes appear to correspond to Kayenta fm. (See U. S. G. S. P. P. 183, 1936, table opp. p. 37.)

†Montgomery buhr.

†Montgomery grits.

†Montgomery sandstone.

Mississippian: West Virginia and Virginia.

W. B. Rogers, 1838 (Va. Geol. Surv. Rept. 1837, p. 17). In Floyd Co., Va., associated with the valley ls. occurs that interesting and valuable siliceous deposit, the *Montgomery Buhr.* Varies from grayish and yellowish white to deep orange brown, and presents a cellular texture and a great hardness and sharpness of grit. Is used for millstones.

W. B. Rogers, 1879 (Macfarlane's Geol. Ry Guide, p. 179). *Montgomery grits and coal measures*, of Lower Carbf. age, underlie Greenbrier ls. and overlie Catskill.

In some repts has been called "*Montgomery ss.*" Is same as Price fm., the name by which it is generally known. Probably named for Montgomery Co., Va., across which Price fm. occupies a wide belt. The Price fm. was named for Price Mtn, in Montgomery Co.

Montgomery limestone.

Silurian (Niagaran): Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Montgomery ls.*, of Niagara age, 10 to 60 ft. thick. Older than Taylor[s]ville slates and younger than Grizzly qtzite.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Montgomery ls.*—Light to dark bluish-gray ls. with occasional knots or benches of black chert. The form of the ls. is lenticular, and the largest lentil, which is on crest of N. end of Grizzly Mtns and is fossiliferous, has thickness of 60 ft. with length of about 200 ft. Five of these ls. lentils have been found. One is on S. bank of Montgomery Creek, where it forms prominent cliffs at an altitude of about 4,000 ft. Rests conformably on Grizzly fm. Believed to be uncon. with overlying Taylorsville fm.

Named for occurrence on Montgomery Creek, 2⅓ mi. S. of Taylorsville, Plumas Co.

†Montgomery formation.

Silurian: Southwestern Ohio, southern Indiana, and northern Kentucky.

A. F. Foerste, 1896 (Cincinnati Soc. Nat. Hist. Jour., vol. 18, pp. 189, 190). *Clinton or Montgomery fm.*—Very pure fossiliferous pink or red ls., becoming more siliceous eastward; 10 to 35 ft. thick. Overlain by white Dayton ls. in Ohio and by Osgood sh. in southern Ind.; underlain by Lower Sil. Belfast bed. Included in Niagara group. Formerly called Clinton fm., but perhaps more Niagara than Clinton.

Preoccupied. Replaced by Brassfield ls.

Named for Montgomery Co.

Montgomery bed. (In Jackson formation.)

Eocene (upper): Northwestern Louisiana (Grant County).

T. L. Casey, 1902 (Sci., n. s., vol. 15, p. 716). *Montgomery bed.*—Light blue-gray argill. marl, 6 ft. thick. Outcrops in well-known long low bluff at Montgomery, La. Older than Kimbrel bed, from which fossils indicate it is separated by a considerable lapse of time. Included in Jackson stage. Named for exposures at Montgomery, Grant Co.

Montgomery Creek formation.

Eocene: Northern California (Redding region).

H. Williams, 1932 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 21, No. 8, p. 215). Resting directly on Chico rocks in area W. of Lassen is a series of fresh-water sands and gravels, containing abundance of andesitic detritus, which Diller classed with "Ione" fm., as Mio. Recently these deposits have been restudied by [R. D.] Russell, by whom they have been termed *Montgomery Creek fm.*, provisionally assigned to Eo., and possibly the age equiv. of the Ione as redefined by Allen. Russell has also suggested that the Susanville gravels, lying SE. of Lassen and containing an admixture of rhyolitic tuff, may be tentatively correlated with Montgomery Creek fm.

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, pp. 79, 114). *Montgomery Creek fm.*—Along SE. slopes of Klamath Mtns in Kosk Creek and Pit River Canyons, farther to S. on Montgomery Creek, and at a few other localities is a series of dominantly fluviatile brownish arkosic ss., sandy shales, and cgls. which Diller in Redding folio called "Ione" fm. and dated Mio. on determination of fossil leaves by Knowlton. These strata have recently been examined by R. Dana Russell, who was associated with me in the geologic studies of southern Klamath Mtns, and will be described by him as *Montgomery Creek fm.* in a rept now in preparation. Determination by R. W. Chaney of a flora discovered by Russell indicates a later Middle Eocene age for the fm. and Russell's field and laboratory studies prove that the fm. is not Ione fm. as Allen has recently redefined it along E. margin of Great Valley. The sediments appear to have come from the E. and NE., but actual source is not known. Only a limited area of this fm. appears along E. margin of Redding quad. S. of Little Cow Creek. Most of strata Diller mapped as Ione belong to the Plio. Tuscan and Tehama fms., which overlie Montgomery Creek fm. The Eocene deposits of Weaverville quad. are here named *Weaverville fm.*

Monticello rhyolites.

Pre-Cambrian: Central Virginia.

W. A. Lambeth, 1901 (thesis presented to Univ. Va., p. 11). *Monticello rhyolites*, of Keweenawan age, in Monticello area, Albemarle Co.

Monticello schist.

Pre-Cambrian: Central Virginia.

W. A. Lambeth, 1901 (thesis presented to Univ. Va., p. 9). *Monticello schists.*—Universally crystalline and fine-grained even when slaty; hard; break with splintery fracture; structure marked by joint planes and quartz veins from thickness of a hair to an inch or more; hornblende in flattened tabular crystals; scales of micaceous chlorite and epidote give rocks a green color. Assigned to Keweenawan epoch of Algonkian.

T. L. Watson and S. L. Powell, 1911 (Am. Jour. Sci., 4th, vol. 31, p. 36). *Monticello schist* is Catoctin schist of Keith. Derived chiefly from basic volcanic rock (basalt) of Algonkian age.

Monticello dolomite.

Silurian (Niagaran): Central eastern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 149, 150). *Monticello terrane.*—Dol., 60 ft. thick, forming top fm. of Niagaran series. Overlain by Goweran series and underlain by Hartwick dol., of Niagaran series. Separated from Hartwick dol. by its fauna.

Probably named for Monticello, Jones Co.

Montijo conglomerate.

Age (?): Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 241).

Mont Joli formation.

Devonian: Quebec.

See *Mount Joli fm.*

Montosa limestone.

See under *Mosca ls.* Is a part of Madera ls., Penn., N. Mex.

Montoya limestone.

Upper Ordovician: Western Texas and southern New Mexico.

G. B. Richardson, 1908 (Am. Jour. Sci., 4th, vol. 25, pp. 476, 478–479). *Montoya ls.*—Upper part, which carries Richmond fossils, according to E. O. Ulrich, is prevailingly gray ls., characteristically mag., in places seamed with conspicuous bands of chert a few inches thick; some beds are almost white, while others are dark. Lower part is commonly marked, in El Paso quad., Tex., by massive dark-colored ls., containing little or no chert and carrying characteristic Galena fossils, according to E. O. Ulrich. The two parts cannot always be distinguished lithologically. Thickness 250 ft. In Van Horn quad. the base of Montoya is commonly marked by presence of thin-bedded earthy yellow and reddish ls., but otherwise in both quads. the contact with underlying El Paso ls. is apparently conformable. Is overlain by Fusselman ls., of Niagara age.

Further studies of faunas contained in Montoya ls. resulted in assigning the *lower* fauna to pre-Richmond Upper Ordovician.

Named for Montoya station, on Santa Fe Ry., about 10 mi. above El Paso, Tex.

Montoyan series.

A time term employed by C. R. Keyes to cover a part of Montoya ls.

Montpelier sandstone.

Middle (?) Devonian: Southeastern Iowa.

C. R. Keyes, 1893 (Iowa Geol. Surv. vol. 1, pp. 40–46, pl. 2). *Montpelier ss.*—Considerable thickness of fossiliferous sss. developed at and near Montpelier, Iowa. Assigned to Middle Dev. Older than Lime Creek sh. and younger than Cedar Valley ls. [Some writers apparently include this in Cedar Valley ls.]

Named for Montpelier, Muscatine Co.

Montpelier.

Tertiary: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol 34, pp. 70–75).

†Montpelier slate.

Ordovician: Northeastern Vermont (Washington County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 95). The terms *Montpelier sl.*, *Northfield sl.*, and *Montpelier and Northfield sl.* have been used interchangeably and indiscriminately in repts on geol. of Vt. If there has been any discrimination whatever, "Northfield sl." has been used more in a commercial sense than in the designation of a geological fm. I would propose, therefore, the single term *Montpelier sl.* for the terrane that has been formerly discussed under these different names. The name *Montpelier* is here applied for first time in a purely geological sense to the belt of sl. that flanks the pre-Camb. schist to E. of Green Mtn axis, lying conformably upon and often interstratified with Waits River ls. It is a highly metamorphic rock derived from beds of plastic clay. [On p. 115 he states that U. S. G. S. has adopted *Memphremagog sl.*, instead of Montpelier sl., preoccupied. Pl. 18 of 11th Rept. Vt. State Geol., 1918, maps this sl. as extending from Montpelier to Northfield.]

Montreal formation.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol 6, sec. 4, pp. 163, 224).

Montreal amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, fig. 28). *Montreal amygdaloid* belongs in Central Mine group. According to A. C. Lane (1911) it lies 150 to 224 ft. below Houghton cgl., and is fourth lode below that cgl. The mineralized part is the Montreal lode. Probably named for occurrence in Montreal mine, Keweenaw Co.

Montreal flow.

Includes Montreal amygdaloid and underlying trap.

Montrose sandstone.

Upper Devonian: Southern-central New York and northeastern Pennsylvania.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 381). *Montrose ss. or ss. of Oneonta.*—Many veins of gray ss. and sometimes red ss.; when weathered exhibits peculiar structure, to all appearance owing to manner in which it was deposited in water; often contains plant remains and thin coal. Is found in Otsego, Chenango, and Broome Counties, N. Y., and covers the whole of upper part of Susquehannah Co., Pa., where it surrounds town of Montrose. Younger than Chemung group and the last or upper rock of Third district.

See under *Oneonta ss.* also under *Honesdale ss. group.*

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 82). The nonmarine Oneonta ss. (1840 Vanuxem) is "Montrose ss., or ss. of Oneonta" of Vanuxem, and is of Portage age.

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7) and 1933 (Sci., n. s., vol. 77, pp. 86–87). *Montrose fm. of Vanuxem* is upper Chemung or Wellsburg ss. changed to red beds. The true Oneonta ss. is older and of Ithaca (lower Portage) age.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 4, p. 283). [I. C.] White (Rept. G5, 1881) devised some subdivisions for his "Catskill," including a "Montrose red sh." that fails to match his sanguine description of it; but Vanuxem had called this whole mass *Montrose* two score years before. Nor had Vanuxem's term lain idle, for Hall had frequently adverted to it in print and public. Hence to these Wellsburg, or true upper Chemung, red-beds, as a whole we must now restore Vanuxem's appropriate name *Montrose*, discarding White's fanciful restriction of it. The interfingering of the Wellsburg and Montrose may be well seen around Skinner's Eddy, Pa.

Montrose red shale. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 68, 115). *Montrose red sh.*—Underlies Honesdale ss. group and overlies Paupack ss. in Susquehanna and Wayne Counties. Thickness 180 ft. At least two-thirds of mass in Montrose county is red sh.; the rest is several intercalated beds of gray ss. Around Honesdale there is at least 150 ft. of red sh., the rest being intercalated gray sss. At Montrose [Susquehanna Co.], the type loc., 125 ft. of almost blood-red sh. is visible, and it contains very few sandy layers.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G6, pp. 94–101). *Montrose red sh.* is 1,500 ft. thick in Pike and Monroe Counties, where it underlies Honesdale ss. group and overlies Delaware River flags (the New Milford and Paupack ss. of Rept. G5). [Other repts give thickness of 2,000 ft.]

G. H. Chadwick, 1933. [See 1933 entry under *Montrose ss.*]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 584), renamed the Montrose red sh. of White the *Damascus red sh.*, the name *Montrose* being preoccupied in N. Y. "White's type loc. was not well chosen, for at town of Montrose, Susquehanna Co., the fm. is rather poorly exposed."

†Montrose chert. (In Osage group.)

Mississippian: Southeastern Iowa.

C. R. Keyes, 1895 (Iowa Geol. Surv. vol. 3, pp. 320, 341, 445). *Montrose chert.*—The flinty beds, 30 ft. thick, forming top part of Upper Burlington ls. in Lee Co., Iowa. Overlain by Keokuk ls.

These beds are now included in Keokuk ls. (See under *Keokuk ls.*) According to F. M. Van Tuyl, 1925 (Iowa Geol. Surv. vol. 30, p. 146), they are not now exposed at Keokuk, the type loc. of Keokuk ls., but were formerly visible in excavation beneath the bed of Miss. River for the Keokuk dam.

Named for exposures at Montrose, Lee Co.

Montrose moraine.

Pleistocene (Wisconsin stage): Southern Minnesota (McLeod and Wright Counties).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 85–86). Included in Crow River morainic system. Village of Montrose, Wright Co., is on this moraine.

†Montville type.

Pre-Cambrian: Northern New Jersey.

F. L. Nason, 1889 (N. J. Geol. Surv. Ann. Rept. 1889, p. 31). *Montville type.*—White crystalline ls. of varying degrees of purity. Provisionally assigned to Archean, but Archean age not yet proved. Occurs at Montville, also at Franklin Furnace, where it is intimately associated with the Franklin type.

Same as Franklin ls.

Monument andesite.

Tertiary: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. 19, pp. 7–21). *Monument andesite*, Tert., 250 ft. thick. Type loc., Monument Peak, near Lake Valley [Sierra Co.].

†Monument Creek group.

Oligocene and Eocene: Eastern central Colorado (Denver Basin region).

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 39–40, 89). *Monument Creek group.*—Variegated sands, sss., and aren. clays, nearly horizontal, resting on upturned edges of older rocks. They range from coarse puddingstones to very fine-grained sands or sss.; very little lime in entire series; much ferruginous matter. Occurs 40 mi. S. of Denver, in region of South Platte Canyon to Colorado City. Occupies space about 40 mi. E. to W. and 50 mi. N. to S. Monument Creek [Castle Rock and Colorado Springs quads.] flows through this tertiary basin.

F. V. Hayden, 1876 (U. S. Geol. and Geog. Surv. Terr. 8th Ann. Rept., pp. 32, 36–37). The peculiar group of fresh-water strata which in 1869 I called the *Monument Creek group*, extends to a point within about 20 mi. of Denver, where the lignitic sediments return to their usual character. The group is 1,500 ft. thick and consists of (descending): (1) Variegated sss., brick red, white, and yellow, varying from fine-grained ss. to puddingstone; (2) rather massive ss., varying from puddingstone to fine-grained ss., usually of light color, sometimes a yellow or iron rust. It may be synchronous with upper part of White River group [Olig.].

G. H. Eldridge, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, pp. 86–112). *Monument Creek beds.*—Embraces true Monument Creek group of Hayden Survey. Extends only short distance into SE. corner of Denver region, but occupies immense area beyond. Its manner of occurrence shows a break in continuity of its deposition sufficient in point of time for formation of a bed of rhyolitic tuff 40 ft. thick. This bed of lava does not extend into Denver field but is well exposed in vicinity of Castle Rock. Though the group is perfectly divisible into 2 distinct fms. it is for present better to retain name first given, more particularly to its lower memb., as a designation for entire group, especially in view of very meagre information. Age undet. Thickness 1,500 ft. Uncon. overlies Denver beds. In places rests on Laramie, showing absence of Denver beds and underlying Willow Creek beds. Eruptive material is prominent in upper part and absent in lower part.

S. F. Emmons, W. Cross, and G. H. Eldridge, 1896 (U. S. G. S. Mon. 27), applied *Monument Creek fm.* to Tert. beds overlying Denver fm. in Denver Basin.

W. T. Lee, 1902 (Am. Geol. vol. 29, pp. 96–109). *Monument Creek group of Hayden* is here divided, in Castle Rock region, into Castle cgl. above (90 ft. thick, and resting uncon. on the lava) and *Monument Creek fm. restricted* below. The name originally applied by Hayden is thus retained for the fm. which is best known, and the new and less cumbersome name *Castle cgl.* is given to the less extensive and little-known fm. The Monument Creek fm. restricted consists of cgls., breccias, sands, and clays which alternate, intermingle, and grade into each other in most lawless manner. It underlies the rhyolite and overlies Arapahoe fm.

G. B. Richardson, 1915 (U. S. G. S. Castle Rock folio, No. 198). "Monument Creek group" of Hayden included *Castle Rock cgl.* (Olig. and 300 ft. thick) and Dawson arkose (Eo. and 2,000± ft. thick). The Dawson is=Denver and Arapahoe fms. and some younger beds. These younger beds and the Castle Rock cgl. were included in "Monument Creek fm." of Emmons, Cross, and Eldridge.

Monument Hill bentonitic member (of Pierre shale).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Monument Hill bentonitic memb. of Pierre sh.*—Impure bentonite and siltstone; some calc. and barite concretions. Marine fossils. Commonly forms a scarp. Thickness 150± ft. Top lies 150 to 250 ft. below Fox Hills ss. Separated from underlying Mitten black sh. memb. of Pierre sh. by 500 to 800 ft. of dark mudstone and sh. Named for exposures at Monument Hill, sec. 32, T. 56 N., R. 68 W., Crook Co., Wyo.

Monument Spring dolomite member (of Marathon limestone).

Lower Ordovician (Beekmantown): Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066–1069). *Monument Spring dol. memb. of Marathon ls.*—Dense massive dolomitic ls., mottled yellow and bluish, which on weathered surfaces changes to spongy brown chert. Thickness few ft. in N. part of Dagger Flat anticlinorium (to S. of which it disappears) to 75 ft. in Marathon anticlinorium. Lies near middle of Marathon ls. The beds are broken and shattered, as result of deformation, so that outcrop is characteristically a chain of disconnected boulders. Typically exposed ½ mi. W. of Monument Spring, Marathon uplift, Brewster Co.

†Monument Valley shale.

Permian: Southeastern Utah and northeastern Arizona.

D. Hager, 1924 (Min. and Oil Bull., vol. 10, No. 2, p. 137; No. 4, pp. 385, 423). *Monument Valley shales*, 1,000 ft. thick, formerly classed as Moencopie and

Upper Goodridge, belong to Supai fm. and are Perm. Older than Lower De Chelly ss. and younger than Upper Goodridge beds.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, p. 1441, etc.). "Monument Valley sh." of Hager, 1924, is lower part of Cutler fm., and is here divided into several units.

Named for exposures in Monument Valley, San Juan Co., Utah, and Navajo National Monument, NE. Ariz.

Moody shale member.

Oligocene: Northwestern Oregon (Lincoln County).

H. G. Schenck, 1927 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 455, 456, 457, 459). *Moody sh.*—Concretionary sh., about 1,200 ft. thick, overlying Burpee fm. and forming lower memb. of Toledo fm. Is overlain by about 1,000 ft. of sss. forming upper memb. of Toledo fm. Fossils rare, but fm. is assigned to lower Olig. Type loc., railroad cuts at Moody Station, on Southern Pacific Railroad, btw. Yaquina and Toledo, in Lincoln Co.

H. G. Schenck, 1928 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 22–31). *Moody sh. memb.* lies near base of Toledo fm.

Moody Ledge granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map, p. 28). *Moody Ledge granite.*—Medium- to fine-grained pink granite of potash feldspar, quartz, oligoclase, and biotite. Late Dev. or late Carbf. Assigned to New Hampshire magma series. [Mapped on and around Moody Ledge.]

Moodys marl member (of Jackson formation).

Eocene (upper): Mississippi and southwestern Alabama.

O. Meyer, 1885 (Am. Jour. Sci., 3d, vol. 30, p. 435). [*Moody's Branch* used in Miss. column of table in parentheses after *Jackson* and opposite *Jacksonian*. No definition.]

G. D. Harris, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 303–304). [*Moody's Branch Beds (substage)* used in table for upper part of Jackson stage, *Marks' Mills Red Beds (substage)* being used to cover lower part of *Jackson stage*.]

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12), described *Moodys Branch green marls* as a fm. of Jackson *group* and as overlying Yazoo clay marl.

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, No. 7, pp. 186–198). *Moodys calc. marl memb.*—Basal memb. of Jackson fm. Thickness 35 or 40 ft. in central and western Miss., 90 ft. in western Ala., a few mi. across Miss. line. At base is bed of shells enclosed in quartz, sand, and glauconite. Toward top becomes less sandy and much more calc. and in many places contains thin strata of indurated marl or impure ls. In eastern Miss. and western Ala. a deposit of fine incoherent yellow sand intervenes btw. the indurated ledges at top and the more argill. marl below. Although the individual indurated ledges are discontinuous, the zone in which they occur is quite persistent and has been traced from western Ala. across Miss. to Yazoo River. In Ala. it constitutes the principal horizon at which *Zeuglodon* occurs, and has therefore been called "Zeuglodon bed." The Moodys memb. rests conformably on Yegua fm. [=Gosport sand of Ala.] and is overlain by Yazoo clay memb. of the Jackson. [Later repts give thicknesses up to 220 ft.]

Later work led Cooke to transfer the *Zeuglodon*-bearing bed to Yazoo clay memb. (See A. A. P. G. Bull., vol. 17, No. 11, 1933, pp. 1387–1388.) He also applied *Cocoa sand memb.* to sandy beds in Ala. that represent lower part of Yazoo clay of Miss. and overlie Moodys marl memb. These are present approved definitions of Moodys marl memb., Yazoo clay memb., and Cocoa sand memb. The U. S. Geol. Survey does not now use *calc.* in connection with *marl.*

Named for exposures along Moodys Branch of Pearl River, in city of Jackson, Miss.

†Moodys Branch marl.

Eocene: Mississippi.

See *Moodys marl memb. of Jackson fm.*

Moon Lake diorite.

Pre-Cambrian: Northwestern New York (Jefferson County).

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, p. 62). *Moon Lake diorite.*—Quartz diorite; forms much of peninsula on S. side of Moon Lake, Antwerp quad. Intrudes Grenville series.

Moonshine conglomerate.

Middle Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 4, pp. 896, 900). *Moonshine fm.*—"New, of geographic origin." [Geographic feature not stated.] Lower part an ordinary cgl. bearing cobbles of granitic plutonic origin and ancient red porphyries, grading upward into red cgls., red sh., and finally red tuffs. Thickness 300 ft. Age middle Middle Jurassic. Underlies Hull aggl. and overlies Mormon ss. Occurs most abundantly on SW. slope of Mount Jura, just below 4,500 ft. elev.

Moorefield shale.

Mississippian: Central northern Arkansas and northeastern and central eastern Oklahoma.

G. I. Adams, 1904 (U. S. G. S. P. P. 24, p. 26). *Moorefield sh.*—Light-grayish or bluish friable sh., in places sandy. Thickness 50 to 75 ft. in vicinity of Moorefield. Overlies Boone ls. and chert and underlies Batesville ss.

E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 102–104). *Moorefield sh.*, 0 to 10 ft. thick, is=Fayetteville sh. in part of Branner. It overlies Boone ls. and grades into overlying Batesville ss. A few mi. NW. of Batesville there is a local deposit of highly fossiliferous ls. and limy sh. which H. S. Williams has called *Spring Creek ls.* Apparently this calc. fm. rests on Boone fm. and underlies Moorefield sh. The increase in argill. matter toward top of exposure probably indicates that the calc. beds grade upward into the sh. Though of small consequence areally, this calc. fm. is too important geologically to be entirely neglected in classification of Miss. rocks of Ark. Perhaps it is sufficiently accounted for by ranking it as a memb. of Moorefield fm.

According to G. H. Girty the Moorefield sh. is of pre-Chester (St. Louis?) age. Overlies Boone ls. and underlies Batesville ss.

Named for Moorefield, Independence Co., Ark.

Mooretown sandstone. (In Chester group.)

Mississippian: Southern Indiana and Meade and Breckinridge Counties, Kentucky.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 408, 515, and chart). *Mooretown ss.*—Sh. and ss., 10 to 60 ft. thick, locally very massive. Overlain by Beaver Bend ls. and underlain by Paoli ls. Of lower Chester age. Included in Gasper oolite of Butts. Name suggested by C. A. Malott.

Named for excellent exposures near village of Mooretown, Ind.

Mooreville tongue (of Selma chalk).

Upper Cretaceous: Northeastern Mississippi.

L. W. Stephenson, 1917 (Wash. Acad. Sci. Jour., vol. 7, pp. 243–250). *Mooreville tongue.*—A basal part of Selma chalk contemp. with and grading laterally into lower part of Coffee sand memb. of Eutaw fm. in E. part of Lee Co. and W. part of Itawamba Co. The material composing Mooreville tongue consists of argill. chalk and shaly chalky clay or marl. Is 215 ft. thick and 20 mi. long. Rests on Tombigbee sand memb. of Eutaw fm., and is overlain by Tupelo tongue of Coffee sand memb.

Named for development at Mooreville, Lee Co.

Moosalamoo phyllite.

Pre-Cambrian: Southwestern Vermont (Brandon quadrangle, Addison County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 362, 395). *Moosalamoo phyllite.*—A fine-grained black rock, mainly quartz and muscovite with a little biotite and disseminated iron ore. Ranges in thickness from 0 (at Lana Falls) to 500 ft. on S. and E. slopes of Moosalamoo Mtn, 1 mi. to N. Pinches out in general latitude of Middlebury but goes still farther to N. Uncon. underlies basal Camb. cgl. and is considered younger than Forestdale marble.

Moose meta-argillite.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 133). Included in Beltian system.

Moosebar formation.

Cretaceous: British Columbia.

F. H. McLearn, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 5).

Moose Creek beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258). *Moose Creek beds* (zone of *Dalmanella emacerata* and *Plectambonites rugosus major*) are main zone in Lorraine gulf and well exposed along Moose Creek [Lewis Co.]. Of Lower Lorraine age, and top div. of Whetstone Gulf fm. Overlie Wood Creek beds and underlie Tremaines Bridge beds (basal part of Pulaski fm. or Upper Lorraine).

Moose Hide group.

Paleozoic (?): Canada (Yukon region).

R. G. McConnell, 1899 (Canada Geol. Surv. Ann. Rept., vol. 12, n. s., pp. 18A–20A).

Assigned to Camb. by H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 198).

Moosehide diabase.

Canada (Yukon region).

R. G. McConnell, 1905 (Canada Geol. Surv. Ann. Rept., vol. 14, pt. B, p. 22).

Moosehorn limestone.

Mississippian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 299–300). *Moosehorn ls.*—Lower part thinly bedded ls. with shaly partings, 545 ft. thick; upper part 645 ft. of coarse-grained, rather thinly bedded ls. Overlies Bedson ls. and underlies Rocky Mtn qtzite. Named for Moosehorn Creek, SW. of Bedson Ridge, but exposures on end of De Smet Range may be more conveniently used as type loc.

†Moose Island shale.

†Moose Island series.

Silurian: Southeastern Maine.

N. S. Shaler, 1886 (Am. Jour. Sci., 3d, vol. 32, pp. 51, 58). *Moose Island shales* (also *Moose Island series*).—A great thickness of black and dark-gray shales and slates comprising what appear to be uppermost beds of Cobscook series, and reminding one of Dev. black sh. of Ohio Valley and western N. Y., but rather thicker-bedded. Upper part is composed of dark siliceous flags, with occasional interbeddings of what will probably prove to be volcanic ash deposits. Thickness at least 1,000 or 1,500 ft., but neither superior or inferior limits seen. May represent the "Great Devonian shale."

Is a sedimentary facies of Eastport fm.

Named for development on Moose Island, SE. coast of Washington Co.

Moose River sandstone.

Middle and Lower Devonian (Schoharie and Esopus): Western Maine (Somerset, Penobscot, and Piscataquis Counties).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21–22, 88–92). *Moose River ss.*—A belt of sss. and aren. shales, in some zones of which there is a fairly abundant fauna. It is generally a tough grayish ss. with some argill. layers, weathering brownish from iron oxides. Thickness runs up into hundreds and probably reaches several thousand ft. Called Oriskany ss. by C. H. Hitchcock.

H. S. Williams and C. L. Breger in 1916 (U. S. G. S. P. P. 89) assigned this fm. to epoch of Schoharie and Esopus grits of N. Y.

Named for exposures near Moose River and Moose River settlement, Somerset Co.

Moosic.

Upper Devonian: Eastern Pennsylvania.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 104–105). No Pocono fm. in Pocono Plateau. It is in Moosic Mtn, W. of Pocono Plateau, that we find the thousand ft. or more of "white" beds corresponding to Lehigh section, and here Lesley might have found the appropriate name.

G. H. Chadwick, 1935 (Am. Jour. Sci., 5th, vol. 29, No. 170, p. 139). If type section of Pocono is up the face of Pocono Knob, then, according to I. C. White, it is all "Catskill," Dev. If it is bottomed on Griswold Gap cgl. (as I. C. White thought in 1881) then there is none of it within miles of Pocono Plateau, and, as I have intimated, it should be called *Moosic*, which I will admit may be post-Chemung (Canadaway) from Griswold Gap cgl. up.

G. H. Chadwick, 1935 (letter dated Dec. 15). *Moosic* has no standing. It is not properly defined or introduced, and has no standing in strat. nomenclature.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 599), objects to *Moosic* or any other substitute for *Pocono*. (See 1936 entry under *Pocono fm.*)

Mooyie argillite.

Mooyie formation.

Pre-Cambrian: British Columbia (Idaho-Montana Int. Bdy).

R. A. Daly, 1905 (Canada Geol. Surv. Summ. Rept. 1904, pp. 96–100). *Moyie argillite.*—Thin-bedded red and gray argill. strata with subordinate thin beds of light-gray qtzite. Thickness 3,200 ft. in section along Int. Bdy from Port Hill, Idaho, to Gateway, Mont. Conformably overlies Kitchener qtzite and conformably underlies Yahk qtzite. Named for its situation on Moyie River [NE. Idaho and B. C.].

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 119–139), redefined *Mooyie fm.* to include Yaak qtzite. See 1913 entry under *Yaak qtzite.*

The U. S. Geog. Bd. has adopted *Mooyie* as the correct spelling of this river.

Mora sandstone.

Cretaceous: Central northern New Mexico.

C. R. Keyes, 1909 (Econ. Geol., vol. 4, pp. 368–369). *Mora ss.*, 500 ft. thick, named for Rio Mora, and refers to so-called Dakota ss. of Tuertos Mtns, S. part of Santa Fe Co., as described by Hayden, Newberry, and others; but does not include Lower Dakota ss. of Stevenson (Jour. Geol., vol. 16, p. 446, 1908).

Moraga formation.

Pliocene: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Moraga fm.*—Chiefly flows of andesite and basalt, with which are associated some basic tuffs and beds of well-cemented rhyolite tuff. Between these volcanic rocks lie lenticular beds of cgl., clay, and ls. One of ls. beds contains fresh-water fossils, is 30 ft. thick, and has lavas above and below it. One of the cgl. lenses in places reaches thickness of about 200 ft. The first of the flows after an unusually long interval [btw. flows of Moraga fm.] was the andesite of Grizzly and Ruin Peaks. Max. thickness of fm. about 1,200 ft. Is basal fm. of Berkeley group. Underlies Siesta fm. and uncon. overlies Merced fm. Named for occurrence in Moraga Valley, Contra Costa Co.

Morales member (of Santa Margarita formation).

Miocene (upper): Southern California (Cuyama Valley).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215). *Morales memb.*—Upper memb. of Santa Margarita fm. Consists of about 2,000 ft. of clay, white sand, and gravel with, at base, 300 to 400 ft. of light-gray, poorly bedded soft clay sh. containing a few thin beds of white ls. which on weathering break up into small irregular fragments. Rests uncon. on Whiterock Bluff sh. memb. of Santa Margarita, which in places it overlaps. Is uncon. overlain by Cuyama fm. Named for development in vicinity of Morales Canyon.

Moran formation. (In Wichita group.)

Permian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Moran fm.*—Light-colored shales and reddish sands, marked, in upper part, by 3 thin lss. Top memb. is Moran ls. (yellow). About 160 ft. below top is Dothan ls. Thickness of fm. 220± ft. Top fm. of Cisco div. in north-central Tex. Overlies Pueblo fm. Includes at top Camp Colorado bed of Drake.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 40, etc.). *Moran fm.*—Sh. and ls., with Sedwick ls. memb. [Moran ls. of 1919 rept] at top, and, in Colorado River region, Watts Creek sh. memb. at base. Is 150 ft. thick to S. and 200 or more to N. Overlies Camp Colorado ls. memb. of Pueblo fm. and in north-central Tex. is conformably overlain by Santa Anna Branch sh. memb. of Putnam fm. Includes (descending) Sedwick ls., Santa Anna sh., Horse Creek ls. (= ? Dothan ls.), and Watts Creek sh., or all beds down to Camp Colorado ls. Named for Moran, Shackelford Co.

This fm. was transferred to Perm. Wichita group by E. H. Sellards in 1933 (Univ. Tex. Bull. 3232), and Perm. is present age designation of U. S. Geol. Survey.

†Moran limestone member (of Moran formation).

Permian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Moran ls.*, top memb. of Moran fm., is uppermost yellow bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 40), replaced this name with *Sedwick ls. memb.*

Named for Moran, Shackelford Co.

Morapos sandstone member (of Mancos shale).

Upper Cretaceous: Northwestern Colorado (Routt County).

E. T. Hancock, Oct. 1, 1923 (U. S. G. S. Press Memo. 16037, with map). In vicinity of Hamilton and Seeping Spring Gulch domes a thick lens of ss. (the Morapos ss. memb. of unpublished rept by E. T. Hancock) lies about 800 ft. below top of Mancos sh. This ss., which forms a conspicuous escarpment, has been removed by erosion from crests of both these domes.

E. T. Hancock, 1925 (U. S. G. S. Bull. 757). *Morapos ss. memb. of Mancos sh.*—Thin-bedded sss., 15 to 30 ft. thick, lying 800 ft. below top of Mancos sh. in Axial and Monument Butte quads. Outcrops in vicinity of Morapos Creek.

Morden beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 128).

†Moreau sandstone.

Lower Ordovician (Beekmantown): Central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 370–375). *Moreau ss.*—Massive sss., 50 or more ft. thick, containing fragments and grains of chert. Underlies Jefferson City ls. and overlies Osage [Gasconade] ls. in central Mo.

Same as Roubidoux fm., older name.

Named for Moreau Creek, Cole Co.

Morehouse quartzite.

Ordovician and Silurian (?): Southwestern Utah (Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Morehouse qtzite.*—Fine-grained pink and white qtzite with some beds of red and reddish-brown sh. Near top a few beds of cgl. Thickness 2,000± ft. Overlain (uncon.) by Tert. intrusives and Quat. alluvium, and underlain (probably conformably) by Grampian ls. Contains Ord. fossils, but upper part is probably Sil. Type loc., Morehouse Canyon, NW. of Frisco.

E. Kirk, 1932 (Am. Jour. Sci., 5th, vol. 26, p. 38). Improbable *Morehouse qtzite* consists of other than Ord. sediments. It is approx.=Eureka qtzite.

Morena rhyolite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 46, etc.). *Morena rhyolite.*—Gray or buff, somewhat darker than Sandstorm rhyolite, which it intrudes. Is older than Milltown andesite, from which it is probably separated by an erosion interval. Occurs on Morena Ridge.

Morenci shale.

Upper Devonian: Southeastern Arizona (Clifton-Morenci region).

W. Lindgren, 1905 (U. S. G. S. P. P. 43). *Morenci shales.*—Upper 100 ft. is clay shales mapped as *Morenci shales*; lower 75 ft. is compact and fine-grained argill. ls. mapped as *Morenci ls.* This lower part is missing in some parts of Clifton quad., and as it cannot conveniently be mapped separately on a small-scale map it has been grouped with the shales into one fm. on pl. 1, but on pl. 17 the two members have been separated. Rests conformably on Longfellow ls. and is conformably overlain by Modoc ls. Is present in vicinity of Morenci and at other places in Clifton-Morenci region.

Moreno formation (also **Moreno shale**).

Upper Cretaceous: Southern California (Diablo Range).

R. Anderson and R. W. Pack, 1915 (U. S. G. S. Bull. 603). *Moreno fm.*—Upper fm. of Chico group. Rests conformably on Panoche fm., the lower fm. of Chico group, and is uncon. overlain by Cantua ss. memb. of Martinez (?) fm. In southern area it consists of foraminiferal and diatomaceous maroon and chocolate-colored sh. and dark clay sh. with some interbedded ss., and has max. thickness of 1,600 to 1,800 ft. In northern area it contains less sh. of truly organic origin and more clay sh. and ss. and is uncon. overlain by Tejon fm. Typically exposed in Moreno Gulch, on E. flank of Panoche Hills, where it is 1,700 to 2,000 ft. thick and composed predominantly of thin-bedded, rather brittle brownish and lavender-colored shales that weather into small bits and flakes. In lower part of fm. are numerous beds of ss., locally containing poorly developed concretions and in general similar to the ss. of Panoche fm. Upper half of fm. is more nearly pure sh. and contains greater proportion of material of organic origin. Calc. sh., ls. nodules, and layers of semi-porcelaneous siliceous sh. occur locally, and near top of fm. is a zone of white platy diatomaceous sh. about 200 ft. thick, which is traceable most of way along face of Panoche Hills, Fresno Co. Line btw. Moreno and Panoche fms. is arbitrarily drawn at horizon where the ss. beds that form steep E. slope of Panoche Hills dip beneath the predominantly shaly beds.

Morgan formation.

Pennsylvanian: Northeastern Utah (northern Wasatch Mountains).

E. Blackwelder, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 519, 529–542). In upper canyon of Weber River [in which is located town of Morgan] the conspicuous Weber qtzite (Penn.) is separated from the dark Miss. lss by a fm. of red ss. and sh. with intercalated thin lss., having a total thickness of 500 to 2,000 ft. This fm. was noted by geologists of 40th Par. Surv. but not named. F. B. Weeks, in unpublished ms. on geol. of NE. Utah and adjacent regions, calls it *Morgan fm.*, and in present paper that name is adopted. Prevailing rock in Morgan fm. is earthy ss., relatively soft. Fresh surfaces are generally white or pink, but the rock weathers brick red. Some beds are distinctly shaly, and here and there thin layers of gray ls. with a few fossils are interbedded. The fm. passes upward through a transitional zone of alternate gray shales, lss., and sss., into the more or less calc. base of Weber qtzite. It rests uncon. on fossiliferous gray Miss. ls. Is of Penn. age. Has been traced from Weber Canyon northward 5 or 6 mi., where it disappears beneath the Eocene. Has not been recognized in other parts of region and is probably of local extent. Is probably of terrestrial origin. These beds were included in Weber qtzite as originally defined by King.

Morgan series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Morgan series*, from Morgan Co., W. Va., as a geographic name for Lower Dev. series, to include Oriskany and Helderberg groups of N. Y.

Morgan Corners formation.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., 1931, pp. 182, 185) to *upper* part of A3 of Logan's section of Philipsburg series of Quebec. McGerrigle mapped his Morgan Corners fm. (Ord.) in small area in St. Albans quad., Vt., and stated that it consisted of 150 ft. of dol. He applied *Wallace Creek fm.* to *lower* part of Logan's A3, and described it as an interstratified series of thin-bedded shaly lss., with thicker bedded lss., gave its thickness as 200 to 250 ft., and mapped it in St. Albans quad. (See 1931 entry under *Philipsburg series*.)

Morgantown sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania, eastern Ohio, western Maryland, and northern West Virginia.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Morgantown ss.*—Named for Morgantown, W. Va. Lies 140 to 160 ft. below Pittsburg coal, and 25 to 38 ft. above Crinoidal [Ames] ls. Thickness 30 to 70 ft.

W. G. Platt, 1878 (2d Pa. Geol. Surv. Rept. H4). *Morgantown ss.*, 40 to 50 ft. thick, overlies Elk Lick coal, and consists of an upper and a lower ss. each 10 to 15 ft. thick, separated by 7 ft. of red sh.

Morgantown red bed. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and western Maryland.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6), applied *Morgantown red bed* to beds shown as=lower part of Morgantown ss. at Pittsburgh, Pa., and to beds underlying Morgantown ss. in Upper Potomac Basin of Md.

Morgantown member. (In Conemaugh formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include (descending) Clarksburg ls., Clarksburg red bed, Morgantown ss., and Wellersburg coal.

Moriah marble.

F. J. H. Merrill, 1895 (N. Y. State Mus. Bull. 3, No. 14). The ophiolite of the crystalline lss. of Moriah and Westport Twps, Essex Co., N. Y., is widely familiar under trade name "Moriah marble." Assigned to Archean.

Morien series.

Pennsylvanian: Nova Scotia.

A. O. Hayes and W. A. Bell, 1923 (Canada Geol. Surv. Mem. 133, pp. 15, 95).

Morin limestone.

Pre-Cambrian (Laurentian): Canada.

W. E. Logan, 1863 (Canada Geol. Surv. 15th Rept. Prog., pp. 837–838+).

Morita formation.

Lower Cretaceous (Comanche): Southeastern Arizona (Bisbee region) and northern Mexico.

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, pp. 56, 63–65). *Morita fm.*—Alternating beds of dull-red aren. sh. and red or tawny sss. with occasional layers of grit and lenses of impure ls. In upper part the red sh. becomes calc. One bed of reddish-brown grit, 10 to 15 ft. thick, occurs 1,200± ft. above base of fm. Some strata are 10 to 15 ft. thick, but usually are less than 4 ft. thick. Is a shallow-water deposit. Grades into overlying Mural ls. and rests conformably on Glance cgl., all of which are included in Bisbee group (of Comanche age). Named for Morita Hills, just S. of Int. Bdy. btw. longitudes 109°45′ and 109°50′, in Sonora, Mexico.

Morley coal group.

Local name for a group of coal beds in Raton fm. of Elmoro and Spanish Peaks region, Colo. Exposed at several places in vicinity of Morley. See U. S. G. S. Elmoro folio, No. 58, 1899.

Mormon sandstone.

Middle Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Mormon ss.*—Fine-grained compact gray ss. with several small beds of cgl. Thickness 500 ft. Older than Bicknell ss. and younger than Thompson ls.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Mormon ss.*—Prevailingly fine-grained gray compact ss., passing on one hand into greenish or reddish cgl. and on other hand into more shaly beds. Thickness 550 ft. Rests conformably on Thompson ls. and is overlain, probably conformably, by Bicknell ss. Extends across Mount Jura from lower slopes of Grizzly Mtns to North Arm.

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81), showed *Mormon ss.* of Mount Jura as underlying Moonshine cgl. and overlying Thompson red sh.

Named for exposures at Mormon Station, on old stage route near Taylorsville, Plumas Co.

Morne l'Enfer formation.

Tertiary: Trinidad.

G. A. Macready, 1920 (Am. Inst. Min. and Met. Engrs. Trans. [preprint 1017], p. 8).

Morning Glory limestone member (of Gold Hill formation).

Cambrian? (Upper Cambrian?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Morning Glory ls. memb.*—White to blue-gray crystalline ls. with mixture of silicates. Thickness 15 ft. Lies near middle of Gold Hill fm., nearly 200 ft. below White Cap ls. memb. and 140 ft. above Pine Nut ls. memb. Exposed near Morning Glory mine.

Morphy.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Morphy* is introduced for lowest Canajoharie or zone of *Mesograptus mohawkensis* in Mohawk Valley.

Morrill limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 234, 235, 237). *Morrill ls.* (in Garrison sh. memb. of Council Grove fm.) consists of 1 to 3 ft. of hard gray massive ls., irregular above, weathering grayish, basal portion weathering brownish and cavernous. Overlies Florena sh. (which rests on Cottonwood ls.) and underlies Stearns sh. Named for exposures 2 mi. NW. of Morrill, Kans.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 17). *Morrill ls.* consists of 2 dark-gray granular lss. separated by thin gray calc. sh. Thickness usually about 4 ft. in northern occurrence but becomes 7 to 13 at places in central and southern Kans. Type loc. W. and ½ mi. N. of Morrill, Kans. When named was well exposed at type loc., in gutter below the road cut in which Eiss ls. is shown, but is now covered here by a new road grade. But it is shown in a small bench, first above the Cottonwood, about ¼ mi. N. of type loc. and E. of N.-S. road in NW. corner of sec. 27 and SW. corner of sec. 22.

G. E. Condra, 1935. (See under *Beattie fm.*)

See also Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Morris granite.

Pre-Cambrian: Long Lake quadrangle, Adirondack Mountains, New York.

H. P. Cushing, 1907 (N. Y. State Mus. 60th Ann. Rept., pt. 2, pp. 482, 510, 525, and map). *Morris granite.*—Quite uniform red, very acid granite, constituted almost wholly of red feldspar and quartz; other minerals not visible to eye. More commonly fine-grained, but there is also a coarse phase.

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95). *Morris granite*, intrusive into Grenville rocks and Saranac fm. Is latest granite of region. Consists almost wholly of alkali feldspar and quartz. Named for occurrence on W. slopes of Mount Morris, Franklin Co.

Morris sand.

A subsurface sand, of early Penn. (Cherokee) age, in central eastern Okla., which is said to correspond to upper Dutcher sand. In type area (Morris pool, Okmulgee Co.) it lies at 1,600 ft. depth, the second Booch sand at 1,300 ft. depth, the so-called Glenn sand at 1,725 ft., and the Fields sand at 1,800 ft.

Morris Ferry greensand.

Upper Cretaceous (Gulf series): Southwestern Arkansas and southeastern Oklahoma.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, p. 89). *Morris Ferry greensands.*—Hard massive rock, composed of fine grains of greensand, calcite, and siliceous sand, outcropping near low-water line of river at Morris' ferry on Little River, in N. edge of Little River Co., Ark. Underlies alluvial and Quat. deposits. Relations to other Cret. rocks undet.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 114, 302). The *Morris Ferry greensands* are most eastern outcrop of Woodbine fm.

According to studies of L. W. Stephenson and C. H. Dane these beds are part of Woodbine sand.

Morris Mountain shaly member (of Logan formation).

Mississippian: Northeastern Kentucky (Powell County).

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 46). *Morris Mtn shaly memb.*—Mostly sh., but includes subordinate amounts of ss. and ls. or calc. and fossiliferous layers. At Carter, Carter Co., it has a bed of red sh. at top. Thickness 15 to 100 ft. Is top memb. of Logan fm., and probably same as Rushville group of Andrews in Ohio, but proof is lacking. Named for Morris Mtn, about 4 mi. N. of Stanton, Powell Co.

Morrison formation.

Upper Jurassic: Colorado, northern New Mexico and northeastern Arizona, eastern Utah, Wyoming, western South Dakota, central southern Montana (Stillwater-Rosebud Counties region), western Oklahoma, and western Kansas (?).

G. H. Eldridge, 1896 (U. S. G. S. Mon. 27). [The fm. was named by Eldridge in this Mon., within the area of which is its type loc.; but Pikes Peak folio, by W. Cross, in which the fm. was also described was published in 1894, before publication of the Mon.] *Morrison fm.*—Throughout Denver region and for much of distance along E. base of Rocky Mtns in Colo., the Jura is essentially a fm. of fresh-water marls, of average thickness of 200± ft. Its upper limit is sharply defined by Dakota ss., while the brown and pink ss. closing the Trias as clearly marks its lower limit. To this fm. has been assigned the name *Morrison*, from the town [near Denver] near which it is typically developed. The marls are green, drab, or gray, and carry in lower two-thirds numerous lenticular bodies of ls. of characteristic drab color and a texture compact and even throughout. About 20 ft. above base occurs a persistent band of alternating lss. and sss., or all sss., 10 to 15 ft. thick. At Morrison the top memb. of underlying Wyoming fm. consists of 15 to 25 ft. of persistent ss., fine-grained, often massive, pink and brown. The clays of lower two-thirds are remarkable for their reptilian remains and from the dominating form have been designated "*Atlantosaurus* clays." The upper third is generally a succession of sss. and marls, of which the sss. predominate. The most important ss. occurs just above the *Atlantosaurus* clays, is very persistent, and from contained Saurian remains has been called *Saurian ss.* It varies in thickness btw. 5 and 35 ft., and in its distance below the Dakota from 10 to 125 ft., although usually from 50 to 80 ft. The Morrison appears to be uncon. with underlying Wyoming fm. [now divided into (descending) Lykins fm., Lyons ss., Ingleside fm., and Fountain fm.].

In western So. Dak., Wyo., and as far S. in eastern Colo. as Loveland, the Morrison fm. is underlain by marine Sundance fm., of Upper Jurassic age. The age of the Morrison was long questioned, some geologists considering it Upper Jurassic, others considering it Lower Cret. The U. S. Geol. Survey now classifies it as Upper Jurassic, although for many years it classified it as Lower Cret. (?).

†Morrison sandstone.

Middle Jurassic: Northern California (Trinity and Shasta Counties).

O. H. Hershey, 1904 (Am. Geol., vol. 33, pp. 356-360). [*Morrison ss.* as used on pages above cited is, according to J. S. Diller (unpublished note), a misprint for *Mormon ss.*]

Morrison sand.

A subsurface sand in Morrison 3-No. 1A well, of Westbrook field, Mitchell Co., Tex., which lies near base of Clear Fork fm.

Morrisonian series.

A term employed by C. R. Keyes to cover Morrison fm. and supposedly contemp. deposits.

Morristown dolomite member.

Upper Cambrian: Eastern Tennessee.

C. R. L. Oder, 1934 (Jour. Geol., vol. 42, No. 5, pp. 476-478, 493, 496). *Morristown dol. memb.*—Lower memb. of Conococheague-Copper Ridge fm. Consists of 800 to 1,250 ft. of thin- to heavy-bedded dark- to light-gray dense to fine and medium crystalline, fine to coarsely laminated dol. and ls., with subordinate aren. and shaly zones. In W. outcrops very little ls. is present and characteristic rock is blackish to brownish-gray dol. with saccharoidal texture and fetid odor. Btw. Jefferson City and Morristown this memb. is almost wholly dol. of western type. Intraformational ls. cgls., somewhat silicified, occur at various levels. Chert usually plentiful in upper half, especially along western outcrops, and varies from grayish white and steel gray to grayish black, the darker colors more abundant in eastern areas; dense, compact, conglomeratic, and oolitic textures are all common. Fossils rare (listed). [Details.] Belongs to Ozarkian series of Camb. system. Rests uncon. on Maynardville ls. Underlies Bloomingdale ls. memb. of Conococheague-Copper Ridge fm., which contains thick aren. zone at base. Type loc. is along U. S. Highway 25E., about 2 mi. NW. of Morristown.

Morrow group (Arkansas).

Morrow formation (Oklahoma).

Pennsylvanian (Pottsville): Southeastern Arkansas and central eastern and northeastern Oklahoma.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 28, 109-113). *Morrow fm.*—Variable fm. of shales with some thin lss. and occasional sss. Basal portion usually ss. or sandy sh. Includes (ascending order) the following divisions of Ark. Survey: Washington sh. and ss.; Brentwood (Pentremital) ls.; coal-bearing sh.; Kessler ls.; and unnamed bed of shales and sss., 5 to 20 ft. thick, the upper limit of which is rather indefinite but at many places is marked by presence of heavy sss. carrying quartz pebbles. Underlies Winslow fm. or Millstone grit. Overlies Pitkin ls.

A. H. Purdue, 1907 (U. S. G. S. Winslow folio, No. 154). *Morrow group.*—Divided into two fms., the lower one, consisting of ss. and sh., called *Hale fm.*, and the upper one, consisting of carbonaceous sh. with two ls. lentils (Brentwood and

Kessler), called *Bloyd sh.* Underlies Winslow fm. and overlies Pitkin ls. Of Pottsville age.

In NE. Okla. is uncon. overlain by Cherokee sh.

Named for Morrow, Washington Co., Ark.

Morrow pay sand.

A subsurface sand in Woodbine fm. of Navarro Co., Tex. Lies 250 ft. below Main pay sand in Currie field.

Morrow Creek member (of Green River formation).

Eocene: Southern Wyoming (Rock Springs uplift).

W. H. Bradley, 1926 (U. S. G. S. P. P. 140, p. 123, map, chart, etc.). *Morrow Creek memb.*—A distinct lithologic unit of plant-bearing lacustrine beds that form upper part of Green River fm. and are easily traceable from N. part of Sweetwater Co. southward along top of White Mtn to Union Pacific R. R. and thence W. to Green River. Largely buff sandy ls. and buff ss., contrasting sharply with underlying bluish-white Laney sh. memb. of Green River fm. Also contains small amount of light-brown paper sh. and an occasional alga reef or pisolite. Exposures characterized by poor bedding and chippy fragments. Thickness 100 to 500 ft. Lower part appears to replace Tower ss. lentil of Green River fm., which occurs farther S. Underlies Bridger fm. Named for exposures in valley of Morrow Creek.

Morse Creek limestone.

Middle Devonian: Western New York (Lake Erie region).

A. W. Grabau, 1917 (Geol. Soc. Am. Bull., vol. 28, p. 946). *Morse Creek ls.*—Has been called "Encrinal ls." Is similar to the younger Tichenor ("Encrinal") ls. Is widespread in western N. Y. Well exposed on shore of Lake Erie, N. and S. of Eighteen-Mile Creek and in gorge of that stream. This ls., for which I propose name *Morse Creek ls.*, from Morse Creek, near Athol Springs, Erie Co., lies in reality below horizon of Ludlowville sh. and is=Centerfield ls. of Cayuga Lake region.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 227). *Morse Creek ls.* of Grabau is same as true Tichenor ls. [See 1930 quotation under *Tichenor ls.*]

†Mortar beds.

A descriptive term applied in early repts to Ogallala fm. (Plio. and Mio.) of Kans. So named because in appearance the beds resemble rough mortar. (See also under *†Plains marl* and *Ogallala fm.*)

Moruga series.

Miocene: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geology of Trinidad, pp. 45–53).

Mosby sandstone member (of Warm Creek shale).

Upper Cretaceous: Central northern Montana (Fort Benton-Little Rocky Mountains region).

C. T. Lupton and Wallace Lee, 1921 (A. A. P. G. Bull. 5, p. 263). Several distinct and easily recognized datum planes occur in exposed part of Colorado sh. in region of Musselshell River. The lowest of these, called *Mosby ss.*, from Mosby P. O., is 1,065 ft. above base of the Colorado. It is 3 to 4 ft. thick, and divided into two approx. equal parts by a dirty fossiliferous ls. bed about 6 in. thick. Along the Musselshell it forms a conspicuous rim rock at top of the bluffs bordering the river and has a uniform and unvarying character. A somewhat similar but noncalc. bed 2 ft. thick, usually less conspicuous, occurs 17 ft. above Mosby memb. on Musselshell River and at some localities closely resembles it.

A. J. Collier and S. H. Cathcart, 1922 (U. S. G. S. Bull. 736F, p. 172), treated the Colorado deposits of Little Rocky Mtn region as a group, divided into (descending) Warm Creek sh., Mowry sh., and Thermopolis sh., the Warm Creek sh. including the *Mosby ss. memb.* about 360 ft. above its base and 775 ft. below overlying Eagle ss. They described the Mosby as a rather thin calc. ss. (5 ft. thick) containing many periwinklelike fossils.

Mosca limestone.

Pennsylvanian: New Mexico.

C. R. Keyes, 1906 (Jour. Geol., vol. 14, pp. 147–154), divided his *Manzanan series* [not same as Manzano group, but older] into (descending) *Mosca lss.*, Coyote sss., *Montosa lss.*, and Sandia shales. Derivation of names not given.

Is a part of Madera ls.

Moscow shale. (In Hamilton group.)

Middle Devonian: Western and central New York.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 298–300). *Moscow shales.*—Fossils and sh. change considerably from those below. Chiefly bluish, sometimes olive, and in certain localities portions near upper part are black. Very little of mass is slaty. Named for occurrence at Moscow, Livingston Co. Underlies Tully ls. and overlies Encrinal ls.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 229). *Moscow fm.*—Top fm. of Hamilton group. Hall (1839) described Moscow fm. from exposures along Little Beards Creek near village of Leicester (formerly Moscow). He limited the fm. at base by an "Encrinal" ls. which he believed to be="Encrinal" of Cayuga Lake region at Ludlowville. But the lower "Encrinal" at Moscow has now been traced eastward to Canandaigua Lake and proved to be Tichenor ls., while the "Encrinal" of Cayuga Lake region, when traced westward from Ludlowville, is found at horizon of Menteth ls., 55 ft. above type Tichenor. The Menteth can be traced to Genesee Valley, where it occurs 9 ft. above the Tichenor. There is thus an overlapping of the original Ludlowville and Moscow, both of which were defined so as to include the interval btw. Tichenor and Menteth lss. *It is therefore proposed to redefine the Moscow* to include Menteth ls. and all beds above it up to base of the "Pyrite," or to base of Tully ls. in localities where it is present. The Moscow as thus redefined can be traced at least as far E. as Unadilla Valley and W. to shore of Lake Erie. Hall's locality will serve as a type section, although the fm. is not exposed completely there. It is here subdivided into (descending) Windom memb., Kashong memb., and Portland Point memb., the latter including Menteth ls. at base. The Moscow as here redefined overlies Deep Run memb., top memb. of Ludlowville fm.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). Menteth ls. is basal bed of Moscow sh. and overlies Ludlowville sh.

The U. S. Geol. Survey now treats Moscow sh. as top fm. of Hamilton group, and draws its base at base of Menteth ls. memb.

Mose Carr sand.

A subsurface sand in Okmulgee Co., Okla., which is said by some geologists to belong to Dutcher sand series (early Penn.) and by other geologists to correlate with Tyner fm. (Ord.).

Moseley limestone lentil.

Eocene (Claiborne group): Eastern central Texas (Burleson and Robertson Counties).

B. C. Renick and H. B. Stenzel, 1931 (Univ. Tex. Bull. 3101, pp. 78, 91). *Moseley ls. lentil.*—From 25 to 35 ft. above Sparta sand memb. of Cook Mtn fm. in Burleson Co. and 15 to 25 ft. above the Sparta in Robertson Co., there is, in Crockett clay memb. of Cook Mtn fm., an argill. ls., sometimes very glauconitic, which is abundantly fossiliferous. In places this ls. grades into an argill., glauconitic shell marl, and at the old Moseley's ferry site on the Brazos (bridge on the Giddings to Hearne branch of Southern Pacific R. R.) it is of latter type. This ls. is persistent across these counties. The Moseley is underlain by sticky blue, gray, and buff clays containing beds of fossiliferous glauconitic sand, and is overlain by 24 to 30 ft. of gray and buff clays.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 612), showed *Moseley ls.* as lying higher in the Crockett than Eaton lentil and lower than Little Brazos ls.

H. B. Stenzel, 1935 (Univ. Tex. Bull. 3501, pp. 267–279), restricted *Crockett* to beds above Moseley ls., and included latter in his Stone City beds (new name).

Mosheim limestone. (Of Stones River group.)

Lower Ordovician: Eastern Tennessee, western Virginia, and northern Alabama.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 413, 414, 538, 543, 544, 557, 636, pl. 27). *Mosheim ls.*—Fine-grained ls. [mentions one locality where it is 84 ft. thick] uncon. overlying Knox dol. In Knoxville and Athens troughs uncon. underlies Lenoir ls.; in Pearisburg trough uncon. underlies Holston ls. In Pearisburg and Knoxville troughs uncon. overlies Upper Knox. In Athens trough uncon. overlies Jonesboro ls., of Beekmantown age. Is of lower Stones River age and older than Murfreesboro ls.

The beds designated Mosheim ls. by Ulrich are present at type loc. of Lenoir ls. and may have been included in original definition of Lenoir by Safford. According to Ulrich and Butts they differ in lithology, color, and fauna from overlying Lenoir and uncon. underlie it, also uncon. overlie Knox dol. According to A. Keith (personal communication) all of the chertless lss. were excluded from the Knox by Safford in his definition and in his mapping. The Mosheim ls. as identified by Butts in Ala. (Ala. Geol. Surv. Spec. Rept. No. 14, 1926, and U. S. G. S. Bessemer-Vandiver folio) uncon. overlies Odenville ls. and underlies, in places uncon., the Lenoir ls. The Mosheim ls. is now treated by E. O. Ulrich and C. Butts as middle fm. of Stones River group of E. Tenn. and western Va., where it underlies Lenoir ls. and overlies Murfreesboro ls.

Named for exposures in railroad cut at Mosheim Station, Green Co., Tenn.

Moshup till member (of Jameco formation).

Pleistocene (Kansan): Southeastern Massachusetts (Marthas Vineyard).

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Moshup till memb.*—Top memb. of Jameco fm. Consists of about 10 ft. of upturned stony blue clay till containing boulders as large as 8 ft. in diam. Known only on No Mans Land and at Nashaquitsa Cliffs, on S. shore of Marthas Vineyard, where it rests uncon. on Weyquosque fm. and is uncon. overlain by Gardiners clay. Gravel of typical Jameco type may underlie the Moshup, but it is not exposed. Is considered = at least upper part of Jameco gravel of other parts of Marthas Vineyard. Named for "a local god finding a place in aboriginal folk-lore concerning the origin of Gay Head."

Mosinee conglomerate.

Pre-Cambrian (upper Huronian): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 364). *Mosinee cgl.*—Mainly cgl., but in one area is mainly a fine-grained brittle sl. or chert. Occurs in scattered exposures on upland area E. and SE. of Mosinee. Thickness can only be surmised, but is believed to be great. Is either upper or middle Huronian. Rests uncon. on igneous rocks.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to upper Huronian.

Mosquito porphyry.

Eocene: Central Colorado (Leadville-Alma region).

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230) and 1886 (U. S. G. S. Mon. 12, p. 83). Light-gray fine-grained dike rock, formed of quartz, orthoclase, and plagioclase feldspars and biotite. [Petrographic description by W. Cross on p. 327 of Mon. 12.]

In U. S. G. S. P. P. 148, pl. 2, 1927, mapped with the other masses of diorite porphyry, without a distinctive name.

Named for occurrence in North Mosquito Amphitheater, on N. face of Mount Lincoln, N. of Alma, Park Co.

Moss porphyry.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). *Moss porphyry.*—Quartz monzonite porphyry. Intrudes Alcyone trachyte, and is believed to be younger than Oatman andesite. May be intrusive equiv. of Gold Road latite. The Moss mine is wholly within this rock.

Mott Haven limestone.

Pre-Cambrian: Southeastern New York (Manhattan Island).

J. D. Dana, 1881 (Am. Jour. Sci., 3d. vol. 21, pp. 431–432). The western or *Mott Haven ls. band* outcrops on New York [Manhattan] Island btw. 118th and 124th Streets. The ledge of ls. with intercalated gneiss, N. of 122d St. and E. of and adjoining Lexington Ave., is principal locality remaining. It is about 125 ft. in breadth.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 23). The W. belt of *Inwood ls.* in New York City in vicinity of Mott Haven has been called *Mott Haven ls.* (1881 Dana).

Mottville member (of Skaneateles shale).

Middle Devonian: Central New York (Onondaga and Cayuga Counties).

B. Smith, 1916 (Acad. Nat. Sci. Phila. Proc., vol. 67, pp. 561–566). *Mottville memb.*—Limy crinoidal band and associated fossiliferous shales above and below, which are exposed along Skaneateles outlet S. of Mottville, and form basal part of Skaneateles sh. in Tully quad. Thickness 15 to 25 ft. The sh. beneath limy band is gray, thin bedded, fossiliferous, and 10 to 25 ft. thick. The sh. above limy band is rather coarse, thick-bedded, and very fossiliferous. To E. the Mottville memb. rests on Cardiff sh.; to W. on underlying Marcellus sh. Named for occurrence at Mottville, Onondaga Co.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 216, 219). *Mottville memb. of Skaneateles fm.*—Smith carefully traced his Mottville memb. E. and W. of type loc. at Mottville and found that to W. it approached in strat. position the beds here named *Oatka Creek sh. memb. of Marcellus fm.*, and finally, at Criss Creek, Cayuga Lake, actually rested directly on Oatka Creek memb. This placed the Mottville in exact position of Stafford ls. Sufficient exposures cannot be found to permit accurate lateral tracing of the Mottville into the Stafford, but all evidence, faunal and strat. (Smith, 1916), points to continuity of these members. Both Clarke and Luther (1909) point out similarity of Stafford fauna to that of the Mottville of Cayuga Lake. The Mottville carries a distinctive Hamilton fauna.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). Skaneateles sh. includes *Mottville ls.* at base. [On p. 391 she says Stafford ls. has recently been proved to be = *Mottville ls.*]

Moulder sand.

A subsurface sand, of Middle Dev. age, in western Ky.

Moulton diorite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Littleton and Moosilauke quadrangles).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps and p. 27). *Moulton diorite*, typically exposed on Moulton Hill, in NW. corner of Moosilauke quad. Intrudes Littleton fm. and is therefore post-lower Dev. Assigned to New Hampshire magma series. [On maps assigned to late Dev. or late Carbf.]

Moulton sand.

A subsurface sand in upper part of Kootenai fm. (Lower Cret.) in Cutbank dist., Glacier Co., NW. Mont. According to J. G. Bartram (Geol. of nat. gas, A. A. P. G., 1935, pp. 257, 267) this sand is now called *upper Sunburst sand*.

†Mound limestone.

A term applied by J. G. Percival (Wis. Geol. Surv. 2d Ann. Rept., pp. 23, 65-70, 1856) to Niagara dol. and Burroughs dol. of southern Wisconsin. According to J. D. Whitney (Wis. Geol. Surv. Rept. 1, 1862) this descriptive term was appropriate only in lead region of SW. Wis.

†Mound group.

Pennsylvanian: Central western Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. rept. on iron ores, pt. 2, pp. 169, 196). *Mound group*.—Sss. and shales, with some lss. and thin coals, 133 ft. thick, including beds 64 to 77 of detailed section of lower Coal Measures from Sedalia to Kansas City. Underlies upper Coal Measures and overlies Holden group.

Includes lower part of Kansas City fm. and upper part of Pleasanton fm. Named for occurrence in mounds of Johnson and Cass Counties.

Mound City shale.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). [See under *Swope fm.*]

J. M. Jewett, 1932 (pp. 99, 100, 103 of book cited above). *Mound City sh.*—Yellow fossiliferous sh. containing local beds of ls. a few inches thick. Thickness of memb. generally less than 5 ft. Underlies Sniabar ls. and overlies Critzer ls.

J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, p. 136). Type loc. of *Mound City sh.* is near Mound City, Linn Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), dropped this name from his classification, without explanation of its fate. But, as he restricted his *Swope ls.* to beds above base of Middle Creek ls., this sh. appears to have been included in his underlying Ladore sh. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Mounds sand.

A subsurface sand, of early Penn. (Cherokee) age, in central and northern Okla., which has been reported to correlate with Dutcher sand series, also with the ss. at base of Chattanooga sh. (Dev.?), and with Wilcox sand (Ord.). In its type loc. (town of Mounds, Creek Co.) the sand is now called Dutcher sand.

Moundsville sand.

A subsurface sand, 15 to 38± ft. thick, in Conemaugh fm. (Penn.) of W. Va., that is believed to lie at horizon of Saltsburg ss. memb. and to correspond to Little Dunkard sand of SW. Pa. Named for Moundsville, Marshall Co., W. Va.

†Mound Valley limestone.

Pennsylvanian: Eastern Kansas.

G. I. Adams, 1896 (Kans. Univ. Geol. Surv., vol. 1, p. 23). *Mound Valley ls.*—Heavy ls., thin to 15 ft. thick, capping row of hills, 120 ft. high, NW. of Mound Valley [Labette Co.] and passing under surface at Cherryvale.

Discarded by U. S. Geol. Survey many years ago, for Bethany Falls ls., the older name. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 86), discussed Adams' miscorrelations and gave synopses of Mound Valley ls. as used by other writers. On p. 88 he stated: Bethany Falls ls. was called †Mound Valley by early Kans. Geol. Surv., but *Bethany Falls* has priority.

†Mound Valley shale.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 47, 102). *Mound Valley shales.*—Heavy bed of light ashy-gray to jet-black sh. carrying some ss. and constituting escarpment to NW. of Mound Valley.

Same as Ladore sh., later but well-established name adopted by Kans. Geol. Survey. Mound Valley sh. was dropped years ago.

Named for Mound Valley, Labette Co., Kans.

Moundville quartz porphyry.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Marquette County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 520). *Moundville quartz porphyry.*—Outcrops at head of Lake Buffalo, on line btw. secs. 8 and 5, T. 14, R. 9 E., Moundville, Marquette Co. Differs from Marcellon quartz porphyry in showing throughout traces of crystalline structure and thickly scattered large brownish feldspar surfaces.

†Mountain limestone.

Nongeographic term replaced by local geographic names in different parts of country. In Mo. it included most of Mississippian fms. In E. Tenn. and western Va. it is same as Newman and Greenbrier lss. In southern Tenn. and Ala. it is divided into several fms. (See Ala. chart.) The rocks generally form the sides of mtns. In Appalachian region the name *Mountain lime* has been applied (1) to subsurface rocks lying btw. Mauch Chunk sh. and Catskill fm.; (2) to Greenbrier ls. memb. of Mauch Chunk fm.; (3) to Loyalhanna ls.; (4) to Greenbrier and Loyalhanna lss. combined; and (5) to Newman ls. Also to Maxville ls. of Ohio.

Mountain sand.

A drillers' term for sands in NW. Pa. oil region, which according to J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_5, Atlas), are 375 ft. thick and include Homewood ss. at top. The term has also been applied by drillers to Burgoon ss. memb. of Pocono fm. of western Pa. and to other sands in Pottsville, Allegheny, and Conemaugh fms. J. P. Lesley (2d Pa. Geol. Surv. Rept. L, p. 221, 1876) also used, in a section at Pittsburgh, Pa., *Pocono Vespertine or Mountain sss.* for beds underlying Mauch Chunk sh. and overlying Catskill.

Mountain bed.

A name applied by J. A. Taff (Tex. Geol. Surv. 2d Ann. Rept., pp. 730-731, 1891) to 4,060 ft. of sandy beds in upper part of Washita group (Lower Cret.) of El Paso Co., Tex.

Mountain shales.

Cretaceous: Mackenzie.

E. J. Whittaker, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. B, p. 54).

Mountain Creek rock.

Cambrian: Central southern Pennsylvania (Franklin County).

J. P. Lesley and R. H. Sanders, 1881 (2d Pa. Geol. Surv. Rept. D_5, Atlas, map of Franklin Co.).

As mapped includes the following Camb. fms.: Tomstown ls., Antietam ss., Harpers schist, and Weverton ss.

Mountain Creek formation.

Pre-Middle Devonian: British Columbia.

M. Y. Williams and J. B. Bocock, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 199).

Mountain Girl conglomerate-quartzite.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Derivation of name not stated.]

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Mountain Girl cgl.-qtzite.*—Apparently a persistent fm. consisting of 10 to 25 ft. of reddish brown cgl. with well-rounded pebbles up to 14 inches diam. of qtzite and rarely of ls., grading into rather massive rock containing allothigenous quartz grains in a cementing medium of sericite, chlorite, muscovite, biotite, and ferruginous material. Thickness 65 to 100 ft. Conformably underlies Wildrose fm. and discon. (?) overlies Middle Park fm., all of which belong to Telescope group (lower Paleozoic?) of S. part of Panamint Range. [Derivation of name not stated and not apparent from his maps.]

Mountain Glen shale.

Upper Devonian: Southwestern Illinois.

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Mountain Glen sh.*—Hard black laminated sh. having band of iron pyrites in basal part and containing numerous spores of *Sporangites huronensis* and shells of linguloid *Barroisella spatulata*. Thickness 25 to 45 ft. Uncon. underlies Springville sh. and uncon. overlies Alto fm. Probably=upper part of New Albany black sh. of Ind. and Chattanooga black sh. of Tenn. Is usually considered late Dev., but Ulrich is convinced it is early Miss. Named for occurrence near Mountain Glen, Union Co. Assigned to Chautauquan series, Dev.

Mountain Home shale.

Pennsylvanian: Southwestern New Mexico (Santa Rita district).

H. Schmitt, 1933 (Am. Inst. Min. and Met. Engrs. Contr. 39, pp. 2, 4, 13). [See under *Humboldt fm.*]

This is lower 100 to 130 ft. of Syrena fm. (Penn.) of Santa Rita dist.

Mountain Park formation.

Lower Cretaceous: Alberta.

B. R. MacKay, 1930 (Canadian Min. and Met. Bull. 222, p. 1312).

Mount Alto quartz monzonite.

Tertiary (Eocene): Central northern Colorado (Boulder County).

P. G. Worcester, 1921 (Colo. Geol. Surv. Bull. 21, pp. 34–35). *Mount Alto quartz monzonite porphyry.*—This rock occurs as a single dike about ¼ mi. N. of Mount Alto Park and about 1 mi. E. of Gold Hill Station.

Mount Ascutney granite.

Carboniferous: Southeastern Vermont (Windsor County).

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, pp. 178–179). *Mount Ascutney granite or syenite* occurs only at Mount Ascutney [Claremont quad.].

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned *Mount Ascutney nordmarkite* to Carbf.

Mount Athos formation.

Pre-Cambrian: Central Virginia (along James River).

A. S. Furcron, 1931 (Pan-Am. Geol., vol. 55, p. 317). *Mount Athos fm.*—About 200 ft. of qtzite and schist. Principal qtzite memb., usually less than 100 ft. thick, occurs generally near middle of fm. and is enclosed by micaceous and talcose schists. Overlain by Cockeysville marble and rests on epidote-hornblende greenstone. [Derivation of name not stated.]

A. S. Furcron, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 232–233). Btw. Lynchburg and Howardsville the oldest exposed rocks are basaltic lava flows of unknown thickness, now altered to epidote-chlorite-hornblende greenstone. Over these flows occur about *200* ft. of qtzite and schist here called *Mount Athos fm.* The principal qtzite memb., usually less than 100 ft. thick, occurs generally near middle of fm. and is enclosed by micaceous and talcose schists. Cockeysville marble rests on this fm. and is overlain by Wissahickon schist and phyllite. It outcrops in narrow synclinal belts which are frequently interrupted by normal faults. The fm. is at least *600* ft. thick, and consists of interlayered blue-white and pink marbles, talcose and micaceous schists. Marble composes a large part of the fm. in some localities and in other places it is greatly subordinate to schist. [Derivation of name not stated, but there is a village called Mount Athos, which receives its mail at Lynchburg.]

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 6, 24). In region E. of Lynchburg basic volcanic rocks occur under *Mount Athos qtzite* and are oldest rock exposed in that area. The Mount Athos qtzite, which may be=Setters qtzite, underlies marble that is probably=Cockeysville marble. [In table on p. 6 author divides Glenarm series (pre-Camb.) of "Piedmont and Blue Ridge provinces, Va." into (descending) Wissahickon fm., Cockeysville marble, Mount Athos qtzite, and greenstone volcanics.]

Mount Athos quartzite.

See under *Mount Athos fm.*

Mount Athos greenstone.

Pre-Cambrian: Southeastern Virginia (James River region).

A. S. Furcron, 1935 (Va. Geol. Surv. Bull. 39, pl. 1), mapped *Mount Athos greenstone,* at base of pre-Camb. of James River iron and marble belt, extending over several counties E. of Lynchburg, and described it on map as consisting of basaltic lava flows at base of Mount Athos fm., altered to greenstone schist.

Mount Auburn concretionary shale member (of McMillan formation).

Upper Ordovician: Southwestern Ohio, northwestern Kentucky, and southeastern Indiana.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, p. 85). *Mount Auburn or Platystrophia lynx beds.*—Sh., chiefly blue but in places yellowish, with some irregularly bedded ls.; thickness 20 ft. Overlain by Warren beds [Arnheim fm.] and underlain by Corryville or *Chiloporella nicholsoni* beds.

Upper memb. of McMillan fm.

Named for Mount Auburn, Cincinnati, Ohio.

Mount Baker lava.

Quaternary: Central northern Washington.

G. O. Smith and F. C. Calkins, 1904 (U. S. G. S. Bull. 235, p. 35). *Mount Baker lava.*—Mount Baker, like most of the higher peaks of the Cascades, is an extinct volcano built up of andesitic lavas of comparatively recent age. Although fragmental materials probably form part of the cone, all volcanic materials from Mount Baker observed at close range are lava. The more crystalline varieties are generally gray, but the more glassy phases are black, or, less commonly, red.

Mount Bennett rhyolite.

Tertiary (Oligocene?): Southwestern Idaho.

I. C. Russell, 1902 (U. S. G. S. Bull. 199, p. 42). Extensive sheet of rhyolite forming Mount Bennett. Provisionally termed *Mount Bennett rhyolite.*

According to C. P. Ross (personal communication) this rhyolite flow belongs to his Challis volcanics.

†Mount Bohemia conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1906 (Mines and Minerals, vol. 27, pp. 204–206).

Same as Bohemia or No. 8 cgl.

Mount Cap formation.

Cambrian (Middle): Mackenzie.

M. Y. Williams, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. B, p. 59).

Mount Carmel sandstone.

Pennsylvanian: Southeastern Ill. See under *Hanging Rock ss.*

Mount Champion quartz monzonite.

Probably pre-Cambrian: Central Colorado (Chaffee and Lake Counties).

J. V. Howell, 1919 (Colo. Geol. Surv. Bull. 17, p. 43). *Mount Champion quartz monzonite.*—A light-gray crystalline rock of medium texture. Typically exposed on Mount Champion, Lake Co. Probably pre-Camb.

Mount Charles formation.

Devonian: Mackenzie.

M. Y. Williams, 1924 (Geol. Soc. Am. Bull., vol. 35, p. 96).

Mount Clark formation.

Lower Cambrian: Mackenzie.

M. Y. Williams, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 76).

Mount Clark granite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 128, map). *Mount Clark granite.*—Very siliceous light-colored granite or alaskite, composed almost wholly of feldspar and quartz. Moderately coarse-grained and even-textured. Is practically devoid of ferromagnesian minerals, such as biotite and hornblende.

Named for fact it composes Mount Clark, Yosemite Nat. Park.

Mount Clemens moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (fig. 7) in U. S. G. S. Detroit folio (No. 205), p. 9; also on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Mount Clemens.

Mount Deception granite.

Pre-Cambrian (?): Northern New Hampshire (Mount Washington quadrangle, White Mountains).

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, p. 124). Mount Deception is built up of a coarse Concord granite.

C. H. Hitchcock, 1878 (Geol. N. H., pt. 3, pp. 241–242), mentioned, casually, *Mount Deception granite.*

J. W. Goldthwait, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 281, 283, 285), referred to gray muscovite granite "of type known to Hitchcock as 'Mount Deception granite.'"

Mount Eagle series.

Upper Cretaceous: Virgin Islands.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 478).

Mount Ebel sandstone member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 251, 253, 258, 261, 270, 272, 274, 281+, etc.). *Mount Ebel ss. memb. of Edwardsville fm.*—A bed of ss., 0 to 1 ft. thick, lying 5 to 15 ft. below top of Edwardsville fm., characterized by (1) bright yellowish-brown color often mottled with gray; (2) greater resistance to weathering than other beds in upper part of fm.; and (3) fauna of brachiopods, including *Orthotetes keokuk* and *Syringothyris textus*. [On p. 274 he described it as 10 ft. of ss. beds with alternating shaly ss. resting on 80 ft. of gray to drab siltstone (argill. ss.).] Named for Mount Ebel church, NE.¼NW.¼ sec. 23, T. 7 N., R. 1 W., 3 mi. S. and slightly E. of Smithville and from the surrounding Mount Ebel community. Type exposure is along Smithville-Fairfax road a short distance S. of Mount Ebel church, where it is 1 ft. 3 in. thick.

Mount Eden formation.

Pliocene: Southern California (San Jacinto Mountains).

D. M. Fraser, 1931 (Mining in Calif., vol. 27, No. 4, pp. 511–514). *Mount Eden fm.*—Frick's name *Eden beds* being preoccupied, he suggests that it be replaced by *Mount Eden*, which is herein substituted and used to designate the Lower Plio.

sss. and shales which occupy region about Beaumont. The name is taken from Mount Eden, a rather large hill of schist lying just W. of San Jacinto quad., upon slopes of which the sediments were deposited and are now well exposed. Upper part of fm. consists of 1,500± ft. of nonmarine sh. and sss., only moderately indurated. The sss. are grayish to buff, with occasional green and blue tints, are coarse- to medium- to fine-grained, and arkosic layers are not uncommon. The interbedded shales, having gray, tan, and blue tinges, vary in texture from sandy shales to silt shales. These beds rest conformably on the lower, or *Mount Eden Red Beds memb.*, which consists of 1,800± ft. of massive arkosic red beds, grading up into massive gray ss. and sh.; near top the strata change to finer grits and sss. of gray or greenish-gray color. Upper memb. contains Plio. vertebrate fossils. Lower memb. is unfossiliferous, distinctly more indurated and more resistant than overlying beds, and may possibly be Mio. The Mount Eden fm. uncon. underlies Bautista beds (Pleist.) and overlies the metamorphic series of Paleozoic or older age.

Mount Eden Red Beds member.

See under *Mount Eden fm.*

Mount Forster formation.

Devonian (?): British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 34).

Mount Garfield formation. (In Mesaverde group.)

Upper Cretaceous: Western Colorado (Book Cliffs coal field).

C. E. Erdmann, 1934 (U. S. G. S. Bull. 851, pp. 22, 33). *Mount Garfield fm.*—Upper part, or "barren measures," consists of an assemblage, 405 to 665 ft. thick, of ss., sh., and carbonaceous sh., the ss. averaging about 33 percent, the sh. 51 percent, the sandy sh. and shaly ss. 10 percent, and the carbonaceous sh. 6 percent; the sss. not so thick as those of overlying Hunter Canyon fm. Lower part, or "coal measures," consists of an assemblage (305 to 666 ft. thick) of ss., sh., and carbonaceous sh. containing thick beds of bituminous coal, the rocks being of fluviatile, swamp, estuarine, and littoral environment, the coal being 5.4 percent of this memb., the carbonaceous sh. 14.8 percent, the sh. 25.5 percent, and the ss. 40 percent. The lower part contains Palisade coal (at base), Cameo and Carbonera coals at top, and Rollins ss. memb. below Cameo coal. Included in Mesaverde group. Underlies Hunter Canyon fm. and overlies Sego ss. Named for Mount Garfield, which has been carved from these rocks.

Mount Garfield porphyritic quartz syenite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Franconia quadrangle).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., p. 15; map). *Mount Garfield porphyritic quartz syenite.*—Coarse- to medium-grained, usually green. Named for Mount Garfield, Franconia quad. Extends from just N. of Mount Hale southwesterly to Hardwood Ridge. Is younger than both Kinsman quartz monzonite and Mount Lafayette porphyry, and either late Dev. or late Carbf. Assigned to White Mtn magma series.

Mount Gilead sandstone. (In Henshaw formation.)

Pennsylvanian: Western Kentucky (Webster County).

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 120). *Mount Gilead ss.*—Soft ss., 15 to 30 ft. thick, believed to be highest part of Penn. in Webster Co. Top memb. of Dixon fm. Overlies Mount Gilead shales and underlies Lafayette fm. (Plio.). Occurs around and on ridge W. of Mount Gilead School.

Mount Gilead shale. (In Henshaw formation.)

Pennsylvanian: Western Kentucky (Webster County).

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 120). *Mount Gilead shales.*—Shales very similar to older Bald Hill shales. Become sandier in upper 25 to 50 ft. and weather rusty yellow, as in immediate vicinity of Mount Gilead School, but middle and lower parts are argill. and calc., with thin lss. in places; 2 mi. SW. of Mount Gilead one of lss. becomes 20 to 30 ft. thick. Total thickness of beds 150 to 200 ft. Underlies Mount Gilead ss. and overlies Vanderburg ss., all being included in Dixon fm.

Mount Glen terrane.

A term applied by C. [R.] Keyes to *Mountain Glen sh.* of Savage (1920), Upper Dev., Ill. (See Keyes, 1923, Pan-Am. Geol., vol. 39, No. 4, table on p. 320.)

Mount Harris formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado (Yampa coal field).

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Mount Harris fm.*—Mostly sh., but contains some beds of ss. and Wadge and Wolf Creek coal beds—two of most important coals in Yampa field. Thickness 950 ft. Underlies Twentymile ss. and overlies Trout Creek ss. Included in Mesaverde group. Outcrops at Mount Harris, a coal-mining town on Yampa River.

Mount Herman sandstone.

Devonian or Carboniferous: Southwestern New York.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, p. 525). *Mount Herman or Salamanca cgl.* [also calls it *Mount Herman ss.*].—Overlies red and green Cattaraugus beds and is separated from the younger Olean cgl. by 200 ft. of sh.

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, p. 974). The ss. phase of Salamanca cgl. lentil is well exposed in a number of small quarries on Mount Herman, just S. of Olean, where it is locally known as *Mount Herman ss.*

Mount Holly conglomerate.

Pliocene (?): Southern New Jersey (Burlington County).

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 271, 288). On top of the hill at Mount Holly, N. J., is an identical cgl. and gravel, composed of same materials as Bryn Mawr gravel in Pa. This cgl., which is named *Mount Holly cgl.*, has the peculiar ferruginous glaze of Bryn Mawr gravel. It overlies Cret. marls and sands. From its abundance at Mount Holly, and in order to show its connection with the Pennsylvania deposits, we shall call the cgl. of the Bryn Mawr gravel *Mount Holly cgl.*

Mount Holly gneiss.

Pre-Cambrian: Southwestern Vermont (Rutland County).

C. L. Whittle, 1894 (Am. Jour. Sci., 3d, vol. 47, pp. 347–355). In paper soon to appear in Jour. Geol. writer will call the upper metamorphosed Algonkian clastics (schists, qtzites, cgls., and lss.) *Mendon series*, and the older metamorphics of gneisses, schists, lss., and qtzites the *Mount Holly group*, upon which the Mendon series is believed to lie discordantly.

C. L. Whittle, 1894 (Jour. Geol., vol. 2, pp. 396–429). *Mount Holly series.*—More metamorphosed and more variable [than overlying Mendon series] series of stratified rocks of Algonkian age, together with gneisses and schists of unknown origin, and abundant metamorphic equivalents of old basic igneous rocks. Consists of gneiss, qtzites, lss., and schists. Named for development in town of Mount Holly [Wallingford quad., Rutland Co.].

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 264–269, etc.). *Mount Holly gneiss.*—Oldest known rock in Vt. Highly metamorphosed complex of sed. and igneous rocks, called *Mount Holly "series"* by Whittle. The rocks of probable sed. origin are schists, white gneisses carrying abundant blue quartz, and scattered irregularly shaped ls. deposits largely altered to impure marbles or serpentine. In addition there is a series of banded gneisses that may be mainly orthogneisses. The whole complex is cut by igneous rocks ranging in composition from rather massive amphibolites to granitic rocks commonly characterized by notable content of striking blue quartz. Later intrusions are unmetamorphosed gabbro and dunite. Greatly twisted and contorted. According to present definition of U. S. Geol. Survey it would be called Archean, as it is characterized by exceedingly intricate and variable structure, in which it contrasts strongly with the overlying rocks. Is overlain by Mendon schist (younger pre-Camb.) and is cut by Stamford granite gneiss, a concordant intrusion. Underlies greater part of Green Mtns from Glastenbury Mtn, Vt., southward to Mass. line. [This name was approved by U. S. G. S. instead of the preoccupied name †Woodford gneiss, originally suggested by these authors for use in this rept.]

†Mount Holyoke diabase.

A name applied in some early repts to Holyoke diabase. (See B. K. Emerson, U. S. G. S. Mon. 29, p. 17, etc., 1898.)

†Mount Hope type.

Pre-Cambrian: Northern New Jersey.

F. L. Nason, 1889 (N. J. Geol. Surv. Ann. Rept. 1889, p. 30). *Mount Hope type.*—Country rock of Mount Hope iron mines. Is in part the feldspathic gneiss of Prof. Smock and in part the hornblende gneiss of Dr. Britton. Always underlies Oxford type.

In U. S. G. S. Raritan folio (No. 191) the rocks around Mount Hope, Morris Co., are mapped as Byram gneiss, and the use of *Mount Hope* as a geographic name for a facies of that fm. is considered unnecessary.

Mount Hope shale member (of Fairview formation).

Upper Ordovician: Southwestern Ohio, central northern Kentucky, and southeastern Indiana.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, pp. 75, 76). *Mount Hope or Amplexopora septosa beds.*—Heavy, rather irregularly bedded lss. interbedded with shales; thickness 50 ft. Overlain by Fairmont or *Dekayia aspera* beds and underlain by Upper Utica or *Dekayella ulrichi* beds [McMicken memb. of Bassler].

Lower memb. of Fairview fm.

Named for an exposure on SE. slope of Price Hill, known as Mount Hope, at Cincinnati, Ohio.

†Mount Hope marl.

†Mount Hope phase.

Eocene (Jackson): Southern South Carolina (Berkeley County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 17, 18). *Mount Hope phase.*—Overlying Santee marls the Mount Hope marl is exposed along a narrow belt extending from Eutaw Springs by Pond Bluff and Mount Hope (on Santee River to point on Santee Canal near Pooshee. It consists of a matted mass of spines of echini, fragments of corals, and a few oyster and other shells (80 to 90 percent carbonate of lime). In vicinity of Eutaw Springs, and thence along Santee River from Pond Bluff to Mount Hope this phase appears; a marl described by Tuomey as capping the Cooper marl near Stoney Landing on Biggin Creek (1 mi. NE. of Moncks Corner), possibly represents another limited area. It has not been observed elsewhere in State. The material consists of marl, about 11 ft. thick, in alternate hard and soft layers.

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, p. 462). The *Mount Hope marl* consists of a matted mass of spines and plates of echini, coralline fragments, occasional shells of *Ostrea sellaeformis* and other forms. The color is yellow white; it exhibits ledges which are very hard and partly crystalline, with thick intermediate zones of somewhat softer and more porous, but otherwise similar material. Its thickness as exhibited by borings at Pond Bluff is 16 ft., of which 13.2 ft. extend above zero water level (24.8 ft. M. L. T.); the underlying material comprises 11 ft. of sands and then "rock" (report of well borer); this "rock" is probably the hard Santee marl. Mount Hope marl underlies Cooper marl and overlies Barnwell phase.

Name is preoccupied. Is a synonym of Santee ls., according to C. W. Cooke, 1936 (U. S. G. S. Bull. 867).

Named for exposures at Mount Hope, on Santee River, Berkeley Co.

Mount Hope formation.

Pleistocene: Panama.

A. P. Brown and H. A. Pilsbry, 1913 (Phila. Acad. Nat. Sci. Proc., vol. 65, p. 493).

Mount Houghton felsite.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 83, 175–750 passim, especially p. 190).

According to B. S. Butler (personal communication) Mount Houghton felsite and Mount Houghton quartz porphyry are different facies of same fm., and if intrusive are probably of upper Keweenawan age. They compose Mount Houghton, Keweenaw Co.

Mount Houghton quartz porphyry.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 106).

See *Mount Houghton felsite*.

Mount Jefferson formation.

Pliocene: Central northern Oregon (Cascade Mountains).

E. T. Hodge, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 163). The Plio. *Mount Jefferson fm.*, composed of andesitic and trachytic rocks, cuts the older fms., especially near the divide, and fills in the older valleys. It forms the line of high peaks at 121°45′ long., and covers the eastern surface for at least 12 miles. [The older fms. mentioned are (descending) Columbia River basalt and John Day and Clarno fms.]

E. T. Hodge, 1928 (Pan-Am. Geol., vol. 49, pp. 341–356). Stocks and dikes of granodiorite and syenite cut Columbia basalts at many widely scattered places on W. side of Cascade Mtns. Flows of andesite and trachyte are discovered which fill valleys cut in Columbia basalts to W. of Mount Jefferson and the Three Sisters. Together they are called *Mount Jefferson fm.* and are considered to be Plio. They form Mount Jefferson, 10,523 ft. A. T., and other mtns. Underlie Black Crater and Madras fms.

Mount Joli formation.

Lower Devonian (Helderbergian): Quebec (Percé).

J. M. Clarke, 1908 (N. Y. State Mus. Mem. 9, p. 59). *Mount Joli massive*, Sil., Quebec.

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 170+). Clarke held *Mount Joli fm.* to be late Sil. Writer has collected from these fossiliferous beds many times, and his evidence and that of Clarke are here brought together to show that *Mount Joli fm.* is unmistakably Helderbergian (Lower Dev.), and younger than Coeymans of N. Y.

Mount Kindle formation.

Silurian: Mackenzie.

M. Y. Williams, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. B, p. 60).

Mount Lafayette granite porphyry.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Franconia quadrangle).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., p. 13; map). *Mount Lafayette granite porphyry.*—Hard massive gray or green rock, occupying much of Franconia quad. and typically exposed on summit of Mount Lafayette. Main body is 10 mi. long and 3 mi. wide and extends in SW. direction from Mount Hale to Mount Flume. Cuts Kinsman quartz monzonite and is older than Mount Garfield quartz syenite and Mount Osceola granite. Is late Dev. or late Carbf. Assigned to White Mtn magma series.

See *Lafayette granite porphyry*, the original name.

Mount Laurel sand. (In Monmouth group.)

Upper Cretaceous: New Jersey.

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 315, 333). *Mount Laurel sands.*—Coarse red sands, often indurated by iron content. More or less glauconitic, especially to S. Thickness 5 to 80 ft. Underlies Navesink marls [restricted] and overlies Matawan fm. [group]. Is basal div. of Monmouth fm. Named for Mount Laurel, Burlington Co.

The Monmouth of N. J. is now classified as a *group* and Mount Laurel sand as a fm. See concluding statement under *Navesink marl.*

†Mount Lebanon formation. (In Claiborne group.)

Eocene: Northwestern Louisiana.

H. K. Shearer, 1930 (A. A. P. G. Bull., vol. 14, No. 4, pp. 439–441). *Mount Lebanon fm.*—Marine beds of brown or green sh. and glauconitic sand, with characteristic fauna. Near middle a bed of hard glauconitic, more or less sandy ls. that forms characteristic boulder outcrops. Thickness 350 ft. Replaces St. Maurice fm. as restricted by Spooner in 1926. At St. Maurice only a small part of upper Mount Lebanon beds is visible at low-water periods. Named for Mount Lebanon, Bienville Parish, which is surrounded by good fossiliferous exposures. The name "*Minden fm.*" has also been proposed, but is not as satisfactory as Mount Lebanon, because the typical exposures are several mi. from Minden, and the fm. there is not as characteristic as in Bienville Parish. Underlies Cockfield fm. and overlies Sparta fm. Includes Saline Bayou memb., Milams ls. and marl memb., and Crockett memb. of Wendlandt and Knebel and Ellisor. Either *St. Maurice, Mount Lebanon,* or *Minden* should be considered a La. local name. According to C. L. Moody and others who have done detailed work in E. Tex., the exposure at Cook Mtn, Houston Co., Tex., is definitely on same fm. If this is true, *Cook Mtn* should be used as the fm. name, because of priority over all other names.

This name has been discarded in favor of Cook Mtn fm., the older name.

Mount Lowe granodiorite.

Late Jurassic or early Cretaceous: Southern California (San Gabriel Mountains, Los Angeles County).

W. J. Miller, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 149, abstract). White to light-gray massive to moderately foliated granodiorite, which may be called *Mount Lowe granodiorite,* because of typical occurrence on Mount Lowe and vicinity. Younger than Mount Wilson quartz diorite. [Age not stated.]

W. J. Miller, 1930 (Geol. Soc. Am. Bull., vol. 40, p. 150) and 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 162). Writer has mapped [does not say where published] *Lowe granodiorite (late Jurassic)* in San Gabriel Mtns, Calif.

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. Math. and Phys. Sci., vol. 1, No. 1, map, pp. 62–63). [Mapped *Lowe granodiorite* and assigned it to late Jurassic or early Cret.]

†Mount Marcy anorthosite.

See under *Marcy anorthosite.*

Mount Marion beds.

Middle Devonian: Eastern New York (Ulster County).

A. W. Grabau, 1917 (Geol. Soc. Am. Bull., vol. 28, p. 954). I propose to name the lower fossiliferous Hamilton beds of Ulster Co. region the *Mount Marion beds.* Underlie Ashokan beds, the terminal phase of the Hamilton in Ulster Co. region.

A. W. Grabau, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 468–470). *Mount Marion beds.*—Marine shales and ss., 400 to 500 ft. thick. Underlie, without break, Ashokan fm., and overlie "Marcellus" shales [named *Bakoven sh.* by Chadwick, 1933]. Well exposed at Mount Marion, W. of Saugerties.

G. H. Chadwick, 1933 (16th Int. Geol. Cong. Guidebook 9A, p. 4), divided the Marcellus W. of Catskill into (descending) *Mount Marion ss.,* 800 ft., and Chittenango black sh., 200 ft.

Mount Mesnard quartzite.

Pre-Cambrian: Northern Michigan.

M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. State Bd. 1891, 1892, pp. 64–65), mentioned, in one or two places, "the Mt. Mesnard qtzite and dolomitic series" and "the Mount Mesnard qtzite," of which he asked: "Is it a part of Republic fm. or does it overlie it?" He concluded: The evidence seems so strong that the

2 fms. are distinct and uncon. that the qtzite, dol., and associated rocks belonging with them will be designated here as *Mesnard fm.*, from Mount Mesnard, where the fm., is well exposed.

Mount Moat conglomerate.

Devonian(?): Northern New Hampshire (North Conway quadrangle, White Mountains).

C. H. Hitchcock, 1873 (Boston Soc. Nat. Hist. Proc., vol. 15, pp. 304, 307). *Mount Mote cgls.*—At base of Mounts Pequawket and Mote is the common horizontal granite of Labrador series capped by perhaps 200 ft. of spotted granite. Upon Mount Pequawket there are 2 fragments of sl., neither 1 mi. long. The conical summits of both mtns consist at base of a cgl. composed almost exclusively of fragments of sl. Upon Mount Mote there are also andalusite sl., red feldspar, and labradorite pebbles in it. The proportion of pebbles diminishes in ascending Mount Pequawket, and they are small and few at summit. The paste is feldspathic granite. Upon Mount Mote there is a large amount of greenish granite connected with the cgl. The character of embedded pebbles proves these cgls. to be more recent than the clay slates, and they are certainly the newest rocks about White Mtns. Included in "mostly Camb.?" [See also *Pequawket breccia.*]

The approved spelling of this Mtn is *Moat.*

Mount Moriah formation.

Eocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol. No. 7, p. 44).

Mount Morris limestone member (of Washington formation).

Permian: Southwestern Pennsylvania and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 39–40). *Mount Morris ls.*—Lies 2 to 5 ft. below Waynesburg "A" coal and 2 to 5 ft. above Waynesburg ss. Well exposed on N. bank of Dunkard Creek at Mount Morris, Greene Co., Pa. Seldom seen S. of Pa. line. Thickness 0 to 5 or more ft.

Mount Morris sand.

A subsurface sand in Pocono fm. (Miss.) of SW. Pa. and W. Va. Said to correspond to Big Injun sand (Burgoon ss. memb.). Named for Mount Morris, Greene Co., Pa., where it is 101 ft. thick in wells.

Mount Mote breccia.

See under *Pequawket breccia* and *Moat volcanics.* The geographic name is now spelled *Moat.*

Mount Mote conglomerate.

See *Mount Moat cgl.*, the spelling now used on N. H. maps.

Mount Murray diabase.

Jurassic (?): British Columbia.

W. L. Uglow, 1922 (Canadian Inst. Min. and Met. Monthly Bull. 127).

Mount Nelson formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 10).

Mount Olympus granite.

Pre-Cambrian: Central northern Colorado (Larimer County).

M. B. Fuller, 1924 (Jour. Geol., vol. 32, pp. 51–63). *Mount Olympus granite.*—Fine-grained gray biotite granite cutting Longs Peak granite and Big Thompson schist on Big Thompson River.

Named for peak and quad., over much of whose surface it is exposed.

Mount Olympus sand.

A subsurface sand in Cypress ss., of Chester (Miss.) age, in SW. Ind.

Mount Osceola granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Franconia quadrangle).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., p. 15, map). *Mount Osceola granite.*—Group of granites characteristically exposed on Mount Osceola and Scar Ridge, Franconia quad. Characteristically coarse- to medium-grained granite, weathered to white or gray rock. Writers believe this granite is older than Conway granite and either late Dev. or late Carbf. Assigned to White Mtn magma series.

Mount Pequawket breccia.

See under *Pequawket breccia.*

Mount Pisgah sand.

A subsurface sand, of Miss. age, lying at about horizon of Keokuk ls. in Wayne Co., Ky.

†Mount Pleasant beds.

Middle Ordovician: Southwestern Ohio and northern Kentucky.

See 1st entry under *Point Pleasant beds.*

Mount Pleasant conglomerate.

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 58–59). *Mount Pleasant cgl.*—Massive grayish-white sandrock, through which are scattered quartz pebbles, in places in such abundance as to constitute a cgl. There is always a pebbly portion, 3 to 6 ft. thick, near bottom, whose pebbles are reddish or rose-colored. A calc. cgl. 2 to 3 ft. thick forms base of Mount Pleasant cgl. Thickness of fm. 20 to 25 ft. [50 ft. in Rept. G_6, p. 76]. Caps summit of hill at village of Mount Pleasant, Wayne Co. Seems to become coarser toward Lackawanna Co. line. Is basal div. of Elk Mtn transition group (Sub-Pocono transition measures). Rests on Mount Pleasant red sh. memb. of Catskill fm.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 89–91). Mount Pleasant cgl. is basal memb. of Pocono fm.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7). *Mount Pleasant cgl.* is base of Pocono-Catskill transition group, which underlies Pocono ss.

C. S. Prosser, 1894 (U. S. G. S. Bull. 120, p. 78). *Mount Pleasant cgl.* of eastern Pa. belongs to the Pocono.

For later views see under *Pocono fm.*

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 575, 600), stated this cgl. seems rather local, and he included it in his "redefined" *Mount Pleasant red sh.*, q. v. "White thought he recognized Mount Pleasant cgl. along Lehigh River (Rept. G_6, p. 79), but that bed (No. 6) is probably Griswolds Gap cgl."

Mount Pleasant red shale. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 59, 63). *Mount Pleasant red sh.*—Sh. of uniform dull dark red color; no ss. layers. Thickness 150 ft. [300 in Rept. G_6, p. 76]. Top memb. of Catskill fm. Underlies Mount Pleasant cgl. and overlies Elk Mtn lower sands. Well exposed along road descending from village of Mount Pleasant, Wayne Co.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 94–95). Mount Pleasant red sh. is topmost memb. of Catskill series.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 574–576). *Mount Pleasant red sh.*—White used *Mount Pleasant* for more than one unit, for a cgl. and for a red sh. It is here used more inclusively and redefined to embrace the beds btw. base of Pocono and top of Elk Mtn fm. In Wayne Co. this will include 350± ft. of beds below Griswolds Gap cgl. (basal Pocono), which White thought probably were transitional Dev.–Miss. strata. There seems good reason to assign these to Dev. and abandon the idea of transitional strata. The cgl. seems rather local. The fm. is dominantly intensely red sh. and ss. plus some gray beds. Well exposed along United States Highway 6, in region of Waymart, Wayne Co., and thence W. up grade toward State Hospital. Here thickness is near 500 ft. Thins out to NW. in a Dev.–Miss. discon. Its identity S. of Wayne Co. has been determined on Pocono Plateau, but beyond that it cannot with certainty be distinguished from red Cherry Ridge, because intervening green Elk Mtn ss. is missing. There may be some question as to Dev. age, but until further evidence is produced it will be treated as highest div. of Dev. The village for which this unit was named is now known as *Pleasant Mount*, but the Twp retains the older name. [This "redefinition" appears to include Mount Pleasant cgl. of White and some overlying beds. On p. 600 he stated: Eastward from McKean and western Potter Counties the marine Oswayo becomes fresh-water Elk Mtn, which is separated from basal Pocono by an eastward-thickening wedge of red beds, the Mount Pleasant fm. Latter reaches as far E. as Pocono Plateau, but beyond that it has been eroded.]

Mount Pleasant phosphate.

Middle Ordovician: Central Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 105, 127–128, 209–211). *Capitol ls. or Mount Pleasant phosphate.*—Granular current-formed laminated ls., of blue or light-blue color. Thicker laminae alternate with thin darker laminae, the latter richly phosphatic. Included in Nashville (Trenton) fm. Overlies *Orthis* bed [Hermitage fm.] and underlies Dove ls.

Is part of Bigby ls.

Named for Mount Pleasant, Maury Co.

Mount Pleasant shales and sandstones. (In Chester group.)

Mississippian: Southwestern Indiana and central western Kentucky.

W. N. Logan, 1924 (Ind. Dept. Cons. Pub. 42, pp. 11, 125; taken from unpublished rept on Perry Co., by C. A. Malott). *Mount Pleasant shales and sss.*—Next to top fm. of Chester group. Underlie Negli Creek ls. and overlie Bristow sh. and ss. Thickness 20 ft. in well log in Knox Co., Ind.

C. A. Malott, 1925 (Ind. Acad. Sci. Proc., vol. 34, pp. 112–132). *Mount Pleasant ss.*—Hard quartzitic ss., similar to Bristow ss., and like it occurring in upper Chester deposits. Consists of one or more beds, and in places some of lower beds are separated by sh. Thickness 2 to 35 ft. Lies approx. 245 ft. above Glen Dean ls., 15 to 35 ft. above Bristow ss., and 15 to 53 ft. below Negli Creek ls. Extends from near latitude of Branchville and Bristow, Perry Co., southward into Ky. Named for development at Mount Pleasant, Perry Co., Ind.

M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. 133, p. 78), listed (but did not define) *Gennet Creek fm.*, 10 to 35 ft. thick, as underlying Mount Pleasant ss. and overlying Bristow ss.

Mount Princeton quartz monzonite.

Tertiary: Central Colorado (Sawatch Range).

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, p. 475, map). [Map shows Mount Princeton in midst of mass mapped as *Mount Princeton quartz monzonite.*]

Mount Rainier lavas.

A term that has been applied in a formational sense to the lavas of Mount Rainier National Park, Wash. (See H. C. Culver, State of Wash. Dept. Cons. and Develop., Div. Geol. Bull. 32, 1936, p. 21.)

Mount Roberts formation.

Carboniferous: British Columbia.

O. E. Le Roy, 1913 (12th Int. Geol. Cong. Guidebook 9, p. 84).

Mount Rosa granite.

Pre-Cambrian: Eastern Colorado (Colorado Springs region).

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). *Mount Rosa granite.*—Fine-grained nonporphyritic bluish-gray rock made up chiefly of microcline, quartz, and riebeckite. Most extensively developed on slopes of Mount Rosa. Intrudes Pikes Peak granite in irregular masses, sheets, and dikes.

On 1935 Colo geol. map included in Front Range granite group.

Mount Savage fire clay. (In Pottsville formation.)

Pennsylvanian: Central southern Pennsylvania and western Maryland.

C. A. Ashburner, 1878 (2d Pa. Geol. Surv. Rept. F). [See under †*Mount Savage group*.]

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 201). The famous *Mount Savage fire clay* of Pa. and Md. occurs within limits of Mercer group, and directly underlies Mount Savage coal, which it occasionally replaces.

Most geologists include Mount Savage coal and fire clay in Pottsville fm., correlating the coal with the Upper Mercer, but some geologists include them in Allegheny fm.

Named for occurrence at Mount Savage, Allegany Co., Md.

†Mount Savage group. (In Pottsville formation.)

Pennsylvanian: Central southern Pennsylvania and western Maryland.

C. A. Ashburner, 1878 (2d Pa. Geol. Surv. Rept. F). *Mount Savage group*.—Middle memb. of Pottsville cgl. in S. part of Huntingdon Co., Pa. Thickness 40 ft. Consists of (descending): 14 ft. of ss. and sh.; Mount Savage coal bed, 2 ft.; fire clay; 17 ft. of gray false-bedded ss.; and 7 ft. of dark-gray and black sl. and slaty ss. Underlies Piedmont ss. memb. and overlies Congl. proper memb. [Connoquenessing ss.].

Corresponds to Mercer sh. memb. of Pottsville fm. of established nomenclature.

Mount Savage sandstone. (In Allegheny formation?)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Mount Savage ss.*—Underlies Lower Kittanning (Ellerslie) fire clay and overlies Upper Mount Savage rider coal (Scrubgrass coal?); all included in Allegheny fm.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 43, 45, 116, pl. 6). *Mount Savage ss.*—Very massive and persistent, white, hard, locally conglomeratic. Underlies Ellerslie (Lower Kittanning) fire clay and overlies Upper Mount Savage Rider coal. Thickness 21 ft. in Castleman Basin. Occupies position of Kittanning ss. of western Pa. [On p. 43 it is correlated with Clarion ss.]

Mount Selman formation. (In Claiborne group.)

Eocene: Southern and eastern Texas.

W. Kennedy, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 45, 52–54). *Mount Selman series*.—Marine beds consisting of brown sands, blue sands, greensands, altered greensands, glauconitic ss., and laminated iron ore, more or less fossiliferous throughout. The general section given of the Mount Selman, from Jacksonville to Bullard, shows (descending): (1) Sands with a little interbedded iron ore, 115 ft.; (2) pale-blue and brown clay, 15 ft.; (3) interbedded sands and iron ores, 55 ft.; (4) brown sand and altered green sand, 40 ft.; (5) dark-green sand containing fossil shells and a few shark teeth, 24 ft.; (6) lignite, 2 ft.; (7) lignitic clay, 5 ft.; (8) brown clay at bottom of well near Bullard, dug into 2 ft. Underlies Cook's Mtn beds (also marine) and overlies Queen City beds, uppermost memb. of Lignitic group. Thickness 260 ft. Named for typical development in Cherokee Co. [in which is town of Mount Selman].

E. T. Dumble, 1893 (Tex. Geol. Surv., Brown coal and lignite of Texas), defined *Mount Selman beds* as above, except that he gave thickness as 700 ft.

E. T. Dumble, 1898 (Phys. geog., geol., and res. Tex.) and 1902 (Sci., n. s., vol. 16, pp. 670–671), stated that Queen City beds are same as Carrizo ss. and included them in †*Lignitic* [*Wilcox*]. In 1911 (Tex. Acad. Sci., vol. 11, pp. 52–53) he repeated the correlation of Carrizo ss. with Queen City sand, but included it in Claiborne group.

A. Deussen, 1914 (U. S. G. S. W. S. P. 335). *Mount Selman fm.*—Palustrine and marine deposits, consisting of red ferruginous indurated and probably altered greensand, with casts of shells, lenses of lignite and clay, beds and concretions of limonite; as a whole is conspicuously ferruginous. Thickness 350 ft. in Texas Coastal Plain E. of Brazos River. Underlies Cook Mtn fm. and overlies Wilcox fm., the top unit of which consists of littoral deposits comprising Queen City sand memb.

E. T. Dumble, 1915 (Jour. Geol., vol. 23, pp. 481–498), repeated correlation of Carrizo ss. and Queen City sand and included them in Claiborne group, as a distinct fm.

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 83–84). The *Mount Selman* underlies the Cook Mtn and overlies the Queen City-Carrizo, which is here included in Claiborne group, but which is by some geologists classed as Wilcox. The Mount Selman is at least in part marine. Thickness 225 to 475 ft.

T. W. Vaughan, 1917 (Smithsonian Pub.), treated the Mount Selman as basal fm. of Claiborne group, as did W. G. Matteson, 1918 (Am. Inst. Min. Engrs. Bull. 134), who treated Queen City as top memb. of the Wilcox, and J. A. Udden, 1919 (Tex. Univ. Hdb. series, No. 1).

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869). *Mount Selman fm.* conformably underlies Cook's Mtn fm. and overlies the Carrizo, which in East Tex. is called *Queen City beds*. The Queen City is eastern equiv. if not direct extension of the Carrizo. It is here included in Claiborne group.

E. W. Berry, 1922 (U. S. G. S. P. P. 131A). The plants found in Carrizo ss., as well as those found above and below it near the Rio Grande, definitely settle its upper Wilcox age, but show that it is in nature of a lens which becomes thinner toward Rio Grande, where its upper part is replaced with more typical and more argill. Wilcox, also carrying characteristic fossil plants.

A. C. Trowbridge, 1923 (U. S. G. S. P. P. 131D), treated *Mount Selman* as basal fm. of Claiborne group in Rio Grande region, and divided the underlying Wilcox group into (descending): (1) Bigford fm., 0 to 470± ft. of clay of various colors, with subordinate amounts of gray, green, and brown ss. and many lignite beds; chiefly contemp. with Carrizo ss. but in part younger; contains Wilcox flora; rests with possible uncon. on (2) Carrizo ss., 118 to 400± ft. thick; contains Wilcox plants; rests uncon. and with overlap on (3) Indio fm., 648 to 700 ft.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, No. 4, pp. 424–436), included Carrizo ss. in Claiborne group, but not in the Mount Selman.

A. C. Trowbridge repeated his 1923 classification of Wilcox group in Geol. Soc. Am. Bull., vol. 37, pp. 455–462, 1926.

T. L. Bailey, 1926 (Tex. Univ. Bull. 2645), treated the Mount Selman as basal fm. of Claiborne group of SW. Coastal Plain of Tex., and as resting uncon. on Carrizo ss.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, No. 10). Queen City sand (0 to 400 ft. thick) is younger than Carrizo sand (10 to 80 ft. thick), from which it is separated by Reklaw memb. (40 to 180 ft. thick in Tex.) and the underlying Cane River memb. (0 to 40 ft. thick in Tex.). The Carrizo is treated as basal memb. of Claiborne series because "it differs lithologically from the Wilcox and is separated from it by an uncon."

A. C. Trowbridge, 1932 (U. S. G. S. Bull. 837, pp. 28, 81+), described the Mount Selman as basal fm. of Claiborne group and as overlying Bigford fm. of Wilcox group, but with the statement (footnote 8 on p. 52) that "both the Carrizo and Bigford will probably prove to be of Claiborne age, instead of Wilcox, and on the new geol. map of Tex. will be so classed."

L. W. Stephenson, Julia Gardner et al., 1932 (geol. map of Tex.), treated Bigford as basal memb. of Mount Selman fm. and Carrizo sand as basal fm. of Claiborne group, as did F. B. Plummer, 1933 (Univ. Tex. Bull. 3232). This is present classification of U. S. Geol. Survey.

A. Deussen, 1934 (A. A. P. G. Bull., vol. 18, No. 4, p. 501), and A. Deussen and E. W. K. Andrau, 1936 (A. A. P. G. Bull., vol. 20, No. 5, p. 540), included Carrizo sand in Mount Selman fm.

Named for Mount Selman, Cherokee Co., Tex.

Mount Selwyn formation.

Cambrian (?): British Columbia.

M. Y. Williams and J. B. Bocock, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 200).

Mount Sicker formation.

Jurassic: British Columbia.

C. H. Clapp, 1909 (Canada Geol. Surv. Summ. Rept. 1908, p. 56) and 1911 (Summ. Rept. 1910, p. 105).

Mount Simon sandstone.

Upper Cambrian: Southwestern Wisconsin and Minnesota.

C. D. Walcott, 1914 (Smithsonian Misc. Coll. vol. 57, p. 354). *Mount Simon.—Ulrich ms., 1914.* Series of coarse sss. and grits 235+ ft. thick. Underlies Eau Claire ss. and overlies pre-Camb. granite. About 225 ft. shown in bluffs at Eau Claire and 50 ft. of base at Chippewa Falls. No fossils except *Scolithus* borings.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 553). *Mount Simon ss.*—In central Wis. mainly coarse- to medium-grained gray or yellow ss. with a few layers of green, blue, and red sh.; farther S. it is less coarse-grained; locally there are pink layers, the color being deepest in the fine-grained sands. Max. thickness is 778 ft. at Platteville, Wis.; 368 ft. at Madison. Outcrops have thus far been studied only near Eau Claire, the type loc., where it forms an escarpment [called Mount Simon] which is capped by [10 ft. of] Eau Claire shaly ss. It must be the basal Camb. over a large area in central Wis.

Some recent repts include this ss. in Dresbach fm. (see 1934 and 1935 entries under *Dresbach ss.*), but the U. S. Geol. Survey at present treats it as a distinct fm., uncon. overlying red clastic series. The 1935 repts cited above give thickness at Mount Simon 234 ft.

See 1935 entry under *Hinckley ss.*

Mount Stevens series.

Mount Stevens group.

Pre-Cambrian (?): Yukon, Canada.

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 50).

Originally assigned to lower Paleozoic, but later Canada repts indicate probable pre-Camb. age.

Mount Stuart granodiorite.

Pre-Tertiary: Central Washington (Mount Stuart region).

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137, map). Central part of Wenache Mtns is composed of granite, which forms all of higher peaks, including Mount Stuart, and hence may conveniently be designated *Mount Stuart granite*. Intrusive light-colored biotite granite carrying hornblende.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Mount Stuart granodiorite* is pre-Tert. and post-Carbf., and later than Peshastin fm.

Mount Toby conglomerate. (In Newark group.)

Upper Triassic: Central southern Massachusetts.

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 452). *Mount Toby cgl.*, or the coarse schist and qtzite cgl. (shoreward Triassic rocks) of Mount Toby.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). [See 1898 entry under *Longmeadow ss.* As mapped this cgl. occurs only in NE. corner of Holyoke quad.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 91–100). *Mount Toby cgl.*—Coarse materials ranging from pebbles 2 inches long to masses 2 to 4 ft. in size. Very largely and in many localities wholly made up of comminuted argillites, quartz schist, and vein quartz, with larger cobbles of same material. Westward from ½ mi. S. of old Mount Toby railroad station this cgl. composes whole mass of main ridge of Mount Toby. Several bands of Longmeadow ss. from the W. penetrate the horizontal beds of Mount Toby cgl., indicating successive oscillations of level or of flood violence, during which the finer-grained ss. extended E. across the cgl. several times and then gave place to the coarser material again. Is basal fm. of Newark group, to E., and synchronous with all except possibly basal part of Sugarloaf arkose to W.

Mount Tom hornblende gneiss.

Age (?): Western Connecticut.

W. M. Agar, 1927 (Conn. Geol. and Nat. Hist. Surv. Bull. 40). *Mount Tom hornblende gneiss.*—Dark-green or green and white hornblende gneiss. Forms Mount Tom, Little Mount Tom, and Mount Rat. Occurs as dikes in Hartland schist [Ord.] along NW. slope of Mount Rat.

†Mount Vernon series.

Lower Cretaceous: Eastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 324). *Mount Vernon series* (also *Mount Vernon clays*).—Stratified clay of dark chocolate-brown color, fine texture, very little sand, highly charged with carbonaceous matter. Thickness 0 to 25 ft. Contains unique flora, differing decidedly from that of uncon. underlying Rappahannock series and from that of uncon. overlying Aquia Creek series, all of which are included in Potomac fm. First discovered about 1 mi. below Mount Vernon mansion, directly underneath high bluff known as Rose's Delight, within former Mount Vernon estate.

W. B. Clark and B. L. Miller, 1912 (Va. Geol. Surv. Bull. 4). Patapsco fm. includes Mount Vernon series and part of Aquia and Rappahannock series.

†Mount Vernon beds.

Silurian (Niagaran): Central eastern Iowa.

W. H. Norton, 1895 (Iowa Geol. Surv. vol. 4, pp. 130–135). *Anamosa stage or Mount Vernon beds*.—Soft even-bedded granular noncrystalline buff or drab ls. 0–70 ft. thick. Included in Sil. Underlain by LeClaire beds and overlain by Bertram beds. [In table on p. 127 of vol. 4 *Anamosa* "is substituted for *Mount Vernon* as used in text, at suggestion of Dr. Calvin." The book containing Calvin's name *Anamosa* was distributed in June 1895, and vol. 4 of Iowa State Surv. was distributed in December 1895.]

Named for Mount Vernon, Linn Co.

Mount Victory moraine.

Pleistocene (Wisconsin stage): Northern Ohio. Named for Mount Victory, Hardin Co. Merges with Wabash moraine. See U. S. G. S. Mon. 41, p. 543.

†Mount Washington series.

Ordovician and Cambrian: Southwestern Massachusetts and northwestern Connecticut.

W. H. Hobbs, 1893 (Jour. Geol., vol. 1, pp. 717–736, 780–802). *Mount Washington series* [SW. Mass.].—Includes (descending) Everett schist, correlated [erroneously] with Greylock schist of NW. Mass.; Egremont ls., correlated [erroneously] with Bellowspipe ls. of NW. Mass.; Riga schist, correlated [correctly] with Berkshire schist; and Canaan dol., correlated [correctly] with Stockbridge ls. Named for occurrence on Mount Washington.

The †Everett schist is now known to be Berkshire schist, and the †Egremont ls. to be Stockbridge ls.; the younger Greylock schist and Bellowspipe ls. of NW. Mass. are now considered not to be represented in SW. Mass. (See B. K. Emerson, U. S. G. S. Bull. 597, 1917, map, etc.)

Mount Whyte formation.

Lower Cambrian: British Columbia and Alberta.

C. D. Walcott, 1908 (Smithsonian Misc. Coll. vol. 53, No. 1804, pp. 2, 4). *Mount Whyte fm.*—Alternating bands of ls. and siliceous and calc. sh., underlying Cathedral fm. and overlying St. Piran fm. in Canadian Rocky Mtns. Thickness 386 ft. on N. slope of Mount Whyte, 390 ft. on S. slope of Mount Bosworth, 315 ft. on Mount Stephen, and 248 ft. on SE. slope of Castle Mtn. Contains Lower Camb. fossils. Type loc. is Mount Whyte, above Lake Agnes, and E. slope of Popes Peak, SW. of Mount St. Piran.

L. D. Burling, 1916 (Am. Jour. Sci., 4th, vol. 42, pp. 469–472), modified definitions of Cathedral and Mount Whyte fms. See 1916 entry under *Cathedral ls.*

C. D. Walcott, 1917 (Smithsonian Misc. Coll. vol. 67, No. 1, Pub. 2444, pp. 1–5). The name *Ptarmigan fm.* is proposed for a series of Middle Camb. lss. and interbedded shales that occur above Mount Whyte fm. (Lower Camb.) and beneath Cathedral fm. (Middle Camb.) in Alberta and B. C. The Ptarmigan fm. includes the Middle Camb. *Albertella* fauna about 100 ft. below its top.

C. D. Walcott, 1917 (Smithsonian Misc. Coll. vol. 67, No. 2, Pub. 2445), stated that his recently named Ptarmigan fm. was formerly included in Cathedral ls.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 67, No. 9, pp. 487, 549), assigned *Mount Whyte fm.* to Lower Camb.

Mount Wilson quartzite.

Devonian: Alberta.

C. D. Walcott, 1923 (Smithsonian Misc. Coll. vol. 67, No. 8, pp. 464–465), and 1928 (Smithsonian Misc. Coll. vol. 75, p. 208).

Mount Wilson quartz diorite.

Late Jurassic or early Cretaceous: Southern California (San Gabriel Mountains, Los Angeles County).

W. J. Miller, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 149, abstract). The most typical and extensively developed of the diorites of San Gabriel Mtns, southern Calif., may be called *Mount Wilson quartz diorite*, because of fine exposures on and near Mount Wilson. A hornblende-rich diorite, occurring in smaller masses, may be older than Mount Wilson diorite or may be only a facies of it. A pinkish-gray, more or less foliated granite, which occupies a considerable area, is younger than the diorite. The diorite is older than Mount Lowe granodiorite.

W. J. Miller, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 149–150). *Wilson diorite* is cut by Lowe granodiorite. [Age not stated.]

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. Math. and Phys. Sci., vol. 1, No. 1, map of western San Gabriel Mtns, pp. 62–63). [*Wilson diorite* mapped and tentatively assigned to late Jurassic or early Cret.]

Mount Wissick group.

Devonian (?): Quebec.

H. W. McGerrigle, 1934 (Quebec Bur. Mines Ann. Rept. 1933, pt. D, p. 120).

Mount Zion porphyry.

Eocene: Leadville district, Colorado.

S. F. Emmons, 1883 (U. S. G. S. Atlas of Leadville dist., Colo.) and 1886 (U. S. G. S. Mon. 12, p. 76). *Mount Zion porphyry.*—A gray porphyry, consisting chiefly of quartz, orthoclase, and biotite, occurring on Mount Zion and Prospect Mtn. [Petrographic description of W. Cross on p. 323 of Mon. 12.]

Belongs to Gray porphyry group. Contains more quartz and less biotite than Evans Gulch porphyry.

Named for development on Mount Zion, N. of Leadville.

Moutray sand.

A subsurface sand, of Penn. age, in Moutray and Hatchett fields of Callahan Co., north-central Tex., lying at 450 ft. depth in Hatchett field and at 730 ft. depth in Moutray field.

Mowitza shale.

Upper Devonian: Southwestern Utah (southeast of Frisco region).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Mowitza sh.*—Calc. sh. interstratified with thin beds of ls. Thickness 50 ft. Underlies (conformably) Topache ls. and overlies (conformably) Red Warrior ls. Type loc., Mowitza shaft, Star dist., SE. of Frisco dist.

Mowry shale. (Of Colorado group.)

Upper Cretaceous: Wyoming (rather widespread), western South Dakota, and Montana (rather widespread).

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). *Mowrie beds.*—Hard lighter-gray shales and thin-bedded sss. that weather light gray and form ridges. Contains large numbers of fish scales and occasional fish teeth and bones. Thickness 150 ft. on E. side of Bighorn Mtns. Distinctive Benton fossils occur above it, and in other parts of E. Wyo. Its relations indicate that it occurs below middle of the Graneros. Is included in Benton fm. of this area (E. side of Bighorn Mtns). Separated from older Cloverly fm. by several hundred ft. of dark sh. underlain by dark-gray sh. in part sandy and of rusty-brown color, with occasional thin beds of brown ss., all of which are here included in Benton fm., although it is possible part of the dark-gray beds may represent Dakota ss. Named for Mowrie Creek, NW. of Buffalo [Johnson Co.], Wyo.

Mowry has been approved spelling of this name since 1906.

In 1916 (U. S. G. S. Bull. 621, p. 168) C. T. Lupton applied *Thermopolis sh.* to the 700± ft. of beds conformably underlying Mowry sh. and conformably overlying Greybull sand of drillers (the top memb. of Cloverly fm.). This is present approved definition of U. S. Geol. Survey, except that in Black Hills region the 10 to 50 ft. of dark-gray sh. and sandy sh. to which Collier applied name *Nefsy sh. memb. of Graneros sh.*, and which represents upper part of Thermopolis sh., is now included in Mowry sh. and *Nefsy* has been abandoned. In latter region the Mowry as thus redefined rests on Newcastle ss. memb. of Graneros, and the beds overlying the Mowry and underlying the Greenhorn are the Belle Fourche memb. of Graneros sh. In western Wyo. the beds separating Mowry sh. from the younger Carlile sh. (of late Benton age) have long been known as *Frontier fm.* In parts of Wyo. *Mowry sh.* is now treated as a distinct fm.; in some other places (where Carlile, Greenhorn, and Graneros can be differentiated) the Mowry is locally called *Mowry hard memb. of Graneros sh.* or, locally, *Mowry siliceous memb. of Graneros sh.* In areas where the Mowry is the only subdivision of the Benton that can be differentiated it has been treated as a memb. of Benton sh.

Moxahala clay. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio (Perry County).

E. Orton, 1884 (Ohio Geol. Surv., vol. 5). *Moxahala clay*, 0 to 8 ft. thick, underlies Lower Freeport coal (No. 6A) in N. part of Perry Co. and at Zanesville and vicinity, Muskingum Co. Is=Lower Freeport clay.

Named for Moxahala, Perry Co.

Moydart formation.

Silurian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 203).

Moyer gas sands.

Occur about 290 ft. below top of Penn. section in Graham field, NW. part of Carter Co., southern Okla., and 320 to 400 ft. above Kirk gas sand.

Moyie argillite.

See *Mooyie argillite*.

Moyie sill (gabbro).

See under *Kitchener qtzite*.

Muav limestone. (Of Tonto group.)

Middle Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Muav ls.*—Impure thin-bedded bluish-gray ls. having characteristic mottled appearance imparted by numerous thin bands or lenses of buff or greenish shaly material. Thickness 450 to 475 ft. Consists of (descending): (1) mottled ls., more shaly, 65 ft.; (2) fine-grained white ss., 4 ft.; (3) mottled ls., 208 ft.; (4) mottled ls., more shaly, 45 ft.; (5) mottled ls., 23 ft. Uncon. underlies Redwall ls. and conformably overlies Bright Angel sh. Is top fm. of Tonto group. Named for Muav Canyon, Grand Canyon dist., in lower part of which the fm. is well exposed. Is "mottled ls." of Walcott.

L. F. Noble, 1922 (U. S. G. S. P. P. 131B), transferred from Muav ls. to Bright Angel sh. 58 [68?] ft. of shaly beds containing near base a few beds of mottled ls. similar to mottled lss. of Muav ls.

Mud sandstone. (In Bluestone formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 320–321). *Upper Mud ss.*—Brown shaly micaceous ss., 0 to 5 ft. thick, underlying Lower Belcher sb. Rests on *Upper Mud sh.*, which consists of 20 to 50 ft. of red sh. overlying *Lower Mud ss.* The latter ss. consists of 0 to 5 ft. of greenish-gray or brown ss., resting on *Lower Mud sh.* (red and variegated or dark-green and sandy sh. 15 to 40 ft. thick, which rests on Glady Fork ss.). All are members of Bluestone group [fm.], and all are exposed on Mud Fork of Bluestone River in Tazewell Co., Va., about 1 mi. N. of Bailey Station, also in Mercer Co., W. Va.

Mud shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926. [See under *Mud ss.*]

Muda limestone.

Cretaceous (?): Puerto Rico.

D. R. Semmes, 1919 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, p. 74).

Muddy sand.

Drillers' name for a sand (or sands) in Thermopolis sh. (Upper Cret.) of Bighorn Basin and other areas in Wyo. F. F. Hintze, Jr., who described the sand as occurring in lower part of Benton sh., stated (Wyo. State Geol. Bull. 10, 1915, pp. 20–21) that it is almost pure white on outcrop, but that probably in drilling the soft shales above and below it are so mixed with the white sand grains that the mixture has a muddy appearance, hence the name. In the Basin and Greybull fields the sand is said to lie 210 to 330 ft. above base of the Thermopolis; in Rex Lake and other domes W. of Laramie, Wyo., the sand called *Muddy* is said to lie 90 ft. above base of the Thermopolis. The name has also been applied by drillers to sands in strata that have been identified by geologists as lying in Cloverly fm., which underlies Thermopolis sh. In Rock Creek oil field, south-central Wyo., the name *First Muddy sand* has been applied by drillers to a sand in Thermopolis sh., *Second Muddy sand* to a sand in what is said to be top of Cloverly fm., and *Third Muddy sand* to a sand in lower part of the Cloverly. There are at least 8 Muddy Creeks in Wyo., but, although the sand outcrops, it is not known to be exposed on any Muddy Creek.

Muddy Creek formation.

Tertiary (Pliocene?): Southeastern Nevada and northwestern Arizona.

C. Stock, March 1921 (Geol. Soc. Am. Bull., vol. 32, p. 147). Approx. 80 mi. S. of Panaca, in Meadow Valley, a second series of mammal-bearing deposits is exposed. These beds are mapped by Spurr as Plio. Between villages of Overton and Logan, Lincoln Co., Nev., and on SW. side of Muddy River, the deposits consist of well-indurated sands and clays, red or light brown in color. They rest uncon. on a series of beds that are presumably of early Tert. age. Are also terraced, and yielded a small collection of mammalian remains, which differ from those in Panaca beds and suggest that northern and southern deposits are not of same age. Possibly the mammal-bearing beds of Muddy Valley, which may be designated *Muddy Creek beds*, are earlier in age than the Panaca deposits.

The Muddy Creek fm. rests uncon. on Horse Spring fm.

Muddy Peak limestone.

Middle Devonian and possibly older: Southeastern Nevada (Muddy Mountains).

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, pp. 46–53) and 1928 (U. S. G. S. Bull. 798). *Muddy Peak ls.*—Dense hard lss.; many beds with siliceous appearance; beds heavy and regular, 2 to 20 ft. thick; in color either distinctly carbonaceous and dark or decidedly light, beds of the two colors alternating; lenses and thin layers of ss. at frequent intervals, especially near top. Includes all rocks btw. the overthrust and the Mississippian, all of which are of same general nature and no break in them. Thickness 1,300+ ft. Underlies Rogers Spring ls. (Miss.) with suggested discon. No dependable fossil evidence in lower 1,000 ft. Very probably several hundred ft. at base are Camb. Best exposed in vicinity of Muddy Peak Basin, especially on N. side of Muddy Peak.

†Muddy Valley beds.

Tertiary (Pliocene?): Southeastern Nevada.

C. Stock, November 1921 (Am. Jour. Sci., 5th, vol. 2, pp. 254–257). The sed. deposits of Muddy Valley, SE. Nev., in which mammalian remains were found, may be known as *Muddy Valley beds*, as distinguished from Panaca deposits of Meadow Valley. The beds consist of well-indurated sands and clays, red and light brown, and uncon. overlie the early Tert. deposits in region. A small vertebrate fauna, including camels and a horse, was collected in the fine ss. approx. 3 mi. W. of Overton.

Same as **Muddy Creek fm.**, which has priority.

Mud Hill series.

Miocene to Pleistocene (?): Southern California (Riverside County).

E. E. Free, 1914 (Carnegie Inst. Wash. Pub. 193, pp. 22–23). *Mud Hill series.*—Consists of an upper memb. of very variable sss. and clays, mostly thinly bedded and showing many probable unconformities; underlain by a thick memb. of coarse arkose ss., usually of reddish color and quite uniform texture; at base a basal cgl., resting normally upon eroded surface of schists and granites such as make up core of the range. Thickness 3,000 ft. No fossils at type loc. at Mecca, but in Carrizo Creek Valley Blake found Mio. fossils in lower beds. Very probably includes beds of all ages from Carrizo Creek Mio. into early Pleist. Named for occurrence in Mecca Mud Hills, Mecca, Riverside Co.

J. P. Buwalda and W. L. Stanton, 1930 (Sci., n. s., vol. 71, pp. 104–106). *Mud Hill series* of Free includes Indio and Carrizo fms.

Mud Lake granite.

Pre-Cambrian (Laurentian): Western Ontario (Rainy Lake region).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 54).

Mugford series.

Pre-Cambrian: Labrador.

A. P. Coleman, 1921 (Canada Geol. Surv. Mem. 124, p. 25).

Mukwa granite.

Pre-Cambrian (Laurentian): Central northern Wisconsin (Waupaca County).

T. C. Chamberlin, 1877 (Geol. Wis., vol. 3, p. 248). *Mukwa granite.*—An isolated outlier in SE¼NE¼ sec. 26 and NW¼SW¼ sec. 25, town of Mukwa, Waupaca Co.

Mulatto tongue (of Mancos shale).

Upper Cretaceous: Northwestern New Mexico (Gallup region).

J. D. Sears, 1934 (U. S. G. S. Bull. 860A). The lower tongue of Mancos sh. (marine) that grades laterally into Mesaverde fm. (nonmarine) of part of area from Gallup eastward toward Mount Taylor, is named by C. B. Hunt (U. S. G. S. Bull. 860B,

1934) *Mulatto tongue of Mancos sh.*, from its excellent exposures at mouth of Canyon Mulatto, in T. 14 N., R. 9 W. It in part underlies and in part grades laterally into Dalton ss. memb. of Mesaverde fm., both of which are of Colorado age.

C. B. Hunt, 1934 (U. S. G. S. Bull. 860B, p. 44). *Mulatto tongue of Mancos sh.*—Lies btw. Dilco coal memb. and Dalton ss. memb. of Mesaverde fm. The name is here given for exposures at S. end of Canyon Mulatto, 9 mi. NW. of San Mateo. Best exposures are in southward-facing scarp extending NW. from San Mateo. Toward S. part of Mount Taylor coal field the tongue is largely light-tan marine sandy sh. with some thin sss. and very local grits. Northward the proportion of sh. increases until, where Gallup and Dilco members of the Mesaverde thin out, the Mulatto tongue is entirely dark-gray sh. and cannot be distinguished lithologically from main body of Mancos and is there mapped with rest of Mancos. Thickness of Mulatto tongue ranges from 250 ft. (in S. part of field) to 400 ft. (in N. part of field).

Mule sandstone.

Lower Cretaceous: Southeastern Arizona.

C. [R.] Keyes, 1935 (Pan-Am. Geol., vol. 64, No. 2, pp. 125 to 140). *Mule ss.*, proposed for the ss. stratum in Mural ls. fm. of Ransome. Thickness 50 ft. Name derived from Mule Mtns, in which Bisbee mining camp is situated, with type section in Mural Hill, E. of town.

Muleros sandstone.

Lower Cretaceous (Comanche): Southeastern Arizona and western Texas.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 247, 250, 337). *Muleros sss.*, the capping memb. of Cerro de Muleros, W. of El Paso, Tex. Thickness 800 ft. Represent lower part of Cintura fm. of Ransome.

Mulford formation.

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Mulford fm.*—Shales, 146 to 250 ft. thick in Webster Co., with thin ls. in upper part, and, in S. part of Webster Co., a prominent ss. near base. Includes coals Nos. 9, 10, and 11. Uncon. underlies Lisman fm. (Penn.) and uncon. overlies De Koven fm. (Penn.).

Seems to be named for Mulfordtown, Webster (?) Co.

Mumm limestones.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll. vol. 57, No. 12, pp. 334, 337).

Muncie Creek shale.

Pennsylvanian: Northeastern Kansas and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Iola ls.* On p. 45 *Muncie Creek sh.* is described as consisting of (descending): (1) calc. sh. with *Conularia* and concretions, 0.2 ft.; (2) black fissile sh., 1.2 ft.; (3) gray sh. 0.7 ft.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 51–55). *Muncie Creek sh. memb.*—Middle memb. of Iola ls. Consists of sh., carbonaceous where thick, argill. buff or gray where thin, with spherical phosphatic concretions. To S. replaced by 6-inch bed of clay. Thickness 3 to 5 inches. Underlies Raytown ls. memb. and overlies Paola ls. memb. Named for Muncie Creek, in S. part of Wyandotte Co., Kans., E. of town of Muncie.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 115). If it were not for geographic persistence and significance of this unit in terms of cyclic sedimentation, differentiation of such a thin sh. as a distinct memb. would hardly be justified. Despite its thinness, it is by no means the least important element of Iola fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Munising sandstone.

Upper Cambrian: Northern Michigan.

A. C. Lane and A. E. Seaman, 1907 (Jour. Geol., vol. 15, pp. 680, 692). *Munising ss.*—White or light-colored ss., 200 to 250 ft. thick, composing uppermost part of Lake Superior ss. of previous repts. [See further explanation under *Jacobsville ss.*]

Named for exposures in bluffs back of Munising, Alger Co.

Munson's granite.

See under *Mapleton granite*.

Murailles formation.

Lower Devonian: Quebec.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 67).

Mural limestone.

Lower Cretaceous (Comanche): Southeastern Arizona (Bisbee region).

F. L. Ransome, 1904 (U. S. G. S. P. P. 21, pp. 56, 65+). *Mural ls.*—Upper memb. consists of 350± ft. of relatively thick-bedded and pure lss. Lower memb. consists of 300± ft. of thin-bedded impure lss. with 25± ft. of buff sss. at top. Underlies (conformably) Cintura fm. and overlies (conformably) Morita fm., all of which belong to Bisbee group, of Comanche age. Caps Mural Hill, Bisbee quad.

C. [R.] Keyes, 1935 (Pan-Am. Geol., vol. 64, No. 2, pp. 125–140), proposed that these rocks be called *Muralian series* and be divided into the units listed under that name.

Mural limestone.

Cambrian: British Columbia.

L. D. Burling, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 109).

Muralian series.

Name proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 64, No. 2, 1935, pp. 125–140) to replace *Mural ls.* of Ransome, which Keyes divided into (descending): Comanche lss., 350 ft.; Mule sss., 50 ft.; and Glenrose lss., 300 ft.

†Murat limestone.

Lower Ordovician: Central western Virginia.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). *Murat ls.*—Massive gray crystalline ls.; lower part often contains chert nodules. Thickness 100 to 150 ft. Underlies Liberty Hall ls. and overlies Natural Bridge ls. About 125 ft. exposed along Buffalo Creek at Murat, Va.

Same as Holston ls., older name.

Murchison formation.

Middle Cambrian: Alberta and British Columbia.

C. D. Walcott, 1920 (Smithsonian Misc. Coll. vol. 72, No. 1, p. 15). *Murchison fm.*, Camb., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll. vol. 67, No. 8, pp. 462–463, Mar. 5, 1923, when he assigned it to Middle Camb., gave thickness as 497 ft., showed it uncon. below Arctomys fm. and younger than Cathedral fm.]

Murdock breccia.

Tertiary: Northwestern Arizona (Oatman district, Mohave County).

C. Lausen, 1931 (Ariz. Bur. Mines Bull. 131). *Murdock breccia.*—A detrital deposit near Murdock mine. Largely granitic detritus with angular fragments and boulders of granite, gneiss, schist, vein quartz, and some dark rocks, perhaps diorite. Matrix is composed of angular grains of quartz and feldspar derived from disintegration of exposures of granite. More or less red mud in matrix was probably formed from decomposition of feldspar. Age uncertain, but probably Tert., perhaps early Tert. Underlies Alcyone trachyte and overlies pre-Camb. granite.

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Murdockville sand.

A subsurface sand in Pocono fm. (Miss.) of Washington Co., SW. Pa., that lies at horizon of Burgoon ss. memb.

Murfreesboro limestone. (Of Stones River group.)

Lower Ordovician: West-central and eastern Tennessee and western Virginia.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 105, 125). *Murfreesboro ls.* (*Central ls.*).—Light-blue heavy-bedded and often cherty ls. Lowest ls. of Central Basin; 70 ft. exposed. Basal fm. of Stones River (Chazy). Underlies Pierce ls. and overlies Knox dol.

In eastern Tenn. and western Va. the Stones River group is now divided by E. O. Ulrich and C. Butts into (descending) Lenoir ls., Mosheim ls., and Murfreesboro ls.

Named for Murfreesboro, Rutherford Co., Tenn.

†Murfreesboro stage.

Miocene (upper and middle?): Northeastern North Carolina and eastern Virginia.

A. Olsson, 1917 (Bulls. Am. Pal., vol. 5, No. 28). *Murfreesboro stage.*—New name for lower Upper Miocene deposits. Consists of blue sandy clays, typically exposed at Murfreesboro, N. C., and along Meherrin River in immediate vicinity of Murfreesboro. Throughout its areal distribution the stage is uniform and in many respects represents most typical expression of our east coast or cold-water Mio. to which the name Chesapeake is generally given. After its close, and during Yorktown stage, changes toward the warmer Plio. were inaugurated and new faunal elements introduced. Rests on crystalline rocks, on Cret., on Eo., and on some memb. of Mio. series. Known to extend from central Va. to central N. C. The whole series of blue clays beneath Yorktown stage on James River belong to the Murfreesboro. This stage has in general been misinterpreted and different parts correlated with different portions of Mio. series. Clark and Miller (Va. Geol. Surv. Bull. 4, 1919) referred part of these beds to Calvert stage and remainder to the St. Marys. Both Calvert and St. Marys are well represented in northern or NE. Va. Fossils of the Murfreesboro indicate much closer relationship with overlying Yorktown than with underlying St. Marys or older beds.

W. C. Mansfield, 1929 (Wash. Acad. Sci. Jour., vol. 19, p. 266). The "Murfreesboro stage" of Olsson belongs in reality to lower part of Yorktown fm.

W. C. Mansfield, 1931 (Geo. Wash. Univ. Bull, Summaries of Doctoral Theses, 1925–28, p. 94). There are 2 faunal horizons at type loc. of "Murfreesboro stage" (preoccupied) of Olsson. The lower horizon I have assigned to zone I of Yorktown fm. and the upper horizon to zone II of the Yorktown.

Murky conglomerate.

Pre-Cambrian: Northwest Territory, Canada.

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 378).

Murphy marble.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 5). *Murphy marble.*—Entirely marble, rather fine-grained and wholly recrystallized from original condition. Predominant color white, but a large portion is dark gray or blue, and many layers consist of banded or mottled blue and white; some layers btw. Nantahala and Red Marble Gap have a beautiful rose-pink color. Base is exposed near Nantahala River, where it passes downward into Valleytown fm. by interbedding with the slates of the latter. Upward it passes into Andrews schist through several ft. of interbedded marble and schist. Thickness 150 to 500 ft.

Named for fact that town of Murphy, Cherokee Co., N. C., is partly located on this marble.

Murphy sand.

A subsurface sand in Conemaugh fm. (Penn.) of western Pa. and W. Va. that is believed to correspond to Morgantown ss. memb.

Murphy's Creek formation.

Cambrian (Upper): Quebec (Gaspé Peninsula).

C. H. Kindle, 1936 (Eastern Geol., No. 1, April 1936, p. 1). *Murphy's Creek fm.*—Dark sh. and interbedded layers of sh. and dark ls., also lighter-colored lss. and intraformational breccia. Fossils found on bank of Murphy's Creek are Upper Camb. [See also Kindle, Geol. Soc. Am. Proc. 1934, June, 1935, p. 354.]

Murray slate (also **Murray shale**). (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Murray sh.*—Grayish-blue sandy, micaceous, and calc. sh., 300 ft. thick. Overlies Nebo ss. Underlies Hesse ss.

Named for Murray Branch of Walden Creek, Sevier Co., Tenn.

Murrysville sand.

A subsurface sand in western Pa. that probably corresponds to Berea ss. of Ohio. Named for village in Westmoreland Co., Pa.

Muscogee.

See *Muskogee*.

Muskingum conglomerate. (In Washington formation.)

Permian: Southeastern Ohio.

J. P. Lesley, 1856 (Manual of coal, p. 105). *Muskingum cgl.*—Cavernous sandrock, 60 ft. thick, quarried at Marietta, Ohio. Forms cliffs 60 ft. high btw. Hockhocking and Muskingum Rivers and up the Muskingum. Underlain by 1½ ft. of coal and overlain by 25 ft. of argill. ss.

Compare Marietta ss.

Named for Muskingum River.

†Muskogee group.

Pennsylvanian: Central eastern and central Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 6, 7). *Muskogee group.*—Chiefly sss. and shales, 450 to 9,550 ft. thick, extending from uncon. at top of Miss. series on E. to base of Claremore fm. and its approx. equiv., Calvin ss., on W. In N. part of State is represented by Cherokee sh. To S. includes rocks btw. base of Atoka fm. and top of Calvin ss.

Has also been spelled *Muscogee*.

Named for Muskogee Co.

Muskogee sand.

A subsurface sand, 12 to 20 ft. thick, in Muskogee Co., central eastern Okla., which is said by some geologists to correlate with one of the sands of Dutcher sand series, but according to p. 17 of Okla. Geol. Surv. Bull. 40Q, 1928, the Muskogee sand of Beland pool, Muskogee Co., lies at 1,270 ft. depth and the first or upper Dutcher at 1,650 ft. In Muskogee pool it lies at 1,400 ft. depth and the underlying and overlying sands are not correlated. In Timber Ridge pool it lies at 1,480 to 1,510 ft., the Bad Hole sand lying at 1,385 to 1,407 ft. and the Timber Ridge sand at 1,540 to 1,560 ft. C. W. Wilson, Jr., says (A. A. P. G. Bull., vol. 19, No. 4, 1935, p. 515) this sand corresponds to Pope Chapel ss. memb. of Atoka fm.

Muskogee lime.

A subsurface unit, of Penn. age, in NE. Okla. lying lower than Burgess sand and higher than Dutcher sand.

Mussellem sand.

See *Musselman sand.* The correct spelling is *Mussellem.*

†Musselman sand.

A subsurface sand, of Penn. age and 25± ft. thick, in central and northern Okla. Correlated with a part of Ochelata fm. In Oilton pool, Creek Co., this sand lies at 700 ft. depth and Layton sand at 1,480 ft. This sand was named for its occurrence in wells on land owned by M. S. Mussellem (a Syrian), lying along Cimarron River 1½ mi. S. of Oilton. The name of the sand has been spelled *Musselman* and *Mussellem.* The latter is the correct spelling.

Muttleberry limestone.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 80). *Muttleberry lss.*—Calc. beds (lss.), 500 ft. thick, underlying Oreana shales and composing lower fm. of Lovelockian series (Early Jurassic) of Nev. Named for exposures in Muttleberry Canyon, E. of Lovelock, Humboldt Co., NW. Nevada.

Myers shale.

Mississippian: Northeastern West Virginia and western Maryland.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Myers sh.*—Largely bright-red crumbly sh. and thin argill. sss., with, at base, thick cross-bedded dirty-gray gritty ss. 60 ft. thick. Thickness 800+ ft. Underlies Pinkerton ss. and overlies Hedges sh.; all included in Pocono group. Named for exposures on the Myers place, in Meadow Brook Valley, Berkeley Co.

Myers Hill sandstone.

Upper Cambrian: Wisconsin.

C. E. Resser, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 4, p. 738), in a table of Camb., divided his Trempealeau fm. (Upper Camb.) into several members, the upper 3 of which he designated (descending) Norwalk ss., *Myers Hill ss.*, and Lodi sh. He did not define these members.

†Myrick formation.

Eocene: Southern Texas.

T. W. Vaughan, 1900 (U. S. G. S. Uvalde folio, No. 64, p. 2). *Myrick fm.*—Coarse- and fine-grained soft yellowish or brownish sss. and clays, 800 to 850 ft. thick in Uvalde quad., but upper limit not determined. Underlies Neocene Uvalde fm. and overlies Upper Cret. Pulliam fm.

According to Julia Gardner, Myrick fm. of Vaughan included beds later mapped as Midway, Indio, Carrizo, Bigford, and Mount Selman fms. Named for Myrick's lower apiary (on map), on Frio River, Uvalde Co.

Myrtle formation.

Lower Cretaceous: Southwestern Oregon.

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Myrtle fm.*—Lss., cgls., sss., and shales, the lss. mapped separately as *Whitsett ls. lentils.* Thickness 6,000± ft. in valley of Myrtle Creek. Contains Horsetown and Knoxville fossils. Uncom. underlies Umpqua fm.

See also under *†Dillard series.*

Myrtle Creek formation.

Upper Cretaceous: Alberta.

J. A. Allan, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 12).

Mysterious Creek formation.

Upper Jurassic: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132).
C. H. Crickmay, 1930 (Geol. Mag., vol. 67, p. 487 and map). *Mysterious Creek fm.*—Argillite, 2,500 ft. thick, carrying *Cadoceras schmidti* and *Lilloettia lilloetensis*. Underlies Billhook fm. (Upper J.) and overlies Echo Island fm. (Middle J.). Assigned to Upper J.

Mystic.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6).

Myton member.

Eocene (uppermost): Northeastern Utah (Uinta Basin).

H. E. Wood, 2nd, 1934. [See under *Blacks Fork memb. of Bridger fm.* The beds to which this name is applied comprise the Uinta fm. of U. S. Geol. Survey and other writers—the "true Uinta" or *Diplacodon* zone of H. F. Osborn and others.]

Nabesna limestone.

Carboniferous: Southeastern Alaska (Upper Tanana River region).

W. C. Mendenhall and F. C. Schrader, 1903 (U. S. G. S. P. P. 15, pp. 33–37). *Nabesna ls.*—Provisional name for series of lss. occurring on upper Nabesna and Chisana Rivers, whose exposures, so far as seen, are almost entirely restricted to Wrangell Mtns. Is more or less freely associated with diabasic intrusives and apparently also with older effusives. Is probably part of Nutzotin series of Brooks farther E. In general the ls. is heavy bedded, much of it white and crystalline, but darker gray or bluish layers, apparently dolomitic, are also present. No fossils found in the lss. on Nabesna and Chisana Rivers, but from fossils from similar lss. in pass btw. Jack Creek and head of Platinum Creek the Nabesna is regarded as Perm.

Nacatoch sand. (In Navarro group in Texas.)

Upper Cretaceous: Southwestern Arkansas, northwestern Louisiana, and northeastern Texas.

A. C. Veatch, 1905 (La. Geol. Surv. Bull. 1, pp. 84, 85, 87–88, and U. S. G. S. W. S. P. 114, pp. 180, 183). *Nacatoch* (*Washington*) *sand.*—Name taken from typical exposures at Nacatoch Bluff, on Little Missouri River in Clark Co., Ark., and includes the sandy beds btw. the Marlbrook below and the Arkadelphia above. Called Washington Greensands by Hill, which name is preoccupied. Thickness 150 to 200 ft.
A. C. Veatch, 1906 (U. S. G. S. P. P. 46, pp. 26–27). *Nacatoch sand.*—A series of sandy beds overlying Marlbrook marl and underlying Arkadelphia clay. Outcrop at Nacatoch Bluff, on Little Missouri River, Clark Co., Ark., measures 64 ft. in thickness, and includes a minor amount of sandy ls. and calc. ss. In W. part of region the sands are of rather light color. About Hope they are 100 to 160 ft. thick in wells. Toward Arkadelphia the sand grows darker and thinner. In well of Arkadelphia Ice & Fuel Co. it appears to extend from 100 to 160 ft., and is therefore about 60 ft. thick. Nearly="Washington greensand" or "Washington or High Bluff greensand" of Hill.
C. H. Dane, 1929 (Ark. Geol. Surv. Bull. 1). *Nacatoch sand* as now interpreted is a complex unit of cross-bedded yellowish and gray fine-grained unconsolidated quartz sand, hard crystalline fossiliferous sandy ls., coarse, richly glauconitic sand, fine argill. dark blue-black sand, and pure light-gray clay and marl, resting uncon. on Saratoga chalk, also on the older Marlbrook marl restricted and the still older Ozan fm. There is no doubt that most of the beds included by Hill in "Washington or High Bluff greensand beds" as well as the underlying "Blue sands of High Bluff and of Pate's Creek" were included by Veatch in upper part of his Marlbrook fm. From point W. of Washington, Hempstead Co., Ark., E. to Dobyville, Clark Co., the Nacatoch is divisible into three gradational lithologic units (descending): (1) Unconsolidated gray fine-grained quartz sand which weathers yellowish and reddish. (2) Dark-greenish sand containing 20 to 80 percent of coarse glauconite grains and weathering to lighter shades of green; generally fossiliferous where strongly glauconitic; contains hard irregular concretionary beds cemented

with calcite and subordinate beds of dark blue-gray argill. massive fine-grained sand. Most extensive exposures in vicinity of Washington, where 30 ft. is shown. (3) Bedded gray clay, sandy clay, and marl; dark clayey, very fine-grained sand and harder irregular concretionary beds; contains lenses of calc. fossiliferous, slightly glauconitic sand. Nacatoch Bluff exposes about 50 ft. of upper part of fm. Thickness 150 to 400 ft.; in vicinity of Arkadelphia not much over 150 ft.

The Navarro deposits of NE. Tex. are now called a *group*, divided into (descending) Kemp clay (restricted), Corsicana marl (restricted), Nacatoch sand, and Neylandville marl. (See Univ. Tex. Bull. 3232, 1933, L. W. Stephenson and W. S. Adkins, and U. S. G. S. geol. map. of Tex., 1937.)

Naches formation.

Eocene: Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Naches fm.*—Interbedded gray sss. and olive sh. with basalt lava flows, chiefly in upper part. A heavy flow of in part contemp. Kachess rhyolite is interbedded with it. Thickness of fm. 4,000± ft. Overlain uncon. by Roslyn fm. (Eocene), also by Kachess rhyolite and by Keechelus volcanics. Uncon. overlies Peshastin fm. (Carbf.?). Believed nearly contemp. with Swauk fm. (Eocene). Named for Naches River, in whose basin it is most extensively developed. No known occurrence outside of Snoqualmie quad.

Nacimientan series.

See first 2 entries under *Nacimiento group*.

Nacimiento group.

Eocene: Northwestern New Mexico.

C. R. Keyes, 1906 (Sci., n. s., vol. 23, p. 921; Am. Jour. Sci., 4th, vol. 21, pp. 298–300). *Nacimientan series.*—Shales, 800 ft. thick, underlying Wasatchan series and overlying Cret. Laramian series in N. Mex.

C. R. Keyes, 1907 (Iowa Acad. Sci. Proc., vol. 14, pp. 223–228). *Nacimientan series* of N. Mex. is Eocene and includes Torrejon sands (300 ft.) above and Puerco marls (500 ft.) below.

J. H. Gardner, 1910 (Jour. Geol., vol. 18, No. 8, p. 713). *Nacimiento group* (Cope's original Puerco) includes Torrejon fm. and Puerco fm. as restricted.

J. B. Reeside, Jr., 1924. [See 1924 entry under *Puerco fm.*]

Named for town of Nacimiento (better known as Cuba), Sandoval Co.

Naco limestone.

Permian and Pennsylvanian: Southeastern Arizona (Bisbee-Tombstone region).

F. L. Ransome, 1904 (U. S. G. S. P. P. 21). *Naco ls.*—Chiefly light-colored, regularly stratified fossiliferous beds, consisting essentially of calcium carbonate; compact, nearly aphanitic, breaking with splintery fracture; granular crinoidal beds not uncommon. Beds range in thickness from a few inches to 10 ft., but are usually thinner than those of Escabrosa ls. Chert not uncommon; occurs in irregular bunches and nodules. Rests conformably on Escabrosa ls. Is uncon. overlain by Glance cgl., basal Cret. Composes Naco Hills, near W. edge of Bisbee quad., where it is at least 1,500 and probably 2,000 ft. thick. Original thickness, before erosion, probably 3,000+ ft.

Nacogdoches beds. (In Claiborne group.)

Eocene: Eastern Texas (Nacogdoches County).

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869, pp. 57, 65, 67, 79–101, 255). *Nacogdoches beds.*—Marine and palustrine transition beds btw. Cook's Mtn greensands and the massive gypsiferous clays of Yegua fm. Regarded as distinct lithologic unit. Consists of alternating sands and clays with a few layers of greensand; much cross-bedding; frequent alternation of sand, clay, sh., and gravel; in places gypsiferous; sand is mottled in places but mainly reddish brown; 35 ft. above base at Ortons Hill is a layer of medium-coarse and for most part angular cgl. with boulders up to 6 in. diam. Thickness 25 to 60+ ft. Rests uncon. on Cook's Mtn fm. Difficult to separate from overlying Yegua fm., but top is placed where last marine fossil is found. The Nacogdoches beds are well exposed at Nacogdoches, also along streams flowing southward into Angelina River, in Nacogdoches Co., and in some of river bluffs, also in lower reaches in tributaries on S. side of river.

B. C. Renick, 1928 (A. A. P. G. Bull., vol. 12, p. 531). *Nacogdoches memb. of Cook Mtn fm.*—Mostly brown sand, locally containing some glauconite and some beds of brown clay; weathers red and tan gray. Thickness 275 to 375 ft. Underlies Lufkin memb. of Cook Mtn fm. and overlies San Augustine memb. of Cook Mtn.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 651). Dumble's name Nacogdoches appears to be a synonym for Vaughan's older name Sparta as restricted by Spooner. Since some doubt exists as to just what Dumble intended to include in his "transition beds," and since *Sparta* was in good usage in La., Miss Ellisor and Wendlandt and Knebel have been justified in dropping *Nacogdoches*.

Naese sandstone member (of Lee formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 35, 86). *Naese ss. memb.*—Massive cliff-making ss., probably 256 ft. thick, forming top memb. of Lee fm. in Cumberland Gap coal field.

Named for Naese Cliff, on Cumberland River, Bell Co., Ky.

Nagle sand.

A subsurface sand lying at horizon of lower ss. bed of Connoquenessing ss. memb. of Pottsville fm. in Willowwood field, Lawrence Co., SE. Ohio.

†Nahant schist.

Lower Cambrian: Eastern Massachusetts (Nahant).

N. S. Shaler, 1889 (U. S. G. S. 9th Ann. Rept., pp. 577–578). West of Lynn, in region called southwestern extremity of Boston Bay syncline, we have an extensive series of more or less metamorphosed rocks, including Cambridge slates, Roxbury cgls., *Nahant schists*, and Braintree fossiliferous slates.

The rocks referred to above as "Nahant schists" are mapped by B. K. Emerson (U. S. G. S. Bull. 597, 1917) as part of Weymouth fm.

†Nahant limestone.

Lower Cambrian: Eastern Massachusetts (Nahant).

J. H. Sears, 1891 (Essex Inst. Bull., vol. 22, p. 32). *Nahant lss.*—Much metamorphosed into bands of light and dark lydite. Occur on S. side of Nahant Head, at the Shag Rocks, and extend about 300 yds. to just beyond Bennett's Head on N. Contain *Olenellus* Lower Camb. fossils.

Belong to Weymouth fm., and are of too small extent to map.

†Nahant gabbro.

Early Paleozoic: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.), used *Nahant gabbro*.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 181–182 and map). *Gabbro at Nahant* was mapped as a distinct fm.

L. LaForge, 1932 (U. S. G. S. Bull. 839), treated the isolated area of gabbro at Nahant as a part of Salem gabbro diorite.

Naheola formation. (In Midway group.)

Eocene (lower): Southern Alabama and eastern Mississippi.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 57–60). *Naheola and Matthew's Landing series.*—Mostly gray sandy clays alternating with cross-bedded sands, with a bed (3 to 6 ft. thick) at base of section containing marine fossils and consisting of glauconitic sands and dark-gray, nearly black sandy clays. Uncon. underlies Nanafalia series and overlies Black Bluff series [Sucarnoochee clay]. Thickness, 130 to 150 ft. [In descriptions in rept cited and in subsequent repts the basal marl bed, 3 to 6 ft. thick, is called *Naheola marl*, also *Matthew's Landing marl*.]

In present usage the Naheola is top fm. of Midway group, and is underlain by Sucarnoochee clay and overlain by Wilcox group. It is of marine origin. C. W. Cooke, 1933 (A. A. P. G. Bull., vol. 17, No. 2, pp. 192-195), restricted Nanafalia fm. to its upper two members, the lower memb. (†Coal Bluff beds of early repts) having proved to be an eastern extension of Ackerman fm., basal fm. of Wilcox group of Miss. The beds that overlie the Naheola fm. are therefore now called *Ackerman fm.*

Named for exposures at Naheola, on Tombigbee River, in Choctaw Co., Ala.

†Naheola marl.

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1887 (U. S. G. S. Bull. 43, pp. 57-60).

For definition, see under *Naheola fm.*, of which this bed is basal memb. and with which the name conflicts.

Named for exposures in lower part of section at Naheola, on Tombigbee River, in Choctaw Co.

Naiad limestone.

Silurian (?): Southwestern New Mexico (Silver City region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257-259; Conspectus of geol. fms. of N. Mex., pp. 3, 10). *Naiad ls.*—Main ore-bearing fm. at Georgetown, Silver City, and elsewhere in these districts. Thickness 250 ft. Overlies Cibola ls., both of which comprise Santa Ritan series. Assigned to Sil. [Derivation of name not given.]

Naish limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 87, 97). *Naish ls.*—Basal memb. of Stanton ls. along Kansas River. Absent in SE. Nebr. Underlies Linwood sh. memb. [Derivation of name not stated. On p. 46 *Naish ss.*, at base of Stanton ls., is described as consisting of 1.8 ft. of hard gray calc. ss.]

R. C. Moore and G. E. Condra also used this name in their Oct. 1932 revised classification of Penn. of Kans. and Nebr., but there is no other record of the name. R. C. Moore in his 1936 classification of Penn. rocks of Kans. (Kans. Geol. Surv. Bull. 22) dropped this name, without explanation, and defined *Captain Creek ls.* as basal memb. of Stanton ls., underlying Eudora sh. memb. and overlying Vilas sh. The bed appears to be included in his Captain Creek ls.

Nakimu limestone.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 137). Included in Beltian system.

Nakimuan series.

A term employed by C. [R.] Keyes to cover rocks of Cordilleran region interpreted by him as having been formed during interval btw. the Keweenawan and upper Huronian epochs. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Naknek formation.

Upper Jurassic: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 169-171, 179, 181). *Naknek series.*—Great thickness of granitic arkoses and cgls., which generally contain granite pebbles. Cut by later basaltic lava. Outcrops about halfway from mouth of Naknek Lake to head of Savonoski. Westernmost rock of Naknek series is an augite andesite that outcrops on Naknek Lake. Not certain this rock represents a flow contemp. with the sed. rocks of the series. Fossils indicate Upper Jurassic.

G. C. Martin, 1905 (U. S. G. S. Bull. 250, p. 44), in description of Enochkin Bay, identified *Naknek fm.* (=Naknek series of Spurr) as consisting of 583 ft. of dark sandy shales overlain by an alternating series of andesite flows and beds of aggl. 270 ft. thick, and as separated from the older Enochkin sh. by 290 ft. of aggl. The beds originally defined as *Enochkin fm.* were later divided into 2 fms. (Chinitna sh. above and Tuxedni ss. below), and Enochkin fm. was discarded.

In 1912 (U. S. G. S. Bull. 485, pp. 68+) G. C. Martin and F. J. Katz applied the name *Chisik cgl.* to the cgl. ("aggl." of Martin, 1905) overlying the Chinitna sh. and underlying the Naknek fm. Later (G. C. Martin, U. S. G. S. Bull. 776, 1926) Chisik cgl. was treated as basal memb. of Naknek fm., and this is present definition of U. S. Geol. Survey.

†Nampa beds.

A term loosely applied by S. F. Emmons (Boston Soc. Nat. Hist. Proc., vol. 24, pp. 432–433, 1890) to the deposits called *Idaho* and *Payette fms.* in U. S. G. S. Nampa folio, No. 103, 1904.

†Nanafalia marl. (In Wilcox group.)

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1883 (Ala. Geol. Surv. Prog. Rept. 1881–82, pp. 256, 318–321). *Nanafalia marl.*—Marl containing a large percentage of greensand, and characterized by *Gryphaea thyrsae;* thickness 50 ft. Included in lower part of Lagrange or Lignitic.

Conflicts with Nanafalia fm., better-established name, of which it is a memb.

Named for exposure at Nanafalia Landing, on Tombigbee River, in Marengo Co.

Nanafalia formation. (In Wilcox group.)

Eocene (lower): Southern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 51–57). *Nanafalia series.*—The series of strata to which the Nanafalia marl has given the name, broadly considered, is susceptible of threefold division upon basis of lithological and paleontological characters: (1) 40 to 50 ft. of indurated gray clays and sandy clays, in part glauconitic; (2) 75 to 80 ft. of yellow, reddish, and whitish sands, alternating with green-sand beds, and highly fossiliferous, *Gryphaea thirsae* being characteristic fossil; near base a bed 20 ft. thick literally packed with these shells; (3) 70 to 80 ft. of sandy clays and sands, variously interstratified, cross-bedded sands passing near base into greensands, which overlie the Coal Bluff lignite, 4–7 ft. thick. Uncon. overlies Matthew's Landing and Naheola series and uncon. underlies Bell's Landing series. [E. A. Smith had in 1886 (Ala. Geol. Surv. Bull. 1, p. 12) described these same rocks under heading *Nanafalia and Coal Bluff section*, and he also used that term in his description in Ala. Geol. Surv. Bull. 2, p. 48, 1892.]

C. W. Cooke, 1933 (A. A. P. G. Bull., vol. 17, No. 2, pp. 192–195), restricted Nanafalia fm. by removing its basal memb. (†Coal Bluff beds of early repts), 80± ft. thick, which he stated is an E. extension of Ackerman fm. of Miss. Basal fm. of Wilcox group in Ala. is therefore now called *Ackerman fm.*

See also 1932 entry under *Salt Mtn ls.*

Named for exposures at Nanafalia Landing on Tombigbee River, in Marengo Co.

Nanaimo group.

Upper Cretaceous: Southwestern British Columbia.

G. M. Dawson, 1886 (Canada Geol. Surv. Rept. 1886, p. 10B) and 1890 (Am. Jour. Sci., 3d, vol. 39, pp. 181–183). [See under *†Vancouver fm.*]

C. H. Clapp, 1912 (Canadian Mg. Inst. Trans., vol. 15, pp. 337–338). *Nanaimo series*, Cret., B. C., includes Gabriola, Northumberland, DeCourcy, Protection, Newcastle, Cranberry, Extension, East Wellington, Haslam, Departure Bay and Benson fms.

Nanjemoy formation. (Of Pamunkey group.)

Eocene: Eastern Maryland and Virginia.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Nanjemoy fm.*—Generally highly argill. greensand, particularly in lower part. Characterized by well-marked fauna, representing a clearly defined paleontological stage. Top fm. of Pamunkey group. Divided into Woodstock memb. or substage above and Potapaco memb. or substage below. Uncon. underlies Chesapeake group and overlies Aquia fm. Named for Nanjemoy Creek, Charles Co., Md.

Now classified by U. S. Geol. Survey as of Claiborne and Wilcox age.

Nannie Basin limestone.

Middle (?) Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 6, 36, and passim). *Nannie Basin ls.*—At type loc. (where it forms the lower cliffs which are the rim of physiographic feature known as Nannie Basin) consists of homogeneous gray-white, very massive thick-bedded, rather fine-grained ls. with a few beds of chocolate-gray ls. in upper part; in lower 28 ft. there is also drab-gray nodular ls. with much buff clay in thin bands. The ls. weathers dull gray, and clay in lower part weathers buff. In nearly all other places Nannie Basin ls. is more tan than gray and has much more buff clay than at type loc. Thickest (203 ft.) in Nannie Basin; thinnest (111 ft.) on Wall Creek-Juliet Creek Ridge. Underlies Dearborn ls. and overlies Damnation ls.

Nantahala slate.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 4). *Nantahala sl.*—In the main black and gray banded slates and schists distinguished by mica, garnet, staurolite, or ottrelite. Most of schists are near base of fm. and strongly resemble the sl. and schist beds in Great Smoky cgl. The slates and ottrelite schists are as a rule somewhat darker than the other beds, the color being due to very minute grains of iron oxide. The slates are banded light and dark gray and bluish gray and cannot be distinguished from the slates in other fms. In N. half of quad. sl. makes up nearly all of fm., but forms only the upper beds at S. Many ss. and cgl. beds are interstratified with the sl. near its base and form a transition into underlying Great Smoky cgl. Unimportant layers of graywacke or cgl. are also found higher up in the sl. Thickness 1,400 to 1,800 ft. Overlain by Tusquitee qtzite.

Named for fine exposures along Nantahala River in Nantahala quad., Macon and Swain Counties, N. C.

Nantucket moraine.

Pleistocene: Southeastern Massachusetts (Nantucket Island, Marthas Vineyard) and southeastern Rhode Island (Block Island).

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Nantucket moraine* occurs on Nantucket and Block Islands and Marthas Vineyard and No Mans Land. Is a corrugated moraine, submarginal, mainly folded pre-Wisconsin beds, overlain by thin Wisconsin drift, and is not a true moraine but a pseudomoraine of Nantucket outwash plain.

Nantucket substage.

The time during which the Nantucket moraine was deposited.

Nanushuk formation.

Upper Cretaceous: Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 247). *Nanushuk series.*—Mainly thin-bedded gray and brown ss., generally fine-grained and sometimes friable; slate-colored aren. and impure fossiliferous ls.; dark sh. or mud rock; soft uncleaned slates; fine-grained gray qtzite; drab chert; and bituminous coal. Upper Cret. fossils. Uncon. overlies Anaktoovuk series on N. and underlies Tert.

Named for Nanushuk River.

Naparima marl.

Miocene: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trinidad, pp. 36–37).

†Naples shale.

†Naples group.

Upper Devonian: Western to central New York.

J. M. Clarke, 1885 (U. S. G. S. Bull. 16). *Naples beds or Naples shales* (Cashaqua and Gardeau beds of previous repts, which are abandoned, because there seems no paleontological evidence for their separation, and for which I have substituted *Naples beds*, from town of Naples, Ontario Co., where the sections are very perfect and where the beds have been carefully studied).—Author does not mean to assume, in absence of complete evidence, applicability for this subdivision outside of dist. here discussed [Ontario Co.]. Underlies Portage [Nunda] sss. and overlies Genesee beds. [The blocks on Clarke's map of Ontario Co., published in 1885 (N. Y. State Geol. Rept. for 1884) are (descending) High Point Chemung; Lower Chemung (Portage) sss.; Naples ("Portage") shales; Transition shales; Genesee shales with Styliola layer; Tully ls. * * *]

J. M. Clarke, 1894 (N. Y. State Mus. 47th Ann. Rept., p. 750), correlated the Naples of *Naples* section with Ithaca or middle Portage and lower Portage to E. In 1897 (N. Y. State Geol. 15th Ann. Rept., pp. 33–62) Clarke described the *Naples fauna*, or "the fauna of the typical Portage series," as an exotic fauna derived from the W. and having little relation to the contemp. Ithaca or eastern fauna of the Portage; and stated (p. 57) that the name *Naples beds* is "a local name for the strata which carry the *Intumescens* fauna." The beds consist of shales and flags. In 1902 (N. Y. State Mus. Bull. 52, pp. 420–421) Clarke stated that Naples fauna occupies all the ground from meridian of Cayuga Lake to shores of Lake Erie, and persists to W. much longer than to E., where it became replaced by the Ithaca and in part by the Chemung fauna. In 1903 (N. Y. State Mus. Hdb. 19, pp. 23–24) Clarke divided *Naples beds* into several units, the Middlesex black sh. being the basal one and the Wiscoy sh. (or Westhill ss.) the topmost one, the overlying High Point ss. being said to carry a Chemung fauna. In several subsequent repts the High Point ss. and overlying Prattsburg sh. were excluded from the Chemung.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), included in *Naples* all beds btw. base of Middlesex sh. and top of Wiscoy sh. (=Prattsburg ss.).

This name seems to have fallen into disuse until revived by G. H. Chadwick in 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 313–318, 352). His classification is: *Naples group*, divided into Enfield or Attica memb. above (which includes Hatch and Rhinestreet) and Ithaca or Sonyea memb. below (which includes Cashaqua and Middlesex shales). See also Chadwick, Am. Mid. Nat., vol. 16, No. 6, Nov. 1935, pp. 858, 862. W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 405), included *Naples fauna* in *Portage group*. The U. S. Geol. Survey has discontinued the use of *Naples*.

Napoleon sandstone.

Mississippian: Michigan (Southern Peninsula).

W. H. Taylor, 1839 (Mich. Geol. Surv. Rept. State Geol. in re improvement of State salt springs, Mich. Leg. H. R. Doc. 2). *Napoleon ss.* is source of brine.

A. Winchell, 1861 (Mich. Geol. Surv. 1st Bien. Rept. Prog., pp. 88, 90, 139). *Napoleon group*.—Consists of (descending): (1) Shaly micaceous ss., 15 ft.; (2) *Napoleon ss.*, highly saliferous in many places, 78 ft.; (3) shaly micaceous ss., 15 ft.; (4) clay or sh., 10–64 ft. [In several places he speaks of No. 4 as "the separating sh. lying between the Napoleon and Marshall groups." In some places he seems to call the whole "group" the *Napoleon ss.*] Thickness 173 ft. "There is no reason, except its negative paleontological characters, for separating the Napoleon group from the Marshall group." "If correctly separated from Marshall group it has no distinct equivalent in surrounding States." Outcrops at Napoleon, Jackson Co. Tentatively included in Carbf. Underlies Michigan salt group and grades into underlying Marshall group, which contains Chemung Dev. fossils.

A. C. Lane, 1904 (Mich. Acad. Sci. 5th Ann. Rept., pp. 189–193). *Upper Marshall or Napoleon* is 130 ft. thick, and underlies Lower Grand Rapids or Michigan, and overlies Lower Marshall.

In some subsequent repts these beds were called "Upper Marshall," and they are now commonly included in *Marshall ss.*, as the Marshall deposits are now designated.

Napoleon group.

See under *Napoleon ss.*

†Narcissa sandstone. (In Cherokee shale.)

Pennsylvanian: Northeastern Oklahoma (Ottawa County).

S. Weidman, 1932 (Okla. Geol. Surv. Bull. 56, p. 24). *Little Cabin ss. memb.* (of Cherokee sh.), named by D. W. Ohern in unpublished ms., consists of 10 to 15 ft. of medium- to coarse-grained ss. grading into shaly beds. It lies 50± ft. above base of Cherokee sh. in Ottawa Co., and is well exposed in vicinity of Narcissa, Ottawa Co. Its approx. distribution is indicated on the geol. map, pl. I, under name *Narcissa ss.* No fossils except plants. [The name *Little Cabin ss.* was published in 1928, and "Narcissa ss." is therefore an unnecessary synonym.]

Nariva series.

Eocene: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trinidad, pp. 35–36).

†Narragansett series.

A term that has been used in some repts to include same rocks as †Narragansett Basin series.

†Narragansett Basin series.

Pennsylvanian and Permian (?): Rhode Island.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, Geol. ser., vol. 8, No. 4, p. 99, etc.). *Narragansett Basin series.*—Arkoses, coarse and fine cgls., shales, and interbedded sss., some ls. Thickness 12,000 ft. In general appearance resemble the rocks of Boston and Norfolk Basins, but are more highly fossiliferous and of more pronounced red color. The Dighton cgl. is upper memb. of series.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks of Narragansett Basin as (descending) Dighton cgl. to N. and Purgatory cgl. to S.; Rhode Island fm.; Wamsutta fm.; and Pondville cgl.

Narrows chert. (In Beekmantown limestone.)

Lower Ordovician: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 641–643). *Narrows chert.*—Dol. or dolomitic ls. carrying abundant quantities of chert, which appears to be usually gray at top but black toward base. Thickness 200 to 283 ft. Forms top memb. of Beekmantown ls. Type loc. in Giles Co., Va., on low spur of Wolf Creek Mtn, W. of Mill Creek, S. of Wolf Creek and about 2.2 mi. SW. of Narrows. Also observed in Mercer and Monroe Counties, W. Va.

†Nash group.

Upper and Middle Ordovician: Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 160, 260).

Abbreviated form of †Nashville group.

Nash marble series.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 636). *Nash marble series.*—Chiefly dense marble, massive to thin-bedded, white to pink or gray, alternating with beds of jasper, chloritic phyllite, striped ferruginous metadolomite, and thin biotitic schists. Some beds contain structures believed to be fossil algae.

Lower part largely massive slaty gray metargillites. Thickness 2,400 ft. Underlies Anderson phyllite with probable conformity and overlies Sugarloaf metaqtzite, but contact with latter not seen. Exposed on west branch of Nash Fork. Assigned to early Algonkian.

†Nashaquitsa series.

Pleistocene: Southwestern Massachusetts (Marthas Vineyard).

N. S. Shaler, 1888 (U. S. G. S. 7th Ann. Rept., pp. 303–363), casually called the deposits of Nashaquitsa the *Nashaquitsa series*, but mapped them as Weyquosque series.

N. S. Shaler, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 536–539). *Nashaquitsa series.*—Gray and reddish sands and clays in general character like those formed during last glacial period, but on account of greater age they have been more changed in texture. Of Plio, or post-Tert. age. No fossils. In part at least laid down in salt water.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). At Nashaquitsa Cliffs, on S. shore of Marthas Vineyard, the Wisconsin drift, Manhasset, Jacob, Gardiners, Jameco, and Weyquosque fms. are present and no Tert. has been recognized.

†Nashua marl.

Pliocene (lower): Northeastern Florida.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50, and pp. 128–133). *Nashua marl.*—Light-colored marine sand beds alternating with shell marl. Although matrix is usually calc., it is always more or less sandy and sometimes consists of nearly pure sand. Bears strong lithologic resemblance to Caloosahatchee marl. Thickness 6 to 32 ft. Is thought to rest uncon. on Mio. and is uncon. overlain by Pleist. sand. Occupies St. Johns Valley, where it underlies a broad terrace bordering the stream. It probably occurs beneath the plain E. of St. Johns River.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept. and Geol. Soc. Am. Bull., vol. 40, p. 92). "*Nashua*" *marl* abandoned for Caloosahatchee marl, which is so nearly of same age that two names are not needed.

Named for exposures on St. Johns River near Nashua, Putnam Co.

†Nashville group.

Upper and Middle Ordovician: Western, central, and eastern Tennessee.

J. M. Safford, 1851 (Am. Jour. Sci., 2d, vol. 12, pp. 353, 356–357). *Nashville group.*—Lower 60 to 80 ft. a well-characterized memb. of siliceous or sandy ls.; remaining 260 ft., not affording grounds for positive division, has simply been divided equally into Upper and Lower Nashville beds, consisting of thick-bedded blue and blackish-blue ls., running up into thinner layers separated by seams and, rarely, beds of sh., generally granular, often gritty and impure, and prone to disintegrate. Older than Harpeth and Tenn. River group. Overlies Stones River group.

J. M. Safford, 1856 (Geol. reconn. Tenn.), called these beds *Nashville memb. of Central ls. and sh. group.*

Includes (descending) **Fernvale fm.**, **Arnheim ls.**, **Leipers ls.**, **Catheys ls.**, Bigby ls., and Hermitage ls., which range in age from early Trenton to late Richmond. Some repts have excluded Richmond at top. In Ga. the Rockmart sl. has been called "Nashville sl."

Named for Nashville.

†Nashville slate.

Ordovician: Northwestern Georgia.

J. W. Spencer, 1891 (Ga. Geol. Surv. 1st Rept. Prog., p. 112). *Nashville (or Rockmart) sl.* [Described. See under *Rockmart sl.* Same as Rockmart sl., which has priority, and *Nashville* conflicts with other uses of that name.]

†Nashvillean.

A time term proposed by A. W. Grabau in 1909. See explanation under *Trentonian.*

†Nasina series.

†Nasina group.

Pre-Cambrian and Paleozoic: Eastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 465-467, 478, 483). *Nasina series*.—Largely clastic rocks, essentially quartz schists and white crystalline ls., with some slates and some intrusive sheets and dikes. Occurs only on lower White River up to about mouth of Ladue Creek. Seems to correspond to Birch Creek schist and Fortymile series of Spurr; but I could not differentiate. It seems likely it includes Tanana schists. Assigned to pre-Sil. [*Nasina* is Tanana native name for *White River*.]

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, p. 60). *Nasina "series"* (which preferably should be *Nasina group*) includes Spurr's Birch Creek and may also include Fortymile "series" [Paleozoic and pre-Camb.].

According to J. B. Mertie, Jr., the Nasina series of Canadian geologists is same as Birch Creek schist as now restricted to sed. rocks, and *Nasina series* and *Nasina group* are no longer useful terms for rocks in Alaska.

†Nass formation.

Jurassic or Triassic: Northwestern British Columbia (Salmon River Valley region).

R. G. McConnell, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 65), 1912 (Canada Geol. Surv. Summ. Rept. 1911, pp. 53, 58), 1914 (Canada Geol. Surv. Mem. 32, p. 17); no age assignment. S. J. Schofield and G. Hanson, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, p. 8), assigned these rocks to Jurassic, as did Schofield, 1922 (Canada Geol. Surv. Mem. 132, p. 13). G. Hanson, 1921 (Canada Geol. Surv. Mem. 159, p. 9), assigned them to Jurassic or Triassic. Late Canadian repts say the name should be dropped. (See Canada Geol. Surv. Summ. Rept. 1923, pt. A, p. 34.)

Nassau beds.

Lower Cambrian: Eastern New York (Rensselaer County) and western Vermont (?).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 69-70). *Nassau beds*.—Divisions A to E of [T. N.] Dale's series in Rensselaer Co. Consists of 150 to 800 ft. of alternating reddish and greenish shales and qtzites, underlying Bomoseen grit—all of Lower Camb. age. Named for exposures in Nassau, N. Y.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, No. 2, p. 414), placed *Nassau beds* above Schodack beds and both in Lower Camb., with Middle and Upper Camb. absent.

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285). [See 1930 entry under *Schodack fm.*]

Nass River argillite.

Age (?): British Columbia.

W. V. Smitheringale, 1928 (Econ. Geol., vol. 23, p. 193).

Nastapoka series.

Pre-Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 197).

Natapoc formation.

Eocene: Central Washington (central part of Chelan County).

E. Houghland, 1932 (Northwest Sci., vol. 6, No. 2, p. 68). *Natapoc fm.* is here used to designate the ss. series about 11 mi. N. of Leavenworth, Wash., and about 15 mi. E. of crest of Cascade Mtns. It is Tert., and uncon. overlies metamorphic rocks. Mr. Parrott has shown this fm. as about 15,000 ft. thick. It has been folded into at least 2 anticlines and 2 synclines with av. dip of 40°. The major fold is an anticline btw. 7 and 8 mi. wide at base. From unmetamorphosed character of beds and light shearing effects it is inferred this series was not subjected to intensive stresses during the folding. In two places the underlying rock has been exposed by erosion.

E. Houghland, 1932 (Pan-Am. Geol., vol. 58, No. 4, pp. 263–270). Natapoc Mtn is 15± mi. E. of crest of the Cascades, near Great Northern Railway, 10 mi. N. of Leavenworth. It is composed almost wholly of broadly folded aren. strata of Eo. age and of great thickness, resting upon a foundation of metamorphics and igneous masses. The section consists of cgl., pebbly sss., some layers of sh., and an interstratified basaltic plate and some felsites. Appears to correlate with the Eo. fms. of Mount Stuart area, namely, Swauk fm., Teanaway basalt, Roslyn ss., and Manastash fm.

Natchez formation.

Early Pleistocene: Mississippi.

T. C. Chamberlin, 1896 (Am. Geol., vol. 17, pp. 108–109). *Natchez fm.*—Alternating stages of deposition and erosion of Pleist. stratified gravel, sand, and fine silt of immediate valley of Mississippi River in vicinity of Natchez. The Natchez fm. and associated deposits and stages of erosion are of special interest on account of their probable relationship with Kansan, Aftonian, and Iowan stages of Glacial period in upper and more northern part of Mississippi Basin.

T. C. Chamberlin and R. D. Salisbury, 1906 (Textbook geol., vol. 3, pp. 386–388). *Natchez fm.*—At Natchez, Miss., a section of assorted material chiefly made up of derivatives from Lafayette fm., upon which it rests uncon. Also contains crystalline pebbles and calc. clays assignable to wash from the glacial regions. Marked interval btw. its deposition and that of overlying loess. Probably of either Aftonian or sub-Aftonian age. Thickness 200± ft.

E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14) and 1925 (Miss. Geol. Surv. Bull. 20). *Natchez fm.*—In river bluffs at Natchez is 75 to 80 ft. of reworked gravels and sands which overlie Citronelle fm. and seem to be of early Pleist. age. The materials are derived in part from older Plio. deposits and in part from glacial drift from the north. Uncon. underlies the loess.

L. W. Stephenson, W. N. Logan, and G. A. Waring, 1928 (U. S. G. S. W. S. P. 576, p. 61). As described by E. W. Shaw in an unpublished ms. the *Natchez fm.* is a very early Pleist. stream deposit consisting of 150 to 175 ft. of gravels, sands, and clays. Only good exposure known is at Natchez, where it lies considerably above position of highest floods of present day and is well exposed in bluff. It appears to be much older than the loess.

Natick granite.

A name mentioned in some early repts. (See W. O. Crosby, Boston Soc. Nat. Hist. Occ. Papers No. 3, 1880.) The granite at Natick, Mass., was mapped as Dedham granodiorite by B. K. Emerson in U. S. G. S. Bull. 597, 1917.

Natick arkose.

Carboniferous: Eastern Rhode Island (Kent County).

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 253–256, 375–376, 383–385). *Natick arkose.*—Largely detrital quartz derived from decayed granite, and usually found near those localities where the immediately underlying pre-Carbf. rocks consist chiefly of granite. Exposed along steep hill face from Natick [Kent Co.], R. I., for 2½ mi. northward into Cranston. Underlies Kingstown series.

Is part of Wamsutta fm. as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

National sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. with map, Phila., 1863; map and p. 21). North of Minesota traps is a belt of ss. 50 ft. wide. It is well exposed in a creek on the National Location and is known as *National ss.* [Is shown as overlying Minesota traps and underlying Toltec traps.]

According to B. S. Butler (U. S. G. S. P. P. 144, 1929) this is probably cgl. No. 12.

Nation River formation.

Carboniferous (Pennsylvanian?): Central eastern Alaska (Nation River region).

A. H. Brooks and L. M. Prindle, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 294, etc.). *Nation River fm.*—Cgls., sss., and shales, 3,700± ft. thick, containing plant fragments. Assigned to Upper Carbf. Overlies (uncon.) Calico Bluff fm., and underlies (uncon.?) heavy lss. of Upper Carbf. age. Exposed on Yukon River at mouth of Nation River.

The fossils of the ls. overlying Nation River fm. are now classified by G. H. Girty as Perm., and the Nation River is now classified as Penn. (?). Its max. thickness is now stated to be 6,000 ft. J. B. Mertie, Jr., 1933 (U. S. G. S. Bull. 836, p. 423), stated that he believed a group of intermediate or transitional rocks, 1,000 to 2,000 ft. thick, exists btw. Nation River fm. and Calico Bluff fm. in Tatonduk-Nation dist., but that this remains to be proved. He classified Nation River fm. as *Penn.* (?) and Calico Bluff fm. as *upper Miss.*

Natural Bridge limestone.

W. W. Mather, 1843 (Geol. N. Y., vol. 1, pl. 45). [This geologic cross section (from Monticello, Sullivan Co., to Croton River near Bulls Bridge, Westchester Co., N. Y.) shows *Natural Bridge ls.*]

†Natural Bridge limestone.

Middle and Upper Cambrian and Lower Ordovician: Central western Virginia.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). *Natural Bridge ls.*—Chiefly heavy-bedded gray and light-blue mag. lss. with thin siliceous laminae conspicuous. Beds of white and pinkish dol. occur now and then. Calc. sss. from few in. to 8 ft. thick are occasionally prominent. Black chert nodules more or less abundant throughout, and heavy chert beds are usually very conspicuous near top. Thickness 3,500+ ft. Beekmantown fossils found 300 to 400 ft. below top and Camb. fossils lower down. Underlies Murat ls. and overlies Buena Vista sh.

Now divided into (descending) Beekmantown group, Conococheague ls., and Elbrook ls.

Natural Corral member.

Lower Cretaceous (Comanche series): Central Kansas.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, pp. 31–32). *Natural Corral memb.*—The basal strata of Belvidere fm., underlying Windom memb. Exposed at Natural Corral, a box canyon about 5 mi. SW. of Marquette (NW¼ sec. 5, T. 18 S., R. 5 W.), McPherson Co.

See also 1924 entry under *Mentor fm.*

Naugatuck sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 163). *Naugatuck ss.*—Massive grayish-white medium-grained, 15 to 40 ft. thick. Lies 1 to 5 ft. below Hernshaw coal and overlies Dingess coal. Named for Naugatuck, Mingo Co.

†Naugus Head series.

Age (?): Eastern Massachusetts (Boston region).

W. O. Crosby, 1877 (Geol. map of eastern Mass.), mapped as *Naugus Head series* (1) the rocks of Naugus Head (on NW. shore of Marblehead); (2) the rocks of Salem, Salem Neck, and S. shore of Beverly and some adjacent islands; and (3) the rocks of Nahant. The rocks of Naugus Head and S. shore of Beverly and adjacent islands are mapped by B. K. Emerson (U. S. G. S. Bull. 597, 1917) as Beverly syenite; the rocks of Salem Neck as in part nephelite syenite and in part Salem gabbrodiorite; and the rocks of Nahant as granite.

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers, No. 3, with map). The oldest of these crystalline series [of eastern Mass.] is smallest in extent. I propose to designate it, provisionally, *Naugus Head series*, in allusion to promontory of this name on Marblehead shore, where the rocks of this series are best developed and were first observed. Rocks are chiefly feldspar and pyroxene.

M. E. Wadsworth, 1883 (Boston Soc. Nat. Hist. Proc., vol. 21, pp. 288-294), discussed the "so-called Naugus Head series," but "did not assent to the views which led to its establishment."

†Naushon series.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard).

N. S. Shaler, 1888 (U. S. G. S. 7th Ann. Rept., pp. 303-363 and map). *Naushon series.*—Yellowish and reddish stratified sands, containing occasional water-rounded pebbles, occurring on island of Naushon [N. of Marthas Vineyard]. Also occurs at several places on Marthas Vineyard. Not of strict glacial origin. Appears to antedate ice sheet, though it may represent deposits of one of the interglacial periods. Uncon. underlies till and kame deposits.

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). Shaler recognized beneath the surface moraine of Naushon Island a thick series of fine sands to which he gave the name "Naushon series," comparing it with beds now referred to the older Pleist. [probably Weyquosque fm.] of Marthas Vineyard.

Navajo sandstone. (In Glen Canyon group.)

Jurassic (?): Northern Arizona, southeastern Utah, western Colorado, and extreme northwestern New Mexico.

H. E. Gregory, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 102, 112). *Navajo ss.*, upper memb. of La Plata group in Navajo Ind. Res., Ariz., consists of light-red massive cross-bedded ss., 30± ft. thick. Underlies McElmo fm.

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380). *Navajo ss.*—Red ss., massive exceedingly cross-bedded; locally thin-bedded and greatly reduced in thickness. Thickness 400 to 1,000 ft. Underlies McElmo fm. and overlies Todilto fm. Is top fm. of La Plata group.

H. E. Gregory, 1917 (U. S. G. S. P. P. 93, pp. 57+). [Detailed description.] Is widely displayed in Navajo country and is appropriately termed *Navajo ss.* Nearly complete section is exposed in walls of Navajo Canyon and other canyons.

The beds that overlie Todilto ls. in NW. N. Mex. are now known to be younger than true Navajo, and they, as well as Todilto ls., are now included in Morrison fm., while the beds that separate Navajo ss. from underlying Wingate ss. in Utah and Ariz. are now known as *Kayenta fm.* (See U. S. G. S. P. P. 183, 1936, by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.)

†Navajo shales.

Name applied by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 22, p. 257, 1915, and Conspectus of geol. fms. of N. Mex., pp. 2, 10, 1915) to 1,000 ft. of sh. overlying Pictured Cliffs ss. and underlying Tert. in San Juan region, N. Mex. Now divided into several named fms. of Upper Cret. age. (See J. B. Reeside, Jr., U. S. G. S. P. P. 134, 1924.)

Navarro group.

Upper Cretaceous (Gulf series): Eastern Texas.

B. F. Shumard, 1862 (Boston Soc. Nat. Hist. Proc., vol. 8, p. 189). *Navarro beds.*—Fossiliferous blue and gray aren. clays in Navarro Co., not hitherto recognized in Tex. but believed to occupy strat. position above Austin ls.

R. T. Hill, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 298). *Navarro beds* (*Exogyra ponderosa marl*).—Marls, clays, and lss. of varying hardness and in beds of limited extent. Overlie Dallas ls. and underlie basal Tertiaries. [As thus defined included Taylor marl.]

R. T. Hill, 1889 (Am. Jour. Sci., 3d, vol. 37, p. 290). *Navarro beds.*—Calc. sands overlying *Exogyra ponderosa* [Taylor] marls. Top fm. of Upper Cret. in Tex.

Adopted in well-established sense, for aren. glauconitic deposits overlying nonglauconitic Taylor marl and underlying Eocene. (See also *Taylor* *marl.*) The Navarro deposits of NE. Tex. are now treated by U. S. Geol. Survey as a group, divided into (descending) Kemp clay (restricted), Corsicana sand (restricted), Nacatoch sand, and Neylandville marl. See U. S. G. S. 1937 geol. map of Tex. and Univ. Tex. Bull. 3232, 1933. In Medina River region Navarro group is now divided by L. W. Stephenson into (descending) Escondido fm. and Corsicana marl. In Rio Grande region it is now divided into (descending) Escondido fm. and Olmos fm.

Named for development in Navarro Co.

†Navasota beds.

Miocene and Pliocene: Eastern Texas.

W. Kennedy, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 9–15, 43–44). *Navasota beds.*—Upper div., 75 ft. of blue and yellow, sometimes red clays, occasional strata of gray calc. sands containing Cret. shells, and thin-bedded coarse-grained soft calc. ss.; lower div., 350 ft. of gray and yellow calc. sss. interstratified with coarse yellow sand containing worn Cret. shells and beds of tufaceous yellow siliceous ls. Overlies Eo. beds corresponding to Fayette div. and underlies Quat.

Includes Lagarto clay and Oakville ss., according to U. S. G. S. P. P. 126, 1924.

Named for Navasota, Grimes Co.

Navesink marl. (In Monmouth group.)

Upper Cretaceous: New Jersey.

W. B. Clark, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 336–337, and Jour. Geol., vol. 2, pp. 161–177). *Navesink fm.*—Distinguishing feature is greensand. Lower part frequently quite sandy. Upper part highly argill., and at top frequently aren. and so oxidized that it is difficult to separate from Redbank fm. Highly fossiliferous. Thickness 40 to 60 ft. Is Lower Marl Bed of previous repts. Overlies Matawan fm. conformably. Extensively developed throughout region of Navesink Highlands, in vicinity of village of Navesink and along N. bank of Navesink River. [As thus defined the Navesink fm. included the beds separated, in 1897, under the name *Mount Laurel sands.*]

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 315, 333–334). *Navesink marls.*—Typically glauconitic sands, 12 to 50 ft. thick, which admit of subdivision throughout much of Monmouth Co. Underlie Redbank sands and overlie Mount Laurel sands. Is middle div. of Monmouth fm. [group].

The Navesink and Mount Laurel are generally treated as distinct lithologic units, but according to S. Weller and G. N. Knapp, 1907 (N. J. Geol. Surv. vol. 4, pp. 25, 137, 154), they are in part contemp.

Navosaigame formation.

Age (?): Mexico.

E. O. Hovey, 1907 (Am. Mus. Nat. Hist. Bull., vol. 23, pp. 401–442).

Naylor ledge.

Lower Ordovician (Beekmantown): Quebec (Philipsburg region).

E. O. Ulrich, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, p. 348). *Naylor ledge.*—So called by Dr. H. W. McGerrigle, who is mapping the area adjacent to town of Philipsburg, Quebec. Upper Canadian [upper Beekmantown] marine ls. in upper part of Philipsburg series. Corresponds essentially to div. D of Brainerd and Seely's section of "Calciferous" in Champlain Valley. Max. thickness 30 ft. Is div. B5 of Logan. Contains Upper Canadian fossils in the matrix. Fills caverns in Upper Ozarkian fms. [Derivation of name not stated.]

Naylor Ledge formation.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 185, 1931) to summit bed (30 ft. thick) of B2 (lss.) of Logan's section of Philipsburg series of Quebec. McGerrigle mapped his Naylor Ledge fm. in small area in St. Albans quad., NW. Vt. (See 1931 entry under *Philipsburg series.*)

Nazareth cement rock.

Middle Ordovician: Eastern Pennsylvania (Lehigh Valley district).

E. T. Wherry, 1909 (Sci., n. s., vol. 30, p. 416). *Nazareth cement rock* (lower Trenton), 0 to 500+ ft. thick. Underlies Martinsburg sh. and overlies Nisky fm.

Probably named for occurrence at or near Nazareth, Northampton Co.

Btw. 1910 and 1927 this name was used in several Pa. Geol. Survey and other repts. In 1928 (letter dated March 26) B. L. Miller stated: (See quotation under *Coplay ls.*) Has also been called *Nazareth ls.*

Nazlini shales.

Upper Triassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 337). *Nazlini shales* is proposed for median and main body of shales of Doloresian series in Apache Co. [NE. Ariz.], and typically exposed on Nazlini Creek, S. of Chinle and NW. of Fort Defiance. Thickness 450 ft. Underlies Ventana sss. [This name was later (Pan-Am. Geol., 1924) applied by him in Utah and Colo. In his table for latter State he spelled the name *Noxlini*.]

Neabsco Run diorite.

Pre-Cambrian (?): Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). *Neapsco Run diorite.*—Outcrops 1 mi. NE. of Minnieville P. O. and 5 mi. NW. of Dumfries, along Neapsco Run. Assigned to pre-Camb. or Camb. [Neabsco is spelling of the stream on Va. maps.]

Neahga shale.

Silurian (Niagaran): Western New York (Niagara Gorge).

J. T. Sanford, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 194). The term *Neahga sh.* is proposed for the lower Clinton green sh. of Niagara Gorge. [All.]

J. T. Sanford, 1935 (Jour. Geol., vol. 43, No. 2, pp. 169–183). [Under heading *Neahga fm.* he stated:] At Niagara Gorge the lower Clinton green sh. is 6 ft. thick; thins to E. and is nearly or completely missing at Lockport, where about 3 in. of green sh. occur btw. underlying Thorold ss. and overlying Reynales ls. Originally correlated by Hall with green sh. below *Pentamerus ls.* at Rochester (Maplewood sh.), to which it corresponds in strat. position. Fossils (listed) seem more closely related to overlying fms. Btw. the Neahga and underlying Thorold ss. is a bed of calcitic sandy rock, with possibly a small uncon. at its base. The bed of green sh. may be of Furnaceville age, or may correspond, at least approx., to Maplewood sh., but laid down in separate basin or embayment or under different environment. The term "Neahga" (meaning Niagara River), which can be used as a local name implying no correlation, is proposed to designate this fm. [On p. 169 he stated relationships of Neahga fm. not certainly known except in Niagara Gorge. On p. 183 he stated the Neahga and Maplewood occur at same strat. horizon and are of approx. same age.]

Neapsco Run diorite.

See *Neabsco Run diorite.*

Nebo quartzite. (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Nebo ss.*—Massive fine white ss., containing only grains of fine white sand and small quartz pebbles. Thickness 500 ft. Overlies Nichols sh. Underlies Murray sh.

Named for Mount Nebo Springs, on Mount Nebo, Blount Co., Tenn.

†Nebo.

Ordovician (Lower): Southern Oklahoma (Arbuckle and Wichita Mountains).

C. E. Decker, 1930 (A. A. P. G. Bull., vol. 14, No. 12, p. 1495), published a ms. chart that was prepared by E. O. Ulrich in 1928 and shown by him at Geol.

Soc. Am. meeting in N. Y. in Dec. 1928, in which he divided the Simpson of Okla. into (descending) Bromide, Criner, Tulip Creek, McLish, Falls, *Nebo*, and Joins Ranch fms.

In 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73) Ulrich published a list of his subdivisions of the Simpson, in which he substituted *Oil Creek* for the preoccupied name *Nebo*.

Named for village in Murray Co.

†Nebraska beds.

Miocene: Nebraska.

W. B. Scott, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 594–595). *Nebraska or Loup Fork proper.*—Second or middle horizon of Loup Fork. Covers a vast area from Nebr. to Mexico. Characterized by *Cosoryx*. Underlies Palo Duro horizon and is younger than Deep River horizon of Loup Fork of Mont.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 65, 79), assigned these beds to upper Mio. and to lower part of Ogallala fm., and stated (footnote p. 79): Under misapprehension of Scott's definition of "Nebraska," both Hatcher [Am. Phil. Soc. Proc., vol. 41, p. 117, 1902] and Peterson [Carnegie Mus. Annals, vol. 2, p. 473, 1904] first applied this term to part of the lower Arikaree or lower Mio.

Named for State of Nebraska.

†Nebraska conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 588, fig. 52). *Nebraska cgl.* is same as Caledonia cgl. [which is same as Bohemia (No. 8) cgl., top fm. of Bohemian Range group].

Probably named for occurrence in old Nebraska mine (which later became the Caledonia mine), Ontonagon Co.

Nebraska City limestone.

Pennsylvanian: Southeastern Nebraska, northeastern Kansas, and northwestern Missouri.

G. L. Smith, 1919 (Iowa Acad. Sci. Proc. 1918, vol. 25, p. 526). *Nebraska City ledge.*—Ledge of ls. and ss. that weather into irregular slabs with a rough granular surface. Not named in Condra and Bengston's [1915] Nebr. rept. I suggest name *Nebraska City ledge* for this double ledge. Upper 2 ft. is dark-bluish ls. of fine texture along some layers and along other seams almost wholly made up of very small and thin shell fragments, lying flat; this is underlain by 1 ft. of shaly silt; followed below by ¾ ft. of dark-gray ls., in places brownish; basal 2½ ft. is aren. and calc. rock of fine texture and bluish color, consisting of a siliceous, well-assorted silt or sand embedded in calc. material. Type section is upper strata in brickyard sh. pit ¼ mi. S. of Missouri River bridge at Nebraska City, Nebr. This ledge is not a constant horizon. In passing S. it grades into ss. and cannot be recognized a few mi. S. of State line in Mo.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 116). *Nebraska City ls.*—Dark bluish-gray massive, hard, somewhat sandy and pebbly, in large rectangular blocks, weathering buff to brownish and slabby, 2 ft. 10 in. thick in bluff and clay pits SE. of Nebraska City. Fossils. Top bed of Pony Creek sh., which is top unit of McKissick Grove sh.

R. C. Moore and G. E. Condra, Oct. 1932 (Kans. and Nebr. revised classification chart). *Nebraska City ls. memb. of McKissick Grove sh.* underlies Pony Creek sh. and overlies Frenck sh. (redefined).

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 9–10), changed last definition, as explained under *Jim Creek ls.*

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), treated this ls. as basal memb. of his Caneyville ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Nebraskan stage of glaciation, also **Nebraskan drift** (Pleistocene).

Nebraskan drift is name applied to oldest Pleistocene drift of western or Keewatin part of Laurentide ice sheet; *Nebraskan stage* being applied to the time during which this drift was deposited. The drift was named for its occurrence in Nebr., where, however, it is poorly exposed. The name was originally proposed by B. Shimek (Geol. Soc. Am. Bull., vol. 20, p. 408, 1909; Sci., n. s., vol. 31, pp. 75–76, 1910). This drift has also been called *sub-Aftonian* (from fact it underlies the Aftonian interglacial deposits) and *pre-Kansan* (from fact it is an older drift than the Kansan). See also *Jerseyan drift*.

Necedah quartzite.

Pre-Cambrian (Huronian?): Central southern Wisconsin (Juneau County).

R. D. Irving, 1877 (Geol. Wis. vol. 2, pp. 523–524). *Necedah qtzite.*—A qtzite hill at foot of which stands village of Necedah. The rock is glassy, translucent, subgranular, grayish qtzite, much of it dark gray. Much more nearly allied to qtzite of Rib and Mosinee Hills, Marathon Co., than to that of Baraboo ranges.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 724). Age of qtzite at Necedah is unknown, but its lithologic similarity is with the lower Huronian.

Necessity shale member (of Graham formation).

Pennsylvanian: Central northern Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 113, 114). *Necessity sh. memb. of Graham fm.* replaces South Bend sh., which is preoccupied. [Derivation of name not stated. On p. 113 he called it *Necessity sh. and ss.*]

Nechacco series.

A local facies of Kootenai fm. See G. M. Dawson, 1878 (Canada Geol. Surv. Rept. 1876–77, p. 72).

Necoxtla formation.

Cretaceous: Mexico.

J. deD. Villarello and E. Böse, 1902 (Mexico Inst. geol. Bol. 16, p. 16).

Neda formation (iron bearing).

Upper Ordovician (Richmond): Southeastern Wisconsin (Dodge and Door Counties) and northeastern Iowa.

T. E. Savage and C. S. Ross, 1916 (Am. Jour. Sci., 4th, vol. 41, pp. 187–193). The iron-ore bed in old ore pit near Neda, Wis., heretofore correlated with and called Clinton iron ore, is here named *Neda iron ore*, because it is now known to be much older than the Clinton of N. Y., Maquoketa (Richmond) fossils having been found in it. It consists of a hard nonoolitic iron-ore band ⅗ to 1⅕ ft. thick, underlain by 25 to 32 ft. of horizontally and regularly stratified beds of reddish-brown oolitic iron ore, with a thin band of iron-coated fragments of shaly material and iron pebbles near bottom. It uncon. underlies Mayville ls. in ore pit near Neda, and also at Cascade Falls, near Green Bay, and at both places it rests uncon. on Maquoketa sh. Occurs in several [listed] isolated patches or lenses in SE. Wis. It is "*Mayville ore bed*" of Chamberlin, but he applied Mayville more definitely to the ls. immediately overlying the ore.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 536). *"Clinton" or Neda fm.*—Oolitic hematite with subordinate red sh. layers and sh. pebbles. Greatest known thickness 55 ft. (at Manitowoc, Wis.). Occurs only in local lenses. Outcrops in Dodge and Door Counties.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21). *Neda fm.*, of eastern Wis., 0 to 55 ft. thick, is of Richmond age. Uncon. underlies Mayville dol. Included in Maquoketa group.

Needle Mountains group.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). During survey of this quad. it was found that the main Algonkian qtzites and slates were like those of Uncompahgre section, but from structural complexities the portion represented was less, and, as in Uncompahgre Canyon, the upper and lower parts were not seen. In Vallecito Canyon, however, at S. margin of quad., a heavy cgl. was discovered and traced to E., where it was found in such relations with Uncompahgre qtzites and slates as to appear unquestionably to be lower part of the group. To this cgl. the name *Vallecito cgl.* is given, and to the group which includes it and the *Uncompahgre*, together with higher fms. that may hereafter be recognized, the name *Needle Mtns group* is applied. Total thickness of group unknown. Vallecito cgl. is 2,000 or more ft. thick 2 mi. E. of this quad., and overlying Uncompahgre qtzites and slates are 5,000+ ft. thick in Grenadier Range.

For many years this group was classified as Algonkian, but the terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey the group is now classified as *pre-Camb.*

Neeley lake beds.

Pliocene? (lower Pliocene?): Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Neeley lake beds.*—Flesh- to brown-colored sandy lacustrine deposits consisting largely of reworked tuffs. Thickness 100+ ft.; base not exposed. Older than Eagle Rock tuff and younger than Pillar Falls mud flow. Exposed in bluffs of Snake River in vicinity of village of Neeley, 5 mi. SW. of American Falls.

Neelytown limestone.

Upper Cambrian: Eastern New York (Orange County).

W. Horton, 1839 (N. Y. Geol. Surv. 3d Rept., p. 148), mentioned a ls. associated with argillite in Orange Co., which "is called the *Neelytown ls.* in the neighborhood where it lies."

W. W. Mather, 1843 (Geol. N. Y., vol. 1, p. 367). *Neeleytown ls.* is a synonym of Black River ls.

H. Ries, 1897 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 442–443). In woods S. of Neely station is a small area of light-blue granular ls. which is sometimes brecciated in its upper layers. The ls. first crops out in the cross road a few hundred ft. E. of Neelytown station. A short distance to S., on W. side of road in a field, is a small ls. quarry. The rock is massive and irregularly bedded, with brecciated structure and very indistinct traces of fossils in its upper layers. Chert nodules are very abundant. [Mentions some other outcrops. This ls. is mapped as *blue Cambrian ls.*]

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 12). The Cambric or *Neelytown lss.* of Orange Co., which constitute a part of Kittatinny ls. series of N. J., are deeper-water deposits of similar character [to Greenfield ls. which overlies Potsdam ss. in Saratoga Co. The chart of Hdb. 19 shows Neelytown ls. as older than Schaghticoke sh.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 31). *Neelytown ls.* (*1839 Horton*).—This is a small outlying area surrounded by "Hudson River" shales near Neelytown, in central Orange Co. In lithologic features it resembles upper part of the Cambric lss. farther S. and is therefore provisionally considered as of same age. In early repts this ls. was doubtfully referred to Hudson River group.

†Nefsy shale member (of Graneros shale).

Upper Cretaceous: Northeastern Wyoming.

A. J. Collier, 1922 (U. S. G. S. Bull. 736, table opp. p. 76, p. 82, etc.). *Nefsy sh. memb. of Graneros sh.*—Soft dark sh. interbedded with lenses of sandy sh. Thickness 25 to 50 ft. Overlies Newcastle ss. memb. of Graneros and underlies Mowry sh. memb. of Graneros. Named for fact that large part of Nefsy townsite at Osage is underlain by this sh.

This soft sh. is now included in base of Mowry sh. memb., into which it grades, and *Nefsy* has been abandoned. (See W. W. Rubey, U. S. G. S. P. P. 165, 1930, p. 4.)

Negaunee iron-formation.

Pre-Cambrian (middle Huronian): Michigan (Upper Peninsula).

M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, pp. 65–66). *Negaunee fm.*—Schist, qtzite, and graywacke. Overlies Holyoke fm., apparently uncon., in Marquette dist. Is highest fm. of Azoic or Archean system of Mich. [As thus defined it apparently includes Negaunee fm. and overlying upper Huronian.]

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 561+). *Negaunee fm.*—The Lower Marquette iron-bearing fm. Consists of sideritic slates, grünerite-magnetite schists, ferruginous slates and cherts, and jaspilite. Thickness 1,500 ft. Rests conformably on Siamo sl. or Ajibik qtzite and uncon. underlies Goodrich qtzite. [This is present commonly accepted definition of Negaunee, although R. C. Allen (Am. Inst. Min. and Met. Engrs. Bull. 153, pp. 2579–2594, 1919) correlated Negaunee fm. with lower part of Michigamme sl., Vulcan fm. and Ironwood fm., and assigned all to middle Huronian.]

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), adopted the name *Negaunee iron-fm.*

J. L. Adler, 1935 (Jour. Geol., vol. 43, No. 2, pp. 113–132), divided Negaunee fm. of part of Marquette Co. into (descending) Jasper Knob zone, Corning Creek zone, North Lake zone, and Makasin Hill zone.

Named for exposures at and S. of Negaunee, Marquette Co.

Negli Creek limestone. (In Chester group.)

Mississippian: Southern Indiana and central western Kentucky.

W. N. Logan, 1924 (Ind. Dept. Cons. Pub. 42, pp. 11, 125. Taken from unpublished rept on Perry Co., Ind., by C. A. Malott). *Negli Creek ls.*, top subdivision of Chester group, overlies Mount Pleasant shales and sss. Thickness 20 ft. in well log in Knox Co.

C. A. Malott, 1925 (Ind. Acad. Sci. Proc., vol. 34, pp. 112–132). *Negli Creek ls.*—Uppermost fm. of upper Chester of Ind. Consists of ls., usually quite massive, but on weathered faces bedding is well brought out, the beds being from a few in. to a few ft. thick. Ranges in color from rusty yellow to white or dove color. Very fossiliferous. Thickness 2 to 20 ft. Lies at or near base of Mansfield ss. and 15 to 53 ft. above Mount Pleasant ss. Named for excellent exposures along Negli Creek, a tributary of Little Deer Creek, 4 or 5 mi. E. of Tell City, Perry Co., Ind. At Buffalo Wallow, Ky., 1½ mi. W. of Cloverport, Breckinridge Co., it is separated from Mansfield ss. by 5 ft. of upper Chester sh. and from underlying Mount Pleasant ss. by 53 ft. of sh.

Negra clay.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 61, 80). *Negra clays* is name locally used in Death Valley region for upper borax silts exposed in fine section in E. wall of Furnace Canyon, beneath Mesa Negra [E. of Death Valley, in Inyo Co., Calif.]. [On p. 61 Keyes says these clays are known as *Mesa Negra beds*, and that they are tentatively considered as Miocene.]

Nehant limestone.

Misprint (on p. 284 of U. S. G. S. Bull. 191) for *Nahant ls.*

Nehawka limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 6, 33). *Nehawka ls.*—Hard gray bedded ls. forming base of Andrew (Lawrence) sh. in Weeping Water section, Nebr. Exposed in bed of North Branch of the Weeping Water 2 mi. N. of Nehawka. Best shown in sec. 6, T. 10 N., R. 13 E. Largest exposures show thickness of 4 ft. 6 in. (under wagon bridge just N. of center of sec. 6, T. 10 N., R. 13 E.), but correlated neighboring exposures indicate total thickness of 10 ft. or more.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 34). *Nehawka ls.* is Iatan ls. memb., and latter name is now used.

Neihart quartzite.

Pre-Cambrian (Belt series): Central western (Philipsburg region) and central southern (Little Belt Mountains) Montana.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Neihart qtzite and ss.*—Coarse reddish sss., with interbedded dark-greenish layers of fine-grained ss. and sh., 300 ft.; underlain by 400 ft. of pinkish-gray massive, sometimes cross-bedded qtzite, in some parts a compact hard ss. Basal fm. of Belt series. Underlies Chamberlain shales. Named by W. H. Weed, for its occurrence on

Neihart Mtn, where the qtzites and sss. are in contact with the gneiss. Thickness measured by Weed 700 ft. [The compiler has been unable to find any Neihart Mtn, and assumes that Walcott referred to mtn slightly NE. of Neihart, which is called Long Mtn on Little Belt Mtns topog. map, as in Little Belt Mtns folio (No. 56) Neihart qtzite is mapped over S. part of Long Mtn and over large area to S. and E. of village of Neihart.]

Neihart porphyry.

Cretaceous (?): Central Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Neihart porphyry.*—Rhyolite porphyry, pale yellowish or earthy-colored. Intrudes Archean rocks. Is probably Cret. Occurs on divide above Neihart and on slopes drained by Snow and Mackey Creeks.

P. A. Schafer, 1935 (Mont. Bur. Mines and Geol. Mem. 13). *Snow Creek (Neihart) rhyolite or quartz porphyry* is the rock called *Neihart porphyry* by Weed. It is probably early Tert.

†Nelagoney sandstone.

Pennsylvanian: Central northern Oklahoma.

L. C. Snider, 1911 (Okla. Geol. Surv. Bull. 7, p. 221). *Nelagony ss.*, 40 ft. thick, underlies Elgin ss. in Pawhuska quad., and is separated from underlying Bigheart ss. by 85 ft. of sandy and clay shales. Included in upper part of Sapulpa group, in beds approx.=Buxton fm. of Kans.

Upper part only of unit for which name Nelagoney fm. was later adopted, and is approx.=Wynona ss. memb.

Named for Nelagoney, Osage Co.

Nelagoney formation.

Pennsylvanian: Central northern and northeastern Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 75). *Nelagoney fm.*—Named by D. W. Ohern, in unpublished ms. Consists of shales and sandy shales interstratified with sss. and with ls. lentil, 20 ft. thick, near middle. Thickness averages 500 to 600 ft. in Osage Co. Basal bed is Bigheart ss. memb. Underlies Elgin ss. and overlies Ochelata fm. Type loc., Nelagoney, Osage Co.

Nelchina limestone.

Lower Cretaceous: Central southern Alaska (Matanuska district, Cook Inlet region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 313–315, table opp. p. 474). *Nelchina ls.*—Massive dark-colored fine-grained unaltered ls. separated by thin laminae of gray sh.; some beds so highly siliceous they probably should be called calc ss. Thickness 100 to 300 or 400 ft. Occurs in several isolated areas, mostly small, on hilltops at headwaters of Nelchina River and of Billy Creek. Overlies, with apparent conformity, Lower Cret. tuff and cgl.; at some places is uncon. overlain by Tert. cgl. The Upper Cret. strata that crop out on Billy Creek were not observed in contact with the ls. Almost unfossiliferous, but assigned to Lower Cret.

Nellie gas sand.

A subsurface sand, of Penn. age, in Stephens Co., Okla., lying at a depth of 1,840 ft. in Nellie pool.

Nellie Bly formation.

Pennsylvanian: Northeastern, central northern, and central Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 74). *Nellie Bly fm.*—Named by D. W. Ohern in unpublished ms. Alternating shales and hard gray sss., the latter ranging in thickness from a few in. to several ft., from 15 ft. on Kans. line to 200 ft. in SE. Osage Co. Is middle fm. of Drum group. Rests on Hogshooter ls. and underlies Dewey ls. Named for Nellie Bly Creek, southern Washington Co. Enters Okla. in NW. Nowata Co., and extends SW. across Nowata, Washington, SE. Osage, and Creek Counties as far as northern Okfuskee, where it merges with Francis fm. [Later repts give thickness up to 400± ft.]

Drum group is no longer used to include these rocks.

Nellie Juan granite.

Mesozoic (?): Southeastern Alaska (Prince William Sound region).

U. S. Grant and D. F. Higgins, 1910 (U. S. G. S. Bull. 443, pp. 37, 46). *Nellie Juan granite*.—Typical biotite granite, chiefly light pink; the porphyritic facies is light gray. Occurs in W. part of Prince William Sound, on S. shore of Port Nellie Juan. Cuts Valdez group.

Nelson granodiorite.

Jurassic: British Columbia.

C. W. Drysdale, 1915 (Canada Geol. Surv. Mem. 56, p. 48).

Nelson limestone.

Ordovician: Manitoba.

A. F. Foerste and T. E. Savage, 1927 (Denison Univ. Bull. Sci. Lab. Jour., vol. 22, pp. 4, 8).

Nelson Hill facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons. Div. Geol. Pub. 98, pp. 77, 145, etc., 1931) to lithologic development of his Locust Point fm. in a part of southern Ind.

Nelson Mountain quartz latite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). The upper flow, 0 to 350 ft. thick, of Piedra group (in Potosi volcanic series) in Creede dist. Is a quartz latite of uniform character. Named for fact it is cap rock on Nelson Mtn, where it is less than 200 ft. thick. Younger than Rat Creek quartz latite.

Nelson River limestone.

Ordovician: Canada.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 342, 344).

Nemaha formation.
Nemaha member. (In Wabaunsee group.)
Nemaha subgroup.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 8, 14, 26). *Nemaha fm.*—A fm. of lss. and shales, 110 to 130 ft. thick, underlying McKissick Grove shales and overlying City Bluffs (Scranton) shales. Includes (descending) Tarkio ls., Preston ls., Fargo ls., Burlingame ls., and Rulo ls. members and the separating shales. Best developed in Big Nemaha Valley, with exposures btw. Tecumseh and Humboldt and btw. Union and Nebraska City, N. of Rulo, and at mouth of the Big Nemaha.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 62, 71). The *so-called Nemaha memb. or fm.* is reduced by excluding at base the Rulo ls. and overlying Silver Lake sh., which some geologists would assign to Scranton sh. The "Preston" ls. is the Emporia; the "Fargo" ls. is the Wakarusa, both of which have priority. Nemaha fm. is dropped provisionally, to be revived if it is decided by State and Federal Geol. Surveys that Wabaunsee beds represent 2 fms., and bdy of lower one is placed at Rulo ls. or at Silver Lake coal.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 4, 10). *Nemaha subgroup* is adopted to include Tarkio ls. fm. at top, down to base of Burlingame ls. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 215). In Nebr. Geol. Surv. Bull. 5, 1932, table C, p. 18, by G. E. Condra, R. C. Moore, and C. O. Dunbar, strata from base of Burlingame ls. to top of Tarkio are called "*Nemaha ls.*" Moore was not consulted on this usage and has never adopted it. [Nemaha is discarded by Kans. Surv., being preceded by dagger in this 1936 Bull.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Nemenjish series.

Pre-Cambrian: Quebec.

H. C. Cooke, 1919 (Jour. Geol., vol. 27, pp. 75, 188, 374).

Nemire sand.

A subsurface sand, of Penn. age, in northern Okla., lying lower than Red Fork sand and higher than Glenn sand.

Nemo series.

Pre-Cambrian: Southwestern South Dakota (northern Black Hills).

J. J. Runner, 1926 (Chicago Univ. Abstracts of Theses, Sci. ser., vol. 2, pp. 229–234). *Nemo series.*—Pink to gray qtzites, quartz and graywacke schists, and iron fms. occupying interior of oval-shaped area of about 5 sq. mi. extent to W. of village of Nemo [Lawrence Co.]. The iron fms. consist of beds containing alternating bands of crystalline quartz with specular hematite and magnetite, and grade into qtzite above, below, and laterally. Believed to be uncon. with overlying series of thick cgls. alternating with qtzite and quartz schist, siliceous ls. and sl., with iron fms. near base.

In 1934 (Am. Jour. Sci., 5th, vol. 28, p. 355) Runner called the rocks *Nemo system;* divided them into qtzites (above) and some iron fm. (below); and stated that they uncon. underlie Estes system.

Nenana gravel.

Tertiary (Eocene or later): Central Alaska (Nenana River region).

S. R. Capps, 1912 (U. S. G. S. Bull. 501, pp. 30–34). *Nenana gravel.*—Widespread series of elevated gravels which cover a large area in foothill belt of Bonnifield region. Named for exposures on Nenana River near mouths of Lignite and Healy Creeks. Greatest known thickness 1,760 ft., on lower Healy Creek. No determinable fossils. Underlain by Eo. coal-bearing series, probably uncon.; overlain by glacial deposits of probable Pleist. age. May be Mio.

Nenzel rhyolite breccia.

Triassic (Middle?): Northwestern Nevada (Rochester district).

A. Knopf, 1924 (U. S. G. S. Bull. 762). *Nenzel rhyolite breccia.*—Explosive outbursts of (descending): (1) Massive breccia, no trace of bedding, fragmental origin obvious, especially in basal part, 325 ft.; (2) stratified tuff and breccia, in bed 3 inches to 3 ft. thick, 25 ft.; (3) cgl. breccia or subangular cgl., 0 to 10 ft.; (4) well-stratified breccias carrying abundance of euhedral quartz crystals, 50 ft. Total thickness 30 to 600 ft. Lies 0 to 70± ft. below Weaver rhyolite. Forms summit of Nenzel Hill. Is of Triassic (Middle? Tr.) age.

Neocene.

A term that had considerable usage in early geol. repts to cover the Plio. and Mio. series, but is now used in repts of U. S. Geol. Survey in a quotational sense from early repts.

Neodesha sandstone.

Pennsylvanian: Southeastern Kansas.

Robt. Hay, 1887 (Kans. Acad. Sci. Trans., vol. 10, p. 7 and cross section). *Neodesha ss.*—Ss., 30 to 40 ft. thick, exposed at Neodesha. Separated from overlying Dun ls. by 80 to 100 ft. of sh.

There is no other record of this name. It appears to apply to the whole or part of Chanute sh.

Named for Neodesha, Wilson Co.

Neogene.

A term employed by European geologists to include the Miocene and Pliocene series of American geologists. (See also *Eogene* and *Paleogene.*)

Neosho shale member (of Garrison shale).

Permian: Eastern Kansas, southeastern Nebraska, and northern Oklahoma (?).

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 764–771, 799–800). *Neosho fm.*—Gray lss. alternating with varicolored shales. Thickness 130 ft. Underlies Strong flint [Wreford ls.] and overlies Cottonwood shales [Florena sh.].

Named for excellent outcrops in Neosho Valley, near Council Grove, Morris Co., Kans.

For the many units into which this sh. has been divided in recent years, see Kans.-Nebr. Perm. chart compiled by M. G. Wilmarth, 1936. The name appears to have recently been discarded by Kans. Geol. Survey.

Neosho limestone.

Pennsylvanian: Central eastern Kansas (Lyon County).

A. J. Smith, 1903 (Kans. Acad. Sci. Trans., vol. 18, p. 99). *Neosho ls.*—Ls., 30 to 40 ft. thick, in Lyon Co., characterized by rough weathering, many cavities filled with calcite crystals, a conglomeratic appearance, and clusters of *Fusulina cylindrica*. Separated from overlying Burlingame ls. by 54 ft. of sh. containing a thin ls. and some ss. Underlain by 40 ft. of sh.

Appears to be same as Topeka ls.

Named for Neosho Rapids, Lyon Co.

Neozoic.

A term employed by some European geologists to include Tertiary system of American geologists.

Nepigon group.

Same as Nipigon.

†Neponset conglomerate.

Carboniferous or Devonian: Eastern Massachusetts.

W. W. Dodge, 1882 (Boston Soc. Nat. Hist. Proc., vol. 21, pp. 210–213), applied *Neponset cgl.* to cgl. mapped as Roxbury cgl. by B. K. Emerson in U. S. G. S. Bull. 597, 1917.

†Nerinaea flags (also †Nerinea flags).

A paleontologic name applied by R. T. Hill (Biol. Soc. Wash. Proc., vol. 8, pp. 10–15, 1893) to lss. and marls locally forming top bed of Glen Rose ls. of Tex.

Nerola.

See *Neroly*.

Neroly formation. (In San Pablo group.)

Miocene (upper): Central western California (Mount Diablo region).

B. L. Clark and A. O. Woodford, 1927 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 17, p. 69). Uncon. on San Lorenzo deposits is San Pablo group, divided into two fms., the Cierbo and the *Nerola*. Uncon. on the San Pablo is a series of tuffs and sss.; the tuffs have generally been referred to Pinole tuff, the sss. to Orinda fm.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 764–767, 774, pls. 15, 20). *Neroly fm. or Astrodapsis tumidus zone.*—Ss. cgl., sh., 4,000 ft. thick W. and S. of Mount Diablo; 250 ft. thick N. of Mount Diablo. On S. side of Mount Diablo it uncon. underlies 1,000± ft. of sss. and cgls., mostly marine, correlated by writer with Jacalitos fm., and it overlies Cierbo fm. Is of upper Mio. age, and included in San Pablo group. [This is present approved definition of U. S. Geol. Survey.]

Neruokpuk schist.

Paleozoic or older: Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103–105, map). *Neruokpuk schist.*—Chiefly qtzite schist. Oldest exposed fm. Both upper and lower contacts believed to be fault contacts. Metamorphism so great that it is unquestionably pre-Carbf. Typically developed on 3 sides of Lake Peters, also near forks of Canning River. *Neruokpuk* is Eskimo name for Lakes Peters and Schrader.

Neslen coal-bearing member (of Price River formation).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

D. J. Fisher, 1936 (U. S. G. S. Bull. 852). Series of relatively light-colored alternating sss. and shales, in about equal proportions. A rather heterogeneous unit of brackish-and-fresh-water origin. Thickness 250 to 410 ft. Underlies Farrer non-coal-bearing memb. and overlies Sego. ss. memb. of Price River fm. Includes Chesterfield coal zone, Bluecastle ss. bed, Sulphur Canyon ss. bed, Thompsons Canyon ss. bed, and Ballard and Palisade coal zones. Named for Neslen Canyon, in which town of Sego is located.

Nespelem silt.

Pleistocene: Northeastern Washington (Colville Indian Reservation).

J. T. Pardee, 1918 (U. S. G. S. Bull. 677). *Nespelem silt.*—Largely very light-colored silt but includes small amount of gravel. Unconsolidated lake and stream deposits of glacial origin, deposited on terraces that line Columbia River Valley and the correlated flats that fill the mouths of tributaries at elevations btw. 1,700 and 1,800 ft., including the well-developed flat below Nespelem village. Max. thickness, equiv. to vertical distance btw. Columbia River and the Nespelem flat, is about 750 ft. Thickness gradually lessens upstream to 500 or 600 ft. near N. bdy of Colville Indian Res. Near mouth of Nespelem River this silt overlies glacial drift of earlier epoch, and along Columbia River above mouth of the Spokane it is deposited on the latest drift. With little doubt it is=White Silt fm. of Dawson in southern B. C.

Nester ground moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan.

W. A. Ver Wiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 164). Lies in SE. part of Nester Twp. (T. 21 N., R. 1 W.)

Neudeckian stage.

A term applied by W. Upham (Am. Geol., vol. 16, p. 104, 1895) to a stage of the Pleist. "Included in Champlain epoch."

Neva limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

J. W. Beede, Sept. 1902 (Kans. Univ. Sci. Bull., vol. 1, p. 180). *Neva ls.* proposed in unpublished mss. of C. S. Prosser and J. W. Beede. Consists of gray ls., 6 to 8 ft. thick, in two beds separated by sh. layer. Weathers rough, which caused Swallow to call it "drybone" ls. Underlies Eskridge shales and overlies Elmdale fm. [See also Prosser, Jour. Geol., vol. 10, p. 709, Oct.–Nov. 1902, and U. S. G. S. Cottonwood Falls folio, No. 109, p. 2, 1904.]

Some authors have treated the Neva as basal fm. of Perm. Later repts give thicknesses up to 28 ft., and state that the sh. separating the two lss. is 15 to 20 ft. thick. G. E. Condra and C. E. Busby (Nebr. Geol. Surv. Paper No. 1, p. 30, 1933) stated that different members or combinations of members of their Grenola fm. (defined in rept cited) have been correlated as the Neva at places in Nebr. and Kans. They restricted *Neva* to top bed (12½ ft.) of their Grenola fm., q.v. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), placed Perm.-Penn. bdy at top of his Brownville ls. fm., which threw Neva ls. and several underlying fms. into Perm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 50), showed *Neva ls.* of "old classification" is same as Grenola ls. of "revised classification," which he divided into (descending) Neva ls. [restricted], Salem Point sh., and Burr ls., and showed it as underlying Eskridge sh. and overlying Roca sh. (top bed of Elmdale sh. of "old classification"). He assigned it to Perm.

N. W. Bass (Kans. Geol. Surv. Bull. 23, in press). At type loc. of Neva ls. (near Neva Station, Cottonwood River Valley [Chase Co., Kans.]), it is a prominent ledge-forming rock 11 ft. thick; light gray with light-buff hue; weathers to pitted, sharply rough surface; many fossils. About 4½ ft. above main ledge in this vicinity is a light-gray ls. 1 ft. or less thick, separated from main ledge by calc. gray sh. To S. this upper thin ls. thickens, becomes massively bedded, crops out with a slightly pitted, sharply rough surface, and closely resembles the main ls. of type loc. Early Kans. repts restricted Neva ls. to main ledge-forming ls. of type loc., but rept on Cowley Co., by writer, placed in Neva ls. both these lss. and the intervening sh. In southern Kans. and northern Okla. these two lss. merge into one thick ls. The Neva as expanded by Moore and Condra included all beds btw. Roca sh. below and Eskridge sh. redefined above. Subsequent to preparation of this rept the expanded Neva was named *Grenola fm.* by Condra and Busby [1933 rept cited above], and they restricted Neva to the ls. originally named by Prosser.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

The U. S. Geol. Survey has not yet had occasion to consider, for its publications, these recent innovations in classification.

Nevada limestone.

Upper and Middle Devonian: Eastern Nevada (Eureka region).

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map 4, of NE. Nev.). "Nevada (Chemung to Upper Helderberg)." [Shown as upper part of Dev., and younger than Ogden qtzite.]

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 264–266). *Nevada ls.*—Lower horizons indistinctly bedded, saccharoidal texture, gray color, passing up into strata distinctly bedded, brown, reddish brown, and gray, frequently finely striped, producing a variegated appearance. Upper horizons are massive, well bedded, and bluish black, highly fossiliferous. The fm. is mainly ls., although intercalated beds of sh. and qtzite occur. Thickness 6,000 ft. Grades into underlying Lone Mountain ls. and is conformably overlain by White Pine sh. Named for great development in State of Nev.

C. W. Merriam, 1936 (Geol. Soc. Am. Proc. 1935, p. 92), restricted *Nevada fm.* to lower part of Nevada ls. of previous repts, which he divided into 5 paleontologic zones, the lowest of which he assigned to Oriskany (?) and the next younger one to Onondaga. The beds of Upper Dev. age he assigned to a new (unnamed) fm. This restriction of Nevada ls. has not been considered by U. S. Geol. Survey for its publications.

†Nevadan series.

A name applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 55, 80), to Nevada ls. (Dev.) of Nev., and to supposedly contemp. deposits in other States. *Nevadan* has also been applied to a series of late Jurassic intrusives in northern Calif. (Redding, Weaverville, and Red Bluff quads.). (See N. E. A. Hinds, Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, pl. 3, p. 104.)

Nevadian revolution.

A term applied by C. Schuchert and C. O. Dunbar (1933 Textbook geol., p. 64) to diastrophic movements in early Lower Cret. and late Jurassic time. Is called *Nevadan* by some geologists.

Newala limestone.

Lower Ordovician (Beekmantown): Northern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 95, etc.). *Newala ls.*—Much ls. and proportionately little dol. Most of ls. is thick-bedded, compact or noncrystalline or textureless, dark gray, pearl gray (which predominates), and bluish gray. Yields very little or no chert. Thickness 1,000 ft. in Cahaba Valley. Contains Beekmantown fossils. Underlies Odenville ls. and overlies Longview ls. (both of Beekmantown age). Named for Newala P. O. [Shelby Co.], which is located upon a broad belt of the fm. Best exposures are about ½ mi. NW. of Pelham.

New Albany shale.

Upper Devonian: Indiana and north-central Kentucky.

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., pp. 150, 152, 158, 172). *New Albany black sl.*—Geographic name applied to fm. which in previous Ind. repts has been called "Dev. black sl." and "Dev. black sh." Thickness 50 to 120 ft. Usually jet black, and occurs in thick beds, but after exposure exhibits thin laminated cleavage and becomes of pink, drab, or mottled color. Invariably capped by ferruginous ls. Rests on the blue crinoidal [Sellersburg] ls., which overlies the Hydraulic ls. [Jeffersonville ls.].

W. S. Blatchley and G. H. Ashley, 1898 (Ind. Dept. Geol. and Nat. Res. 22d Ann. Rept.), and G. H. Ashley, 1899 (Ind. Dept. Geol. and Nat. Res. 23d Ann. Rept., p. 74), defined *New Albany sh.* as overlain by Rockford ls. and underlain by 25 to 47 ft. of brown sh.; but in all other repts the brown sh. is included in New Albany sh., which is defined as overlying Sellersburg ls. and underlying Rockford ls. Exact relations to Ohio sh. and Chattanooga sh. undet.

The New Albany sh. has been classified by most authorities as Upper Dev., but Schuchert, Ulrich, and Bassler have considered it partly Dev. and partly Miss. J. W. Huddle has made special study of conodonts of New Albany sh. of Ind., and concludes (Bulls. Am. Pal., vol. 21, No. 72, Nov. 5, 1934) that its deposition in Ind. began in Genesee time and that upper 5 or 10 ft. afford only likelihood of Miss. age of any part of fm. Most of conodonts from this upper part are new sp., but aspect of entire fauna indicates all of fm. is Dev.

Named for exposures at New Albany, Floyd Co., Ind.

New Arcadian amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs near base of Central Mine group and is older than Arcadian amygdaloid. The mineralized part is the New Arcadian lode. Named for occurrence in New Arcadian mine, Houghton Co.

New Arcadian flow.

Includes New Arcadian amygdaloid and underlying trap.

Newark group.

Triassic (Upper): Connecticut to North Carolina.

W. C. Redfield, 1856 (Am. Jour. Sci., 2d, vol. 22, p. 357; Am. Ass. Adv. Sci. Proc., vol. 10, p. 181). I propose latter designation [*Newark group*] as a convenient name for these rocks [the red sss. extending from N. J. to Va.] and to those of Connecticut Valley, with which they are thoroughly identified by footprints and other fossils, and I would include also the contemp. sss. of Va. and N. C.

In Mass. the Newark group includes (descending) the following sed. fms. and interbedded flows: Chicopee sh., Granby tuff, Hampden diabase, Longmeadow ss., Holyoke diabase, Talcott diabase, Mount Toby cgl., and Sugarloaf arkose. In N. J. and SE. Pa. it includes (descending): Brunswick sh., Lockatong fm., Stockton fm., and Watchung basalt (a flow; the diabase dikes and intrusives not being a part of the Newark, but younger). In southern Pa. it is divided into Gettysburg sh. above and New Oxford fm. below. In Va. it has been divided into several units (see Va. chart I). In Deep River coal field, N. C., it includes (descending) the Sanford, Cumnock, and Pekin fms.

Named for development of rocks at and around Newark, N. J.

The fauna and flora of Newark group of Connecticut Valley are described in U. S. G. S. Bull. 597, 1917, pp. 105–132.

Newark granite.

Devonian: Northeastern Vermont (Caledonia County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Quarried in E. part of Newark Twp, in NE. part of Caledonia Co., according to pl. 18, 11th Rept. Vt. State Geol., 1918.

Newaukum series.

Pre-Tertiary (?): Southwestern Washington.

H. E. Culver, 1919 (Wash. Geol. Surv. Bull. 19, pp. 18–33). *Newaukum series.*—Oldest rocks in Thurston, Cowlitz, Gray Harbor, and Lewis Counties. Consists of (descending): (1) Breccia of red volcanic fragments in dense black matrix, absent in places; grades down into (2) graywacke, in places replaced by dense siliceous sh., nearly black sl., with, in places, interbedded ls. lenses; (3) dense resistant cgl. at base, with, in places, interbedded ls. lenses. Total thickness unknown; max. exposed not more than 100 ft. Underlies Puget series (Eocene) with possible uncon. Is probably pre-Tert. Typically exposed in channel of North Fork of Newaukum River, in sec. 19, T. 14 N., R. 1 E. Possibly correlates with Peshastin fm.

†New Bedford gneiss.

Early Paleozoic (pre-Devonian): Southeastern Massachusetts.

E. Hitchcock, 1833 (Rept. geol., min., bot., and zool. of Mass., pp. 389–390). *New Bedford gneiss.*—At New Bedford this gneiss is schistose, passes into mica sl., and contains a beautiful variety of porphyritic gneiss in boulders.

Included in Dedham granodiorite as mapped by B. K. Emerson in U. S. G. S. Bull. 597, 1917.

Newberger sand.

A subsurface sand in lower part (Hiawatha memb. of Nightingale) of Wasatch fm. of Vermilion Creek gas area, on Wyo.-Colo. State line in Sweetwater Co., SW. Wyo., and Moffat Co., NW. Colo. Lies lower than Wilson gas sand. (See W. T. Nightingale, A. A. P. G. Bull., June 1935.)

Newbern shale (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, 1936 [See under *Donegal ls.*]

Newberry sand.

Permian (?): Central southern Oklahoma (Garvin County).

A. R. Denison, 1923 (A. A. P. G. Bull., vol. 7, No. 6, pp. 627–644). *Newberry sands.*—Occur around edges of Robberson buried hills [SW. part of Garvin Co.], at depth varying from 1,375 to 1,877 ft. Named for the discovery well. Are of Perm. age, but older than Garvin and Mauldin beds.

R. Roth, 1927 (Okla. Geol. Surv. Bull. 40K). In old ravines and gullies of these buried hills, and also spread over the hills themselves at a depth varying from 1,375 to 1,877 ft., is a sand series called in Denison's rept the *Newberry sands*, after the discovery well, Newberry No. 1. These sands are undoubtedly an erosional residue and probably represent an overlap of the last of the Penn. seas in the area, prior to Perm. deposits, as they may be correlated with the Pontotoc cropping out to SE. There can be little doubt they represent a fm. older than Perm.

According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 179, these sands are of Penn. age.

Newberry.

Name applied to a Pleist. glacial lake in central N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, p. 614, 1932.)

New Brighton fire clay.

See under *Kittanning fire clay.*

Newburg limestone.

Pennsylvanian: Western Kentucky (Henderson County).

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pl. showing geol. section of Henderson Co.). *Upper Newburg ls.*—Hard gray rock with some lime, 4 ft. 1 in. thick, about 66 ft. below top of Upper Coal Measures; separated from *Lower Newburg ls.* (hard gray heavy rock 3½ ft. thick) by Little coal (4 ft. 5 in. thick at Newburg) and by 3 ft. 7 in. of sh. or fire clay.

Newburg sand.

A subsurface sand, 0 to 30 ft. thick, that occurs about 200 ft. above base of Niagara ls. in Cleveland region of northern Ohio. It has been most successfully prospected in SW. part of Cleveland, which is known as Newburg and Brooklyn. W. Stout et al. state (Geol. of nat. gas, A. A. P. G., 1935, p. 907) that it lies near contact btw. Salina fm. and underlying Niagara.

Newburgh limestone.

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept. of 1st dist., p. 257). The range of ls. described in 2d ann. rept under name of *Barnegat ls.*, and in 3d rept under the name *Newburgh ls.* occupies a small area in the dist. under examination this year. [The compiler has been unable to find *Newburgh ls.* in 3d rept. but on pp. 151–152 of that rept, in rept of W. Horton on geol. of Orange Co., is the following: "On the whole our blue ls. formation is abundant for useful purposes, and conveniently distributed. It is found at Newburgh." (He mentions several other places, also the "superior lime" that is burned from the *ls. at Newburgh.*) "There is little if any good ls. in the county, except at Newburgh, and as a consequence the *Newburgh lime* has comparatively excluded all other from use."]

W. W. Mather, 1843 (N. Y. Nat. Hist. Surv. vol. 1, pp. 367, 410, pls. 45, 46). *Newburgh ls.* is same as Barnegate ls.

Newbury volcanic complex.

Probably early Devonian: Northeastern Massachusetts (Essex County).

B. F. McDaniel, 1884 (Essex Inst. Bull., vol. 16, p. 165), in describing the geol. of Newbury, Mass., casually applied *Newbury felsite* to the rocks lying btw. the granite and the diorite of that area. In U. S. G. S. Bull. 597, 1917, B. K. Emerson named the felsitic fm. referred to the *Newbury volcanic complex*, and L. LaForge described it (pp. 161–164) as consisting of flows (of rhyolite, andesite, dacite, basalt, etc.), breccias, tuffs, and sh. and as occupying Newbury and Parker River basins in towns of Rowley and Newbury, Essex Co.

On basis of the few fossils obtained, E. O. Ulrich has classified the fm. as probably early Dev.

Newbury granite gneiss.

Cambrian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Camb. of eastern Vt., but without definition. Probably named for village or twp in Woodsville quad., E. part of Orange Co.

Newburyport quartz diorite.

Early Paleozoic (pre-Devonian): Northeastern Massachusetts (Essex County and Boston Basin) and southeastern New Hampshire.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 177–178 and map). *Newburyport quartz diorite.*—A medium-grained, somewhat gneissic rock, consisting essentially of andesine-labradorite, orthoclase, quartz, and hornblende, with accessory biotite, augite, ilmenite, magnetite, apatite, rutile, and titanite. Named for occurrence at Newburyport, Essex Co., Mass. Assigned to Dev. (?).

L. LaForge, 1932 (U. S. G. S. Bull. 839), changed age to *early Paleozoic*. He regards it as "certainly pre-Dev."

Newcastle formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canadian Min. Inst. Trans., vol. 15, p. 338). Included in Nanaimo series.

Newcastle sandstone member (of Graneros shale).

Upper Cretaceous: Northeastern Wyoming.

E. T. Hancock, 1920 (U. S. G. S. Bull. 716, pp. 39, 42, 96). *Newcastle ss. memb. of Graneros sh.*—Reddish to light-yellow ss. associated with black carbonaceous sh. In Lance Creek field, Wyo., it is divisible into upper ss., 20 ft.; middle sh., 15 ft.; lower ss., 15± ft. In Mule Creek field, Wyo., the Newcastle memb. is 3 to 15 ft. thick. In both fields it is separated from underlying Dakota ss. by 175 ft. of dark-gray to black sh., and from overlying Mowry sh. memb. of Graneros by 25 ft. of dark sandy sh. [Nefsy sh. memb. of Collier's 1922 rept. but now included in Mowry sh. and Nefsy discarded]. Named because it is conspicuously developed at Newcastle, Wyo.

E. F. Schramm and H. J. Cook, 1921 (Kanoka Pet. Co., Geol. Dept., Bull. A, pp. 12, 14). In Agate, Nebr., anticline [Sioux Co., NW. Nebr.] *Newcastle ss. memb. of Graneros sh.* is 3 to 50 ft. thick.

Newcastle Creek formation.

Pennsylvanian: New Brunswick.

W. S. Dyer, 1926 (Canada Geol. Surv. Mem. 151, p. 8).

New Chapel chert bed. (In Silver Creek limestone.)

Middle Devonian (Hamilton): Southeastern Indiana (Clark County).

G. I. Whitlatch and J. W. Huddle, 1932 (Ind. Acad. Sci. Proc., vol. 41, pp. 363–371). *New Chapel chert bed.*—A bed in uppermost part of Silver Creek ls. in Clark Co., which normally contains abundance of chert, often in distinct horizontal bands, embedded in a matrix of drab fine-grained ls. lithologically similar to Silver Creek ls. Is characterized in basal part by distinctly bedded character and extreme abundance of chert as compared with that found in lower part of Silver Creek fm. In literature has been called "bastard rock" and "cement rock." Since this chert bed is a fairly persistent and distinct lithologic unit, and since earlier writers have seen fit to discriminate btw. the chert bed and the "cement rock," it is proposed that the bed be called *New Chapel chert bed of Silver Creek ls.*, from a small country church in SW¼SE¼ sec. 37, Clark Grant, Clark Co. Well exposed near top of hill in a road cut a few yds E. of church. Better exposed at Watson and Charleston, where overlying and underlying fms. are present. Thickness a few ft. to 14 ft.; absent in few places only. In a few places an inch or so of sh. separates the cement rock from New Chapel chert bed.

New Corydon limestone.

Silurian (Niagaran): Northeastern Indiana.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Dept. Cons., Div. Geol. Pub. 75, pp. 53, 54, 113–117). *New Corydon ls.*—A series of irregularly bedded brown cherty layers of impure ls. with intercalated carbonaceous partings. Has conspicuous blocky nodular appearance on weathered surfaces. Thickness few ft. to possibly 20 ft. Fossils listed. Fauna, with its Lockport affinities, may indicate brief return of Lockport fauna at close of Niagaran, or the New Corydon may represent closing phase of Guelph deposition, in which practically all typical Guelph forms had disappeared. Conformably overlies Huntington fm. Is probably overlain by Kokomo ls. or its eastern equivalent. We know of no fm. like the New Corydon in Ohio, and so far as we have observed it is not present in western Ind. Is exposed at but 3 localities—in vicinity of New Corydon [Jay Co.]; at and near Linn Grove; and 2½ to 3 mi. E. of Huntington, along Little River. In vicinity of New Corydon the fm. crops out in old bed of the Wabash, just N. of Jay City, and in the Karsch and the Smith & Baker quarries. Is 15 ft. thick in Karsch quarry.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 159). *New Corydon fm.* is not exposed S. of NE. corner of Jay Co.

Newett limestone member (of Weber? formation).

Pennsylvanian: Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 973–1009). *Newett ls. memb. of Weber (?) fm.*—Resistant lss., light gray to dark gray, in layers less than 1 in. to 2 ft. thick; dense; with conchoidal fracture. Thickness 20 ft. Lies 330± ft. above Leadville ls. (upon which it rests uncon.) and about 1,375 ft. below top of Weber (?) fm. in Salt Creek area, Park and Chaffee Counties. Named for abandoned town of Newett, in sec. 3, T. 14 S., R. 77 W., near which it is exposed.

Newfoundland coal formation.

Age (?): Newfoundland.

J. B. Jukes, 1839 (Rept. on geol. of Newfoundland, p. 4).

†Newfoundland quartzite.

†Newfoundland grit.

Middle Devonian (Onondaga): Southeastern New York and northern New Jersey.

E. C. Eckel, 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1, p. r148). *Newfoundland qtzite.*—Usually a light-colored qtzite but locally conglomeratic. At some localities carries fossils which correlate it with basal Dev. Oriskany qtzite. The fm. name here proposed is in allusion to the exposure of the qtzite at Newfoundland, N. J., where its lithologic and paleontologic characters are well shown and were described by Britton and Merrill in 1886 (N. J. State Geol. Rept.). Is exposed at several other points along margin of the Dev. outlier in both N. Y. and N. J. Underlies Monroe shales.

H. B. Kümmel and S. Weller, 1902 (N. J. Geol. Surv. Ann. Rept. State Geol. 1901, p. 18). *Newfoundland grit* consists of 115 ft. of rather thin-bedded hard greenish ss. underlain by 100 ft. of heavy-bedded fine-grained cgl. Contains a mixed Oriskany-Corniferous fauna. Grades into overlying Monroe shales. Overlies Decker Ferry ls., but nowhere seen in contact with that fm., so that intervening Helderbergian strata may be present. Ledges of this grit have been found at Newfoundland [Morris Co., N. J.].

This name was replaced by Kanouse ss. in 1908. The Kanouse is of Onondaga age.

Newfoundland series.

Cambrian: Newfoundland.

B. F. Howell, 1926 (Canadian Field Nat., vol. 40, pp. 53, 55).

New Galilee clay shale. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania (New Castle quadrangle).

F. W. DeWolf, 1929 (Topog. and Geol. Atlas Pa., No. 5, New Castle quad., pl. 6, pp. 30, 31, etc.). *New Galilee clay sh.*—Lies 10 to 20 ft. below Brush Creek coal and 70 to 90 ft. above base of Conemaugh group. Has characteristic rusty color of orange brown or ocher, but its hardness and flinty fracture are even more striking. Yellowish gray when fresh; weathers much deeper shade of yellow brown. Is a flint fire clay of possible value. Thickness 5 to 20± ft. Named for its occurrence 1 mi. E. of New Galilee, where it has been prospected on land of W. H. Anderson.

†New Germantown trap.

Name applied by N. H. Darton (Am. Jour. Sci., 3d, vol. 38, pp. 134–139, 1889) to the sheet of Watchung basalt, about 400 ft. thick, W. of New Germantown, Hunterdon Co., N. J. Interbedded in upper half of Brunswick sh. of Newark group (Upper Triassic).

New Glasgow conglomerate.

Carboniferous: Nova Scotia.

H. Fletcher and E. R. Faribault, 1887 (Canada Geol. Surv., n. s., vol. 2, pp. 93P to 94P).

New Hampshire magma series.

Late Devonian or late Carboniferous: Northwestern New Hampshire.

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55-56). [See under *Highland Croft magma series.*]

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 9, 19, map). *New Hampshire magma series* is proposed for a group of intrusive igneous rocks which either accompanied the great period of folding in western N. H. or were intruded shortly thereafter but are separated from overlying Moat volcanics by pronounced uncon. Is characterized by muscovite in many members, a distinct foliation in some, and an abundance of pegmatites. Bethlehem granodiorite gneiss and Kinsman quartz monzonite are typical representatives. Also includes Scrag granite, intrusive breccia ("Franconia breccia" of Hitchcock), Bickford granite, and Priest Hill granite. Is definitely post-lower Dev. and may be either late Dev. or late Carbf., probably the former.

M. Billings, 1935 (letter dated July 19). If there must be a type loc. for *New Hampshire magma series* it is the Littleton and Moosilauke quads.

See also M. Billings, Geology of Littleton and Moosilauke quads., N. H., 1935.

New Haven limestone member (of McLeansboro formation).

Pennsylvanian: Southeastern Illinois.

A. H. Worthen, 1875 (Ill. Geol. Surv., vol. 6, p. 67). *New Haven ls.*—Hard, brittle ls., 3 to 4 ft. thick, weathering rusty brown, in lower part of upper Coal Measures of White and Hamilton Counties, Ill. Lies probably 100 to 150 ft. above coal No. 7.

G. H. Cady, 1916 (Ill. Coal Min. Invest. Cooperative Agreement Bull. 15). *New Haven ls.*, in McLeansboro fm. of SE. Ill. is 10 to 25 ft. thick. Appears to be a solid bed. Lies higher than coal No. 11 and 200 to 250 ft. above Carlinville ls., and considerably higher than Shoal Creek ls., which lies in interval btw. coals Nos. 9 and 10.

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129-138). *New Haven ls.* is same as Shoal Creek ls.

Probably named for New Haven, Gallatin Co.

See also 1935 entry under *St. Wendell ss.*

New Haven clay.

Name applied by R. F. Flint (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 965-987, 1933) to a late Pleist. clay at and N. of New Haven, Conn.

Newington moraine.

Pleistocene (Wisconsin): Southwestern Maine, southeastern New Hampshire, and northeastern Massachusetts.

F. J. Katz and A. Keith, 1917 (U. S. G. S. P. P. 108, pp. 11-29). *Newington moraine.*—A recessional moraine consisting of several separate segments disposed along a sinuous course near Atlantic coast, and traced for 60 mi.—from Saco, Maine, to Newbury, Mass. Of Wisconsin (probably late Wisconsin) age. Deposited in the sea. Youngest strictly glacial deposit in immediate vicinity of coast of N. H. and SW. Maine. Named for development in Newington, Rockingham Co., N. H. Is contemp. with, in part older, and probably in part younger than the Pleist. marine clays (the so-called "Leda clay") of region.

Newkirk limestone.

Permian: Central northern Oklahoma (Kay County).

L. L. Hutchison, 1911 (Okla. Geol. Surv. Bull. 2, pp. 205-206). The surface ls. at Newkirk, Kay Co., is locally known as *Newkirk ls.*

C. N. Gould, 1930 (letter dated Oct. 30). The surface fm. at Newkirk is the Herington ls.; at least the Herington outcrops very close to the town.

Newkirk sand.

A subsurface sand, of Penn. age and 10 to 40 ft. thick, in central northern Okla., reported to correlate with a part of Pawhuska fm. and to lie 200-250± ft. higher than Hoover sand series.

Newland limestone.

Pre-Cambrian (Belt series): Central southern (Little Belt Mountains) and western central Montana (Helena-Big Belt Mountains region).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Newland ls.*—Hard lss., dark bluish gray on fresh fracture, and buff to straw color on weathering. Thickness 2,000 ft. Underlies Greyson shales and overlies Chamberlain shales. Type loc. on Newland Creek, 10 mi. N. of White Sulphur Springs, Meagher Co., btw. Big Belt and Little Belt Mtns.

New Lisbon member.

Upper Devonian: Central New York (Butternut Valley).

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 809). *New Lisbon memb.* is proposed by writers for the *Leiorhynchus* beds of Tully fm. in Butternut Valley, extending from top of Hamilton up to first appearance of *Hypothyridina*. Well exposed along first S. tributary to Stony Creek, 1½ mi. E. of New Lisbon, where it consists of 60 ft. of shaly blue-gray thin-bedded fossiliferous ss. and is overlain by Laurens memb. of the Tully, which is 35 ft. thick and contains *Hypothyridina* at 3 known levels.

Newlon limestone and shale. (In Kanawha formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1918 (W. Va. Geol. Surv. Rept. Barbour and Upshur Counties, p. 281). *Newlon ls. and sh.*—Dark sandy sh. with numerous concretions and large siliceous ls. "turtlebacks." Thickness 0 to 25 ft. Underlies Eagle ss. and overlies Eagle coal. Just E. of Newlon, Upshur Co., in cut along Chemical & Helvetia R. R., it is a ls., but near village of Czar it is black sh. 5 ft. thick.

New London granite gneiss.

Late Carboniferous or post-Carboniferous (?): Southeastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 149, 152, and map). *New London granite gneiss.*—Distinctly granitic. Light-gray, rather fine-grained rock of uniform texture, composed largely of feldspar and quartz with subordinate brilliant black biotite and occasional hornblende crystals. Has been marked off from Mamacoke gneiss by rather arbitrary bdy. Is intruded by Westerly granite. Typical exposures in and about New London.

Newman limestone.

Mississippian: Southwestern Virginia and eastern Kentucky and Tennessee.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 38). *Newman ls.*—Interbedded lss. and calc. sh., with a few thin sss., covering entire Appalachian Basin except in Pa. and Ohio; 930 ft. thick in Bigstone Gap coal field of Va. and Ky., where it forms lower fm. of Miss. series. Overlies Grainger sh. and underlies Pennington sh. (Miss.).

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, pp. 125, 161, 168, 178). *Newman ls.* includes Glen Dean ls. at top and St. Louis ls. at base, but St. Louis ls. is absent at Newman type loc.—Newman Ridge, Hancock Co., Tenn.

The Warsaw ls. is now believed to be included at base of Newman ls.

†Newman sandstone lentil. (In Newman limestone.)

Mississippian: Northeastern Tennessee (Wartburg and Standingstone quadrangles).

A. Keith, 1897 (U. S. G. S. Wartburg folio, No. 40). *Newman ss. lentil.*—Grayish-white ss., 10 to 30 ft. thick, lying in midst of Newman ls.

The U. S. Geol. Survey does not apply the same name to a fm. and to a memb. of that fm. Therefore this name is no longer in use. The ss. is correlated by C. Butts with Cypress ss. of Ky. (See Ky. Geol. Surv., Mississippian series in western Ky., 1917, p. 90.)

New Mass amygdaloid.

Pre-Cambrian (Keweenawan) : Northern Michigan.

W. H. Weed, 1925 (The Mines Hdb., pp. 1008, 1049, as reported by Mass Consolidated Mining Co.). Lies about 120 ft. below Evergreen amygdaloid. Occurs on property of Mass Consolidated Mining Co., in Ontonagon Co. The mineralized part is the New Mass lode.

Belongs to Central Mine group.

New Mass flow.

Includes New Mass amygdaloid and underlying trap.

New Mayflower amygdaloid.

Pre-Cambrian (Keweenawan) : Northern Michigan.

Local name for an amygdaloid which is older than Old Mayflower (=Mayflower) amygdaloid, and which is probably slightly younger than New Arcadian amygdaloid. Belongs in Central Mine group.

New Milford group. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 68–70). *New Milford group.*—Consists of (descending): (1) *New Milford upper ss.*, 40 ft. (massive, grayish, current-bedded); (2) *New Milford middle sand and shales*, 300 ft. (greenish-gray current-bedded sss. 20 to 25 ft. thick, regularly alternating with shales, some red, 30 to 50 ft. thick); (3) *New Milford lower ss.*, 20 to 25 ft. (current-bedded); (4) *New Milford red sh.*, 100 to 120 ft. (deep red; occasional sandy layers covered by calc. breccia; along Starrucca Creek is almost wholly olive and greenish shales). The group is finely displayed in New Milford part of Susquehanna Co.; the basal red sh. is concealed at New Milford, but appears just S. of village. Overlain by Paupack shales and underlain by Starrucca gray and olive shales. All included in Catskill fm.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, p. 73). *New Milford group* along Delaware River from Narrowsburg to Shawangunk Mtn, N. Y., consists of (descending) 20 ft. of red shales; 40 ft. of green ss.; and 15 ft. of red sh. Underlies Delaware flags, 1,000 ft. thick, and rests on 600 ft. of greenish-gray ss. forming basal part of Catskill fm. [On pp. 94 and 99–101 of above rept he stated that New Milford and Paupack sss. of Rept G_5 cannot be followed in Pike and Monroe Counties, but are represented in the very thick Delaware River flags, which rest on New Milford red sh. and are overlain by Montrose red sh. See quotation under *Delaware River flags*.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1205–1206). *Delaware River flags* (late Portage) are older (instead of younger) than New Milford red sh. in Monroe Co. At type loc. New Milford is upper Chemung. [Red sh. underlying Delaware River flags is here renamed *Analomink red sh.*]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571+). *New Milford fm.* included in Chemung group, but uppermost beds are post-Chemung, probably Canadaway. To E. they are continental and assigned to Catskill facies group. To W. they carry Luthers Mills coquinite near top. Remainder of New Milford is probably of Wellsburg age and partly continental and partly marine. Includes Lanesville memb. and underlying Kingsley red sh. Overlies Cayuta fm. and underlies Damascus red beds. In Susquehanna Co. the Cayuta includes at top the Starrucca sh. of I. C. White. The Paupack (upper) ss. memb. of Shohola fm. is=part or all of the New Milford. [On p. 589 he states the New Milford to E. becomes upper part of Shohola.] I. C. White mistook the much older Analomink red sh. for his New Milford, and hence placed New Milford beneath Delaware River flags, instead of above them. White considered the New Milford chiefly fresh-water, but D. S. Harding has found marine invertebrates at intervals in lower two-thirds at least, if not higher. Writer believes the fm. in type region consists of alternating continental and marine beds distinguishable only by fossils. The continental beds dominate at top in type region, but to W. pass over to marine facies.

New Milford sandstone.
New Milford shale.
See under *New Milford group*.

New Oxford formation. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania and western Maryland.

A. I. Jonas, 1928 (Md. Geol. Surv. Carroll Co. geol. map). *New Oxford fm.*—Arkosic ss. with quartz cgl. at base. Underlies Gettysburg red sh. (Triassic) and uncon. overlies Conestoga blue slaty ls. Assigned to Triassic.

G. W. Stose, 1929 (U. S. G. S. Fairfield-Gettysburg folio, No. 225). Red sh. and ss. containing many beds of light-colored micaceous ss., arkose, and cgl. Is distinguished from overlying Gettysburg sh. by these light-colored ss. and cgl. beds. In lower 3,000 ft. cgls. and arkosic beds are more common. Upper 4,000 ft. composed largely of soft red sh. and ss. with scattered light-colored ss. In 500 ft. near middle, gray to white micaceous ss. beds are thicker and more numerous than in rest of fm. Upper limit of fm. is drawn where the light-gray micaceous harder sss. cease to be prominent and softer beds predominate. Is basal fm. of Newark group in this region. The overlying Gettysburg sh. is upper fm. of Newark group. Occurs W. of Susquehanna River. Occupies same general strat. position as Stockton fm. E. of Susquehanna River, and has somewhat the same lithologic character.

Named for exposures at New Oxford, Adams Co., Pa.

New Paris moraine.

Pleistocene (Wisconsin stage): Northeastern Indiana. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for New Paris, Elkhart Co.

†Newport conglomerate.

Carboniferous: Southern Rhode Island.

E. Hitchcock, 1861 (Am. Jour. Sci., 2d, vol. 31, p. 377). The *Newport cgl.* is probably only a special variety of the extensive deposit of highly siliceous puddingstone found so abundantly btw. Boston and Rhode Island. Both have same geol. position, we believe, and were *Roxbury cgl.* to be brought into a plastic state, and the pebbles elongated and flattened by pressure, we think result would resemble Newport cgl.

W. B. Rogers, 1877 (Boston Soc. Nat. Hist. Proc., vol. 18, p. 100). The mass known as *Newport cgl.* has its typical loc. in Purgatory Rocks.

Replaced by Purgatory cgl., the better-defined and better-established name.

Newport shales and sandstones.

Upper Devonian: Central southern Pennsylvania (Perry County).

F. Platt, 1881 (2d Pa. Geol. Surv. Rept. T, p. 28), gives following subdivisions in Perry Co. (downward): Chemung olive shales on Juniata River, 4,384 ft.; *Newport (Portage?) sandy shales and sss.*, 835 ft.; Genesee sh.; * * *.

Newport limestone.

Upper Devonian: Central Pennsylvania (Perry County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, p. 1594). *Newport ls.* is at base of the Catskill or top of the Chemung in Perry Co. Is local deposit, 3 to 5 ft. thick; best exposed opposite the furnace at Newport and 1 mi. E., on bank of the Juniata, as a lenticular mass of fossil shell casts and siliceous matter; is blue and hard. Seen only in Howe and Oliver Twps, Perry Co.

Newport granite.

Devonian: Northeastern Vermont (Orleans County).

C. H. Richardson, 1908 (6th Rept. Vt. State Geol.). *Newport granite*, Dev., intrudes Waits River ls.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this granite to Dev. [Newport is in Memphremagog quad.]

Newport formation.

Pleistocene: Northwestern Oregon (Lincoln County).

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, p. 269). *Newport fm.*—Unconsolidated sands and gravels typically exposed at Newport. Of Pleist. age. Younger than Pleist. marine terraces, and=San Pedro of Calif.

Newport Neck shale.

Pre-Cambrian: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 316–318, 383). *Newport Neck shales.*—Shales with thin dol. layers occurring along W. shore of Newport Neck. May be Camb.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped the rocks of area described as Marlboro fm.

New Providence shale. (In Osage group.)

Mississippian: Southern Indiana and northern and eastern Kentucky.

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., p. 161). *New Providence sh.*—Fine greenish marly sh., 80 to 120 ft. thick. Basal fm. of Knobstone group. Near New Albany is capped by thin bed of ferruginous ss. In NW. part of Clark Co. is capped by thin bed of crinoidal ls., which is overlain by what I recognize as true Knob sh., 120 to 160 ft. thick. New Providence sh. rests on a thin bed of ferruginous ls. containing crinoid stems [Rockford ls.].

E. M. Kindle, 1899 (Bull. Am. Pal., vol. 3, No. 12). *New Providence sh.* of southern Ind. consists of 125 ft. of blue clay sh., overlain by Riverside ss. and underlain by Rockford ls.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, p. 137). *New Providence sh.*—Soft green clay sh., 150 to 160 ft. thick in Jefferson Co., Ky., where it underlies Kenwood ss. and uncon. overlies New Albany sh. Basal fm. of Osage group. Contains Burlington and Fern Glen fossils.

E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4, Sep. Pub. 21, p. 489). *New Providence sh.*, 120 to 150 ft. thick, underlies Kenwood ss. for a short distance in southern Ind., and in places overlies Rockford ls., thin and local. Until recently the name has been used for lower and middle shaly part of Borden group, but Butts limits name to lower 120 to 160 ft. of green sh. below the lower sss., which is evidently what Borden had in mind when he proposed the name.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, pp. 29+). In *eastern Ky.* the *New Providence* becomes a *group*, more than 600 ft. thick, overlain in places by Rosewood sh. and in places by Fort Payne chert, and underlain in places by Sunbury sh. and in other places by Ohio sh.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 85, 93–94). New Providence sh. was named for village of New Providence, Clark Co., Ind., which has since been renamed Borden. The village is situated higher than top of New Providence fm., and lies upon and is surrounded by younger fms. Rocks that can be doubtfully ascribed to top part of the New Providence barely crop out in creek beds immediately S. and SE. of the village, although good "typical" exposures are not seen nearer than about 4 mi. E. of the town, in vicinity of Broomhill and Carwood. Observers have therefore been misled into thinking of the next overlying sandy sh. (here named *Locust Point fm.*) exposed in the bluffs about town of Borden as the fm. intended by Borden as New Providence fm. There are objections to the name, but it is firmly entrenched in the literature and is therefore used in this rept. Most of the fm. is argill. sh. bordering on claystone. It is here treated as basal fm. of Borden group. [On pp. 93–94 he proposes to include Kenwood ss. in the New Providence and names overlying beds Locust Point fm. He says:] Uppermost limit of New Providence fm. is nicely marked in east-central and south Floyd Co., Ind., and in Jefferson Co., Ky., because of presence of abrupt ss. layers (Kenwood ss. of Butts); but northward as far as Brown and Bartholomew Counties the upper limit is conjectural in most places as a consequence of a remarkably gradual transition into overlying rocks. To limit the fm. to "a thickness from 80 to 120 ft." (Borden, 1874, p. 161) above the Rockford is not sound nor justified because no significant strat. differences are observed at those horizons. Borden may have been in error in his calculations because of failing to take into consideration the W. dip of the strata. Interval btw. base of the New Providence and top of zone with ss. layers is 190 ft. in Kenwood-New Albany region, according to Butts; 10 mi. to N., in Floyd Co., it averages 200± ft., but the zone of ss. layers does not here extend as low in typical New Providence nor contain as many ss. beds. To N. of T. 2 S. the ss. beds disappear. Writer wishes to assign top of this zone—within which the sh. is highly argill. and shows traits common to the sh. below, and above which the sh. becomes gradually more sandy and begins to lose the characteristics of the rock beneath—as upper limit of New Providence fm. in this southern region, and to describe the New Providence fm. of this region as *Silver Hills facies*. In accordance with this interpretation the ss. layers of S. and east-central Floyd Co. and "Kenwood ss." of Butts in Jefferson Co., Ky., are part of New Providence fm. There seems lack of justification for assigning "Kenwood ss." the rank of a fm., but one may be justified in considering it as a local memb. of New Providence fm. In this rept the ss. layers will be referred to as the *Kenwood beds of New Providence fm.* [See also under *Kenwood ss.* Fossils listed on pp. 106–108.]

Named for New Providence, Clark Co., Ind., now known as Borden.

†New Red sandstone.

A name used in early repts to include, in some areas, Triassic system and part of Permian series of Carboniferous system. In Atlantic States it was applied to Newark group (Upper Triassic).

New Richmond sandstone.

Lower Ordovician (Beekmantown): Central western Wisconsin, southeastern Minnesota, and Iowa.

L. C. Wooster, 1878 (Wis. Geol. Surv. Ann. Rept. 1877, btw. pp. 36 and 41). In vicinity of New Richmond [St. Croix Co., Wis.] there appear to be bodies of ss. in upper part of Lower Mag., which may possibly represent horizon of Jordan ss. of Minn. These are penetrated by 3 wells in neighborhood. The wells in this part of St. Croix Co. quite uniformly penetrate the ls. 15 to 20 ft. for water, striking it at horizon of *New Richmond ss.* [Name used only once.]

L. C. Wooster, 1882 (Geol. Wis., vol. 4, pp. 106, 123–129, in a rept on the lower St. Croix dist.). The name Lower Mag. ls. covers a series of layers more uniformly dolomitic than the same strata on the east, there being no layers of any thickness to which the term ss. may be applied with the exception of one horizon. It is possible that the upper layers in NW. Wis. are not represented by ls. at the E., having been laid down after the deposition of St. Peters ss. commenced in those regions. In this rept these layers of ls. will be termed *Willow River beds* and the ss. btw. these layers and the Lower Mag. proper [Oneota dol.], the *New Richmond beds*, from the localities in which these strata are best exposed and most fully developed. [Page 106.] About 100 ft. from the base and about 80 ft. from the top of the Lower Mag. ls., in several localities, a varying amount of white quartzose sand is found that probably represents the horizon of Jordan ss. of Minn. [For many years known to be a miscorrelation. (Pages 124, 125.) Fig. 4, on p. 126, shows the ss. exposed at base of bluff of Willow River at Jewett's Mills, Wis.] Sandstone was penetrated at this same horizon in 3 wells in sec. 23, T. 30, R. 18 W. The presence of thin layers of ss. at the same horizon in other portions of the dist., and the character and thickness of the ls. above and below, indicate that in this ss. we have the eastern equiv. of the Jordan ss. of Minn. [Miscorrelation.] Along Kinnickinnick River the entire Lower Mag. ls. is shown, but presents no new features except a layer of white sand about 100 ft. above the Potsdam ss.

Wooster's name *New Richmond ss.* was introduced into Minn. repts as early as 1886, into Iowa repts as early as 1895, and into Ill. repts in 1910, for a sandy unit in the middle of Prairie du Chien group (†Lower Mag. ls. of early repts on upper Miss. Valley). This sandy unit has been recognized by many geologists in at least 20 repts on Wis. geology, 30 or more repts on Minn. geology, 30 or more repts on Iowa geology, and 18 or more repts on the unexposed rocks of northern Ill. In these published repts its thickness has been given as 1 to 40 ft. in Wis., 5 to 40 ft. in Minn., 10 to 170 ft. in Iowa, and 0 to 188 ft. in northern Ill. It has been identified in at least 22 counties in Iowa, 16 counties in SE. Minn., several counties in southern Wis., and 10 counties in northern Ill. Notwithstanding the identification by many geologists of these sandy beds as a distinct unit, some geologists have questioned the validity of the unit, as indicated in some of the citations that follow:

C. W. Hall and F. W. Sardeson, 1895 (Geol. Soc. Am. Bull., vol. 6, pp. 167–198). *New Richmond (Elevator B) ss.* consists of 20 ft. of pure-white quartz sand. It seems stratigraphically to belong to the Oneota. It may prove to be an area cap to the Oneota when further localities have been explored or fossils have been discovered.

C. W. Hall, 1905 (U. S. G. S. W. S. P. 114, pp. 226–228). The layer of ss. called *New Richmond ss.* appears to be basal cgl. of Canadian series of upper Miss. Valley.

U. S. Grant, 1906 (Wis. Geol. and Nat. Hist. Surv. Bull. 14, Econ. ser., No. 9). In Grant, Iowa, and Lafayette Counties, Wis., the Lower Mag. ls. contains a thinner middle div. known as *New Richmond ss.*, which is lacking or apparently lacking at many points.

S. Calvin, 1906 (Jour. Geol., vol. 14, pp. 571–574). *New Richmond ss.* when present divides the Lower Mag. of Owen into 3 units. It lies in thin beds, the surface of the beds being often ripple-marked. It differs from St. Peter ss.

H. F. Bain, 1907 (Wis. Geol. and Nat. Hist. Surv. Bull. 19, pp. 16–35). *New Richmond ss.* is not always well developed in outcrop, but is clearly defined in well records far to S. and W. of the outcrop, though not well exposed in lead and zinc dist. proper. Seems to be absent in places.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 640–641). *New Richmond ss.* is included in Shakopee dol. because it is thought to indicate an introductory clastic phase of the Shakopee rather than a distinct fm.

A. C. Trowbridge, 1914 (Iowa Acad. Sci. Proc., vol. 21, pp. 205–209). *New Richmond memb.* of Prairie du Chien fm. seems to be developed only locally, and it now appears unfortunate that the Minn. classification of that fm. has been followed in Iowa.

A. C. Trowbridge, 1917 (Iowa Acad. Sci. Proc., vol. 24, pp. 177+). The uncon. btw. St. Peter ss. and Prairie du Chien fm. explains discontinuity of *New Richmond memb.* of Prairie du Chien fm., which is missing where the Prairie du Chien is thin and present where it is thick.

F. W. Sardeson, 1924 (Pan-Am. Geol., vol. 41, pp. 113, 115). At Shakopee 50 ft. of Shakopee ls. is exposed, but wells there give 96 ft. It is there mainly ls., with eroded top, and base concealed below Minn. River water level. It contains ss. beds in lower part and overlies Oneota dol. There is no distinct unit of ss. btw. Shakopee and Oneota lss. in Minn. or elsewhere, but there are lenses and strata of ss. in top part of Oneota ls. and others in lower part of Shakopee ls., as at town of Shakopee. These sandy strata, when weathered out in SE. Minn., appear to be what gave Prof. N. H. Winchell the grounds for calling them the "Jordan" by error.

F. W. Sardeson, 1926 (Pan-Am. Geol., vol. 45, btw. pp. 29–48). Shakopee fm. includes Willow River beds (the upper ls. layers) and *New Richmond beds* (a ss. btw. Willow River beds and "Lower Magnesian proper"). It is faunally totally distinct from Oneota dol.

C. E. Needham, 1931 (Ill. State Acad. Sci. Trans., vol. 24, No. 2, pp. 363–368). At New Richmond, Wis., on S. bank of Willow Creek, at the dam, the *New Richmond fm.* is 1¼ ft. thick, consists of white to pale-yellow ss., friable, thin-bedded, irregular, fine-grained, and cross-bedded; is overlain by 10 ft. of Shakopee dol. and uncon. (?) underlain by Oneota (?) dol. In bluffs of Miss. River just E. of Prairie du Chien, Wis., the New Richmond is 5 ft. thick, and consists of pale-yellow friable, slightly dolomitic medium-grained cross-bedded ss., with smaller quantities of fine and coarse sand, overlain by 35 ft. of Shakopee dol. and underlain by 200 ft. of Oneota dol.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 73). Recent work by E. H. Powers (unfinished doctor's thesis, Univ. of Iowa) seems to show that although some variation may occur in strat. position of *New Richmond beds*, and although in some sections these ss. beds appear to be missing, there are so many sections in which they do occur at about same strat. position that the New Richmond may properly be considered as a memb. separating the Oneota and Shakopee.

The U. S. Geol. Survey treats *New Richmond ss.* as middle fm. of Prairie du Chien group, and assigns it to Lower Ord. This is generally accepted classification.

New River group.
New River series. } (In Pottsville group.)

Pennsylvanian: West Virginia and southwestern Virginia.

W. M. Fontaine, 1874 (Am. Jour. Sci., 3d, vol. 7, p. 463). The *New River system of coals*, "which for the sake of distinction we may call the Conglomerate series."

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii–xxx). The *New River Coal Measures* of Fontaine is middle or coal-bearing part of Pottsville cgl.; the name is preoccupied by J. P. Lesley's application of New River to a part of Pocono fm.; and Lesley has therefore replaced it by *Kenawha River Coal Measures*.

H. M. Chance, 1881. [See quotation under *Beaver River fm.*]

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 202–204). *New River coal group.*—The great development of coal in middle and lower half of Pottsville series along New River, W. Va., has given name to this group, which underlies Connoquenessing sss. and overlies Sharon cgl. Includes Sharon shales and Sharon coal.

I. C. White, 1899 (W. Va. Geol. Surv. vol. 1). *Pottsville cgl., No. XII (New River or Pocahontas coal series)*.—Underlies Lower or Allegheny River coal series and overlies Mauch Chunk red sh.

J. J. Stevenson, 1904 (Geol. Soc. Am. Bull., vol. 15). Lower Pottsville=*New River series* of Fontaine, and includes Sharon ss. at top, but not the overlying Sharon group of shales and coals.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A). *New River group (Middle Pottsville)*.—Underlies Connoquenessing ss. and overlies Pocahontas group or Lower Pottsville, which includes Flat Top Mtn ss. at top and all of Pocahontas coals (Nos. 1 to 9, inclusive).

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. on Wyoming and McDowell Counties). No. 8 Pocahontas coal is younger than Flat Top Mtn ss. and is basal memb. of *New River group*, which rests on Flattop Mtn ss. (top memb. of Pocahontas group) and extends upward to base of Gilbert coal.

W. Va. Geol. Surv. broadside sheet, 1917. *New River group* extends from base of Gilbert coal down to base of No. 8 Pocahontas coal.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co.). Top of *New River group* lies from a few inches to 15 ft. below Lower Douglas coal.

D. B. Reger, 1921 (W. Va. Geol. Surv. Rept. Nicholas Co.). Lower Douglas coal rests on *New River group*, which extends down to top of Flattop Mtn ss.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties). No. 8 Pocahontas coal is basal bed of *New River group*, and Flattop Mtn ss. is top memb. of Pocahontas group.

†New River coal series.

Mississippian: West Virginia.

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, pp. 519–560). Lesley was original proposer of *New River series*, "a number of years" prior to 1877. [The compiler is unable to ascertain, without expenditure of more time than matter merits, where *New River* was published by Lesley prior to 1877. In publication cited above Ashburner states that original *New River series* of Lesley is middle part of Pocono ss. and is 313 ft. thick, and that "New River series of Fontaine" is middle or coal-bearing part of Pottsville cgl.]

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii–xxx). *New River system (No. X)*.—Includes (descending) *New River Coal Measures* and Pocono ss.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. xxiii). *New River coal group* is included in Mountain ls., which rests on Pocono ss.

†New River system.

Mississippian: Pennsylvania and West Virginia.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii–xxx). *New River system (No. X)*.—Includes (descending) New River Coal Measures and Pocono ss. Underlies Mountain ls. and overlies Catskill Old Red ss.

New Rochelle serpentine.

Pre-Cambrian: Southeastern New York.

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). *New Rochelle serpentine*.—Occurs at Davenport's Neck at New Rochelle. Intrusive into Fordham gneiss, Inwood ls., and Manhattan schist.

†New Salem serpentine.

Late Carboniferous or post-Carboniferous: Northern central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 55). *New Salem serpentine.*—A lenticular mass of rather coarse biotite-granitoid gneiss on W. slope of Rattlesnake Hill, about 300 yds. NE. of A. A. Haskell's house.

Discarded by B. K. Emerson, as an unnecessary name, and New Salem adopted for the aplite described by him in U. S. G. S. Bull. 597, 1917.

New Salem aplite.

Late Carboniferous or post-Carboniferous: Northern central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 244 and map). *New Salem aplite.*—A broad lobe of "ribbon gneiss," which extends up from Enfield through Prescott and New Salem. Is white, and all very fine-grained and aplitic, though uniformly biotitic. Is made up of quartz, orthoclase, and sodic plagioclase. In places it has a tourmaline-bearing border. [See also under *Dana diorite.*]

New Scotland limestone. (In Helderberg group.)

Lower Devonian: Eastern New York and Pennsylvania, western Maryland and Virginia, and northern West Virginia.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *New Scotland beds* (also *ls.*).—Is Catskill or Delthyris shaly ls. Exposed at town of New Scotland, Albany Co., N. Y. Underlies Becraft ls. and overlies Coeymans ls. Included in Helderbergian group. [For lithologic description see *†Catskill or Delthyris shaly ls.*]

In subsequent repts the thickness of New Scotland ls. has been given as 50 to 127 ft. Thickness of Kalkberg ls. (see next paragraph) has not been stated.

In 1908 (Sci., n. s., vol. 28, pp. 346–348) G. H. Chadwick introduced *Kalkberg ls.* "to cover certain layers heretofore included variously by writers with the beds above (New Scotland) or below (Coeymans)," and carrying a mixed fauna, highly developed and excellently silicified on Catskill Creek [Greene Co., N. Y.], where the beds show numerous thin parallel seams of black flint nodules.

Has also been called "*Shaly ls.*"

Chadwick's restricted definition of New Scotland ls. is generally accepted.

In central Pa. the Helderberg is treated as a fm. and these beds are designated as *New Scotland ls. memb. of Helderberg ls.*

Newsom shaly clay.

Silurian (Niagaran): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402). *Newsom shaly clay.*—Overlies Whites Bend (Laurel) ls. and underlies Bledsoe (Louisville) ls. in Tenn. Thickness 0 to 8 ft. Included in Clifton ls. Same as Waldron shaly clay of Ind.

Named for Newsoms Station, Davidson Co.

Newton sandstone. (In Pottsville group.)

Pennsylvanian: Southeastern Tennessee (Cumberland, Grundy, Hamilton, Van Buren, White, Bledsoe, Sequatchie, Rhea, and Marion Counties).

W. A. Nelson, 1925 (Tenn. Dept. Ed., Div. Geol. Bull. 33A, pp. 50–51, and under county descriptions). *Newton ss.*—Top memb. of Bonair ss. Consists of 50 to 175 ft. of soft coarse white, yellow, or reddish-white micaceous ss., generally strongly cross-bedded. In places there are thin ripple-marked beds and one or two coal beds. In N. part of field this ss. rests on Eastland sh. lentil of Bonair ss. In S. part of field it rests on Whitwell sh. Named for fact that it occurs at Newton P. O., in SW. corner of Cumberland Co.

Newton sandstone member (of Everton formation).

Lower Ordovician: Northern Arkansas (Harrison, Eureka Springs, and Yellville quadrangles).

E. T. McKnight, 1935 (U. S. G. S. Bull. 853). *Newton ss. memb. of Everton fm.*—Thickness 0 to 20 ft. In Yellville quad. its base is estimated to lie 160 and 200 ft. above base of Everton. Shows, especially in Harrison and Eureka Springs quads., pronounced uncon. at base. In Eureka Springs-Harrison folio was erroneously called St. Peter ss. Named for prominence in northern Newton Co. Enters Yellville quad. from W. and wedges out in W. part of quad. [The Eureka Springs-Harrison folio, No. 202, 1916, describes this ss. as consisting of 0 to 150 ft. of massive, cross-bedded, and laminated saccharoidal ss., underlying [so-called] Joachim ls. (0 to 95 ft. thick) and uncon. overlying Everton ls. (0 to 115 ft. thick). The so-called Joachim ls. of this folio is now known to be older than true Joachim and to belong to Everton fm. The Newton ss. memb. of Everton fm., therefore, lies 95± ft. below top of Everton and 115± ft. above base of Everton in Eureka Springs-Harrison quads.]

†Newtonville limestone.

Mississippian (late): Central Ohio.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 93). *Maxville or Newtonville ls.*—Is=Sub-Carbf. ls. of Ky. hills. Overlies Logan ss. group, and is overlain by cgls. [Pottsville fm.] on which Productive Coal Measures rest.

Same as Maxville ls.

Named for Newtonville (now called White Cottage), Muskingum Co.

†New Ulm quartzite.

Pre-Cambrian (Huronian): Southwestern Minnesota (Brown County).

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2, pp. xxii, 35). *New Ulm qtzite.*—Red qtzite outcropping at New Ulm. Believed to be older than the several hundred ft. of red shales and red sandrock encountered in deep wells at Belle Plaine, Mankato, Hastings, and East Minneapolis.

N. H. Winchell, 1895 (Am. Geol., vol. 16, pp. 150–162). *New Ulm qtzite* is same as Sioux qtzite.

New Ulm conglomerate.

Cambrian (?): Southwestern Minnesota (Brown County).

F. W. Sardeson, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 221–242). *New Ulm basal cgl.*—The qtzite cgl. which outcrops on left side of Minn. River opp. New Ulm. 1½ mi. above Redstone. Mapped. Has heretofore been considered by geologists as basal part of Courtland qtzite, but it is Middle Camb. and contains pebbles of Courtland qtzite.

†New Vernon trap.

Name applied by N. H. Darton (Am. Jour. Sci., 3d, vol. 38, pp. 134–139, 1889; U. S. G. S. Bull. 67, 1890) to the extrusive sheet of Watchung basalt, 150 to 250 ft. thick, around New Vernon, Morris Co., N. J.

†New York system.

Devonian, Silurian, Ordovician, and Cambrian: New York.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, Geol. 2d dist., pp. 99, 429). *New York Transition System.*—The Transition rocks of New York constitute, as a whole, the most perfect system which has hitherto been described. The remarkable series which fill up the space btw. the Primary and the Old Red System constitute together the New York Transition System. It is composed of several groups. [Page 99.]

Tabular view of the sedimentary rocks of New York

Tertiary.***

New Red system.**

Old Red system. [Also calls it "Old Red ss." On other pp. of vol. cited L. Vanuxem included this in "New York system."]

New York system:
Erie group (Marcellus and Hamilton shales, Tully limestone, Genesee slate, Ithaca and Chemung shales and grits).
Helderberg series (Pentamerus limestone, Delthyris shaly limestone, Oriskany sandstone, Encrinal limestone, Cauda-galli grit, Schoharie grit, Helderberg limestone).
Ontario group (Medina sandstone, Green shales and Oolitic iron ore, Niagara limestone, Red shale, Onondaga salt and plaster rocks, Manlius water-lime).
Champlain group (Potsdam sandstone, Calciferous sand rock, Chazy and Birdseye limestone, Marble of Isle La Motte, Trenton limestone, Utica slate, Loraine shales, Grey sandstone, Conglomerate).
Taconic system (Taconic slate, Magnesian slate, Stockbridge limestone, Granular quartz). [Page 429.]

As above defined "New York system" comprises all rocks btw. base of Potsdam ss. and top of Chemung fm., and thus includes nearly all of Dev., all of Sil. and Ord., and part of Camb.

H. S. Williams, 1891 (U. S. G. S. Bull. 80, p. 60). See quotation under †*Appalachian group*.

Neylandville marl. (In Navarro group.)

Upper Cretaceous (Gulf series): Northeastern Texas.

L. W. Stephenson and W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 488, 516, etc.). [For definition see 1933 entries under *Corsicana fm. (restricted)*.]

See U. S. G. S. 1937 geol. map of Tex., where Navarro group is divided into (descending) Kemp clay (restricted), Corsicana marl (restricted), Nacatoch sand, and Neylandville marl. This is present approved classification.

†Niagara sandstone.

Silurian: Western New York.

T. A. Conrad, 1837 (N. Y. Geol. Surv. 1st Rept., pp. 166–172). Red and variegated sss. of Niagara River. [Called *Niagara ss.* on p. 172.] The only ss. developed in course of Niagara River. Probably not more than 200 ft. thick. Includes at top the "Gray Band" of Eaton, about 4 ft. thick. The red ss. is underlain by siliceous cgl. [Whirlpool ss. memb.?] which is either part of underlying or overlying fm.

T. A. Conrad, 1840 (N. Y. Geol. Surv. 4th Ann. Rept., p. 201). This name [Niagara ss.] I applied to the red ss. of Niagara and Oswego.

Essentially same as Albion ss.

†Niagara shale.

Silurian: New York.

T. A. Conrad, 1839 (Phila. Acad. Nat. Sci. Jour., vol. 8, pt. 1, pp. 228–235). *Niagara sh.*, at base of Helderberg system or Middle Sil. group, is underlain by Clinton group.

Replaced by Rochester sh. memb. of Clinton fm.

†Niagara limestone.

Silurian: New York.

L. Vanuxem, 1839 (N. Y. Geol. Surv. 3d Rept., p. 248). [Describes upper fm. of †Protean group as consisting of concretionary ls. and blue sh. and states that in some quarries of the ls. "we find that singular concretionary rock which forms the upper part of the *Lockport and Niagara ls.*, being the terminal mass in the Third District, and from which its name was in part derived."]

Same as Lockport dol., the established name.

Niagara group (also **limestone** and **dolomite** where not divisible).

Silurian: New York, Michigan, northern Ohio, Wisconsin, and Illinois.

J. Hall, 1842 (Am. Jour. Sci., 1st, vol. 42, pp. 52, 57–62). *Niagara group* includes Rochester sh. and Lockport ls., and rests on "Protean group" (green shales, Pentamerus ls., and iron ores and=Clinton fm. minus Rochester sh. memb.).

The foregoing definition of Niagara group persisted for several decades, although J. D. Dana as far back as 1857 used *Niagara period* to include Niagara group, Clinton group (excluding Rochester sh. memb.), Medina ss., and Oneida cgl. [Oswego ss. and not true Oneida, which is=upper Medina]; but Dana excluded "Galt ls." [Guelph] at top. The 1863, 1864, 1868, 1869, 1875, and 1895 editions of his Textbook of geol. employed the foregoing classification. In some early repts the Rochester sh. was called "Niagara sh." and the Lockport dol. was called "Niagara ls." In 1898 (Buffalo Soc. Nat. Sci. Bull., vol. 6, No. 1, p. xvii) A. W. Grabau applied *Niagara group* to all rocks btw. Onondaga group (as he called the middle Sil.) and Upper Ord. In 1899 (Sci., n. s., vol. 10, pp. 874–878) J. M. Clarke and C. Schuchert introduced *Niagaran period or group* to include Guelph dol., Lockport ls., Rochester sh., and Clinton beds. This is present commonly accepted definition of Niagara group, although Rochester sh. is now treated as a memb. of Clinton fm. and the beds carrying the Guelph fauna are included in Lockport dol. by U. S. Geol. Survey and others. G. H. Chadwick's 1908 classification, however (Sci., n. s., vol. 28, pp. 346–348), also A. W. Grabau's 1909 classification (Jour. Geol., vol. 17, pp. 209–252), included "upper Medina" (Albion ss.) in the Niagaran. In 1865 James Hall included the Guelph in Niagara group, and it is generally now included in that group, although the Canadian Geol. Survey (see M. Y. Williams 1914 and 1919) formerly excluded, and probably still excludes, the Guelph from the Niagara. In 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 560–561) E. O. Ulrich stated that Brassfield ls. is oldest Clinton known, and he included it in his *Niagaran series*. Later, however, he correlated the Brassfield with Albion ss. and excluded it from the Niagaran, as do other geologists. On pl. 28 of Bull., vol. 22, cited above, Ulrich classified Louisville ls. of Ky. as younger than the Guelph, but included it in his *Niagaran series*, as did R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4), Ulrich and Bassler, 1923 (Md. Geol. Surv. Sil. vol., pp. 244, 267), and E. O. Ulrich, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 329, where he seems to correlate it with Guelph).

The Clinton fm. of Niagara group is a distinct unit as far S. as NE. Tenn. In Upper Mississippi Valley States the deposits of Niagara age are usually not divided, and are there called *Niagara ls.* or *Niagara dol.*, depending upon the lithology.

Named for exposures in Niagara Co., N. Y., all of the subdivisions, including those of Guelph age, being well exposed in gorge of Niagara River.

†Niagara period.

A term applied by some early writers (see early editions of J. D. Dana's Textbook of geology) to include the time during which Niagara group, Medina ss., and Oneida cgl. were deposited. The U. S. Geol. Survey applies the term *Niagara epoch* to the time covered by Niagara group, in which it includes Clinton fm. at base and Guelph at top.

†Niagara transition group.

A term applied by E. N. S. Ringueberg (Am. Nat., vol. 16, pp. 711–715, 1882, and Am. Geol., vol. 1, pp. 264–272, 1888) to 0 to 2 or more ft. of light-bluish ls. "heretofore included in the Clinton group," but "its fossils prove it is more closely allied to the Niagara." Characterized by abundance of Cephalopoda. "It forms the connecting link btw. the Clinton lss. beneath and the Niagara shales" [Rochester sh.].

Niagara series.

A term applied by some authors to Niagara group.

Niagara Falls moraine.

Pleistocene (Wisconsin stage): Western New York and southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17. Named for Niagara Falls, N. Y.

Niagara Gulch latite. (In Silverton volcanic series.)

Miocene: Southwestern Colorado (Silverton quadrangle).

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Niagara Gulch latite.*—The most widely distributed variety of the hornblendic latite of Burns latite complex. Named for Niagara Gulch, E. of Eureka, where it occurs in a massive flow several hundred ft. thick, which lies btw. two notable tuff bands.

Is a facies of Burns latite, of Silverton volcanic series.

Niagaran.

A time term covering the interval during which the rocks of the Niagara group were deposited. See under *Niagara group.*

Nicholas limestone. (In Cynthiana formation.)

Middle Ordovician: North-central Kentucky and southwestern Ohio.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, pp. 209, 210, 294, 297). *Nicholas bed.*—The coarse-grained ls., with relatively few fossils, forming top bed of Cynthiana fm.; 35 ft. thick in Nicholas Co., Ky., but decreases along Ohio River, where the lss. become more argill., fine-grained layers more frequent, and fossils more abundant. Underlies Fulton layer. [On pp. 209 and 210 author states it overlies Point Pleasant, "which term should be restricted to lower part of exposures at Point Pleasant, as intended by Prof. Orton." On pp. 295 and 297 the Point Pleasant seems to be divided into Greendale and Perryville beds, and the Nicholas bed is described as resting on Greendale. Foerste repeated latter classification in 1910 and 1912.]

A. M. Miller, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 651–657) and 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 2) applied *Point Pleasant ls.* to the beds overlying Greendale ls. in Ky.

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided Cynthiana fm. into (descending) Rogers Gap, Gratz, Bromley, and Greendale, and did not recognize Nicholas ls. as defined by him in earlier repts.

A. C. McFarlan and D. M. Young, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 12, p. 1977). *Nicholas ls.* is a quarry rock, and is not recognized in all sections in central Ky., in which case the Greendale is overlain by the Rogers Gap. The Nicholas is regarded as a ls. facies of the upper Greendale.

Named for Nicholas Co., Ky., where it is fully developed SW. of Pleasant Valley.

Nicholas sand.

A subsurface sand, 150 ft. thick, in SW. Okla., correlated with a part of Garber ss. (Perm.).

Nichols slate. (In Chilhowee group.)

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Nichols sh.*—Grayish-blue shales, sandy, micaceous, argill., and slightly calc.; of uniform composition throughout. Thickness 550 to 800 ft. Overlies Cochran cgl. Underlies Nebo ss.

Named for Nichols Branch of Walden Creek, at E. end of Chilhowee Mtn, Sevier Co., Tenn.

Nichols sand.

A subsurface sand assigned to upper part of McElroy memb. of Fayette ss. of eastern Tex., by O. L. Brace (A. A. P. G. Bull., vol. 15, No. 7, 1934, pp. 779–781).

Nickel Plate formation.

Carboniferous (?): British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 44, 54). [Assigned to Carbf. Later repts by other geologists assign this fm. to Triassic or Jurassic.]

Nickerson morainic system.

Pleistocene (Wisconsin stage): Northeastern Minnesota and northwestern Wisconsin.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Nickerson, Pine Co., Minn.

Nickwaket graywacke.

Pre-Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 362, 394). *Nickwaket graywacke.*—Entirely schistose rocks with large percentage of graywacke and feldspathic qtzite. The schists and schistose coarser beds consist of variable amount of quartz, muscovite, biotite, and chlorite, with local developments of magnetite. The graywacke beds at top of fm. are coarse and in many places conglomeratic, while at base there are important lenticular cgls., consisting of pebbles and boulders of the older rocks, largely quartz, granite, and gneiss. Best development of this cgl. is a few mi. SE. of Middlebury, in town of Ripton. The upper graywacke beds are seen in contact with overlying Forestdale marble at Forestdale. Overlies Archean granite and gneiss. In central Green Mtns is uncon. overlain by Cheshire qtzite.

According to A. Keith (personal communication) this graywacke is exposed on Nickwaket Mtn, in SW. corner of Rochester quad., in Rutland Co.

Nicola series.

Triassic: British Columbia.

G. M. Dawson, 1879 (Canada Geol. Surv. Rept. 1877–78, p. 74B).

Nicollet clay.

A term listed in U. S. G. S. Bull. 191, 1902, p. 292. The reference given simply refers to "Nicollett's great bed of clay."

Nicoyan series.

Miocene: Costa Rica.

J. Romanes, 1912 (Geol. Mag., dec. 5, vol. 9, p. 262).

Nigh sand.

A subsurface sand in Stephens Co., southern Okla., lying at 1,600 ft. depth in Empire pool, the Miller sand lying at 1,500 ft. and the Surber sand at 1,700 ft. According to Okla. Geol. Surv. Bull. 40Q, 1928, p. 179, this sand is Perm.; according to Okla. Geol. Surv. Bull. 40E, 1926, it is Penn.

Nikanassin formation.

Lower Cretaceous: Alberta.

B. R. MacKay, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. B, p. 7).

Nikolai greenstone.

Permian and Triassic(?): Eastern Alaska (Nizina-Tanana region).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 425–432). *Nikolai greenstone.*—A series of greenstones that contain the Nikolai copper vein. Is a series of ancient basic volcanics. Underlies Chitistone ls.

Later work showed that typical Nikolai greenstone as defined by Rohn is of Perm. and possibly Triassic age, but that in many subsequent repts the name was used to include the Miss. tuffs, basalts, and interbedded sh., chert, and ls. which have been named *Strelna fm.* The name is now restricted to the Perm. (and possibly Triassic) rocks to which it was originally applied.

Nikomeki sand and silt.

Pleistocene: British Columbia.

E. M. J. Burwash, 1918 (The geology of Vancouver and vicinity, p. 81).

Nile sand.

A subsurface sand, of Dev. age, in western N. Y., lying lower than Bradford sand.

Nilkoka group.

Pre-Cambrian: Eastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 472, 480, 483). *Nilkoka beds.*—Fine quartz cgl. and sss., with red and green clay slates. Upper part of fm. seems in general more argill. and lower part more aren. Closely folded. Little evidence of metamorphism. No fossils. Tentatively assigned to Paleozoic. Exposed on bluffs of lower Tanana River btw. Nilkoka Creek and Baker Creek. Younger than Tanana schist, on which the beds probably rest uncon.

According to recent work by J. B. Mertie, Jr., the Nilkoka group is pre-Camb.

Nimrod limestone. (In Cisco group.)

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, p. 136), used *Nimrod* in section only, for what appears to be the ls. in Pueblo fm. which Plummer and Moore in 1922 called *Eolian ls.*, but it may be a younger ls.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated *Nimrod ls.* as younger than Eolian ls. and older than Camp Colorado ls., and stated that it was named for exposures near Nimrod, Eastland Co.

Nimrod shale. (In Pueblo formation.)

Pennsylvanian: Central northern Texas (Shackelford, Stephens, and Eastland Counties, Brazos River region).

F. Bradish, Feb., 1929 (Tex. Bur. Econ. Geol., geol. map of Stephens Co.). *Nimrod sh.*, 100± ft. thick, underlies Camp Colorado ls. and overlies Stockwether ls.

O. F. Hedrick, E. Owens, P. A. Meyers, May 1929 (Tex. Bur. Econ. Geol., geol. map of Shackelford Co.). *Nimrod sh.*, 50± ft. thick, overlies Stockwether ls. and lies below Camp Colorado ls.

W. G. Wender, 1929 (Tex. Bur. Econ. Geol., geol. map of Eastland Co.), shows *Nimrod sh.* occupying interval of about 50 ft. in Pueblo fm. btw. Camp Colorado ls. (at top) and Stockwether beds below.

This name is not listed by E. H. Sellards in Tex. Univ. Bull. 3232, 1933, and presumably has been discarded by Tex. Survey, being preoccupied by Nimrod ls. of Plummer.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 198, 249), named the shale lying below Camp Colorado ls. and above Stockwether ls. in McCulloch Co., Colorado River region, the *Salt Creek Bend sh.*

Nineveh limestone member (of Greene formation).

Permian: Southwestern Pennsylvania and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 22, 32–33). *Nineveh ls.*, 7 to 30 ft. thick. Several ls. layers separated by shales. Lies 75 to 100 ft. above Fish Creek ss. and 25 to 30 ft. below Nineveh coal. Included in Dunkard Creek series [Dunkard group].

Nineveh sandstone member (of Greene formation).

Permian: Southwestern Pennsylvania (Greene and Washington Counties).

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 22, 32). *Nineveh shales and ss.*, 25 ft. thick on Dunkard Creek, Greene Co.; lie 20 ft. above Nineveh coal and 230 ft. below Gilmore ss. Included in Dunkard Creek series [Dunkard group]. Also *Nineveh ss.* (massive yellowish-gray coarse-grained ss.), which lies 225 to 250 ft. below Gilmore ss. Named for exposures near Nineveh, Greene Co., Pa.

Nineveh.

A name applied by drillers to several sands of probable Upper Dev. age in western Pa., because first discovered to be productive at Nineveh, Greene Co. The Nineveh 30-foot sand lies btw. 100-foot sand above and Snee sand below.

Ninole basalt.

Tertiary or older: Hawaii (Kau district).

H. T. Stearns, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 150). *Ninole basalt*, Hawaii, assigned to Tert.(?).

H. T. Stearns, 1930 (U. S. G. S. W. S. P. 616). *Ninole basalt.*—Lava flows, chiefly massive gray pahoehoe, often in beds 75 ft. thick, interstratified with a few beds of aa. About 500 ft. below top occurs a bed of compact fine-grained dark-red to brown palagonitic tuff, usually 2 ft. thick but reaching a known maximum of about 15 ft. At Noguchi tunnel a lava flow is interbedded with the tuff. Thickness of Ninole basalt unknown, but 2,100 ft. of it is exposed at Makaalia Peak, at head of Hilea Valley. Type section is exposed in walls of Ninole Valley, at Puu Enuhe.

Ninos schist.

Pre-Cambrian: Central northern New Mexico (Las Vegas region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; also Conspectus of geol. fms. of N. Mex., pp. 4, 10). *Ninos schists.*—Lower and principal schistose section above Azoic gneisses in Solitario Mtn region NW. of Las Vegas. Thickness 1,000 ft. [Derivation of name not given.]

†Niobenton sandstone.

Drillers' name for a ss. that forms top bed of Carlile sh. memb. of Benton sh. (Upper Cret.) in NE. Colo. and Ellis and Hamilton Counties of western Kans. The top of this ss. is base of Niobrara fm. in that region. The term is a contraction of Niobrara and Benton, and has been replaced by *Codell ss.*

Niobrara formation (also **Niobrara limestone**). (In Colorado group.)

Upper Cretaceous: Nebraska, South Dakota, North Dakota, central southern and southeastern Montana, eastern Wyoming, eastern Colorado, northeastern New Mexico, Kansas, and southern Minnesota.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 419, 422). *Niobrara div.* (*Formation No. 3 of Cret.*).—Upper part is lead-gray calc. marl weathering to yellowish or whitish chalky appearance; lower part is light-yellowish and whitish ls. Total thickness 200 ft. [Fossils listed.] Occurs in bluffs along the Missouri below Great Bend to vicinity of Big Sioux River, also below there on hilltops. Overlies Fort Benton group [Benton sh.] and underlies Fort Pierre group [Pierre sh.].

Is upper fm. of Colorado group. In some repts on eastern Colo. the Niobrara deposits have been treated as a group, divided into Apishapa sh. above and Timpas ls. below. In some regions the deposits are chiefly or wholly sh. and are called *Niobrara sh.*

Named for exposures along Missouri River near mouth of Niobrara River, Knox Co., Nebr.

†Niobrara group.

Miocene, Pliocene, and later (?): Eastern Wyoming and Colorado, and western and northern Nebraska.

O. C. Marsh, 1875 (Am. Jour. Sci., 3d, pl. 9, pp. 51–52). At close of Mio. a subsidence took place E. of Rocky Mtns. A great Plio. lake was thus formed directly over the eastern Mio. basin, having nearly the same boundaries on N. and W., but extending much farther E., and stretching S. nearly to Gulf of Mexico.

It covered an area at least 5 times as great as the older lake, while its deposits attained a thickness of nearly or quite 1,500 ft. This lake basin may with great propriety be called the Niobrara Basin, since Niobrara River cuts through its typical strata for more than 200 mi. The beds in this basin lie nearly horizontal. They are light in color, and much more aren. than the Mio. below. The upper strata consist of hard sss. or calc. grits, which weather but slowly, and hence still form the great table-lands over much of the basin. Writer has traced these high plateaux and the intervening isolated buttes from near Black Hills S. to Arkansas River, and found them all of Plio. age. South of Smoky Hill River these strata rest directly on the Cret.

A. Hague, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 42, 67–71). *Niobrara beds.*—For the Plio. strata of Tertiary plains of Wyo., E. of Colorado Range, the name Niobrara, first suggested by Prof. O. C. Marsh, has been retained. The beds consist of marls, clays, coarse and fine sss., and cgls., with some nearly pure lss. The fine marly sss. are predominant and light-colored lss. exceptional. Thickness 1,200 to 1,500 ft. Uncon. overlies White River and older fms. Contains Plio. fossils.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 425, 458, 544). *Niobrara group.*—East of Colorado [Front] Range the great Plio. lake stretched from base of Rocky Mtn system eastward well toward Miss. Valley, and extended in N.-S. line from lowlands of Tex. to unknown distance into British Columbia. Deposited in lake named Cheyenne Lake. Correlated with North Park group and Humboldt group. Is older than Wyoming cgl. and younger than White River group.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 115). *Upper Miocene and (?) lower Pliocene.*—First phase (Arikaree fm.) in part. Includes *Fort Niobrara* (*"Nebraska fm."*), *Nebraska.*

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 23, 25). *Fort Niobrara fm.*—Upper Mio. or lower Plio. Name *Niobrara fm.* is preoccupied in Cret. Type loc. on Niobrara River near Fort Niobrara [Cherry Co.], Nebr. This is "Horizon F" of Hayden and Leidy, 1869, and lower part of "Loup Fork" of Hayden. [Fossils listed. On pp. 9, 23, 25, he calls the beds "Niobrara River."]

Includes Ogallala and Arikaree fms. (the former of Plio. and Mio. age and the latter of Mio. age) and possibly later deposits. The Niobrara River is cut in Arikaree fm., the Ogallala being absent in that area.

†Niobrara River formation.

See 1918 entry under †*Niobrara group* (Tertiary).

†Nipigon group.

Pre-Cambrian (Keweenawan): Canada.

Name introduced by R. Bell, 1875 (Canadian Nat. and Geol., 2d ser., vol. 7, pp. 49–51), for the rocks now known as *Keweenawan series*. Named for Nipigon Basin, where the rocks have their max. development in Canada.

Nipisiguit granite.

Devonian (?): New Brunswick.

G. A. Young, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 220).

Nipissing clay.

Pleistocene: Ontario.

A. P. Coleman, 1909 (Ont. Bur. Mines Ann. Rept., vol. 18, pt. 1, p. 297).

Nipissing diabase.

Pre-Cambrian (Keweenawan): Quebec and Ontario.

M. E. Wilson, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 278).

Nipissing.

Name applied to glacial lakes, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

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Nipple Mountain series.

Miocene: British Columbia.

L. Reinecke, 1915 (Canada Geol. Surv. Mem. 79, pp. 57, 60).

Nisconlith series.

Cambrian (?): British Columbia.

G. M. Dawson, 1890 (Canada Geol. Surv., n. s., vol. 4, pp. 31B–32B).

These rocks were assigned to Camb. until 1912, when R. A. Daly assigned them to pre-Camb., as did Drysdale in 1917.

Nisconlithian series.

A term applied by C. [R.] Keyes to rocks of Cordilleran region interpreted as having been formed during early part of pre-Animikie erosion interval. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Nishnabotna sandstone.

Upper Cretaceous: Southwestern Iowa.

C. A. White, 1867 (Am. Jour. Sci., 2d, vol. 44, pp. 27, 31). *Nishnabotany ss.*—Coarse-grained friable ferruginous ss., sometimes more than 30 ft. thick, lying uncon. on Coal Measures in Mills, Montgomery, Cass, and Pottawatomie Counties. Of supposed Cret. age and suspected to be part of Dakota group.

C. A. White, 1870 (Iowa Geol. Surv., vol. 1, pp. 26, 167+, 289, pl. at end), described fms. of Iowa and divided Cret. into (descending) *Inoceramus* beds, 50 ft.; Woodbury sss. and shales, 130 ft.; Nishnabotany ss., 100 ft.

Named for East Nishnabotna River.

Nisky limestone.

Middle Ordovician: Eastern Pennsylvania (Lehigh Valley district).

E. T. Wherry, 1909 (Sci., n. s., vol. 30, p. 416). *Nisky fm.* (*Black River*).—Gray, very shaly ls., 100 ft. max. Underlies Nazareth cement rock and uncon. overlies Coplay ls.

B. L. Miller, 1911 (Pa. Topog. and Geol. Surv. Rept. 4), called the fm. *Nisky ls.* "Is quarried near Nazareth."

Derivation of name not known.

Btw. 1910 and 1927 this name was used in several Pa. Geol. Survey and other repts. In 1928 (letter dated March 26) B. L. Miller stated: (See quotation under *Coplay ls.*)

Nitinat formation.

Jurassic or Triassic (?): British Columbia.

C. H. Clapp, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 88) and 1912 (Canada Geol. Surv. Mem. 13, p. 44).

Nittany dolomite. (In Beekmantown group.)

Lower Ordovician: Central Pennsylvania (Center and Blair Counties), western Maryland, and western Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 552, 658, pl. 27). *Nittany dol.*—At Bellefonte consists of (descending): (1) Massive light-gray, finely crystalline dol., 198 ft.; (2) alternating beds of light- and dark-gray crystalline dol. in beds of medium thickness, 313 ft.; (3) gray crystalline dol., some chert, and a little ss., 132 ft.; (4) mainly thick-bedded, in part probably slightly calc. dol., light to medium shades of gray, crystalline to compact, 624 ft. Underlies Axeman[n] ls. and overlies Stonehenge ls. [All these fms. belong to Beekmantown group.]

Named for exposures in Nittany Valley, Center Co.

[library stamp]

†Nittany Valley limestone.

Ordovician: Central Pennsylvania (Clinton County).

H. M. Chance, 1880 (2d Pa. Geol. Surv. Rept. G_4, pp. 17–24). Trenton, Birdseye, Black River, etc. are all exposed in Nittany Valley. [In several places he used *Nittany Valley ls.* and *Nittany Valley lss.*]

Niverton shale. (In Conemaugh formation.)

Pennsylvanian: Western Maryland and southern Pennsylvania.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 67, 114, pl. 6). *Niverton sh.*—A bed of dark to olive sh., 8 ft. thick, found at various places in Castleman Basin above lower bench of Clarksburg ls. Contains great profusion of a new sp. of *Pleurophorus* and a few *Estheria ortoni*. Well exposed on W. bank of Castleman River 1.3 mi. S. of Niverton, Pa. Rests on Lower Clarysville coal and lies 25± ft. below Upper Clarksburg ls.

Nixon sand.

A subsurface sand, of Chester (late Miss.) age, in southern Ind., that has been correlated with Sample ss. memb. of Gasper oolite.

Nizina limestone.

Upper Triassic: Eastern Alaska (Nizina-Tanana region).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 429, 431, 435, etc.), casually applied *Nizina ls.* to the ls. he named, in that rept, *Chitistone ls.*

G. C. Martin, 1916 (Geol. Soc. Am. Bull., vol. 27, p. 690), introduced *Nizina ls.* for the thin-bedded lss. forming upper conformable part (1,000 to 1,200 ft.) of Chitistone ls. as defined by Rohn, and restricted *Chitistone* to the massive lss. composing lower and major part (1,800 to 2,000 ft.) of the original Chitistone. The Nizina ls. is overlain by McCarthy sh. (See also G. C. Martin, U. S. G. S. Bull. 776, 1926.)

Noah Parker horizon.

Lower Cambrian: Northwestern Vermont (Franklin County).

G. E. Edson, 1906 (5th Rept. Vt. State Geol., pp. 133–155). *Noah Parker horizon.*—The type of the Lower Camb. terrane is represented by shales and sss. The fm., by a series of ledges, passes westward from and over W. part of Noah Parker farm, in town of Georgia, Vt. This is last exposure of this horizon in N. part of Georgia, although the fm. to W. continues northward.

G. E. Edson, 1908 (6th Rept. Vt. State Geol., pp. 210–220). *Noah Parker horizon.*—The *Olenellus* zone of Walcott. Type loc. in Georgia, Vt., on farm of Noah Parker, W. of highway passing Chase's corners, where the rocks are shales and sss.

Noatak formation.

Mississippian (upper and lower): Northern Alaska (Noatak-Kobuk region).

P. S. Smith, 1913 (U. S. G. S. Bull. 536, pp. 55, 69, 74, map). *Noatak ss.*—Chiefly ss. with subordinate qtzite, sh., and thin lss. Underlies Lisburne ls. (Miss.) and overlies Upper Dev. ls. Contains large fauna of Miss. age. Possibly some of lower beds may be very late Dev., but there is considerable reason for believing the fm. is all Miss. Occurs most extensively in central and W. parts of Noatak Basin, from the canyon as far E. as camp of Aug. 9.

P. S. Smith and J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 815, p. 153). *Noatak fm.*—At its type loc., in W. part of Noatak Valley btw. Nimiuktuk and Kugururok Rivers, was originally described by Smith in 1913, under designation *Noatak ss.*, but work of that date did not yield a complete section across the strike. For this reason, and also because other Miss. rocks have in present rept been assembled and treated collectively with original Noatak ss., it has seemed desirable to create a new and more comprehensive cartographic unit, to be known as *Noatak fm.* [Long description.] Underlies Lisburne ls. and includes all pre-Lisburne Miss. rocks in northern region. In some areas includes numerous cherty beds and, along Killik River, a peculiar chert cgl. All variations may be seen btw. chert cgl. and sed. chert breccia. Present available evidence seems to justify hypothesis that Noatak fm. is a group of rocks confined essentially to northern Alaska.

Noblesville dolomite.

Silurian (Niagaran): Central Indiana.

E. M. Kindle, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept., p. 407). *Noblesville dol.*—Hard thin-bedded buff-colored dol., 100 ft. thick, containing an older Niagara fauna (Lockport fossils) than Huntington ls., which contains a Guelph fauna.

E. R. Cumings and R. R. Shrock, 1928 (Geol. Soc. Am. Bull., vol. 39, p. 585). Noblesville fm. of Kindle (1904) is based on the highly inclined beds in flank of a reef that may lie in the Liston Creek, or more likely in both the Liston Creek and Mississinewa fms. It is certainly not permissible to name a fm. from a reef facies that in no way represents the typical fm., either lithologically or faunally; and the name Noblesville is therefore regretfully abandoned.

Named for Noblesville Twp, Hamilton Co.

†Nodaway limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 53). *Nodaway ls.* contains *Fusulina* and Bryozoa, underlies Nodaway or No. 9 coal, and overlies coal No. 8.

Is a part of Deer Creek ls. memb. of Shawnee fm., older name, according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13). R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 181), cites Hinds and Greene and includes this ls. in synonymy of Deer Creek ls.

Named for exposures at Nodaway, Andrew Co.

†Noel shale.

Devonian (?): Southwestern Missouri and northwestern Arkansas.

G. I. Adams, 1904 (U. S. G. S. P. P. 24, p. 24). *Noel sh.*—Previously described by Ark. Surv. under name "Eureka sh." (preoccupied). Hence renamed from town of Noel [McDonald Co., SW. Mo.], where it is typically exposed. Often black, but not infrequently it has a greenish and sometimes a yellowish appearance. Thickness from a few in. up to 70 ft.; usually averages 15 to 30 ft. Thus far it has never been found lying on Polk Bayou ls., as does the Sylamore. It commonly rests on Key ss., or, where that is absent, on Yellville fm. In upper part it contains at some places thin limy layers, and when not abruptly succeeded by the even-bedded St. Joe memb. of Boone fm., it grades upward into that fm.

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville folio, No. 119), stated that the 30 to 70 ft. of black carbonaceous fissile sh. forming upper memb. of Chattanooga sh. and overlying 0 to 75 ft. of light-colored ss. called Sylamore ss. memb. of Chattanooga sh., is the sh. exposed at Noel.

†Nogal formation.

Permian: Southeastern New Mexico (Roswell artesian basin).

A. G. Fiedler and S. S. Nye, 1933 (U. S. G. S. W. S. P. 639). *Nogal fm.*—A lithologic unit consisting chiefly of red beds, gyp., and anhydrite, but including interbedded ls. in thick beds, dolomitic ls., ss., sh., and salt. Thickness 1,000 to 2,000+ ft. Is 1,000± ft. thick in vicinity of Nogal Canyon, for which it is named. Underlies, apparently conformably, Picacho ls. and rests on Abo ss. In SE. part of basin it gives place laterally to a thick ls. section, which is tentatively included in Picacho ls. The Nogal fm. differs from the younger Pecos fm. in that it is usually much more thickly bedded and includes but a small proportion of red beds. The Nogal fm. is considered by geologists working in SE. N. Mex. to be Yeso fm. of Lee and Girty, and it forms lower part of Chupadera fm. of Darton in this region. The Picacho ls. of this rept is considered by geologists working in this region to be the San Andres ls. of Lee and Girty.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). Picacho ls. is here abandoned for San Andres ls. memb. of Chupadera fm., and Nogal fm. is here abandoned, being replaced by Hondo ss. memb. of Chupadera fm. (above) and Yeso memb. of Chupadera fm. (below). [As originally defined and heretofore used San Andres ls. rested on Yeso. The recognition of Hondo ss. involves slight redefinition of San Andres and Yeso.]

Nogales division.

A term applied by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, 1900, and vol. 31, 1902) to 1,000 ft. of "late Tertiary" [now assigned to Cret. or Tert.] lavas, aggls., and cgls., with some andesitic lavas and tuffs, in Sonora, Mexico, and Cochise Co., SE. Ariz. Probably named for Nogales, Santa Cruz Co., Ariz.

Noix oolite member (of Edgewood limestone).

Silurian (early): Northeastern Missouri and southwestern Illinois.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 62). *Noix oolite.*—Very white massive fossiliferous oolite, 4 to 7 or more ft. thick, lying on Buffalo shales (Ord.) at Louisiana, Mo., and vicinity, and extending over area of 100 sq. mi. in Pike and Lincoln Counties, Mo., and Calhoun Co., Ill. Underlies Bowling Green ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28). *Noix oolite* uncon. underlies Brassfield ls. and uncon. overlies Girardeau ls.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 351–376). *Noix oolite memb.* will refer to local oolite facies of Edgewood fm. that is=upper half to two-thirds of Cyrene memb. of Edgewood.

C. R. Keyes, 1914 (Am. Jour. Sci., 4th, vol. 37, pp. 254–256), included in *Noix ls.* the upper local oolitic ls. or Noix oolite of previous repts as well as underlying nonoolitic ls. resting on Girardeau ls., and discarded Cyrene memb.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4). *Noix oolite* overlies Edgewood ls. and underlies Bowling Green dol.

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Noix oolite memb.* of Edgewood fm., 8 to 10 ft. thick, is a local phase of Cyrene ls. memb. of Edgewood, which wedges in btw. typical Cyrene and the Bowling Green. Occurs in Mo. only near Louisiana.

At present the U. S. Geol. Survey divides Edgewood ls. into Bowling Green ls. memb. above and Noix oolite memb. below, the underlying fm. being Girardeau ls.

Named for exposures along Noix Creek at Louisiana, Pike Co., Mo.

Nolans limestone. (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, Jan.–Feb. 1936 (Jour. Geol., vol. 44, No. 1, pp. 5–9), divided Sumner group into (descending) Wellington [restricted], Donegal, and Nolans fms., but did not define the new names *Donegal* and *Nolans*.

R. C. Moore, Sept. 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12). *Nolans ls.* underlies Pearl sh., overlies Odell sh., and includes (descending) Herington ls., Paddock sh., and Krider ls. [Derivation of name not stated.]

Nolichucky shale.

Upper Cambrian: Eastern Tennessee, western North Carolina, and southwestern Virginia.

A. Keith, 1896 (U. S. G. S. Morristown folio, No. 27, p. 2). *Nolichucky sh.*—Calc. shales and shaly lss., with beds of massive blue ls. in upper portion. When fresh the shales and shaly lss. are bluish gray and gray, but they weather readily to various shades of yellow, brown, red, and green. Over much of region the fm. is nearly uniform, and contains only yellow and greenish-yellow sh. Passing NE. to N. of Holston River the ls. beds become more prominent and the shales more highly colored and calc. Thickness 400 to 750 ft. Very fossiliferous. Overlies Maryville ls. and underlies Knox dol.

Foregoing is original definition in type region. The name, however, first appeared in print in 1894, in U. S. G. S. Estillville folio (No. 12), by M. R. Campbell, who accepted Keith's name and correlated the rocks of Estillville area with those of Nolichucky type loc. He described the fm. as consisting of 500 to 730 ft. of calc. sh. carrying lentils of blue ls., the center of fm. in Carter Valley consisting of a lentil of massive blue ls. 400 to 500 ft. thick. Underlain by Maryville ls. and overlain by Knox dol.

Named for exposures along Nolichucky River, Greene Co., Tenn.

Nome group.

Early Paleozoic or older: Northwestern Alaska (Seward Peninsula).

A. H. Brooks, G. B. Richardson, and A. J. Collier, 1901 (Reconn. Cape Nome and Norton Bay regions, Alaska, in 1900: U. S. G. S. Spec. Pub., p. 29, map). *Nome series.*—Lss., graphitic mica and calc. schists, with many greenstone intrusives and some chloritic schists of undet. origin; green schists common. Broadly speaking the rocks are calc. Thickness 5,000 to 6,000 ft. Overlies Kuzitrin series. Differs from Kuzitrin series and from older Kigluaik series in character of metamorphism. Can hardly be considered a strat. unit, as lithological constitution of its beds is rather heterogeneous. Most typically developed to S. of Kigluaik Mtns and Bendeleben Mtns.

Nomlaki tuff member (of Tehama and Tuscan formations).

Pliocene: Northern California (Tehama County).

R. D. Russell and V. L. Vander Hoof, 1931 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 20, No. 2, pp. 12–15). *Nomlaki tuff memb.*—A massive coarse-grained pumice tuff memb. that occurs near base of Tehama fm. and also near base of Tuscan fm. Is of dacitic composition and consists of white pumice fragments embedded in a medium- to light-gray matrix of glass and crystal shards. Most of pumice fragments are less than 3 in. max. diam., but they occasionally exceed 1 ft. Upper 6 ft. of the tuff has a salmon-pink color, in marked contrast to the predominant gray below. Thickness variable; in Tehama Co. the max. is 50 ft. A separate designation for this tuff memb. seems advisable because of its highly distinctive appearance, dacitic composition in contrast to the andesitic Tuscan, much wider distribution, and value as a horizon marker. The Tehama fm. with exception of this tuff memb. contains only a very subordinate amount of volcanic debris. The tuff memb. is therefore named for its good exposures on old Nomlaki Indian Reservation, in Tehama Co.

Nonesuch shale. (In Oronto group.)

Pre-Cambrian (late Keweenawan): Northern Michigan and northeastern Wisconsin.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 221–224, pls. 17 and 18). The *Nonesuch sh. belt* consists of black sh. and gray ss. It overlies Outer cgl. and underlies a red ss. [Freda ss.]. At Nonesuch mine, SE¼ sec. 1, T. 51, R. 43 W., the sh. is seen with a thickness of over 200 ft., trending N. 45°–50° E., and dipping SE. 28°. Near base of the sh. is the ss. seam, 4 ft. thick, worked at Nonesuch mine for its copper, and known as Nonesuch lode.

According to C. R. Van Hise and C. K. Leith (U. S. G. S. Bull. 360, p. 346, 1909) the Nonesuch sh. has been traced 125 mi. and varies in thickness from 125 to 500 ft.

Named for occurrence at Nonesuch mine, Gogebic Co., Mich.

Noodle Creek lime.

A subsurface unit, of Penn. age, in Noodle Creek field, Jones Co., north-central Tex., lying at 2,500 ft. depth.

Noonday greensand.

A name locally applied to Tyler greensand of Wendlandt and Knebel in Smith Co., Tex.

Nora limestone.

Upper Devonian: Central northern Iowa.

A. O. Thomas, 1913 (Sci., n. s., vol. 37, p. 459). A new substage, for which *Nora ls.* is proposed, is added as lowest memb. of Lime Creek stage. Uncon. overlies Cedar Valley stage in Floyd Co.

According to C. L. Fenton (Am. Jour. Sci., 4th, vol. 48, 1919) this ls. possibly belongs to Cedar Valley ls. In 1924 (Univ. Mich. Pub. Contr. Mus. Geol., vol. 1, frontispiece) C. L. and M. A. Fenton divided the Cedar Valley into (descending) *Nora*, Shell Rock, and Lower Cedar Valley.

C. H. Belanski, 1927 (Am. Mid. Nat., vol. 10, No. 10), redefined *Nora substage of Shell Rock stage* to include at base the uppermost part (first *Actinostroma* zone) of Mason City ls. of previous repts. He divided his Nora substage into (descending) Second *Actinostroma* zone, *Platyrachella* zone, and First *Actinostroma* zone, and described it as consisting of 0–20 ft. of hard white stromatoporoidal ls., mag. sh., shaly ls., and (in northern phases) dol.

Named for exposures in an abandoned quarry near Nora Junction, Floyd Co.

See also under *Shell Rock ls.* (Upper Dev.).

Nordenskiöld dacite.

Jurassic or Cretaceous: Yukon Territory, Canada.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 29).

Nordheimer formation.

Carboniferous (?): Northwestern California (Klamath Mountains).

O. H. Hershey, 1906 (Am. Jour. Sci., 4th, vol. 21, pp. 58–66). *Nordheimer fm.*—Black slaty sh. with max. estimated thickness of 3,000 ft. At base a slight development of coarse ss. apparently made up of debris from underlying quartz-bearing rhyolite. This ss. is nowhere more than 50 ft. thick, but can be traced for several miles. No evidence of noncon. btw. the ss. and the rhyolite. No other sss. and no cgl. or ls., but contains a few thin layers of chert. Is badly shattered by intrusive rocks. No fossils. May be late Dev. but is more likely Carbf. Some characters suggest Baird fm. It might also be a western representative of Triassic Pit shales, but is not likely to be any younger. The valley of Nordheimer Creek is cut in the fm.

Nordstrom oil zone.

Subsurface Plio. beds encountered in wells of Santa Fe Springs oil field, Los Angeles Co., Calif., that lie lower than Meyer oil zone and higher than Buckbee oil zone.

†Norfolk formation.

Pleistocene and Pliocene (?): Southeastern Virginia.

W. B. Clark and B. L. Miller, 1906 (Va. Geol. Surv. Bull. 2, pt. 1, p. 20). *Norfolk fm.*—Clays and sands; in places sandy clays, as in canal cuts below Portsmouth; contain great quantities of shell remains, making the beds distinctly calc. Thickness probably not 50 ft. Buried beneath heavy mantle of later Pleist. sediments so that areal extent and thickness cannot be readily determined. Probably forms northward extension of Plio. beds of N. C. Fossils chiefly marine Mollusca of characteristic Plio. types. Underlies Lafayette fm. Named for Norfolk Co., Va., where the deposits have been recognized in deep cutting in Dismal Swamp Canal.

T. L. Watson, 1909 (Va. Geol. Surv. Bull. 1A, p. 9). *Norfolk* included in Plio. Underlies Lafayette.

Later revision of fossil lists by T. W. Vaughan and W. C. Mansfield has led to opinion that these beds are Pleist. and Plio. (?).

†Norfolk Basin series.

Carboniferous: Southeastern Massachusetts.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull. vol. 49, Geol. ser., vol. 8, No. 4, pp. 91–271). *Norfolk Basin series.*—Narrow belt of sediments which bear many resemblances to members of Roxbury cgl. series. Consists of arkose, coarse and fine cgls., sss., and slates much like Roxbury series. Pebbles are composed of same substances as Roxbury series. Both Roxbury series and Norfolk Basin series contain casts of same tree trunks. The Narragansett Basin sediments are redder than Norfolk Basin sediments, and latter are redder than Roxbury series. Connected through a narrow pass at Sheldonville with the cgls. and other sediments of Narragansett Basin.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the belt of sediments described above as Wamsutta fm. and Pondville cgl.

†Norian.

A name applied in some early repts to the anorthic rocks of the pre-Camb. Laurentian series. Named for prevalence of rocks of this age at Esmark, Norway, where the norites were first described. For particulars see U. S. G. S. Bull. 360, 1909.

†Norman division.

Permian: Central Oklahoma.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 43). *Norman div.*—All rocks of Red-beds from base of that series to lowermost gyp. ledges on E. slope of Gypsum Hills. Chiefly brick-red clay shales with some interbedded ledges of red and whitish ss. To E. sss. predominate, but along base of Gypsum Hills the beds are almost wholly clay. Underlies Ferguson gyp. memb. of Blaine div., where that gyp. is present; elsewhere extends up to base of Medicine Lodge gyp.

Later work showed that Norman, Cleveland Co., is not on unit named.

Norman sandstone.

Permian (?): Central Oklahoma.

C. T. Kirk, 1904 (Okla. Dept. Geol. and Nat. Hist. 3d Bien. Rept., p. 10). *Norman ss.*—Ss. carrying a mass of peculiar concretions commonly called petrified roses. Well exposed on hilltops 6 mi. SE. of Norman [Cleveland Co.] and on bluffs at Purcell, Ind. T. Separated from overlying Wreford ls., or its equivalent Payne ss., by 15 to 40 ft. of reddish-gray sh. or clay. Gould's prior use of "Norman" has been dropped.

Normandy limestone.

Middle and Upper Ordovician: Central Tennessee.

M. R. Campbell, 1899 (U. S. G. S. Standingstone folio, No. 53, p. 2). *Normandy ls.*—Blue calc. sh. and thin-bedded ls., with, locally, at top, a bed of dark heavy-bedded brown siliceous ls. 20 ft. thick. Thickness of fm. 200 or more ft. Constitutes upper part of Safford's Nashville series. In McMinnville folio (No. 22) the southward extension of presumably these same beds has been termed Chickamauga ls. Neither of these terms is definite enough for detailed mapping of central basin, therefore *Normandy ls.* has been suggested by Dr. Safford as an appropriate term for the two uppermost members of his Nashville series. These two divisions are presumably inseparable in field, but are clearly distinguished from the *Orthis* bed, which lies immediately below. Underlies Chattanooga sh.

Includes beds of Trenton, Eden, Maysville, and later (?) age.

Named for Normandy, Bedford Co.

Normanskill shale.

Lower and Middle (?) Ordovician: Eastern New York, southwestern Vermont, and northwestern Massachusetts.

R. Ruedemann, 1901 (N. Y. State Mus. Bull. 42, pp. 489–568). *Normans Kill sh. (Lower Dicellograptus zone).*—It is proposed to employ *Normans Kill shales* for the clastic facies of part of lower Trenton, which is characterized by the graptolite fauna at the Normans Kill [a tributary entering Hudson River just S. of Albany, at Kenwood]. Includes [in upper part] the lower Trenton ls. cgl. of Rysedorph Hill [named *Rysedorph Hill cgl.* in Bull. 49, 1901]. Underlies sh. containing middle Trenton fauna and overlies lower Trenton ls. The Normanskill shales differ strongly faunistically and lithologically from lower Trenton ls. and certainly deserve to be designated by separate name. Heretofore included in "Hudson River shales," abandoned because too inclusive.

In 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 371–372, 512, and pl. 27) E. O. Ulrich stated that Normanskill fauna (which comprises little besides graptolites) occurs in great development in Athens sh. of Tenn., and assigned both fms. to upper Chazy.

In 1912 (N. Y. State Mus. Hdb. 19, p. 35) C. A. Hartnagel stated that *Rysedorph cgl.* is intercalated in or overlies Normanskill sh., and in accompanying chart stated that Normanskill sh. includes at top Rysedorph cgl. and possibly the Burden cgl.

In 1914 (N. Y. State Mus. Bull. 169, pp. 66-99, 140) R. Ruedemann classified *Upper Normanskill sh.* as of Black River age, and included in it the *Rysedorph Hill cgl.*, "which is intercalated at a number of localities." He stated: "Fossils of Rysedorph Hill cgl. indicate it is younger than typical Normanskill sh. and that it intervenes in age btw. typical Normanskill sh. and Snake Hill sh. (of lower and perhaps middle Trenton age). The *Normanskill sh. s. str.*, 1,000± ft. thick, is of upper Chazy age, based on evidence obtained by Ulrich in Athens trough of Tenn., and consists of blue to gray, mostly argill., often more or less sandy shales with thin bands of black, highly carbonaceous graptoliferous and pyritiferous shales, with some included grit beds; it uncon. overlies Bald Mtn ls., of Beekmantown age." [The map accompanying Bull. 169 maps Rysedorph Hill cgl. as overlying Normanskill sh.] In 1921 (N. Y. State Mus. Bull. 227 and 228, p. 130) Ruedemann classified Normanskill sh. as of Black River and upper Chazy age. In letter to compiler dated May 3, 1927, Dr. Ruedemann stated: "It appears that the Athens sh. in Va. has afforded fossils which demonstrate the upper Chazy age of the Normanskill sh. At the same time here [N. Y.] an upper zone of the Normanskill sh. (that with *Corynoides gracilis*) appears to be younger and has therefore been correlated by me with the Lowville and Leray lss. No positive evidence for this correlation has as yet been obtained."

R. Ruedemann, 1929 and 1930. [See these entries under *Rysedorph cgl.*]

L. M. Prindle, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 257-302, fig. 2) mapped *Normanskill sh.* in N. Y., Vt., and Mass. parts of Taconic quad. As mapped in Vt. it occurs in SW. part of Bennington Co. "The Normanskill fauna of Capital dist., N. Y., ranges in age from Chazy to possibly Black River."

Norrie ferruginous chert member (of Ironwood formation).

Pre-Cambrian (upper Huronian): Northwestern Michigan (Gogebic district) and northwestern Wisconsin.

W. O. Hotchkiss, 1919 (Eng. and Min. Jour., vol. 108, pp. 501, 504). *Norrie ferruginous chert memb.*—Almost wholly wavy-bedded granular and fine-grained ferruginous cherts with hematite in beds and grains. Thickness 30 to 230 ft. Is a memb. of Ironwood fm. Uncon. underlies Pence ferruginous sl. memb. and conformably overlies Yale memb. Named for Norrie mine, E. of Ironwood, Mich.

Norris limestone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 889, 897, pls. opp. pp. 889, 900, 912, 921). *Norris ls.*—Buff ls., usually less than 2 ft. thick, 25± ft. below Shawnee or Buff ls. in Hocking Valley. In southern Ohio, if correctly identified, it becomes an important ore horizon.

Later repts state it is same as Snow Fork and Lower Freeport lss.

Named for proximity to Norris coal.

Norristown sandstone. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Montgomery County).

E. V. d'Invilliers, 1883 (2d Pa. Geol. Surv. Rept. D_3, vol. 2). *Mesozoic fm.* (*"Trias," "New Red," "Norristown ss.," etc.*)—Unaltered red sss. and shales, trap dikes, and altered beds, and cgl. beds.

Probably same as Stockton fm.

†Norristown shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1893 (Pa. Geol. Surv. geol. and topog. map of Bucks and Montgomery Counties) and 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, pp. 2589–2638). *Norristown shales*.—Red shales, brown and gray ss., and pebble rock, 6,100 ft. thick. Underlies Gwynedd shales. Is basal fm. of Mesozoic.

Same as Stockton fm.

Named for exposures at Norristown.

†Norristown stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, pp. 51–52). *Norristown stage*.—Ss. 100 ft. thick in Okla., where it overlies Booneville stage and underlies Tomlinson stage. In Ark. usually consists of two sss. (upper one 0 to 200 ft. thick and lower one 100 to 200 ft. thick), underlies Spadra stage (absent in Ind. T.), and overlies Booneville stage. In Ind. T. underlies Tomlinson sh., the intervening Hartwell ss., Belva sh., and Ozark ss. of Ark being absent.

Same as Hartshorne ss., later but better-established name.

Probably named for Norristown, Pope Co., Ark., just across river from Dardanelles.

North amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs to Central Mine group. Is older than National ss. and younger than Calico amygdaloid. The mineralized part is the North lode. Derivation of name not known.

North flow.

Includes North amygdaloid and underlying trap.

North Ada limestone.

Miners' local name for an ore-bearing ls., 3 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 140 ft. below their St. Patrick ls. and 18 ft. above their South Ada ls. Exposed in Ada claim. (See U. S. G. S. P. P. 173, 1932.)

†North Amherst granite.

Late Carboniferous or post-Carboniferous: Central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 323). *North Amherst granite*.—A peculiar rock appearing in hills SE. and W. of North Amherst Station and at foot of W. slope of Pelham Ridge E. of D. Hawley's, beside a brook.

B. K. Emerson, 1914 (personal communication). The North Amherst granite is same as Williamsburg granodiorite.

Northbrae rhyolite.

Pliocene: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Northbrae rhyolite*.—Numerous isolated patches of white rhyolite lava, apparently the remnants of a flow the greater part of which has been removed by erosion. Thickness probably nowhere exceeds 100 ft. Occurs on W. slope of Berkeley Hills N. of Berkeley. Rests on worn surface of Franciscan and Cret. fms. Overlain by Campus and Orinda fms. Named for occurrence in Northbrae dist., near Berkeley.

Northbridge granite gneiss.

Pre-Cambrian: Central southern Massachusetts and northwestern Rhode Island.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18), showed *Northbridge gneiss* of Worcester Co., Mass., as older than Sutton gneiss. (All of definition.)

B. K. Emerson and J. H. Perry, 1903 (Geol. of Worcester, with map). *Northbridge gneiss.*—Light gray, tinted flesh red by feldspar. Oldest fm. in area. Overlain by Westboro qtzite.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 155–156 and map). *Northbridge granite gneiss.*—Occupies a broad area, with a core of coarse, slightly gneissoid porphyritic microcline-biotite granite and a broad border of completely mashed, stretched, and penciled, highly muscovitic gneiss. Named for occurrence at Northbridge, Worcester Co., Mass. Assigned to Archean (?).

North Butler amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Older than Mass amygdaloid and younger than Butler amygdaloid. The mineralized part is North Butler lode. Probably named for its occurrence N. of Butler amygdaloid.

North Butler flow.

Includes North Butler amygdaloid and underlying trap.

North Carolina grit.

Commercial term for quartz cgl. at Parkwood, Moore Co., N. C., that is used for an abrasive material.

†North Denison sand.

Lower Cretaceous (Comanche series): Northeastern Texas and southeastern Oklahoma.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13, pp. 302, 303, 328–330, 334). *North Denison sands.*—Fossiliferous beds characterized by alternations of excessively ferruginous laminated sands and clay, which by infiltration and induration are sometimes converted into fossiliferous hematite. Thickness 100 to 130 ft. Overlie Marietta clays and are inseparable from overlying Pawpaw clays; all included in Denison beds. Include, at top, Quarry ls.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 384–385), applied *North Denison terrane* to beds beneath Pawpaw terrane and above Denton terrane, or to Weno clay memb. of current nomenclature.

Named for exposures in northern half of Denison, Grayson Co., Tex.

Northeast shale.

Upper Devonian: Western New York (Chautauqua County) and northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Northeast sh.* is applied to beds overlying Shumla ss. and uncon. underlying Volusia sh. in Chautauqua Co., the uncon. representing Cuba ss.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 152). Shumla ss. initiates over 400 ft. of beds in no wise different from the Gowanda and Westfield as they enter the State. These, the "Portage flags" of I. C. White, are here renamed *Northeast sh.*, from twp in Erie Co., Pa. Fully exposed (about 415 ft.) in Chautauqua Creek gulf and on the Canadaway (Arkwright Falls) above Shumla. Here nearly barren, but eastward they assume an easily recognized fauna, best exhibited in Pierce quarry W. of Machias. [See explanation about this fauna under *Machias fauna.*] Northeast sh. is part of Wellsburg ss. to E. Included in Chautauquan [Chemung] of N. Y. Survey.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), placed Northeast sh. below Cuba ss. and above Shumla ss., and included them all in Chemung.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). Restudy of Upper Dev. correlation problems in SW. N. Y. indicates a discrepancy in thicknesses along Genesee River and at Lake Erie of beds formerly supposed to be identical, which may require some further examination in field before publication of map. Former revisions may not have gone far enough in their departure from old ideas. The beds involved are only those above Dunkirk black sh., whose continuity with Canaseraga sss. above the Wiscoy sh. has been amply corroborated. It now seems likely, however, that the Cuba ss., 835 ft. above the Dunkirk along Genesee River, goes below, instead of above, Northeast shales at Lake Erie, whose base there is

526 ft. above the Dunkirk, and their top, 1,001 ft. With the known westward thinning of all these Upper Dev. strata, generally to about 98.52 percent a mi. NW., which would bring the Cuba top down to 484 ft. above the Dunkirk, the Cuba seems likely to connect with Shumla ss., and the Northeast to embrace all beds above it, perhaps including the Cattaraugus. Consequently it becomes desirable to introduce local names for two of these members on the Genesee-Olean meridian, namely, *Cadiz beds* for the supposed "*Volusia*" btw. the Cuba and the Hinsdale sss., and *Haymaker beds* for those formerly taken for the Chadakoin, btw. *Hinsdale* ("*quarry*") *ss.* and Wolf Creek cgl. The succession thus becomes Cuba, Cadiz, Hinsdale, Haymaker. In any event, it grows increasingly clearer that there are no Miss. strata in N. Y.

†Northern Lignitic.

A descriptive term applied to Claiborne group, also to Wilcox group and Midway fm., in early geologic repts on Gulf Coastal Plain.

A. C. Veatch, 1906 (La. Geol. Surv. Bull. 4, p. 28). The name Chickasaw fm. or stage was suggested by Hilgard as an appropriate equiv. for his Northern Lignitic (Geol. Miss., 1860, pp. 110–123; Am. Jour. Sci., 3d, vol. 2, 1871, pp. 304–396), for the very sufficient reason that the entire Northern Lignitic is within Chickasaw Purchase, and its most characteristic and conspicuous outcrops are on the four Chickasaw Bluffs, of which the Memphis Bluff is the last. Dall, however, assumed that Hilgard's Northern Lignitic was exact equiv. of the Lignitic defined by paleozoologic criteria in Ala. section, and so used it. As a matter of fact the Northern Lignitic is a lignitiferous complex, containing representatives of all beds btw. the Midway and the Jackson, and therefore represents the swamp and estuarine deposits of the Sabine, Claiborne, and Jackson epochs. The strata exposed in Chickasaw Bluff, the type loc., are stratigraphically either Jackson or underlying Cockfield, which is uppermost Claiborne. In the whole of Chickasaw Purchase (about 20,000 sq. mi.) no locality of the Sabine (Lignitic) containing typical marine fossils has been found, and it is necessary to go 100 mi. from its border for such a locality. It therefore appears necessary either to use the name Chickasaw fm. in sense in which Hilgard defined it or to abandon it.

†Northfield slate.

Lower Ordovician (Beekmantown): Northeastern Vermont (Washington County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 95). [See 1906 entry under †*Montpelier sl.* Northfield is in Barre quad., in Washington Co.]

Northfield conglomerate.

Lower Ordovician: Northeastern Vermont (Northfield Township, Washington County).

C. H. Richardson, 1919 (11th Rept. Vt. State Geol.). [Suggests *Northfield cgl.* as name for geologic equiv. of Irasburg cgl. in Northfield and Roxbury Twps. See 1919 entry under *Irasburg cgl.*]

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 107–110). *Northfield phase of Irasburg cgl.* is characterized by pebbles of devitrified rhyolite embedded in a paste of clay sl. from which Ruedemann identified Deepkill (Beekmantown) fossils.

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., p. 346). The *Irasburg, Albany, and Northfield cgls.* form base of Ord. in eastern Vt.

North Fork shale. (In lower part of Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 239). *North Fork sh.*—Black sh. with lenses 1 to 2 in. thick of iron ore. Marine fossils. Thickness 5 to 10 ft. Lies 10 to 15 ft. below Keystone coal and overlies Simmons coal. Exposed flush with N. & W. Railway grade at North Fork, McDowell Co.

North Haven greenstone.

Cambrian (?): Central southern Maine (Penobscot Bay quadrangle).

G. O. Smith, 1896 (Geology of Fox Islands, Maine, pp. 12, 13–19). *North Haven greenstone complex.*—Greenstone schists, in the main aphanitic and of light-yellow to grayish-green color. Includes diabases, also large masses of amygdaloidal greenstone and smaller amounts of a rather tuffaceous rock, at one point breccialike. Locally the greenstone is quite plainly crystalline. The greenstone complex resolves itself into a series of diabase flows with accompanying pyroclastics. The age of these diabasic lavas is determined as pre-Niagara, from their relations to the cgl. at base of Niagara sediments.

G. O. Smith, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 6). *North Haven greenstone.*—Name applied to rocks earlier described and mapped as North Haven greenstone complex. Is much older than the Sil. sediments and about contemp. with Islesboro and Castine fms. Assigned to Camb. (?). Named for development on North Haven Island, Penobscot Bay.

On 1933 geol. map of Maine, by A. Keith, this fm. is included in block labeled "Mainly Sil., but some of Dev. age."

North Higgins moraine.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).

W. A. Ver Wiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 161). Lies on N. and NE. side of Higgins Lake.

North Hill member.

Mississippian (Kinderhook): Southeastern Iowa.

L. R. Laudon, 1931 (Iowa Geol. Surv., vol. 35, pp. 344, 347, 366–371). *North Hill* is proposed for oldest memb. of Hampton fm. in SE. Iowa. Thickness 8 ft.; at Burlington 20 ft. Conformably underlies Wassonville memb. of Hampton fm. and rests uncon. on English River fm. and possibly in a few places on underlying Maple Mill fm. Consists of (descending): (1) oolitic ls. (*Schellwienella* zone), 3 ft.; (2) yellow ss. (*Palaeoneilo* zone), 6 ft.; (3) semilithographic ls. (*Parypho-rhynchus* zone); (4) oolitic ls. (*Chonetes* zone), 9 inches. Named for exposure on North Hill, in city of Burlington, where both upper and lower contacts are exposed. Is correlated with Chapin memb. of Hampton fm. of north-central province and with some part of the Chouteau of Mo.

L. R. Laudon, 1933 (Univ. Iowa Studies, n. s., No. 256, vol. 15, No. 2, p. 9), gave a "Composite Mississippian section of Iowa," in which he applied *North Hill memb.* to beds underlying Maynes Creek memb. and overlying English River fm., and did not mention Chapin memb., which as defined occupies this interval and has priority over *North Hill.*

L. R. Laudon (1935) stated these beds should be removed from Hampton fm. (See 1935 entry under *Hampton fm.*)

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc. pp. 241, 245). I am inclined to accept Laudon's conclusions that entire North Hill memb. should be classed as Chouteau, but not the higher parts of so-called Hampton fm.

North Lake zone. (In Negaunee formation.)

Pre-Cambrian (middle Huronian): Northern Michigan (Marquette County).

J. L. Adler, 1935 (Jour. Geol., vol. 43, No. 2, pp. 113–132). *North Lake zone of Negaunee fm.*—Chiefly straight, medium- to thin-bedded or massive red, yellow, brown, and gray dense ferruginous cherts with interbedded hematite and limonite at many horizons in form of concretions (characteristic feature) and branching growths. Some wavy-bedded portions in upper part. Thickness 650 to 670 ft. Grades into overlying Corning Creek zone and into underlying Makasin Hill zone. [Type loc. not stated, but the map shows it around North Lake Location.]

North Leon limestone member (of Graham formation).

Pennsylvanian: Central northern Texas.

F. Reeves, 1923 (U. S. G. S. Bull. 736E, p. 117). *North Leon ls. memb.*—Blue fine-textured siliceous ls., stained pink in spots, which weathers in thin yellow plates and shelly fragments. Thickness 4 ft. Lies 71 ft. below Bunger ls. memb. and 50 ft. above Gonzales ls. memb. in Ranger oil field, Eastland Co. Exposed on North Fork of Leon River, in Eastland Co., but North Fork and Leon are both preoccupied, so that North Leon is used.

North Mound conglomerate and quartzite.

Pre-Cambrian (upper Huronian): Central northern Wisconsin (Wood County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 371). *North Mound cgl. and qtzite.*—The rock forming North Mound [about 5 mi. NW. of Babcock, Wood Co.] is mainly a qtzite grading into a fine cgl. Rests on laminated and schistose rhyolite. Thickness 200 to 500± ft. Resembles Baraboo qtzite. Is either upper or middle Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to upper Huronian.

North Mountain basalt.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

North Nahanna River dolomite.

Silurian: Mackenzie, Canada.

E. M. Kindle, 1936 (Sci., n. s., vol. 83, No. 2140, pp. 14–15). *Lone Mtn dol.* (preoccupied) replaced by *North Nahanna River dol.* North Nahanna River enters Mackenzie River adjacent to Lone Mtn.

North Park formation.

Tertiary (Miocene?): North Park, Colorado, and Hanna Basin, Wyoming.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map 1). [*North Park (Pliocene?)* of northern Colo. is shown as younger than *Niobrara (Pliocene)*, White River (Miocene), and Vermillion Creek (Eocene), and as overlain by Quaternary.]

A. Hague, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, p. 128). The Tert. deposits of North Park, Colo., a few hundred ft. thick, are probably of late Plio. age. They are given local name *North Park Tert.* They uncon. overlie sss. that may prove to belong to Fox Hill. [On pp. 130–141 he stated that North Park Tert. of Park Range uncon. overlies Laramie group.]

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 431–434, 458, 544). *North Park group.*—Lake deposits of loose friable drab sss., soft whitish and grayish-white and buff marls which cannot be distinguished from Niobrara Plio. of Horse Creek. Occupy entire valley of North Park, except where Cret. and volcanic rocks rise above its surface. Uncon. overlies Cret. and in places rests on Archean. Believed to be Plio. and may prove to be same as Niobrara Plio. to E. Thickness not over 300 ft.

A. C. Veatch, 1907 (U. S. G. S. Bull. 316, p. 246, columnar section of Cret. and Tert. rocks of central Carbon Co., Wyo.). *North Park fm.*—White volcanic-ash beds, cherty bands; base conglomeratic. Thickness 4,500 ft. Uncon. overlies Fort Union fm., which consists of 1,200± ft. of dark-colored shales and shaly sss., resting on "Upper Laramie."

A. L. Beekly, 1915 (U. S. G. S. Bull. 596, pp. 20, 49, 66, 71). The uppermost stratified rocks of North Park constitute *North Park fm.*, which outcrops in a long, comparatively narrow area in south-central part of field. The geologists of King Surv. (U. S. Geol. Expl. 40th Par., vol. 1, pp. 431–434, 1878) applied *North Park group* to all strata overlying the marine Cret. in North Park field, but they particularly described the appearance and character of the uppermost white calc. and ashy beds. In 1907 Veatch (U. S. G. S. Bull. 316, pp. 244–260) used *North Park* to designate a similar white calc. and ashy fm. in east-central Carbon Co., Wyo., which, though considerably thicker, is apparently the strat. equiv. of upper white beds of North Park group of King. He used the name in a much more restricted [?] sense in Wyo. than it was originally applied in North Park, for he made a distinction btw. the white ashy beds and the underlying fm., which now appears to be=Coalmont fm. or lower part of North Park group as defined by King. The name *North Park* is therefore restricted [?] in this rept to topmost fm. in North Park, which is characterized by white calc. ss. and ash beds. Relation of North Park fm. to underlying rocks, though very much obscured, is believed to be one of uncon., and Tert. age is unquestioned. Thickness 500± to 1,000 or more ft. Overlies Coalmont fm. (of Cret. or Tert. age, and consisting of 4,000 to 5,000 ft. of fresh-water beds, of dark color and coal-bearing). Contact with Coalmont fm. not sufficiently well exposed to prove relationship, but evidence observed outside the park leaves little doubt it is one of uncon. [See also under *Coalmont fm.*]

North Point member.

Middle Devonian: Southeastern Wisconsin (Milwaukee County).

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 262, 263, 266). *North Point memb.* (*novum*).—Upper memb. of Milwaukee fm. Does not outcrop. Known in borings, tunnel excavations, and material in glacial drift. Consists of gray shales and shaly lss. with quantities of silica in nature of chalky-textured chert. Many fossils [listed]. Thickness in wells 50 ft. Overlies Lindwurm memb. of Milwaukee fm. and underlies Kenwood fm. (Miss.). Type loc., North Point, Intake Tunnel.

Northport clays.

Term applied by A. Hollick, in heading in N. Y. Bot. Garden Bull., vol. 3, No. 11, 1905, to the Cret. clays exposed in vicinity of Northport, Long Island.

Northport limestone.

Paleozoic(?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 75, map). *Northport ls.*—In reality is interbedded with Mission argillites, but as a strat. unit is so distinct it has been mapped as separate fm. Varies greatly in character. Is prevailingly massive fine-grained white ls., in places dolomitic. South of Northport it forms large areas and is typically massive, pure white, passing to light gray, usually finely crystalline, but occasionally becomes rather coarse and shows stratification planes. From Marble to Blossburg it has tendency to become banded and is interstratified with bands of quartz-mica schist and argillite. Thickness 3,000± ft.

North Ridge agglomerate.

Upper Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 5, pp. 896, 901). *North Ridge fm.*—A crudely stratified pyroclastic aggl. of medium grain and basic composition; dark gray, speckled white. Thickness 200 ft. Few fossils. Occurs on Hinchman Ridge and Ravine, north ridge of Mount Jura (type loc.), and elsewhere. Age early Upper Jurassic. Underlies Forman argillite and overlies Hinchman arkose.

North River blue stone.

Commercial term for a quarried bed in Sherburne flagstone memb. of Portage fm. (See C. S. Prosser, 1899, N. Y. State Geol. 17th Ann. Rept., pp. 312–315.)

North Star conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 80 and chart). *North Star cgl.* is cgl. No. 12 of Houghton Co.

According to B. S. Butler (U. S. G. S. P. P. 144, 1929) the North Star cgl. of Marvine is probably same as Allouez cgl., which is No. 15. It belongs to Central Mine group.

Named for occurrence in old North Star mine, Houghton Co.

Northumberland formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 100).

†North Valley Hill sandstone.

Lower Cambrian: Southeastern Pennsylvania (Chester and Montgomery Counties).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 79, 165, 166). *North Valley Hill ss.* of Chester Co. Same as Chiques ss. *North Valley Hill rock* is popular name for the fm. in its long outcrop through Chester and Montgomery Counties. Exposed for miles along North Valley Hill, Chester Co., where it rests uncon. on azoic gneiss of Welsh Mountain country.

Included Chickies qtzite and possibly some of overlying Harpers albite schist.

North Vernon limestone.

Middle Devonian: Southeastern Indiana (Jennings County).

W. W. Borden, 1876 (Ind. Geol. Surv. 7th Ann. Rept., p. 148). *North Vernon ls.*—Dark-blue compact stratified ls. with an occasional upper ledge of gray ls. Thickness 11 ft. 3½ in. Overlain by New Albany sh. and underlain by Corniferous ls. [E. T. Cox, 1879 (Ind. Geol. Surv. 8th, 9th, and 10th Ann. Repts, p. 88) gives exposed thickness as 25 to 33 ft.]

Same as Sellersburg ls.

Named for North Vernon, Jennings Co.

Northview shale. (In Kinderhook group.)

Mississippian: Southwestern Missouri.

S. Weller, 1901 (Jour. Geol., vol. 9, p. 140). *Northview ss. and sh.*—Fossiliferous yellowish ss. grading imperceptibly downward into bluish sh., latter most persistent and very fossiliferous in places but usually barren of fossils. Thickness 10 to 90 ft. Known as Vermicular ss. and sh. in early repts. Overlain by Pierson ls. and underlain by so-called (not typical) Louisiana ls. [Compton ls. of R. C. Moore, 1928]. Not equiv. to typical Hannibal sh. of central Mo. Included in Kinderhook group. Faunas of upper yellow ss. at Burlington and Northview ss. are analogous.

Named for exposures at Northview, Webster Co.

†Northville moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Replaced by *Defiance moraine* (*outer ridge*).

North Warren shale member.

Upper Devonian or Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 203). *North Warren sh. memb.* (of Cattaraugus fm.), new name, is in midst of the Salamanca. It underlies Millers ss. memb. and overlies Watson ss. memb. (Venango 2d "A"). Is Dev.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 87). *North Warren sh. memb.*—Middle memb. of Salamanca formational suite (Dev.). Underlies Pope Hollow cgl. and overlies Bimber Run cgl. memb. Resembles the older Amity sh., but has increased number of yellowish sandy cgl. lenses and contains a rather characteristic Salamanca fauna. Thickness, 20 ft. at Warren and 35 to 40 ft. along the Allegheny. In other places it is indistinguishable and the overlying and underlying cgls. come together. Named for occurrence btw. Asylum quarries at North Warren and Tanner's Hill quarries (now Warren reservoir) on Tanner's Hill, Warren, Pa. Best place for study is in ravines along Allegheny River on E. side, S. and N. of junction of Bimber Run and the river.

The U. S. Geol. Survey classifies Cattaraugus fm. as Upper Dev. or Miss.

Northwestern formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, with maps). *Northwestern fm.*—Essentially green, finely foliated garnet-mica schists interstratified with thin micaceous qtzites. Overlain by Garfield fm. and underlain by West Ledge fm. Thickness 2,200 ft. Believed to be of Keewatin age.

Named for exposures in cuts of Chicago & Northwestern R. R. btw. Lead and Blacktail, Lawrence Co.

See under *Lead system*.

Norton formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and southwestern Virginia.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 34). *Norton fm.*—Shales, sss., clays, and coals, 1,280 to 1,310 ft. thick, underlying Gladeville ss. and overlying Lee cgl. in Bigstone Gap coal field of Va. and Ky.

Belongs in middle of Pottsville group.

Named for Norton, Wise Co., Va., but according to J. B. Eby and M. R. Campbell (Va. Geol. Surv. Bull. 24, 1923) it is now known that Norton is not on Norton fm. but on the younger Wise fm. The full thickness of Norton fm., however, can be seen at Coeburn and Virginia City, Va.

†Norton zone. (In Niobrara formation.)

Upper Cretaceous: Northwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies vol. 6, p. 51). *Norton zone.*—Yellow to white, red, etc., more chalky zone of Smoky Hill chalk than underlying Trego zone. Named for Norton and Norton Co.

Is middle part of Smoky Hill chalk memb. (See W. W. Rubey and N. W. Bass, 1925, Kans. Geol. Surv. Bull. 10, p. 28.)

Norwalk sandstone member (of Jordan sandstone).

Upper Cambrian: Western Wisconsin.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, No. 7, p. 547). Trempealeau fm. is divided by E. O. Ulrich [unpublished at this time] into four members, of which Norwalk fine-grained dolomitic ss. is topmost one. It is overlain by Jordan ss. [as restricted by Ulrich] and underlain by Lodi memb. of Trempealeau fm.

E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett. Trans., vol. 21, pp. 83, 86). The thickest and therefore perhaps the most important of the members of Trempealeau fm. is the one at the top, for which the term *Norwalk sandstone member* is proposed. As a rule it consists of fine-grained ss., sometimes nearly white and often with a yellowish or brownish tinge, commonly rather massive in upper two-thirds and more or less thin bedded and in even plates 1 to 6 inches thick in its lower third. Thickness 0 to over 40 ft.; is about 35 ft. thick at Norwalk, Monroe Co. Has not been observed E. of Cross Plains, in which region Trempealeau fm. is terminated above by Lodi shale memb., which underlies Norwalk ss. memb. in the complete section. The Norwalk contains a large and varied fauna.

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, pp. 699–713). Norwalk ss. memb. of Ulrich should not be excluded from Jordan ss., as it composes all of the beds present at Jordan.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 60). We believe, with Stauffer, that Norwalk ss. is=Jordan ss. at Jordan, Minn., and that these beds and their equivalents can not properly be called *Norwalk* and be classified as a fm. older than the Jordan. Otherwise there would be Norwalk but no Jordan present at Jordan type loc.

A. C. Trowbridge, W. H. Twenhofel, G. O. Raasch, and others (?), 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 142, etc.) abandoned Norwalk ss. and restored the beds to Jordan ss.

E. O. Ulrich, 1936 (Geol. Soc. Am. Proc. 1935, p. 113). There are 3 sss. in Wis. that previously have been regarded as constituting an indivisible strat. unit. The Norwalk ss. is top memb. of Trempealeau fm., the Jordan is a separate final deposit of the Camb. of upper Miss. Valley, and the Madison is first deposit of Ozarkian of the region.

Norway limestone.

Huronian: Northern Peninsula of Michigan (Menominee iron region).

C. L. Rominger, 1881. [See under *Lake Hanbury sl. group.*]

J. Fulton, 1888. [See under *Lake Hanbury sl. group.*]

Norway Point formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Norway Point fm.*—Brown and gray lss., grading up into argill. lss.

and calc. clay. Several beds carry *Spirifer* cf. *granulosus* and *Cryphaeus boothi*. Greatest measured thickness, 46 ft. Underlies Potter Farm fm., and rests on Alpena ls., sometimes with slight hiatus. Type loc., Norway Point dam (also known as Boom Co. or Sevenmile dam), Thunder Bay River, Alpena Co.

Norwich conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and pp. 17–18). *Norwich cgl.*—The first of the intrusive rocks with which we meet is a belt of cgl. and sss. of undet. but not great width. Its southern portion is hidden by deep deposits of drift, but its northern bdy is exposed in deep adit at Norwich mine, where its disturbed and broken structure gives decided evidence of uplifting forces which elevated the trap and associated sedimentary belts through the superincumbent strata of Potsdam ss. [Lies considerably below cgl. No. 8.]

Norwich trap.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 18). A series of trappean belts 1,253 ft. wide, generally characterized by great hardness, peculiar fracture, and presence of an unusual amount of epidote, and in its southern portion by a segregated or banded structure not common elsewhere. For convenience of reference termed *Norwich traps*. [Shown as younger than Norwich cgl., from which it is separated by 80 ft. of trap and 20 ft. of ss.]

Named for occurrence in Norwich mine, Ontonagon Co.

Nosoni formation.

Permian: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Nosoni fm.*—Largely andesite or basalt tuffs and tuffaceous cgl. and a few flows of lava, locally interstratified with shales and sss., in part calc. and often rich in fossils. Thickness 500 to 1,200 ft. Top fm. of Penn. Conformably overlies McCloud ls. and underlies Dekkas andesite. Includes "McCloud shales" of Smith and Fairbanks, as well as the pyroclastic rocks with which these shales are so intimately associated. Named for exposures on Nosoni Creek.

N. E. A. Hinds, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 274, and Calif. Univ., Dept. Geol. Sci. Bull. 20, p. 404), assigned Nosoni to Perm., as did H. E. Wheeler, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 218).

The U. S. Geol. Survey now classifies this fm. as Perm.

Notch Peak limestone.

Upper Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll. vol. 53, No. 1804, p. 9). *Notch Peak fm.*—Gray aren. ls. in more or less massive layers. Thickness 1,890 ft. Overlies Orr fm. Type loc. is upper part of main mass of Notch Peak.

Nottely quartzite.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 5). *Nottely qtzite.*—Entirely fine white qtzite. Thickness more than 150 ft. Overlies (through gradation) Andrews schist. Highest Camb. fm. in area.

Named for excellent exposures along Nottely River, in Cherokee Co., N. C.

Nounan limestone.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll. vol. 53, No. 1804, p. 6). *Nounan fm.*—Light-gray to dark lead-colored aren. lss., 1,041 ft. thick in Blacksmith Fork Canyon, Cache Co., Utah, and 814 ft. W. of Liberty, Bear Lake Co., Idaho. Overlies Bloomington fm. and underlies St. Charles fm. Type loc. is E. slope of Soda Peak, W. of Nounan, Bear Lake Co., Idaho. Nounan Creek Canyon cuts through the fm.

Nouvelle dacites.

Age (?): Quebec.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 73).

Novillo beds.

Cretaceous (?): Mexico.

A. Heim, 1926 (Eclogae geol. Helvetiae, vol. 20, p. 84)

Nowadaga.

Upper Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Nowadaga* introduced for lower Utica or zone of *Climacograptus typicalis* in Mohawk Valley.

Nowata shale.

Pennsylvanian: Northeastern Oklahoma and southern Kansas.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 23). *Nowata sh.*—Bluish or greenish shales with a few sss. and at least one bed of coal. Thickness 50 to 600 ft. Top fm. of Tulsa group. Overlies Altamont ls. memb. of Oologah ls. and underlies Lenapah ls. Named for Nowata, Nowata Co., Okla.

In Okla. is treated by U. S. Geol. Survey as a distinct fm., and in Kans. as a memb. of Parsons fm. But R. C. Moore has recently (Kans. Geol. Surv. Bull. 22, 1936) discarded Parsons fm. and treats Nowata sh. as a fm. in his Marmaton group. These changes have not been considered by U. S. Geol. Survey for its publications.

Nowhere Island granite gneiss.

Age (?): Ontario (Rainy Lake district).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 97).

Noxlini shales.

See under *Nazlini shales.*

Ntlakapamux formation.

Jurassic: British Columbia.

C. H. Crickmay, 1930 (Calif. Univ., Dept. Geol. Sci. Bull., vol. 19, No. 2, p. 33). "The name is that of Thompson River Indian people."

Nugget sandstone.

Jurassic (Middle?): Southwestern Wyoming, southeastern Idaho, and northeastern Utah.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56, p. 56, chart opp. p. 50, map, etc.). *Nugget fm.*—The group of yellow, pink, and red sss. bounded below by the gray fossiliferous lss. of Thaynes fm. and above by the dark-colored fossiliferous shales and lss. of Twin Creek fm. Named for Nugget Station, on Oregon Short Line, SW. Wyo., at and near which the beds are well exposed. Along Twin Creek in vicinity of Nugget the fm. is 1,900± ft. thick and shows two distinct members, a lower brightly colored red-bed memb. 600 ft. thick and an upper light-colored ss. memb. The upper memb. is a thin-bedded ss. the layers of which are perforated with holes at right angles to the bedding planes, but are otherwise without a suggestion of organic life. This ss. is light yellow on fresh exposures and weathers dark brown. In Absaroka Ridge, Wyo., these two divisions are not distinct. [The Nugget fm. of Veatch corresponds essentially to Ankareh sh. as originally defined by Boutwell in Park City dist., Utah, according to studies of G. R. Mansfield (U. S. G. S. Bulls. 713, 716, and P. P. 152).]

H. S. Gale and R. W. Richards, 1910 (U. S. G. S. Bull. 430), in attempting to reconcile the definitions of Boutwell in NE. Utah and of Veatch in SW. Wyo., subdivided the rocks of SE. Idaho and adjacent parts of Utah and Wyo. into following fms. (descending):

Twin Creek ls. 3,500 [ft.].

Nugget ss. 1,900. (Massive red and white ss. and red sandy sh.; greater part dark red or brown, although in places an upper zone is distinct as a clear white ss.; includes intervals of sandy sh.)

Ankareh sh. 670. (Red sh., mottled red and greenish clay and sh., some ss. and ls.)

Thaynes ls. 2,000 or less. (Main body dark-blue ls., in many places fossiliferous; weathers brown muddy color; includes sandy and calc. sh.)

J. M. Boutwell, 1912 (U. S. G. S. P. P. 77, p. 59). *Nugget ss.*—About 500 ft. of white sss. with some intercalated reddish shales complete the section in Park City dist., Utah. These were originally grouped with Ankareh sh., but subsequent work in adjoining areas, in which overlying beds are well represented, makes it apparent they represent lower part of upper portion of Nugget ss. of Veatch (U. S. G. S. P. P. 56, 1907), and further described and mapped by Gale and Richards in U. S. G. S. Bull. 430, 1910. Veatch's Nugget included at base 600± ft. of reddish strata which properly belong to Ankareh sh., and in all later repts Nugget has been restricted to upper heavy white sss., which also include some sh. beds. The beds in Park City dist. that are correlated with Nugget ss. outcrop in ridges E. and W. of Iron Hollow, in extreme NW. corner of dist. They overlie Ankareh sh. [as here restricted]. [Boutwell in above rept. reduced thickness of Ankareh sh. from 1,500+ ft., as given in his original definition, to 1,150+ ft.]

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 31–42), divided rocks of Fort Hall Ind. Res., SE. Idaho, as follows (descending):

Twin Creek ls.

Nugget ss.

Main ss. memb. 1,500 [ft.] (red and light-colored sss.).

Wood sh. memb. 250 (red).

Deadman ls. memb. 150±

Higham grit memb. 500±

Ankareh ss. 800

Thaynes group 3,650 (chiefly lss., some sss. and sh.).

Woodside sh. 900.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713), restricted *Nugget ss.* to the upper or "main ss. memb." of his earlier repts, elevated Wood, Deadman, and Higham to rank of fms., and replaced *Ankareh ss.* of that area with *Timothy ss.* According to his 1927 rept (U. S. G. S. P. P. 152) the Nugget ss. as now recognized in SE. Idaho is=upper part of Veatch's typical Nugget of SW. Wyo., and of Gale and Richards' Nugget of SE. Idaho, but includes more than Boutwell's Nugget of NE. Utah; and *Ankareh* appears not to be applicable to any specific unit in SE. Idaho.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, p. 3). It is believed that typical Nugget ss. of SW. Wyo. and Wasatch Mtns is direct equiv. of Navajo ss. [For further details see pp. listed in index to vol. cited.]

Nulato formation.

Upper Cretaceous: Southwestern Alaska (Nulato-Norton Bay district, lower Yukon River region).

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 247, 276, 331, pl. 3). *Nulato sss.*—Brownish marine sss., 60 to 200 ft. thick, best exposed just above Nulato, a village on Yukon River. Belong to Mio. Conformably overlie Kenai group (probably Eo.).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 395, 400). *Nulato fm.*—Marine ss. and sh., 3,000± ft. thick. Overlies Melozi fm., with apparent conformity, and underlies Kaltag fm., apparently conformably. Marine invertebrates and few plants. Is Upper Cret. Includes Nulato sss. of Dall. Is typically exposed in NW. bank of the Yukon for 2 to 10 mi. above Nulato.

See under *Shaktolik group*, of which these beds form a part. Also see U. S. G. S. P. P. 159, 1930.

Nummulitic.

A term employed by some European geologists to include Oligocene and Eocene of American geologists.

†Nummulitic limestone.

Paleontologic term applied in early repts to Ocala ls. (upper Eocene) of Fla., also to Vicksburg group (Olig.) of Ala.

Nunatami formation.

Ordovician: Greenland.

Chr. Poulsen, 1927 (Meddelelser om Grønland, Bd. 70, pp. 246, 342).

†Nunda group.

Upper Devonian: New York and Pennsylvania.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, p. 172). *Portage or Nunda group.*—Is=Sherburne flags of Hall. Includes Cashaqua sh., Gardeau and Portage groups, and Sherburne flagstone and sh. of repts. Relative position perfectly seen on Cayuga Lake. Underlies Ithaca group and overlies Genesee sl.

The use of *Nunda* for *Portage group* was generally abandoned many years ago, *Portage* having both priority and usage in its favor. The N. Y. State Survey and U. S. Geol. Survey both use *Portage group* and apply *Nunda* to the ss. formerly sometimes called †Portage ss. G. H. Chadwick, however, has recently adopted *Nunda* for the group and *Portage* for the ss. (See his papers in Pan-Am. Geol., vol. 60, 1933, and Geol. Soc. Am. Bull., vol. 46, No. 2, 1935.) He includes in his Nunda group all beds from base of Ithaca to top of Wellsburg.

"Named for superior development along banks of Genesee River in dist. formerly included in town of Nunda, now Portage." (James Hall, 1843.)

Nunda sandstone.

Upper Devonian: New York.

J. M. Clarke and D. D. Luther, 1908 (N. Y. State Mus. Bull. 118, p. 61). *Nunda ss.* is introduced to replace "Portage sss.," the upper terminal memb. of Portage group as defined by Hall. In Portage and Nunda quads. the fm. consists of 215 ft. of light blue-gray ss. in layers 3 to 10 ft. thick, some of which are calc. Is only part of Portage group that can be said to be fairly well exposed in town of Nunda, and only to these sss. can name *Nunda* with any propriety be applied. Is overlain by Wiscoy shales and sands, which paleontologically belong to Portage group. Underlain by Gardeau flags and sh.

The name *Nunda ss.* was also applied to †Portage ss. by Luther in 1911 (N. Y. State Mus. Bull. 152, p. 22), Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), Luther 1914 (N. Y. State Mus. Bull. 172, p. 27), and Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157), 1920 (idem, vol. 31, p. 118) and 1922 (idem, vol. 34, pp. 68–69). The use of *Nunda* for *Portage group* was generally abandoned many years ago. In 1933 (Pan-Am. Geol.) and 1935 (Geol. Soc. Am. Bull.), however, G. H. Chadwick adopted *Nunda* for the group and *Portage* for the ss. (See under *Portage group*.) W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 402, etc.), used *Nunda* for the *ss.* and *Portage* for the *group*.

The U. S. Geol. Survey now treats Nunda ss. as a fm., underlying Wiscoy sh. and overlying West Hill fm. (=Gardeau sh. to E.). This is also the present usage of N. Y. State Survey.

Nunnally coal group.

Pennsylvanian: Central Alabama.

A group of six coal beds in Pottsville fm. of Cahaba coal field, the group lying 650 ft. above Chestnut ss. memb., and occurring within a vertical section of 300+ ft. Includes D or Figh coal, C or Cubical coal, B or Lemley coal, and A coal, also coals called Upper, Middle, and Lower Nunnally.

Nushagak formation.

Tertiary (Miocene or Pliocene): Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 173–174, 184). *Nushagak beds.*—Sands, gravels, arkoses, and clays, practically unconsolidated, slightly folded. Form E. shore of Nushagak Bay, and around Cape Etolin to Bristol Bay. Mio. fossils. Uncon. underlie Bristol Bay silts and gravels (Pleist.).

Nussbaum formation.

Tertiary (Pliocene?): Eastern Colorado (Pueblo and adjacent regions).

G. K. Gilbert, 1897 (U. S. G. S. Pueblo folio, No. 36). *Nussbaum fm.*—Chiefly sand, with gravel and silt. Rests uncon. on Pierre sh. Underlies Pleist. alluvium.

Named for Nussbaum Spring, E. of Pueblo.

Nutrian series.

A term employed by C. [R.] Keyes to include Todilto ls. and underlying Wingate ss. (See Pan-Am. Geol., vol. 66, No. 3, 1936, p. 225.)

Nuttall sandstone member (of Sewell formation).

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Nuttall ss. lentil of Sewell fm.*—Massive cgl., 150 to 200 ft. thick, forming top bed of Sewell fm. along New River from Caperton to Deepwater. Forms the cliffs from Gauley Bridge to Nuttallburg, for which it is named.

Nuttall (Lower) sandstone. (In middle of Pottsville group.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western parts of Mercer and Summers Counties, pp. 112, 139, 210, 330, 355). *Lower Nuttall ss.*—Current-bedded grayish-white coarse-grained, frequently conglomeratic ss., 50 to 100 ft. thick, lying 20 to 60 ft. below Nuttall ss. Is probably a split off Nuttall ss. [Sections show it 0 to 85½ ft. below Douglas coal and overlying Lower Douglas coal.]

†Nutzotin series.

Jurassic, Carboniferous, and older: Southeastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 359). *Nutzotin series.*—Provisional name. Includes great thickness of slates, graywackes, lss., flags, and sss., with heavy cgl. at base. Assigned to upper Paleozoic. Rests, probably uncon., on Kotlo series.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, pp. 231–232). The rocks composing Nutzotin Mtns were grouped together by writer in 1900 rept under name *Nutzotin series*, a strat. subdivision since abandoned. Schrader, who mapped this country in more detail in 1902, found enough fossils to make it evident most of rocks of Nutzotin Mtns are Mesozoic, but was unable to subdivide them.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 240–245). "Nutzotin series" of Brooks included Jurassic, Carbf., and other pre-Jurassic rocks.

Nuuanu volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Nuuanu volcanics.*—Chiefly basalt of 3 petrographic types and of different ages, mapped together. Included in lower part of Honolulu volcanic series [q. v.]. Exposed in Nuuanu Valley, 1 mi. from Pali Gap.

Nye shale.

Oligocene (upper): Northwestern Oregon (Lincoln County).

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, p. 269). *Nye sh.*—Shales of upper Olig. age. Type loc. in Lincoln Co. Regarded as older than *Aturia* bed and younger than Eugene fm.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 450, 456, 459). *Nye sh.*—Dark concretionary shales; on fresh exposures black, massive, jointed, and might more properly be termed a mudstone. [No thickness given.] Replaces "Acila shales" (paleontologic term) of Harrison and Eaton. Underlies, probably uncon., the Mio. deposits of the area and rests, with apparent uncon., on Yaquina fm. Assigned to upper Olig. Type loc. at town of Newport and at Nye Beach, in NW¼ sec. 5, T. 11 S., R. 11 W., Lincoln Co.

H. G. Schenck, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 1, table opp. p. 4). *Nye sh.* of Smith, 1926, was adopted from ms. rept. of H. G. Schenck.

Oak Creek beds.

Lower Cretaceous: Northeastern Wyoming and western South Dakota (Black Hills).

W. P. Jenney, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, p. 593, fig. 122, and map). *Oak Creek beds.*—Lower Cret. clays and ss.; upper beds mostly soft clays, clay shales, sandy shales, and soft sss., 60 to 120 ft. thick; basal 35 to 40 ft. consists of massive yellow ss., often cross-bedded. Uncon. underlie Dakota ss. and uncon. overlie Barrett shales in Black Hills. Formerly included in Dakota ss. (Upper Cret.). [Map shows these beds along Oak Creek, Crook Co., Wyo.]

According to W. W. Rubey (personal communication Jan. 1937) the rocks described are Fuson fm. and upper part of Lakota ss. as mapped in U. S. G. S. Aladdin folio, No. 128, 1905.

Oak Creek formation.

Pliocene (early) or upper Miocene: Central southern South Dakota (Mellette County).

E. L. Troxell, 1916 (Am. Jour. Sci., 4th, vol. 42, pp. 345–348). *Oak Creek fm.*—Very fine-grained ss., built up by a stream, probably a channel deposit resting upon and within the upper Mio. or earliest Plio. Fauna (including a new sp. of horse) indicates early Plio. Occurs in E. part of Rosebud Indian Res., near town of Mission, S. Dak.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, p. 23). *Oak Creek fm.*, near Mission, S. Dak., is upper Mio. or lower Plio.

Named for Oak Creek, E. part of Mellette Co.

Oakdale quartzite.

Carboniferous: Central Massachusetts, central southern New Hampshire, and northeastern Connecticut.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 59, 60–62, 76–78). *Oakdale qtzite.*—Fine, even-grained flaggy qtzite, in many places greatly jointed, reddish brown from development of secondary biotite in minute scales or greenish from development of actinolite in small lenses or subordinate beds that were originally calc. Presumably = Merrimack qtzite, but because of some uncertainty regarding the correlation, and because of its wide separation, it seems best for present to give the qtzite of Worcester trough the name Oakdale, from village in town of Sterling [Twp], Mass., where it is conspicuously displayed. In my opinion the Oakdale qtzite grades into Paxton quartz schist to W. It is overlain by Worcester phyllite.

Oakes moraine.

Pleistocene (Wisconsin stage): Southeastern North Dakota.

H. A. Hard, 1929 (U. S. G. S. Bull. 801, pp. 31–32). Of late Wisconsin age. Younger than Antelope morainic system. Lies E. of village of Oakes, in Lamoure quad.

Oakes sand.

Name applied to a subsurface sand in Homer field of northern La., which is correlated with Buckrange sand lentil of Ozan fm. (Upper Cret.) of southern Ark. Named for Oakes farm. Also known as *Blossom sand* in Cotton Valley and *Haynesville sand* in Haynesville field.

Oak Grove sand. (In Alum Bluff group.)

Miocene (middle): Northwestern Florida and probably southwestern Georgia and southeastern Alabama.

W. H. Dall and J. Stanley Brown, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 166 and 170). *Oak Grove sand.*—Further W., at Oak Grove, on Yellow River [in Okaloosa Co.], Fla., what appears to be this same [Chipola] fauna occurs in a fine incoherent gray sand, with a number of species not found in Chipola marl, including the *Turritella* (n. sp.) referred to as occurring at Rock Bluff. It would seem, therefore, that this same zone is represented at that point, though the matrix is different.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 104, 105). *Oak Grove sand memb. of Alum Bluff fm.*—Fine-grained light-gray to greenish sands—a sandy shell marl, which often has a considerable admixture of calc. material. Thickness a few ft. Contains many excellently preserved shells. Fauna closely related to that of Chipola memb. Is a middle memb. of Alum Bluff fm.

The Alum Bluff was in 1926 (U. S. G. S. P. P. 142, p. 2) elevated by Julia Gardner to rank of a group, and the Oak Grove to rank of a fm., overlain by Shoal River fm. and lying higher than Chipola fm.

Oak Grove member.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to 20± ft. of undescribed beds of alternating lss. and sh. in lower part of Carbondale fm. (Penn.) of central western Ill. Said to underlie his Purington sh. and overlie his Francis Creek sh., which rests on coal No. 2. Derivation of name not stated.

Oak Hill clay. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

W. Stout, 1916 (Ohio Geol. Surv., 4th ser., Bull. 20, pp. 19, 27, 252). *Oak Hill clay*, 2 to 3 ft. thick, locally lies directly on Lower Kittanning coal, but in places lies 20 ft. above that coal. Burned for brick in vicinity of Oak Hill, Jackson Co. Noted in Jackson, Scioto, and Muskingum Counties. [In table on p. 19 Oak Hill clay underlies Lost Seam coal; in tables on pp. 27 and 252 Oak Hill clay is placed immediately above Hamden ore and several ft. above Lost Seam coal.]

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 177). *Oak Hill clay.*—Flint and plastic clay, 0 to 12 ft. thick. Overlies Hamden ls. in Jackson and Muskingum Countjes.

W. Stout and R. E. Lamborn, 1924 (Ohio Geol. Surv., 4th ser., Bull. 28, p. 141). *Oak Hill clay.*—Impure, part flint, 0 to 12 ft. thick. Found locally from Lawrence Co. to Columbiana Co. and to Beaver Valley, Pa. Very unsteady in position. May form roof of Lower Kittanning coal or may merge with Middle Kittanning clay. In Columbiana Co. it lies 15± ft. below Middle Kittanning memb. and 0 to 19 ft. above Hamden memb.

Oak Hill slate.

Cambrian (Upper): Southern Quebec.

T. H. Clark, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 1, pp. 225–226). Uppermost Camb. bed is *Oak Hill sl.*, which may or may not have been forerunner of a third cycle whose other representatives have been lost by faulting and erosion.

†Oak Hill-Pine Barren group.

A name applied by E. A. Smith (Rept. on Coastal Plain of Ala., 1894, p. 188) to beds now known as *Midway fm.*

Oakland limestone.

Oligocene: Southwestern Oregon (Roseburg quadrangle).

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Oakland ls.* on map, *Oakland ls. lentils* in text.—Shaly and nodular argill. ls. generally known in vicinity of Oakland as "cement rock." Only 3 small areas, rather widely separated, were observed, one a mi. NE. of Oakland, another at head of Green Valley, and the third on Starr's ranch, about 4 mi. NE. of Umpqua Ferry. None of areas is more than acre in extent. There are probably other localities. Fossils show it is much younger than Umpqua fm., and must rest on it uncon. According to Dall, fossils are probably Olig., most likely upper Olig.

Oakland conglomerate member (of Chico formation).

Upper Cretaceous: Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Oakland*, 500 ft. (cgl.). [Shown as underlying Chico and as younger than Knoxville.]

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Oakland cgl. memb. of Chico fm.*—Cgl., 100 to 1,000 ft. thick, forming basal memb. of Chico fm. in Berkeley Hills. At many places the cgl. shows distinct stratification, but exhibits none of subordinate plication observed in underlying sh. of Knoxville fm., upon which it rests conformably. Named for type exposure at city of Oakland.

Oakland City sand.

A subsurface productive oil sand, 0 to 50 ft. thick, in Tri-County oil field of SW. Ind. Top lies 40 to 60 ft. below top of Big lime and 20 to 60 ft. above Brown oil sand. Lies in Mooretown ss. of Cumings.

Oakridge sandstone.

Jurassic (?): Western California (Alameda County).

C. F. Tolman, Jr., 1915 (Nature and science on Pacific coast, San Francisco, Elder & Co., p. 45). *Oakridge ss.*—Upper memb. of Franciscan series at Corral Hollow [near Livermore, Alameda Co.]; slightly metamorphosed. Younger than Corral Hollow shales.

Oak Ridges moraine.

Pleistocene (Wisconsin stage): Eastern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Oaks shale.

Pennsylvanian: Kansas and Nebraska.

R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.). [*Oaks sh.* is shown as top memb. of Admire sh. and as overlying Houchen Creek ls. and underlying true Americus ls. Whether these beds were included in Hughes Creek sh. as originally defined or are a newly discovered unit was not stated, but it appears that this sh. and overlying true Americus ls. were included in Hughes Creek sh. of previous repts. Derivation of name not stated.]

G. E. Condra, 1935. (See under *Hamlin sh.*)

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated October 16). Type loc. of Oaks sh. is Oaks farm, SW. of Salem, NE¼ sec. 9, T. 1 N., R. 15 E., Richardson Co., Nebr.

Oakville sandstone.

Miocene (middle and lower?): Southwestern Texas.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, pp. 556–559). *Oakville*.—Grits and coarse sand, cross-bedded, with some beds of clay, but oftener with balls, nodules, or lenses of clay embedded in the grit. Assigned to Mio. Overlies Eocene Frio clays and underlies Lapara div. (Plio.).

A. Deussen, 1924 (U. S. G. S. P. P. 126). *Oakville ss.* is 180 to 603 ft. thick. Contains Mio. fossils. Uncon. overlies Catahoula ss. and underlies (probably uncon.) Lapara sand.

Named for Oakville, Live Oak Co.

O-atka beds.

Silurian: Western New York.

G. H. Chadwick, 1917 (see 1917 entry under *Bertie ls. memb.*).

Derivation of name not stated.

Oatka Creek shale (in Marcellus shale).

Middle Devonian: Central and western New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 130–131+). *Oatka Creek sh.*—Upper memb. of Marcellus sh. from Cayuga Lake westward to Seneca Lake, being overlain by Mottville memb. of Skaneateles sh. and underlain by Cherry Valley ls. memb. of the Marcellus. To W. of Seneca Lake the Oatka Creek memb. comprises all of Marcellus and includes time equivalents of (descending) Cardiff memb., Chittenango memb., Cherry Valley ls. memb., and Union Springs memb. In area to W. of Cayuga Lake the Oatka Creek memb. is overlain by Stafford ls., the equiv. of Mottville memb. The Oatka Creek consists of black sh., markedly calc. and fossiliferous, in which characters it differs from black Chittenango sh., which overlies Cherry Valley ls. in E. part of State. Type section is below Main St. bridge over Oatka Creek at LeRoy, where whole section (30 ft.) is exposed. It thickens to E. and to W. to 50± ft. Other exposures are in bed of Conesus Creek at Ashantee, Genesee Valley, and in Flint Creek 1½ mi. NE. of Orleans. At all these localities it is overlain by a thin Stafford ls.

Oatman andesite.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Volcanic flows, but connected in places with intrusive bodies of same rock. Thickness estimated at 2,700 ft. In places intrudes Alcyone trachyte. In places rests on Esperanza trachyte and in places is separated from the Esperanza by 50± ft. of light-colored tuffaceous ss. Exposed N. of Oatman.

Oatman Creek granite.

Pre-Cambrian: Central Texas (Llano uplift).

H. B. Stenzel, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 144). [See under *Six-mile granite*.]

Obispo limestone.

Age (?): Panama.

E. Howe, 1907 (Isthmian Canal Comm. Ann. Rept. 1907, pp. 108–138).

Obispo breccia.

Age (?): Panama.

E. Howe, 1908 (Am. Jour. Sci., 4th, vol. 26, p. 213).

Observatory Hill quartz porphyry.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Marquette County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 519). *Observatory Hill quartz porphyry* occurs 6 mi. N. of outcrop of Marcellon quartz porphyry, in SE¼ sec. 7, town of Buffalo, Marquette Co.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). "May be supposed to be pre-Huronian."

Ocala limestone.

Eocene (upper): Northern and northwestern Florida, southern and western Georgia, and southern Alabama.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 103, 157, 331). *Ocala ls.*—Yellowish friable rock containing many Foraminifera, conspicuous among which are two species of *Nummulites* (*N. willcoxii* and *N. floridana* Hp.), which appears in central Fla. directly and conformably to overlie *Orbitoides* ls. (Vicksburg). It is best displayed at Ocala, Fla., where it forms the country rock and has been quarried to a depth of 20 ft. without coming to bottom of the beds. [Other places where it is exposed are mentioned.] Assigned to "Eocene or 'Oligocene'."

Later studies by C. W. Cooke (see Ala. Geol. Surv. Spec. Rept. No. 14, 1926) have proved this ls. to be of Jackson (upper Eocene) age and to underlie Vicksburg group of lss.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). As now understood Ocala ls. comprises all rock of Eo. age exposed in Fla. This includes "Orbitoidal," "Nummulitic," and "Miliolitic" lss. of Dall as well as "Peninsular" ls. as interpreted by Matson. The Ocala ls. is of Jackson (upper Eocene) age.

†Ocala group.

Eocene: Florida and Georgia.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, p. 331). *Ocala group.*—Typical locality at Ocala, Fla. W. H. Dall, 1892; this essay, p. 331. Includes the various foraminiferal lss. in which the Floridian and Georgian Eocene culminates, above the typical Orbitoides ls. [Vicksburg]. [All of definition.]

Occoquan granite.

Pre-Cambrian: Northeastern Virginia.

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). *Occoquan granite.*—Coarse-grained and sheeted, mainly horizontally; of greenish-gray color. Exposed on Occoquan Run, from Occoquan village to forks of Bull Run, and at other places. Is capped by crystalline schist.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped the granite along Occoquan Run as pre-Camb. and as intrusive into Glenarm series, and mapped the overlying schist as Wissahickon fm.

Oceana limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 164). *Oceana ls.*—Dark gray, lenticular, calc.; 0 to 2 ft. thick. Lies 35 ft. above Glenalum Tunnel coal and is separated from overlying Upper Gilbert ss. by a thin bed of black sh. May possibly belong at horizon of marine Dorothy sh., but no marine fossils found in it. Present at Oceana, Wyoming Co. Not observed in McDowell Co.

Oceanic series.

Oligocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 69–85).

†Ocheesee beds.

Miocene (lower): Western Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 105, 112, 157, 158, 331). *Ocheesee beds.*—Typically developed at Ocheesee, Jackson Co., where there is visible 5 ft. of creamy-white granular ls. with obscure fossil corals, surmounted by 10 ft. of greenish-yellow unfossiliferous argill. ls. At Rock Bluff 30 ft. of ls., in strata of varying purity, are exposed. These lss. are slightly phosphatic and by disintegration afford a rich black loam characterized by growth of *Torregia taxifolia*. The beds as a whole are more siliceous and argill. than those of *Orbitoides* ls., and were estimated by Langdon to have total thickness of 250 ft. He referred them to newest memb. of Eo. or oldest of Mio., under name of "Chattahoochee group." [In table on p. 157 *Ocheesee beds* are shown to include (ascending) "water-bearing sands, Chattahoochee ls., and (?) Cerithium rock (Tampa)," and they are included in his Chattahoochee group.]

Replaced by *Tampa ls.*

†Ochelata member.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 38, chart, and map). *Ochelata memb.*—Chiefly sh., 20 to 85 ft. thick, with persistent ss., 5 to 12 ft. thick, near middle. Underlies Avant ls. memb. and overlies Dewey ls. memb. All included in Ramona fm.

The broader definition of Ochelata of Ohern 1925 (for beds above Dewey ls. and below Nelagoney fm.) is considered more useful unit.

Named for Ochelata, Washington Co.

Ochelata formation.

Pennsylvanian: Northeastern, central northern, and central Oklahoma.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 75). *Ochelata fm.*—Named by D. W. Ohern, in unpublished ms. Chiefly shales, with several ss. and ls. members. Thickness 400 ft. (in Washington and Osage Counties) to 480 ft. or more to S. Underlies Nelagoney fm. and overlies Dewey ls. Includes Avant ls. memb. about 200 ft. above base. Named for Ochelata, Washington Co.

Ochoco erosion surface.

Name applied by J. P. Buwalda, 1930 (Carnegie Inst. Wash. Pub. 404, p. 3), to an erosion surface that "bevels Columbia [River] lava, Mascall fm., and Rattlesnake fm. in parts of Ochoco Range and John Day country, Oreg. May=*Condon erosion surface* of area N. of John Day country."

Ochre Mountain limestone.

Mississippian (upper): Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Ochre Mtn ls.*—Almost entirely massively bedded lss., usually brownish gray on fresh fracture but weather to light bluish gray. Chiefly fine-grained, but locally there are coarser beds. Beds are 1 to 10 ft. thick. Basal hundred ft. includes beds that contain large amounts of chert, some of them being more than half chert. Thickness 4,500± ft. About 1,700 ft. above base of western facies of fm. is a thin, poorly exposed horizon of black sh. interbedded with ss., which is here named *Herat sh. memb.* Fossils are upper Miss. Overlies Woodman fm. and underlies, uncon. (?), Manning Canyon fm. Named for exposures on Ochre Mtn, Gold Hill region.

See also U. S. G. S. P. P. 177, 1934, by T. B. Nolan.

†Ocoee group.

Lower Cambrian: Eastern Tennessee, western North Carolina, and northwestern Georgia.

J. M. Safford, 1856 (Geol. reconn. Tenn., 1st Rept., pp. 149, 151–152). *Ocoee cgls. and slates.*—Grandly exposed along narrows of the Ocoee [Polk Co., Tenn.], hence the name. Is a very heavy fm., many thousand ft. thick; constitutes most of mtn parts of Polk, Monroe, Blount, Sevier, and Cocke [Counties in Tenn.]. The rocks are coarse gray cgls. and talcose, chlorite, and clay slates, all repeatedly interstratified and generally dipping at high angles to SE. The cgl. abounds in quartz and feldspar pebbles; occasionally it is ss. The slates are generally greenish, though dark-purplish clay slates are present; talcose and chlorite varieties mostly prevail. Assigned to Azoic. Overlie Mica Slate group and underlie Chilhowee sss. and shales.

As mapped and more fully described by Safford in his 1869 rept on Geol. of Tenn., his Ocoee group included the fms. later named by A. Keith Clingman cgl., Hazel sl., Thunderhead cgl., Cades cgl., Pigeon sl., Citico cgl., Wilhite sl., Cochran cgl., Hiwassee sl., Nottely qtzite, Andrews schist, Murphy marble, Valleytown fm., Brasstown schist, Tusquitee qtzite, Nantahala sl., Great Smoky cgl., Snowbird fm., and Unicoi fm.

Oconee Creek zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908 in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 8, 12). *Oconee Creek zone* (*Archean*) comprises a belt bounded on NW. by Poor Mtn zone; on SW. by Tugaloo River; on NE. by N. C. line from point intermediate to Horsepasture River and Toxaway Creek to point about 2 mi. E. of Sassafras Gap; on SE. by line from latter point extending to Tugaloo River, near confluence of Chauga River. This zone consists chiefly of granite and granite gneiss derived from porphyry. Its most characteristic form consists of repeated thin wavy bands of quartz, biotite, and muscovite with fine crystalline texture, separated by eyes of pink feldspar (microcline). It probably pertains to Keith's Henderson granite, of which characteristic exposures may be seen at "The Tunnel," in Tunnel Hill zone, and on Oconee Creek immediately below dam at Lays mill. A granite similar in its petrographic relations may be observed in Vaucluse zone at a small quarry 0.1 mi. N. of jail at Edgefield. The Oconee Creek series is regarded as junior to Carolina gneiss series.

Named for exposures on Oconee Creek, Oconee (?) Co.

O'Connell oil zone.

Drillers' name for Plio. beds encountered in wells in Santa Fe oil field, Los Angeles Co., Calif., that lie lower than Buckbee oil zone and higher than Clark oil zone.

†Ocoya Creek beds.

Miocene (middle): Southern California (Kern County).

H. W. Turner, 1894 (Am. Geol., vol. 13, p. 239; and U. S. G. S. 14th Ann. Rept., pt. 2, p. 461). *Ocoya Creek beds* [heading].—Prof. W. P. Blake (Pacific R. R. Repts, vol. 5, pp. 164–173, 1856) reported extensive deposits of Mio. age on Ocoya or Posé Creek and farther S. [Turner mentioned 3 fossil sp. from these beds that had been identified by Gabb.]

In Pacific Railway Repts, vol. 5, pp. 164–173, 1856, W. P. Blake described the Mio. beds along Ocoya Creek, but did not name them. His heading (p. 164) is: *Ocoya Creek-Miocene.* His opening sentence, beneath the heading, is: "The most extensive Mio. deposits examined during course of the survey were at base of Sierra Nevada, around Depot Camp, at Ocoya or Posé Creek." On pl. 1 he gave a graphic "section at Ocoya or Posé Creek." On p. 167 he gave a lithologic description of "section of the strata at Ocoya Creek." On subsequent pages of his description of "Ocoya Creek-Miocene" he nowhere used *Ocoya Creek* in a formational sense. On p. 169 he mentioned beds elsewhere "similar to those seen in the *Ocoya Creek strata.*" On subsequent pages, under descriptions of other geographic areas, in 3 places (pp. 184, 188, 207) he referred to "the Mio. strata of Ocoya Creek" and "the Mio. fm. at Ocoya Creek." On p. 189 in 2 places he mentioned, in correlation, "*Ocoya Creek series.*" It seems evident from a perusal of Blake's rept that he intended to use *Ocoya Creek* in a purely geographic sense. At bottom of p. 45 he refers to "the Mio. fm. along Ocoya Creek." At top of p. 46 he refers to beds that "more nearly resemble the Ocoya Creek beds," and a few lines beneath he refers to soft strata that are "very probably of the same age as the Ocoya Creek fm."

J. P. Smith, 1910 (Jour. Geol., vol. 18, No. 3) and F. M. Anderson, 1911 (Calif. Acad. Sci. Proc., 4th ser., vol. 3) mentioned *Ocoya Creek beds.*

These beds were for a time included in Vaqueros ss., but according to J. P. Smith (Jour. Geol., vol. 18, No. 3, 1910) they carry the *Turritella ocoyana* fauna, and are therefore younger than Vaqueros ss., which is now restricted to beds characterized by *Turritella inezana* fauna. The name *Temblor fm.* is now generally applied to beds carrying *Turritella ocoyana* fauna in this region.

Octh Louie sand.

Drillers' name for a ss., 25± ft. thick, forming basal bed of Mowry sh. in Basin oil field, Bighorn Co., Wyo. Lies 45 ft. below Kimball sand. (See U. S. G. S. Bull. 621, Jan. 21, 1916, pp. 167, 169, etc.)

†Octoraro schist.

Pre-Cambrian: Southeastern Pennsylvania.

See under *Wissahickon fm.*

Named for exposures in banks of Octoraro Creek btw. Lancaster and Chester Counties.

Odanah series.

Upper Cretaceous: Manitoba.

J. B. Tyrrell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 83E–85E, 199E, 212E–215E).

M. Y. Williams, 1932 (Jour. Geol., vol. 40, No. 6, p. 561), correlated *Odanah* of Manitoba with Bearpaw of Mont., Wyo., and Alberta.

Oddie rhyolite.

Tertiary (upper Miocene?): Central Nevada (Tonopah district).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 49+, map, etc.). *Oddie rhyolite.*—White siliceous intrusive rhyolite. Makes up Mount Oddie and Rushton Hill, Tonopah dist. Intrudes later andesite, Fraction dacite breccia, Tonopah glassy rhyolite-dacite breccia, and Siebert tuffs. Is apparently of about same age as Brougher dacite and of same nature and origin.

J. A. Burgess, 1909 (Econ. Geol., vol. 4, pp. 681–712), assigned this fm. to Plio., but A. Knopf, 1921 (U. S. G. S. Bull. 715), said it is probably upper Mio.

Odell shale. (In Sumner group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv., Bull. 6, 2d ser., p. 59). *Odell sh.*—Basal memb. of Enterprise fm., limited by Krider ls. above and by either Cresswell ls. or transitional top of Luta ls. below [see under *Cresswell ls.*], and generally consisting of 3 zones, as follows (descending): (1) Olive-drab to buff sh., with top 1 ft. becoming quite calc., somewhat fossiliferous, and transitional to Krider ls., 3½ ft.; (2) chocolate-maroon shales, distinctive because of banded appearance due to presence of thin persistent seams of bright olive and light-greenish argill. sh., 18 ft.; (3) olive-drab to gray argill. massive shales with some calc. content, geodal, and some chalcedony concretions, 8 ft. or more. Thickness of Odell sh., 30± ft. in Nebr. and 37 or 38 ft. in vicinity of Arkansas City, southern Kans. Type loc. ravines and highway cuts ¼ mile S. and 2¼ mi. E. of Odell, Gage Co., Nebr.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), treated *Odell sh.* as distinct fm.

Odenville limestone.

Lower Ordovician (Beekmantown): Northern central Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 99, etc.). *Odenville ls.*—Impure argill. and siliceous dark fine-grained cherty ls., 50± ft. thick. Overlies Newala ls. and uncon. underlies Mosheim ls. Only known exposure is in a cut or borrow pit on N. side of Seaboard Air Line Ry about ⅛ mi. E. of Odenville, St. Clair Co. Contains Beekmantown fossils.

Offley Island formation.

Silurian: Greenland.

C. Poulsen, 1934 (Meddelelser om Grönland, Band 72, 2d Afd., No. 1).

Ogalalla.

See *Ogallala*, the correct spelling.

Ogallala formation.

Miocene (upper) and Pliocene: Western Nebraska, northeastern Colorado, southeastern Wyoming, southern South Dakota (?), western and central Kansas, western Oklahoma, northwestern Texas, and eastern New Mexico.

N. H. Darton, 1898 (U. S. G. S. 19th Ann. Rept., pt. 4, pp. 732–742). *Ogallala fm.*—Calc. grit or soft ls., sandy clay, and sand, with basal cgl. at many places. Of late Tert. (Plio.?) age. Thickness 150 to 300 ft. Uncon. underlies *Equus* beds and uncon. overlies Arikaree fm. Extends from Kans. and Colo. far into Nebr. Is a part, if not the whole, of the deposit which in Kans. and southward has been called "Mortar beds," "Tertiary grit," and other names. Is upper part of Loup Fork beds, the lower part of Loup Fork being Arikaree fm.

N. H. Darton, 1920 (U. S. G. S. Syracuse-Lakin folio, No. 212). *Ogalalla fm.*—Thick sheet of sand and gravel (chiefly sand) of late Tert. age, which constitutes surface of Great Plains in western Kans. region and occupies most of highlands of Syracuse and Lakin quads. Extends across Haskell, Grant, and Stanton Counties. Surface considerably eroded, but base is not cut through except by Bear Creek, W. of Johnson. Thickness 180 to 300 or more ft. Is believed to be a strat. unit and to be continuous from type loc. near Ogalalla Station in western Nebr. Hay supposed the deposits comprised 2 fms., "Plains marl" at top and "mortar beds" below, but later studies by Haworth, Adams, and others have shown that these apparent divisions are local features and that generally fine-grained sediments alternate with the coarser "mortar beds" at different horizons. It is possible the 300 ft. or more of beds that constitute Ogalalla fm. comprise deposits elsewhere separable, even including locally in their upper part a representative of McPherson fm. ("*Equus* beds"). Apparently no separation is practicable in this region. Originally the entire fm. was known as "Loup Fork beds," but this term also included Arikaree fm., which is older than the Ogalalla and apparently does not extend into Kans. No fossils in or near these quads., but many bones have been found in the Ogalalla area elsewhere in Nebr. and northern Kans. They range in age from very late Mio. to early Pleist., indicating a longer range in time than would appear to have been required for the continuous deposition of the Ogalalla. Most of material appears to have been laid down rapidly by streams, although the fine-grained strata required considerable time for their accumulation. It is believed the bones of Pleist. age found in some places are in local deposits of later age that overlie true Ogalalla, which appears more likely to have been laid down in Plio. and late Mio. time. In the valleys and in places on the uplands the Ogalalla grades up into fine sands and silts, which appear to have been carried and deposited by the wind at various times from Tert. to very recent. In part these are *Plains marl* of Hay, and fossils found in them are Recent.

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, Kans. Geol. Surv. Bull. 18, pp. 131–180). *Ogallala fm.* is here restricted to beds beneath "Plains marl." In Wallace Co., Kans., the Ogallala rests uncon. on Pierre sh. and is uncon. overlain by Pleist. loess here named *Sanborn fm.* It is usually buff-colored to pinkish and chiefly unsorted sand and gravel, usually mixed in various proportions with fine dust (loesslike fine sand or silt), which makes the rocks of the fm. rough to the touch. In some areas fine unctuous clays of light-green and reddish-brown colors constitute important beds in lower part of fm., and in middle and, especially uppermost parts, lenses of white and pinkish ls. occur. Beds of gravel and light-gray or greenish sorted sand, some cross-bedded, occur in places. The name Sanborn fm. is proposed for the Pleist. loess, with some gravel and sand at base, that is widely distributed on the divides in western Kansas, and is intended as a substitute for the old terms "Tertiary marl" or "*Plains marl*" of Hay. "As far as present experience indicates *Biorbia rugosa* fruits are the most valuable index fossil of the Ogallala in the restricted sense." Fossils found in middle part of typical "mortar beds" of Wallace Co. are Lower Plio. No identified bones were collected near base or near top of Ogallala in Wallace Co., but unbroken continuity of the fm., which is composed largely of coarse material and is only about 200 ft. thick, suggests possible completion of its sedimentation within Lower Plio. One mi. W., and also SW., of Guy Woodhouse ranch bentonitic clays of bright mottled colors are exposed, which writer named *Woodhouse clays*. These clays are a local lateral change in lithology of lower half of Ogallala fm. The prel. examination by H. T. Martin of vertebrate remains from the Woodhouse clays showed decisively they may belong to either Mio. or Lower Plio., or to the age of Ogallala fm. of Wallace Co. [See also under *Woodhouse clay* and under *Rhinoceros Hill beds*. Elias has visited Ogallala, Nebr., and presents his interpretation of where base of Ogallala fm. should be drawn.]

C. J. Hesse, 1935 (Univ. Kans. Sci. Bull., vol. 22, No. 5, pp. 79–117), described and figured vertebrate fauna from Feldt ranch, Nebr., which he stated is type loc. of Ogallala fm. He assigned the fossils collected to Mio., Plio., and Pleist., but stated the latter are not regarded as belonging to the Ogallala. "So far as I am able to determine there is no satisfactory indication that the Ogallala should be subdivided."

H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, pp. 43 (footnote), 44), assigned Ogallala fm. to Plio. and upper Mio.

See also under *Arikaree fm.*

Named for exposures around Ogallala (correct spelling), Keith Co., Nebr.

Ogan clay. (In Allegheny formation.)

Name applied to the plastic clay, 2 ft. 8 in. thick, underlying Ogan coal and lying 16 ft. 4 in. above Putnam Hill ls. in Vinton Co., Ohio. (See W. Stout, Ohio Geol. Surv., 4th ser., Bull. 31, 1927.)

†Ogden quartzite.

Middle and Lower Cambrian: Northeastern Utah (Ogden Canyon).

C. King, 1876 (Am. Jour. Sci., 3d, vol. 11, pp. 477–479). *Ogden qtzite.*—Usually white or pale green, very fine-grained and slightly schistose toward top, and contains zones of cgl. consisting of remarkably smooth quartz pebbles in a fine siliceous matrix. Thickness 1,000 to 1,600 ft. Named for development in Ogden Canyon, Utah. Overlain by Wasatch ls. (Carbf. and Dev., 7,000 ft. thick) and underlain by Ute ls., of Quebec [Ord.] age. The Ogden is provisionally assigned to Dev. In western Nev. it is 700 or 800 ft. thick and is also seen to lie btw. upper and lower Helderberg [Dev.] horizons.

S. F. Emmons, 1907 (Geol. Soc. Am. Bull., vol. 18, p. 297), assigned Ogden qtzite to Ord.(?), and F. B. Weeks (p. 432 of same publication) assigned it definitely to Ord., as did H. S. Gale, 1910 (U. S. G. S. Bull. 415, p. 46).

E. Blackwelder, 1910 (Sci., n. s., vol. 32, p. 188), stated that Ogden qtzite appears to be neither Dev., as first reported, nor Ord., as stated in more recent years, but a repetition of the Lower Camb. qtzite due to overthrusting. In U. S. G. S. Bull. 430, p. 539, 1910, Blackwelder reported 500 to 2,000 ft. of Ord. ls. "with local sh. and qtzite" in Ogden region, but not in Ogden Canyon. Later (Geol. Soc. Am. Bull., vol. 21, pp. 519, 526–527, Sept. 1910) he proposed *Geneva* for the Ord. qtzite from which F. B. Weeks (unpublished ms.) reported Ord. fossils. He also adopted Brigham for the Camb. qtzite, and proposed the abandonment of Ogden qtzite. (See under †*Geneva qtzite.*)

G. B. Richardson, 1913 (Am. Jour. Sci., 5th, vol. 36, pp. 407, 409), proposed *Swan Peak* for the Ord. qtzite (Geneva being preoccupied) and adopted *Brigham* for the Camb. qtzite. These are the present approved names for these qtzites. It seems apparent that King mistook the Ord. qtzite (which is not present in Ogden Canyon) for the upper qtzite in Ogden Canyon, which is now generally conceded to be an overthrust of the Brigham qtzite (Middle and Lower (?) Camb.). There is no Dev. qtzite in Utah. The name †Ogden qtzite has been abandoned, owing to the confusion resulting from its misapplication.

Ogden flint.

Permian: Central Kansas.

C. S. Prosser, 1894 (Geol. Soc. Am. Bull., vol. 6, p. 48). If for any reason the local name *Wreford ls.* should not prove desirable, on account of prominence of this ledge near Ogden, it might appropriately be called *Ogden flint.*

Ogdensburg formation.

Lower Ordovician: Northern New York (Saint Lawrence Valley).

G. H. Chadwick, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 289, 291). In St. Lawrence Valley the *Upper Beekmantown* (*Ogdensburg*) *dol.* lies uncon. on *Bucks Bridge* (*approx.=Tribes Hill*) *mixed beds or fm.*

H. P. Cushing, 1916 (N. Y. State Mus. Bull. 191). *Ogdensburg fm.*—Alternating beds of massive blue-gray granular dol. and thin-bedded iron-gray fine-grained dol. with occasional bed of gray calc. ss. Thickness more than 120 ft. Is upper fm. of Beekmantown in Ogdensburg region, and according to letter from Ulrich dated Jan. 13, 1915, it corresponds, at least essentially, to div. D of Beekmantown. Uncon. overlies Tribes Hill fm., lower fm. of Beekmantown.

G. H. Chadwick, 1920 (N. Y. State Mus. Bull. 217, 218). *Ogdensburg dol. or upper Beekmantown ls.* in Canton quad. underlies a possible outlier of Trenton ls. and rests discon. on Bucks Bridge mixed beds (roughly=Tribes Hill). Thickness perhaps 50 ft., basal part only being present. Typical sections near Ogdensburg.

Ogima amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs to Central Mine group. Is younger than Evergreen amygdaloid and older than South Butler amygdaloid. The mineralized part is the Ogima lode. Named for occurrence in Ogima mine, Ontonagon Co.

Ogima flow.

Includes Ogima amygdaloid and underlying trap.

Ogishke conglomerate member (of Knife Lake slate).

Pre-Cambrian (Knife Lake series): Northeastern Minnesota (Vermilion district).

A. Winchell, 1887 (Minn. Geol. Nat. Hist. Surv. 15th Ann. Rept., pp. 149, 179). *Ogishke cgl.*—Solid and indestructible cgl. of several varieties of granitic and quartzose boulders embedded in a finely granular, mostly greenish groundmass. Also includes boulders of flint, jasper, granulite, porphyry, and "greenstone." Exposed on SW. shore of Ogishke-Muncie Lake, and attains enormous development in region of that lake.

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept., btw. pp. 330 and 367), gave thickness of *Ogishke cgl.* as 4,500 ft., but later repts place thickness at 1,000 to 2,000 ft. He also used *Ogishke group* in what he seems to have regarded as a broader sense than *Ogishke cgl.*, but his Ogishke group was described as consisting of cgl., "10,000 ft., but local. (Perhaps half this.)"

C. R. Van Hise and J. M. Clements, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Ogishke cgl.*—Slates and cgls. underlying the Lower Huronian iron-bearing fm. [Agawa fm.] and uncon. overlying the Archean. Been known by this name for years.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 130–131). *Ogishke cgl.*—Consists of 4 varieties: (1) Greenstone cgl. where it rests on Ely greenstone; (2) granite cgl. along W. border of Lake Saganaga; (3) porphyry cgl., called "Stuntz" cgl. and "Stuntz Island aggl.;" and (4) chert and jasper cgl. where it lies on Soudan fm.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), included Agawa iron fm. memb. and *Ogishke cgl. memb.* in Knife Lake sl., which they tentatively removed from Huronian series and assigned to *Knife Lake series* (pre-Huronian and post-Laurentian).

†Ogishke dolomite.

A name applied by A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept.), to a 10-foot bed of dol. in Ogishke cgl.

Ogishke "group."

See 1888 item under *Ogishke cgl.*

Ogontz member (of Stonington beds).

Upper Ordovician: Northern Michigan (Delta County).

R. C. Hussey, 1926 (Univ. Mich. Mus. Geol. Contr., vol. 2, pp. 113–150). *Ogontz memb.*—Top memb. of Stonington beds. Mostly cherty ls., but varies from soft and argill. ls. to hard and cherty; is massive and irregularly bedded; ranges from light gray through yellowish brown to dark brown, the softer material usually in irregular bands and lenses; a well-defined layer of intraformational cgl. 1 ft. 3 in. thick near top. Thickness of memb. 3 ft. to 20 ft. 2 in. Outcrops 6 mi.

NW. of Ogontz, on farm of Andrew Barbeau N. of Ensign, and at other places along E. shore of Little Bay de Noc for 6½ mi. N. of Lighthouse Point. Overlies Bay de Noc memb. and underlies Big Hill beds.

Ohara limestone member.

Mississippian: Western Kentucky and southern Illinois.

E. O. Ulrich and W. S. T. Smith, 1905 (U. S. G. S. P. P. 36, pp. 24, 41). *Ohara ls.*—Thin-bedded fine-grained earthy lss. and shaly lss., interbedded with soft greenish calc. and clayey shales and so-called marls; 30 to 107 ft. thick. Topmost memb. of Ste. Genevieve ls. in western Ky. Overlies Rosiclare ss. memb. of Ste. Genevieve and underlies Cypress ss. [not true Cypress but Bethel ss.]. [See S. Weller's views of this memb. under *Shetlerville fm.*; E. O. Ulrich and C. Butts contend that all of Ohara ls. memb. is present at Ste. Genevieve and that all of it belongs to Ste. Genevieve ls.]

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430, 439). *Ohara* as originally defined should not be considered a strat. unit, because it transgresses an important uncon. and is capable of easy subdivision. The part that has been termed "Upper Ohara" is strictly equiv. to the Renault of Ill. [Some geologists do not accept this correlation.] The "Lower Ohara" is a well-defined memb. of the Ste. Genevieve and is worthy of a distinctive name. Were it not for persistent use of *Ohara* by Butts and Ulrich for beds of Renault age in western Ky. and probably elsewhere, this name might be redefined and restricted to lower part of original memb. Under the circumstances, however much the writers regret doing so, it seems advisable to reject *Ohara* as a name made useless by nearly 30 years of misinterpretation, and the name *Levias*, with type loc. just E. of town of that name in Crittenden Co., Ky., is now proposed for uppermost memb. of the Ste. Genevieve btw. Rosiclare ss. below and Renault fm. above in western Ky. and adjacent part of southern Ill. [The Renault fm. of Weller includes Renault fm., Bethel ss., and upper part of Ohara ls. memb. of Ste. Genevieve ls. of Ulrich and Butts.]

See also under *Ste. Genevieve ls.*

Named for Ohara, Caldwell Co., Ky. The P. O. was for many years known as Cedar Hill or Cedar Bluff.

In May 1937 the U. S. Geol. Survey decided (1) to adopt Weller's interpretation that the "Upper Ohara" of repts is a part of Renault fm.; (2) to adopt Levias ls. (="Lower Ohara" of repts) as top memb. of Ste. Genevieve ls.; and (3) to include Ste. Genevieve ls. in Meramec group.

Ohio shale.

Upper Devonian: Ohio and north-central Kentucky (north of 37°15′).

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, p. 62). *Ohio black sl.*—Black bituminous sl., 320 ft. thick, overlying Corniferous ls. [Delaware ls.] near Columbus, Ohio. Overlies Cliff ls. in Adams County, Ohio, and underlies Waverly ss. group.

As thus defined Ohio sh. included at base the blue Olentangy sh., but Olentangy sh. has for many years been excluded from the Ohio. There is some question about relation of Cleveland sh. of northern Ohio to Ohio sh. Latter name is applied by U. S. Geol. Survey in Ohio and as far S. in Ky. as 37°15′; S. of that line Chattanooga sh. is recognized fm. (See also under *Chattanooga sh.* and †*Black sh.*)

Named for Ohio River hills.

†Ohio conglomerate.

A name applied in some early Ohio repts to Sharon cgl. memb. of Pottsville fm.

Ohio Creek conglomerate.

Eocene: Western Colorado (Gunnison County).

W. Cross, 1892 (Am. Jour. Sci., 3d, vol. 44, pp. 21–23). *Ohio Creek beds.*—Two small isolated patches of loose friable sss., grits, and fine cgls., resting on coal measures of

Laramie fm. and seemingly in small basins of erosion. The chert pebbles contain crinoid stems and other apparently Carbf. fossils of identical character with those frequently found in basal cgl. of Ruby beds near Irwin. These facts suggest the chert pebbles of Ruby cgl. may be the residuum from destruction of Ohio Creek beds formerly existing to N. of Anthracite Range. No fossils except carbonized plants. Lithologic and strat. evidence suggests it may possibly represent Arapahoe fm. and that Ruby beds may represent Denver fm. Rests uncon. on Laramie fm.

W. T. Lee, 1912 (U. S. G. S. Bull. 510, pp. 18, 48–49). *Ohio Creek cgl.*—In Grand Mesa and West Elk Mtn coal fields consists of 100 to 200 ft. of white friable conglomeratic ss. containing pebbles of quartz, jasper, and igneous rock. Uncon. overlies Mesaverde fm. and uncon. underlies Wasatch ("Ruby") fm. May be of Fort Union age.

Ohio River formation.

Post-Carboniferous (late Tertiary ?): Southern Indiana.

G. H. Ashley, 1903 (Ind. Dept. Geol. and Nat. Res. 27th Ann. Rept., p. 68). *Ohio River fm.*—Remnants, 20 to 30 ft. thick, of once extensive deposit of sand and gravel overlying Coal Measures and underlying Quat. along divide btw. streams flowing E. into the Ohio or Silver Creek and streams flowing W. or S.

Ohio Trap Rock traps.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 19). *Ohio Trap Rock traps.*—We next pass alternating belts of sed. and trappean rocks as follows: Cgl. 75 ft. wide, trap 400, cgl. 80, traps for 270 ft., ss. 30 ft., followed by traps for 390 ft., succeeded by a belt of cgl. 86 ft. wide. Little of a definite character is known of these alternating belts. They are exposed on or near the old Ohio Trap Rock or Colling Locations, and have not, I believe, been positively identified E. of these points. Their position, however, is deducible from analogy and comparison. From data collected, it is probable that last-mentioned belt of cgl. is identical with the belt exposed 500 ft. N. of old Forest mine, and termed Forest cgl. [From description they seem to lie 1,396 ft. higher than Norwich traps.]

†Oil City lime.

A name applied to a subsurface Penn. ls., 0 to 45 ft. thick, in central northern Okla. that is believed to correspond to Avant ls. memb. of Ochelata fm.

Oil Creek formation.

Lower Ordovician (Chazy): Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich, 1928 and 1930. [See under *West Spring Creek fm.*]

C. E. Decker, Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1498–1505). *Oil Creek fm.*—Consists chiefly of dolomites and lss., with some sh. and ss. beds, and at base a ss. from 8 to 200 ft. thick. Underlies McLish fm. and overlies Joins fm. Thickness of fm. 1,600 to 2,300± ft. Of Chazy age.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 11+). The *Simpson* is here raised to a *group*, divided into 5 fms. (ascending) Joins, *Oil Creek*, McLish, Tulip Creek, and Bromide. Oil Creek is of lower Chazyan age.

See also 1933 entries under *Simpson fm.*

Named for exposures on Oil Creek, W. Johnston Co. and SE. Murray Co.

Oil Creek third sand.

Generally known as "Third sand" in Allegany Co., N. Y. Lies 1,000 ft. above Allegany sand in wells.

Oil Creek Lake group.

Mississippian and Upper Devonian: Northwestern Pennsylvania.

J. P. Lesley, 1895 (2d Pa. Geol. Surv. Final Rept., vol. 3, pt. 1, p. 1767). *Oil Creek Lake group*, 130 ft. thick at Oil Creek Lake, 14 mi. NW. of Titusville, may be considered lowest part of Pocono ss. (No. X) of eastern and middle Pa. and corresponds to Berea group of Ohio. [This name is not used in Ohio.] Includes Corry ss. (=Berea grit), Cussewago ls., Cussewago shales, and Cussewago ss. Overlies Riceville sh.

Oilfields shale.

See under *Lillis sh., J. H. Ruckman, 1931.*

Oil Lake group.

Mississippian and Devonian (?): Northwestern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 91–98). *Oil Lake group.*—At Oil Creek Lake, Crawford Co., is 130 ft. thick. Divided into (descending): Corry ss., 20 ft.; Cussewago Upper shales, 5 ft.; Cussewago ls., 2 ft.; Cussewago Middle shales and flags, 30 ft.; and Cussewago ss., 25 ft. Underlies Orangeville sh. and overlies Riceville shales.

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, p. 464), seems to discard "Oil Lake group," as he quotes the name and shows it as including Corry ss. (at top), Bedford sh., big hiatus, Hayfield sh., and Cussewago ss. (at base).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 39–53, 102, table opp. p. 61), advocated use of *Oil Lake series*, as he called the unit extending from top of Berea ss. down to top of Riceville sh., or "the oldest major division of the Mississippian," including *Berea stage* and *Cussewago stage*, as he called them. In Ohio he included Berea, Bedford, Hayfield, and Cussewago ss., and stated there is discon. at top of Berea.

Other workers have ignored the name.

K. E. Caster, 1935 (A. A. P. G. Bull., vol. 19, No. 6, p. 913). *Oil Lake series*, suggested (1933) by writer for Miss. part of the Bradfordian, includes, in upper part, Corry ss. The Oil Lake series is to writer clearly Miss.

G. H. Chadwick, 1935 (A. A. P. G. Bull., vol. 19, No. 6, p. 915), dissents from Caster's claim of Miss. age of *Oil Lake beds*. He considers them Upper Dev.

Oil Springs.

See 1st entry under †*Popo Agie beds.*

Ojibway.

Name applied to a glacial lake, of Pleist. age, in Canada, north of Great Lakes.

Ojinaga formation.

Cretaceous: Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 326).

Ojo Alamo sandstone.

Upper Cretaceous: Northwestern New Mexico (San Juan County).

B. Brown, 1910 (Am. Mus. Nat. Hist. Bull., vol. 28, pp. 267–274). Less than a mi. S. of the store at Ojo Alamo the Puerco fm. rests uncon. on a cgl. composed of red, gray, yellow, and white pebbles. Below the cgl. is a series of shales and sss. evenly stratified and usually horizontal. The shales below the cgl. that contain numerous dinosaur and turtle remains I shall designate as *Ojo Alamo beds*. They were estimated to be about 200 ft. thick, but owing to lack of time I was unable to determine their relation to underlying fms.

W. J. Sinclair and W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, pp. 300–304). Puerco fm. [of Ojo Alamo and Barrel Spring Arroyos] rests with marked erosional uncon. on a coarse cross-bedded conglomeratic yellow-brown ss. 28 to 66 ft. thick, which rests discon. on rusty-yellow, bluish, greenish, and wine-red banded clays with lenses of yellow channel ss. having max. measured thickness of 58 ft. and containing abundant but badly crushed dinosaur bones, ceratopsian, trachodont, and carnivorous, also turtles, crocodiles, and garpikes. This lies conformably on a lower cgl., 6 to 8 ft. thick, which varies from a pebbly ss. to a coarse cgl., with waterworn, chatter-marked qtzite, jasper, andesite, and porphyrite pebbles, the source of which has not been traced. This lower cgl. lies discon. on a series of bluish shales, or rather clay, containing dinosaur remains. [All these beds were included in *Ojo Alamo beds of Brown* according to table at end of paper.]

C. M. Bauer, 1916 (U. S. G. S. P. P. 98K). Overlying Kirtland sh. with apparent conformity is a thin fm. of conglomeratic ss. and sh. These beds were first described by Barnum Brown, who named them *Ojo Alamo*, from locality in which they were examined, but assigned no base and indicated no relation btw. them and underlying beds. On Ojo Alamo Arroyo Brown found dinosaur-bearing sh. below a cgl., which is overlain uncon. by Puerco fm. Later Sinclair and Granger examined Ojo Alamo locality and found that the dinosaur-bearing sh. on Ojo Alamo and Barrel Spring Arroyos is split by a thin cgl., referred to by them as "lower cgl." The discrepancies in these descriptions and failure of these investigators to assign a strat. or paleontologic lower limit to Ojo Alamo beds call for a more accurate definition. Writer made careful study of the beds in type loc. On Ojo Alamo and Barrel Spring Arroyos the succession of sh. and cgl. described by Sinclair and Granger was noted. Section measured by writer on Ojo Alamo Arroyo shows (descending): (1) "upper cgl.," 25 ft.; (2) wine-red and bluish-gray banded shales interbedded with lenses of gray-white, easily eroded ss., 34 ft.; (3) poorly consolidated cgl., 9 ft. Has irregular base, the irregularities amounting to 2 or 3 ft. in a horizontal distance of 50 ft.; (4) bluish-gray to greenish-gray sh., banded here and there with purplish beds and gray-white ss. lenses. Both shales mentioned above contain dinosaur and turtle remains. However, the lower cgl. has been traced laterally to points where the sh. btw. it and the upper cgl. is absent and only a single lithologic unit is present. The lower sh. is lithologically like and conformable with underlying beds and is clearly a part of Kirtland sh. Brown placed upper limit of his Ojo Alamo beds at base of "upper cgl.," and Sinclair and Granger placed it at top of "upper cgl.," and neither of them assigned a lower limit to fm. As writer found the fm. to be essentially a ss. including lenses of sh. and cgl., it seems desirable to call it *Ojo Alamo ss.* and to define it as consisting, on Ojo Alamo Arroyo, of 2 conglomeratic beds and the sh. lenses which they include. Its thickness where overlain by Puerco fm. ranges from 63 to 110 ft. The Ojo Alamo ss. is highly cross-bedded, and pebbles of ss., andesite, felsite, porphyrite, gneiss, and schist are fairly common at different horizons or are scattered through it irregularly. In some places lower 20 or 30 ft. is almost lacking in pebbles.

J. B. Reeside, Jr., 1921 (U. S. G. S. Bull. 716G, p. 173). Field work done by writer in 1920 has shown that a thinning wedge of Animas fm. extends as far S. as San Juan River. The Ojo Alamo ss. extends N. upon the Animas wedge as far as T. 31 N., R. 13 W., where Puerco or Torrejon beds rest on Animas beds. The base of Animas wedge in N. Mex. is apparently conformable, but in Colo. it is clearly uncon. on Kirtland sh. To SE. of Escavada Wash the Ojo Alamo ss. is also clearly uncon. on Kirtland sh., and it is likely both Animas and Ojo Alamo belong with the later rather than with the earlier beds. Full discussion of these new data is in preparation.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134), separated uppermost part of Kirtland sh. of Bauer as a distinct fm., to which he applied the name *McDermott fm.*, and stated that *Ojo Alamo ss.* as now defined rests uncon. upon the McDermott near Ojo Alamo, N. Mex. Also that Ojo Alamo ss. and at least lower part of Animas fm. as restricted in this rept are of nearly same age and overlie the most widespread strat. break in whole series of beds described. Also that Animas fm. as now restricted wedges out a few mi. SW. of Durango, Colo.

C. H. Dane, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 14, p. 407) and 1937 (U. S. G. S. Bull. 860C), transferred Ojo Alamo ss. from Tert. (?) to Upper Cret. and J. B. Reeside, Jr., concurred in transfer.

Ojo Bonito porphyry.

Cretaceous (?): Western Texas (Chinati Mountains).

C. L. Baker, 1929 (Univ. Tex. Bull. 2901, pp. 73–74, 79–82). One of intrusives outcrops in valley of Cibolo Creek, at E. foot of main mass of Chinati Mtns, and will be called *Ojo Bonito porphyry*. It is a coarse-grained porphyry. Is covered on SW. and S. sides by the volcanic series, and it probably underlies that series in SE. part of Chinati Mtns proper. Is post-Trinity Cret.

Okanogan.

Pleistocene: Washington.

C. [R.] Keyes, 1927 (Pan-Am. Geol., vol. 47, p. 353). Some such title as *Okanogan*, possibly, will have to be used for what is commonly known as the Spokane till, since the latter term is preoccupied by Walcott, for a Proterozoic sh. terrane in Mont.

Okaw formation. (Of Chester group.)

Mississippian: Southwestern Illinois.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 127). *Okaw fm.*—Series of alternating dark-blue to gray and nearly white lss. and soft shales, 150 to 200 ft. thick, with four, and perhaps five, important ls. members, the uppermost of which is the quarry ledge at the Penitentiary, which is overlain by 10 to 12 ft. of calc. shales, with thin lss. interbedded, forming top part of Okaw fm. Underlies Menard fm. and overlies Ruma fm.

E. O. Ulrich, 1917 (Ky. Geol. Surv., Miss. fms. of western Ky., pt. 2, pp. 55-61, 112-113). Typical *Okaw ls.* underlies, with probable hiatus, a ss. that apparently corresponds to Hardinsburg ss., and overlies, with probable break, Ruma fm. It is believed to be essentially contemp. with Cypress ss.

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41). *Okaw fm.* of Randolph Co., Ill., is = Glen Dean ls., Hardinsburg ss., and Golconda fm., and is overlain by Menard ls. [restricted].

S. Weller, 1920 (Jour. Geol., vol. 28, pp. 285, 298-303). *Middle Chester or Okaw group.*—Includes (descending) Glen Dean ls., Hardinsburg ss., Golconda ls., and Cypress ss. Underlies Tar Springs ss., basal fm. of Upper Chester group.

A. H. Sutton, 1934 (Jour. Geol., vol. 42, No. 6, pp. 622+). Purpose of this article is to show that the Okaw consists of 2 well-defined portions separated by a discon. Weller (ms. Rept. on geol. of parts of St. Clair, Monroe, and Randolph Counties, Ill.) noted this erosion surface but did not recognize a late Chester age for the Okaw beds above it. During summers of 1932 and 1933 writer examined the Okaw and identified in it 5 and possibly 6 fms. of standard Chester section. These fms. have been grouped into 2 well-defined mappable units, one of middle Chester and one of late Chester age, and each correlated with a definite portion of the Chester farther E., in Eastern Interior Basin. Although *Okaw* has been used with different meanings, it is retained, and the 2 divisions designated *Lower* and *Upper Okaw*. Writer believes this is justified because name is well known and because these strat. units occur in only a limited area. Following is writer's section for SW. Ill.:

Menard.
Okaw:

Upper Okaw [mapped]: Waltersburg memb. Vienna memb. Tar Springs memb.	Upper Chester (in part).
Lower Okaw [mapped]: Glen Dean memb. Hardinsburg memb.* Golconda memb.	Middle Chester.

Conformity.
Cypress (Ruma).

* Believed to be represented by 1 to 3 ft. of chert and cherty ss. that occurs in area S. of Marigold, which is only place Glen Dean and Golconda can be separated with any degree of certainty.

The U. S. Geol. Survey in 1914 adopted *Okaw fm.* as defined by Weller in 1913.

Named for Okaw or Kaskaskia River, SW. Ill., whose valley is entirely excavated in these rocks. The several members of fm. are well exposed in Mississippi River bluffs above and below mouth of the Okaw.

Okay limestone lentil (of Pawhuska formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

K. C. Heald, 1918 (U. S. G. S. Bull. 686E, pp. 28-32). *Okay ls. lentil of Pawhuska ls.*—Lowest ls. in Pawhuska fm. in T. 25 N., R. 9 E. Lies 10± ft. above Elgin ss. and 50 to 100 ft. below Deer Creek ls. memb. of Pawhuska fm. Color ranges from gray to buff, but buff predominates. In most places is of flinty hardness and contains abundant small *Fusulina*, but either or both of these features may locally be absent. Thickness 0-1 ft. Does not crop out N. of Clear Creek in this twp. and although it extends to S. line of T. 24 N. it has not been noted by geologists working the territory to S. Named for good exposures on and in neighborhood of O. K. ranch, in sec. 31.

†Okefenokee formation. (In Columbia group.)
Pleistocene: Georgia Coastal Plain.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 60, 424–434). *Okefenokee fm.*—In part coastal-terrace deposits and in part river-terrace or fluviatile deposits. During this period there was probably a depression of the land, the coast line perhaps being 40 to 75 mi. W. of its present position. Coastal sands and probably other sediments were laid down, forming a terrace, and contemp. fluviatile deposits were formed on terraces skirting the larger rivers as far as the Fall Line. The coastal terrace formed during this period is a flat plain 20 to 40 mi. wide, which varies in elev. from 60 to about 125 ft. above sea level. It is covered with gray and white quartz sand. The river terraces lie 50 to 100 ft. above zero water level and form prominent topographic features along Savannah, Ocmulgee, and Chattahoochee Rivers. The terrace deposits consist of sands and gravels of fluviatile or fluvio-estuarine origin. The Okefenokee is older and higher than Satilla fm. Is not in contact with any fm. older than Plio. and Mio. Thickness 5 to 40 ft. Included in Columbia group.

The Pleist. terrace deposits of Atlantic Coastal Plain from Del. to Fla. are now divided into the 7 fms. enumerated under *Columbia group*, and Satilla and Okefenokee fms. have been abandoned.

Named for Okefenokee Swamp, a great swampy tract in southern Ga. covering part of Charlton, Ware, and Clinch Counties. The swamp occupies a portion of the plain on which these deposits were laid down.

Okesa sandstone member (of Ochelata formation).
Pennsylvanian: Central northern Oklahoma (Osage County).

O. B. Hopkins, 1918 (U. S. G. S. Bull. 686H, pp. 76–77, pl. 12). *Okesa ss.*—Named by F. R. Clark, in rept on T. 26 N., R. 11 E. (U. S. G. S. Bull. 686–I, 1918). In N. part of T. 25 N., Rs. 11 and 12 E., it consists of 3 prominent ss. beds separated by thin beds of sh., and aggregates 30± ft. in thickness. Is separated from overlying Bigheart ss. by 50 to 100 ft. of red clay sh.; in places a thin ls. occurs 7 ft. above it. Increases in thickness to S., so that on line btw. Twps. 25 and 24 N., R. 11 E., it replaces most of underlying sh. (25 ft. thick in places), and locally rests on Torpedo ss. Named for exposures near Okesa.

F. R. Clark, 1918 (U. S. G. S. Bull. 686–I, p. 95). *Okesa ss.* so named because it crops out near railroad station and town of Okesa, forming first prominent bench ½ mi. to SE. Lies 65 to 115 ft. below Buck Point ss. Thickness 20 to 30 ft. In vicinity of Okesa it consists of one bed, which contains numerous pelecypods and a few brachiopods, but in most places within this area two benches are developed, separated by sh. The lower bench is generally massive and forms a ledge, and its upper surface contains fossils. A thin nodular ls. crops out at many places about 5 ft. above lower bench. The upper bench, which lies 10 to 13 ft. above the lower, is thinner and not so well exposed, but wherever seen it contains many pelecypods. The Okesa is separated from underlying Torpedo ss. by 25 to 75 ft. of sh.

Oketo shale. (In Chase group.)
Permian: Central Kansas.

R. C. Moore, Sept. 4–7, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, pp. 12, 69). *Oketo sh.* underlies Fort Riley ls. [restricted] and overlies Florence ls. [Florence flint of the literature, not Florence ls. of Prosser]. [There is no description of this unit, but graphic section on p. 12 shows it as consisting of shaly ls. 5 ft. thick. Derivation of name not stated. This shaly ls. appears to be included in Fort Riley ls. of previous repts.]

Okikeska series.
Pre-Cambrian (Keewatin): Quebec, Canada (upper Harricana River basin).

G. W. Bain, 1925 (Jour. Geol., vol. 33, pp. 728–743). A pre-Keewatin series of sed. rocks, consisting of carbonaceous sl., continental ss., ls., qtzite, and greywacke gneiss, in which original bedding can still be recognized by variation in color and character of clastic material. Uncon. overlain by Keewatin volcanic rocks and intruded by granite, which also intrudes the Keewatin. Okikeska is old name of lake around which these sediments are best developed.

The U. S. Geol. Survey applies *Keewatin series* to all pre-Laurentian rocks, the Laurentian consisting of intrusives.

Oklahoma series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed that *Permian system*, as he called it, be divided into two series, and that lower one be designated *Oklahoma series*.

Oklahoman series.

Permian: Oklahoma.

C. R. Keyes, 1896 (Am. Geol., vol. 18, pp. 22–28). *Oklahoman series* intended to apply to all rocks of Carbf. age which occur N. of Canadian River in Okla. and which lie btw. top of Missourian series, or top of Cottonwood ls., and base of Cret. Essentially covers same succession of strata that has long been vaguely known under title of "Permian." [This name was later restricted by Keyes (Am. Geol., vol. 28, pp. 299–305, 1901) to beds extending from top of Wellington sh. above to top of Cottonwood ls. below, the overlying Perm. rocks being included in his Cimarron series.]

Named for Oklahoma.

†Oklune series.

Tertiary, Mesozoic, and late Carboniferous (?): Southern Alaska (Kuskokwim region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 163–169, 181). *Oklune series*.—Shales, impure lss., and cherts, with beds of arkose and characterized by volcanic material. Folded. Cut by intrusives of probable Neocene age. Exposed where Kanektok River emerges from Oklune Mtns and along the Kanektok on W. side of the mtns. Contains Lower Cret. fossils.

Embraced a wide variety of units of different ages and has been discarded.

Okmulgee group.

Pennsylvanian: Kansas and Oklahoma.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Des Moines series* is divided into 2 uncon. groups—*Okmulgee group* (above) and *Wilburton group* (below). Okmulgee group includes Pleasanton sh. (at top) down to base of Savanna ss. of Okla. [Derivation of name not stated. Not used in 1932 or later classifications of R. C. Moore up to and including Kans. Geol. Surv. Bull. 22, Aug. 31, 1936.]

†Oktibbeha tongue (of Selma chalk).

Upper Cretaceous: Northeastern Mississippi.

L. W. Stephenson, 1917 (Wash. Acad. Sci. Jour., vol. 7, pp. 243–250). *Oktibbeha tongue*.—A long thin tongue of chalk, projecting from extreme top of Selma chalk in Noxubee, Oktibbeha, Clay, and Chickasaw Counties. Probably 50 ft. thick and 50 to 60 mi. long. Underlain conformably by nonchalky sands and clays of the Ripley fm., and uncon. overlain by strata of Midway (Eocene) age.

Named for Oktibbeha Co. Especially well developed at Starkville.

This name was discarded by U. S. Geol. Survey in April 1937, as explained under *Prairie Bluff chalk*.

Olathe limestone member.

Pennsylvanian: Central eastern and northeastern Kansas.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pt. 1, pp. 76–79). *Olathe ls. memb. of Stanton ls.*—Thin-bedded, wavy ls., bluish gray, usually fine-grained, the beds separated by thin limy partings; weathers dark buff. Thickness 15± ft. along Captain Creek; 11 ft. in SW. corner of Johnson Co. Named for Olathe, Johnson Co. Overlies Eudora sh. memb. and underlies Victory Junction sh. memb., all in Stanton ls.

See also Newell, 1936 (Jour. Geol., vol. 44, No. 1, pp. 23–31).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 134). Type loc. of *Olathe ls. memb.* (of Stanton ls.) is quarries at W. edge of Olathe, secs. 34 and 35, T. 13 S., R. 23 E., Johnson Co., Kans. The Stoner ls. of Condra is possibly same as Olathe ls., but it is not possible to trace the beds of Platte Valley southward to NE. Kans. outcrops, and there has been so much confusion in correlation of beds btw. the 2 areas that it seems inadvisable to use *Stoner* in Kans. The Stoner ls. of Platte Valley section in Nebr. includes †Louisville ls. (abandoned), †Kiewitz sh. (abandoned), and "Du Bois" ls.

Olcese sand.

Miocene: Southern California (Kern County).

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, p. 14, pl. 2). *Middle Temblor (Olcese sand of Round Mtn area)*.—Mainly unconsolidated medium-grained to coarse gray sand, containing numerous seashell fragments and occasional pebble and siltstone beds; lower part commonly of finer texture, with some clay and silty materials and strongly sulphurous. Thickness 242 ft. Underlies Round Mtn silt (Upper Temblor), in Mount Poso oil field, NE. of Bakersfield, Kern Co. [Derivation of name not stated.]

Old Colony sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 304, 375, 421, 445, fig. 37). *Old Colony ss.* lies 980 ft. below Wolverine ss.

Belongs in Central Mine group.

Named for occurrence in Old Colony mine, Houghton Co.

Old Colony amygdaloid.

Keweenawan: Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Is younger than Old Colony ss. and older than Wolverine ss. The mineralized part is the Old Colony lode. Named for occurrence in Old Colony mine, Houghton Co.

Old Colony flow.

Includes Old Colony amygdaloid and underlying trap.

Old Crow gypsum.

Permian: Northwestern Oklahoma (Blaine or Dewey County).

F. W. Cragin, 1897 (Am. Geol., vol. 19, p. 363). *Old Crow gyp.*, 1 to 2 ft. thick, is exposed in brow of bluffs on S. side of Canadian River in D Co., Okla., 90 or 200 [100?] ft. below One Horse gyp. Included in Taloga fm.

Named for Old Crow crossing of Canadian River, Blaine or Dewey Co.

Old Dominion limestone.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 66, map). *Old Dominion ls.*—Varies greatly in physical character and color. Exposures along NW. side of North Fork of Mill Creek are very low-grade lss., in places only calc. argillites. They have a banded or shaly appearance and vary from pure white to black, but are prevailingly light to dark gray with occasionally a bluish tint. At S. end of Old Dominion Mtn the ls. is nearly pure white, of uniform texture, and highly crystalline. Varies greatly in mag. content; some varieties become true dolomites. Thickness 1,500± ft. Underlies, apparently conformably, Colville qtzite and overlies Chewelah argillite. Extends as far N. as Old Dominion Mtn.

Olden sand.

A subsurface sand, of Penn. age, in Hightower field, Eastland Co., north-central Tex., lying at 1,200 ft. depth.

Oldham limestone.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 47). *Oldham ls.*—Fossiliferous ls., 10 to 14 ft. thick, forming upper memb. of Indian Fields fm. Underlies Alger fm. and overlies Plum Creek clay (memb. of Indian Fields fm.). All of Niagaran age.

In 1931 (Ky. Geol. Surv. ser. 6, vol. 36, pp. 172, 173) Foerste assigned this ls. to Clinton time. In 1935 (Denison Univ. Bull., Sci. Lab. Jour., vol. 30, pp. 130–133) he amplified his description of this ls. and stated it is probably older than Dayton ls.

Named for Oldham Branch, btw. Panola and Brassfield, Madison Co.

Old Mayflower amygdaloid.

Same as Mayflower amygdaloid.

Old Pewabic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 86 and chart).

Belongs to Ashbed group. Is older than Pewabic amygdaloid and younger than Albany and Boston cgl. The mineralized part is the Old Pewabic lode. (See B. S. Butler, U. S. G. S. P. P. 144, 1929.)

Named for occurrence in an old mine on Pewabic property, in Keweenaw Co.

Old Pewabic flow.

Includes Old Pewabic amygdaloid and underlying trap.

Old Rag granite.

Pre-Cambrian: Northern central Virginia (Madison County).

A. S. Furcron, 1934 (Jour. Geol., vol. 42, No. 4, pp. 400–410). *Old Rag granite.*—Coarse-grained blue-quartz granite of untwinned light-gray feldspar and blue or smoky quartz. Where it occurs in large masses, as in Old Rag Mtn. E. of Oldrag P. O., it may be as coarse or coarser than the hypersthene granodiorite, which it intrudes. Also intrudes Catoctin schist. Is believed to be older than Air Point granite.

†Old Red sandstone.

A name applied in early geological repts to Devonian system of present terminology; also to Catskill fm., of N. Y.; and to rocks btw. top of Catskill fm. and base of Genesee sl.

Olds sand.

A subsurface sand, of Ord. age, in NE. Okla. See under *Kinter sand.*

Olean conglomerate member (of Pottsville formation).

Pennsylvanian: Western New York and northwestern Pennsylvania.

J. P. Lesley, 1875 (2d Pa. Geol. Surv. Rept. I, pp. 89, 96), referred on p. 89, to *Ellicottville, Olean, Chautauqua cgl.* of western N. Y.; and on p. 96 stated this cgl. is also known as "Second Mountain sand" of Venango Co.; "Garland cgl."; "Great Bend cgl." of Warren Co., Pa.; "Rock City cgl." W. of Olean, at Ellicottville, and elsewhere in Cattaraugus Co., N. Y.; and "Rock City cgl." of Chautauqua Co. W. of Lake Chautauqua, N. Y. In same rept J. F. Carll mentioned (p. 38) *Olean cgl. (Garland)*, and on pp. 45 to 46 he described Garland cgl.

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. G_4, pp. 73–78). *Olean cgl.* is basal bed of Pottsville cgl. Thickness 50+ ft. [L. C. Glenn, 1903, gave thickness in Olean and Salamanca quads., N. Y., as 60 to 90 ft., and described it as a round-pebble cgl.]

See *Little Genesee cgl.*

Typical outcrop is at Olean Rock City, 6 mi. S. of Olean, Cattaraugus Co., N. Y.

†Olean shale.

Pennsylvanian: Western New York.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, p. 525). Overlying Olean cgl. in Olean quad. are "calcareous shales which have been termed the Olean sh." [These shales occupy position of Sharon sh. memb. of Pottsville fm., by which name they are now known.]

Olentangy shale.

Upper Devonian: Central Ohio.

N. H. Winchell, 1874 (Ohio Geol. Surv., vol. 2, pp. 243, 287). *Olentangy sh.*—Bluish, sometimes greenish sh., 30 ft. thick, more sectile and containing less bituminous matter than overlying Huron sh. [restricted], and interstratified with black sl.-like beds like those in Huron sh. Overlies blue Upper Corniferous ls. [Delaware ls.] and underlies black Huron sh., of which it is really a subdivision. No fossils found. [Included in Hamilton group on p. 328 and in Genesee on p. 302.]

This sh. was included in original definition of Ohio sh. and in Huron sh. of some early repts, but for many years it has been treated as a distinct fm. It contains few fossils, but has generally been considered to be of Hamilton age. However, A. W. Grabau in 1915 (Geol. Soc. Am. Bull., vol. 26, p. 112) stated that it is of Upper Dev. age and=in part to Huron sh.; and he proposed *Prout series* "for the northern Ohio shales and lss. of Lower Hamilton age" (the Upper Hamilton being absent). In 1917 (Jour. Geol., vol. 25, pp. 337–343) Grabau applied *Plum Creek shales* to the shales beneath Prout ls. of northern Ohio, repeating his opinion that Olentangy sh. of central Ohio is Upper Dev.

C. R. Stauffer, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 95–96) and 1916 (Jour. Geol., vol. 24, pp. 476–487) classified Olentangy fossils as of Hamilton age.

A. W. Grabau (1915 and 1917) assigned Olentangy sh. to Upper Dev.

E. R. Pohl, 1930 (Tenn. Acad. Sci. Jour., vol. 5, No. 2, p. 61). True Olentangy sh. of central Ohio has been repeatedly shown to be Upper Dev. In 2 articles I have incidentally suggested that the name be restricted to its original use for beds in central Ohio.

Named for exposures on Olentangy River, Delaware Co.

Olequa formation.

Eocene: Southwestern Washington.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 566, 568). *Olequa fm.*—Aren. bedded tuffs, of Tejon Eocene age. Younger than Chehalis fm. as redefined in this rept. Olequa and Chehalis fms. are zone of *Venericardia horni* Gabb. [Type loc. not stated.]

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 225–242). Fauna of Olequa and Chehalis fms. is quite similar, but flora is markedly different. Writers are of opinion Olequa may represent a Tejon age, while Chehalis of Arnold and Hannibal, 1913, may possibly represent a higher horizon corresponding to Jackson of east coast. It would seem that an arbitrary line should be drawn through the fresh-water beds which occur btw. Olequa and Chehalis fms. thus separating them if they are to be recognized as separate fms.

Oley Valley slates.

Pre-Cambrian: Southeastern Pennsylvania (Berks County).

E. V. d'Invilliers, 1883 (2d Pa. Geol. Surv. Rept. D_3, vol. 2, pp. 47, 158, 180). *Oley Valley slates.*—Generally considered to belong to Potsdam epoch, but portions of them may belong to Hudson River slates.

According to A. I. Jonas (personal statement Jan. 1937) the Oley Valley slates of D'Invilliers are Martinsburg sh.

Oligocene epoch (or series).

Next to oldest of the 4 epochs of Tertiary period and the rocks formed during the epoch. For definition see U. S. G. S. Bull. 769, pp. 53–54.

Olinger gray shale member (of Chattanooga shale).

Devonian or Carboniferous: Southern Tennessee and southwestern Virginia.

J. H. Swartz, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 485–499). *Olinger gray sh. memb.*—Middle gray sh. memb. of Chattanooga sh. at Chattanooga, Tenn., and in SW. Va. Best exposed at Olinger, Va. Varies in thickness from 0 to 54 ft. 5 in. at Olinger, Va. Uncon. underlies Big Stone Gap sh. memb. (the upper black sh. memb. of Chattanooga sh.) and overlies Cumberland Gap sh. memb. (the lower black sh. memb. of Chattanooga sh.). The Olinger memb. is of same age as [upper part of] Cumberland Gap memb., with which it intertongues to S., representing merely a different environmental condition.

J. H. Swartz, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 431–448), assigned these beds to Miss.

Olive Hill fire clay. (In Pottsville formation.)

Pennsylvanian: Northeastern Kentucky.

A. F. Crider, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 2, btw. pp. 594 and 616). *Olive Hill fire clay* is of same age and origin as Sciotoville fire clay of Ohio. It is associated with the Miss. ls. [The true Sciotoville clay is now known to be younger, and to lie higher than Sharon coal.]

Named for Olive Hill, Carter Co.

Olive Hill formation.

Lower Devonian (Helderbergian): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 738). *Olive Hill fm.*—Uncon. underlies Birdsong sh. and uncon. overlies Rockhouse sh., all included in Helderbergian or Linden group. Divided into (descending) Flat Gap memb., Bear Branch memb., and Ross ls. memb. Outcrops in Hardin Co., Tenn., and adjacent portions of Miss. and Ala. Named for exposure in bluff on Indian Creek at Olive Hill, Hardin Co., Tenn., where it is over 150 ft. thick and consists of the 3 members mentioned above. Fauna early New Scotland or late Coeymans.

Oliver granite.

Jurassic (?): British Columbia.

W. E. Cockfield, 1935 (Canada Dept. Mines, Geol. Surv. Bur. Econ. Geol. Mem. 179, Pub. 2392, pp. 2, 14).

Oliverian magma series.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke, Mount Cube, and Rumney quadrangles).

M. Billings, 1934 (Sci., n. s., Jan. 19, vol. 79, pp. 55–56). [See under *Highland Croft magma series*.]

M. Billings, 1935 (personal communication April 26). *Oliverian* was chosen from stream of that name (Oliverian Brook) in SW. corner of Moosilauke quad.

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map and p. 26). *Oliverian magma series* (late Dev. or late Carbf.) is proposed for a series of intrusive igneous rocks which are definitely younger than lower Dev. and older than the great period of folding. In Moosilauke quad. it is represented only by Owls Head granite, but other rock types of this series are present in Mount Cube and Rumney quads.

†Oljeto sandstone member.

Upper (?) Triassic, Lower Triassic, and upper Permian: Southeastern Utah (San Juan River region).

E. G. Woodruff, 1912 (U. S. G. S. Bull. 471, pp. 80, 87, etc.). *Oljato ss. memb.*—Massive, ferruginous, gritty, cross-bedded tan ss. containing clay pellets, fossil wood, and charcoal. Thickness 20 to 382 ft. Is upper memb. of Moencopie fm. Overlies 1,260 ft. of red sandy sh. and massive tan ss. beds forming lower part of Moencopie fm. Underlies Dolores sh., probably uncon. At Oljato [*Oljeto* now, in San Juan Co.] it forms the cliffs in Moonlight Valley.

Later detailed studies by H. E. Gregory, H. D. Miser, J. B. Reeside, Jr., and other geologists showed that as mapped the †Oljato ss. memb. included Shinarump cgl. (Upper? Triassic) and tan-colored sss. of Lower Triassic and upper Perm. age. The rocks having been subdivided, the name †Oljeto ss. memb. has been discontinued.

Olmos formation. (In Navarro group.)

Upper Cretaceous (Gulf series): Southwestern Texas (Maverick County).

L. W. Stephenson, 1927 (A. A. P. G. Bull., vol. 11, pp. 10, 14). *Olmos fm.*—Greenish-gray shaly clay and fine sandy clay, irregularly interbedded with fine to coarse greenish-gray thin-bedded to massive, more or less cross-bedded soft to hard ss., some layers of which are ripple-marked, and with seams of coal and lignite. Ranges in thickness from zero to 400 or 450 ft. Uncon. underlies Escondido fm. and uncon. overlies San Miguel fm. In previous repts called "Coal Series." Named for flag station of Olmos, Maverick Co., which is located on outcrop of the fm., and also for Olmos Creek (now generally called by its English equiv. Elm Creek), which follows the strike of the fm. near center of belt of its outcrop from a point 7 or 8 mi. N. of Eagle Pass to junction of the creek with Rio Grande.

Olmos sand.

Eocene (Jackson): Southeastern Texas (Atascosa and Live Oak Counties).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1316, etc.). *Olmos sand.*—Top zone of Whitsett fm. in Live Oak and Atascosa Counties. Grayish-brown medium-textured sand or ss. that weathers brown. Thickness 15 ft. Disappears in E. part of Atascosa Co. Exposed on Olmos Creek where Fant City-Whitsett highway crosses the creek about 1 mi. S. of Whitsett. Overlies Fashing clays.

Olmsted shale member (of Cleveland shale).

Upper Devonian or Mississippian: Northeastern Ohio.

H. P. Cushing, 1912 (Am. Jour. Sci., 4th, vol. 33, p. 583). *Olmsted sh.*—Soft blackish sh., with thin bands of blue sh.; 15 to 60 ft. thick, underlying Cleveland sh. and overlying Chagrin sh. Seems to pinch out to E. [Not present at type loc. of Cleveland sh. but has heretofore been included in Cleveland.]

Adopted as basal memb. of Cleveland sh.

Named for exposures at Olmsted Falls, Cuyahoga Co.

Olney limestone.

Silurian: Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 26, 27+). *Olney ls.*—Very largely fine interlaminated blue and drab layers, especially in lower 10 or 15 ft. Upper part often more coarsely bedded than lower part and frequently contains many stromatoporoids of dark color. It is often convenient to regard a zone of 1 to 3 ft. as transitional into overlying water lime (Elmwood A). Base of Olney provisionally placed at sharp contact with a sun-cracked water lime which forms quarry floor at type loc. This subjacent water lime is thought to be below, or at least near lower limit of, *Spirifer vanuxemi;* in central Onondaga Co. Thickness of Olney 33± ft. Is basal fm. of Manlius group in Onondaga Co. Named for Olney Station, on Auburn & Syracuse Elec. R. R. Type section 1¾ mi. E. of station, at old quarry at Split Rock, formerly worked by Solvay Process Co. The Olney ls. may safely be regarded as included in Vanuxem's Manlius. It is also unquestionably represented in the 77 ft. of strata which Hartnagel (1903, p. 1165) allows for the Manlius at type loc., but this latter thickness carries the Manlius of Hartnagel far below base of the Olney.

B. Smith, 1935 (N. Y. State Mus. Bull. 300, p. 18). [See 1935 entry under *Manlius ls.;* also, for further details, see pp. 14–22 of book cited.]

Olpe shale.

Pennsylvanian: Eastern Kansas (Lyon County).

G. I. Adams, 1903 (U. S. G. S. Bull. 211, pp. 51–52). *Olpe shales* is here proposed for the fossiliferous shales, 50 to 60 ft. thick, overlying Barclay ls. (=Burlingame ls., preoccupied), and underlying Emporia ls.

A. J. Smith, 1905 (Kans. Acad. Sci. Trans., vol. 19, pp. 150–154), mapped following fms. in Greenwood, Lyon, and Osage Counties, Kans. (descending): * * *; Admire sh.; Emporia ls. system (of 5 lss.); *Olpe sh.*, 60 ft.; Reading blue ls., 3 ft. (formerly called Emporia blue ls.); Humphrey sh., 40–45 ft. (including 2 thin lss.); Barclay (Burlingame) ls., 12 ft.; * * *.

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2). Admire sh. memb. of Kans. is 300± ft. thick and includes, 70 ft. above base, the 5 thin lss. called by Smith "Emporia system." It rests on true Emporia ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 221). †Olpe sh. of Adams included beds from top of †Barclay (Burlingame and Wakarusa) to base of Emporia. [On p. 224:] †Olpe sh. of Adams included beds btw. top of †Barclay (Wakarusa) ls. and "Emporia ls.," latter indicating beds more than 60 ft. above Reading ls. (=lower Emporia of more recent common usage). [On p. 228:] †Olpe sh. of Adams was defined to include beds btw. †Barclay (Burlingame and ?Wakarusa) and "Emporia" ls., the latter being "Emporia system" of A. J. Smith, 1905, which included Maple Hill to Grandhaven of present classification. The "Emporia" of Adams and Smith thus belong 60 ft. or more above Emporia as generally defined.

Named for exposures at Olpe, Lyon Co.

Olson.

Name applied by C. [R.] Keyes to 200 ft. of lss. in Kootenai fm. of Mont. Derivation of name unknown.

Olympia sand.

A subsurface sand, of Sil. age, in Ky.

Olympus granite.

An abbreviation of *Mount Olympus granite* that has been used by some geologists.

Omega limestone. (In McLeansboro formation.)

Pennsylvanian: Southeastern Illinois.

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, p. 135). *Omega ls.* is less than 1 ft. to 17 ft. thick. Lies higher than La Salle ls. From data at hand it is thought to be a pure ls. [Derivation of name not stated. Probably refers to Omega, in E. part of Marion Co.]

Omen member. (In Mount Selman formation.)

Eocene (middle): Northeastern Texas (Smith, Harrison, Gregg, Rusk, and Cherokee Counties).

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, No. 10, pp. 1355–1356). *Omen memb.*—A local greensand memb. of Queen City memb. of Mount Selman fm. Lies approx. 140 ft. above the main glauconite of the Reklaw and btw. 240 and 280 ft. below top of the Weches. Well exposed near Omen and Arp, in eastern Smith Co., and is here termed *Omen* from the community where it was first recognized. This greensand extends from Harrison, through Gregg, NW. Rusk, and E. Smith Counties, into Cherokee Co. It consists of 10 to 15 ft. of partly cross-bedded mealy, sandy glauconite, which weathers rapidly and is difficult to recognize. The best ores are found in Omen memb.

C. L. Moody, 1931 (A. A. P. G. vol. 15, No. 5, pp. 538, 542). Reklaw as defined by Wendlandt and Knebel the writer considers as basal Claiborne of Tex. and that it properly includes the Omen memb., which they assigned to Queen City sand.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 630). *Omen greensand memb.* was named by MacNaughton (private rept. written for Humble Oil & Refining Co., Feb. 10, 1929). The name was published by Wendlandt and Knebel, 1929. It is middle memb. of Queen City fm.

Onaga limestone.

Pennsylvanian: Northeastern Kansas.

F. F. Crevecoeur, 1903 (Kans. Acad. Sci. Trans., vol. 18, pp. 124, 125). *Onaga ls.*—Series of lss. of economic importance in vicinity of Onaga [Pottawatomie Co.]. Consists of 5 in. of brown ls. at top, underlain by 8 in. of hard brown ls., underlain by 6 in. of bluish-gray ls., with 8 in. of light-blue ls. at base. Separated from overlying Neva ls. by 11½ ft. of dark-blue sh., overlain by two layers of ls., each 9 in. thick, and by 45 ft. 8 in. of yellowish ferruginous shales.

Records show no other use of this name, and R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), does not mention it. It appears to be a part of Elmdale fm.

Onalaska clay.

Miocene: Eastern Texas.

E. T. Dumble, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 466). *Onalaska clays.*—Transitional zone in the Corrigan, in which the sands of the Corrigan are interbedded with calc. clays similar to those of overlying Fleming. On this account the limit is not as well defined as farther E., and upper line is drawn where the sands with porcelaneous cement cease and the clays weather entirely dark brown or black, instead of showing the characteristic yellow weathering of Corrigan clays. These upper beds maintain their character and thickness as far W. as Navasota River. While they appear later than Catahoula proper, they are definitely connected with it by character of the sands and clays of which they are composed. Assigned to upper Olig.

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869, pp. 29, 189–218). *Onalaska beds*, at top of Corrigan fm., are assigned to upper Olig. and possibly Mio. in upper part.

The Catahoula ss. is now considered to be probably Mio., so that this overlying clay cannot be Olig.

Onaping tuff.

Pre-Cambrian (upper Huronian): Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept. 1905, vol. 14, pt. 3, p. 94).

Once Lomas sandstone member (of Carrizo sandstone).

Eocene (middle): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1369–1370, 1371, 1385). *"Once Lomas" ss. memb.*—Massive white and red banded micaceous ss., 135 ft. thick, lying 562 ft. above base of Carrizo ss. Well exhibited at the "Once Lomas," a series of dip-slope hills making a scarp around S. end of Aldamas anticline. Can be traced from Rio Grande to Rio San Juan, Tamaulipas.

Oneco amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Oneco Copper Mining Co., 1925 (The Mines Hdb., by W. H. Weed, p. 1061). An amygdaloid that "has been variously identified as the Isle Royale, Grand Portage, and Kearsarge amygdaloids, but is now termed the *Oneco amygdaloid.*"

According to B. S. Butler (personal communication) this amygdaloid is probably near horizon of Isle Royale amygdaloid. Belongs in Central Mine group. The mineralized part is the Oneco lode. Named for occurrence in Oneco mine, Houghton Co.

Oneco flow.

Includes Oneco amygdaloid and underlying trap.

One Horse gypsum.

Permian: Northwestern Oklahoma (Blaine or Dewey County).

F. W. Cragin, 1897 (Am. Geol., vol. 19, p. 363). *One Horse gyp.*, 3 or 4 ft. thick, is exposed in brow of bluffs on S. side of Canadian River in D Co., Okla., about 250 ft. above river and 90 or 200 [100?] ft. above Old Crow gyp. Included in Taloga fm.

Named for One Horse Ford of Canadian River, Blaine or Dewey Co.

Oneida conglomerate.

Silurian: New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 374). *Oneida cgl.*—The "millstone grit" of Prof. Eaton. There is no other rock of the kind in Oneida Co., if we except the thin irregular layers of small-sized pebbles which make a part of the succeeding group, and which may be seen at Blackstone's quarry, S. of Utica. Overlies Medina ss. and underlies Protean group [Clinton fm.].

L. Vanuxem, 1842 (Geol. N. Y., pt. 3). *Oneida or Shawangunk cgl.*—Composed of quartz pebbles rarely exceeding ¾ in. diam., and white or yellowish quartz sand; in some localities there is some interposed greenish sh. Named for Oneida Co., where its position is well defined. In Herkimer rests on Frankfort sl.; in E. and W. parts of Oneida Co. it rests on Pulaski shales. Forms part of Clinton group, the next mass in order of superposition. It was separated as being a convenient point for division, and from importance which was once attached to this rock, having been confounded with the cgl. of the Coal era. [The Shawangunk cgl. is now considered to be of Tuscarora and Clinton age (see C. K. and F. M. Swartz, Geol. Soc. Am. Bull., vol. 42, pp. 621–662, 1931).]

J. Hall, 1843 (Geol. N. Y., div. 4, 4th dist., pp. 18, 31). *Oneida cgl.* overlies Hudson River group in E. part of State, and occupies same strat. position as Grey ss. of Oswego, which rests on Hudson River group and is overlain by Medina ss. Forms Shawangunk Mtn. and in Oneida Co. [N. Y.] and Pa. attains a much greater thickness. Not seen in place W. of Oneida.

For many years the position of Oneida cgl. was given by most geologists as btw. Medina ss. and the Ord. †Hudson River group, or Lorraine sh., and it was believed to be same as "Grey ss. of Oswego." Some repts, however, included it in the Medina, and some geologists regarded it as younger than "Grey ss. of Oswego." Its thickness in Oneida Co. was given as ranging from 25 to 100 ft.

C. A. Hartnagel, 1905 (N. Y. State Mus. Bull. 80). *Oneida cgl.* in its W. extension gradually grades into ss. known as *Oswego ss.*, and both Oneida cgl. and Oswego ss. are transitional into Medina ss. above.

A. W. Grabau, 1906 (N. Y. State Mus. Bull. 92). In central N. Y. Oswego ss. merges into the Oneida, a pure-white quartz-pebble cgl.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114). *Oneida cgl.* is here considered a local facies of upper Medina. [In Bull. 107, 1907, Hartnagel says Oneida cgl. contains *Arthrophycus alleghaniensis*, which is practically confined to upper Medina, and that for strat. and paleontologic reasons the Oneida cgl. is to be considered part of upper Medina. "Its position is never far below the base of the Clinton."]

J. M. Clarke, 1907 (N. Y. State Mus. 59th Ann. Rept., vol. 1, p. 17). The nonfossiliferous Oswego ss. is older than Oneida cgl.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 46). In Oswego Co. the Oneida cgl. actually lies within upper part of Medina fm. and westward disappears in Wayne Co.

E. O. Ulrich, 1913 (12th Int. Geol. Cong., Canada). *Oneida cgl.* belongs at top of the Medina, if, indeed, it is not, as Vanuxem long ago contended, the basal deposit of the Clinton. [Ulrich continued to thus classify Oneida in 1923 Silurian vol. of Md. Geol. Surv.]

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 431, 460). Thorold ss., top bed of the Medina, is westward extension of Oneida cgl.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, p. 340). Evidence in hand favors conclusion of Vanuxem and Hartnagel that the Oneida is "never far below the base of the Clinton" and is closely connected with its basal sh. [In correlation charts on pp. 359 and 364 Chadwick placed Oneida opposite Thorold ss. (which he excluded from Medina) and the overlying Maplewood sh.]

The Oswego ss. is now considered to be much older than Oneida cgl., and of Upper Ord. (Maysville) age.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 191, 317, 318, 324), included *Oneida cgl.* in the Clinton of central N. Y., and stated that it was named for its excellent exposures in vicinity of Verona, Oneida Co. She placed it beneath Maplewood sh., and stated that it is = Thorold ss. of western N. Y.

C. Schuchert and C. R. Longwell, 1932 (Am. Jour. Sci., 5th, vol. 23, pp. 305–311), excluded Oneida cgl. from Clinton.

J. T. Sanford, 1936 (Jour. Geol., vol. 44, p. 811), excluded Oneida cgl. from Clinton.

The U. S. Geol. Survey does not include Oneida cgl. in the Clinton.

See also under *Oswego ss.*

†Oneida conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map. Phila., 1863; p. 21 and map). Next [above the Toltec trap] follows a narrow belt of cgl., which from the circumstance of being first opened upon the Oneida Location is known as *Oneida cgl.* Overlying it is a large and promising vein, carrying, where opened, sheet and stamp copper. [Shown as younger than National ss. and older than West Minesota cgl.]

According to B. S. Butler (U. S. G. S. P. P. 144, 1929) is probably same as Allouez cgl.

Oneida glass sand.

A commercial term for a sand of Pleist. age occurring at E. end of Oneida Lake, N. Y.

Oneonta sandstone.

Upper Devonian: Eastern and east-central New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 381). *Montrose ss. or ss. of Oneonta.*—Younger than Chemung group. [See quotation under †Montrose ss.]

T. A. Conrad, 1841 (N. Y. Geol. Surv. 5th Rept., p. 31). [*Oneonta group* appears in table as overlying Cazenovia group, which is shown resting on Tully ls.]

J. Hall, 1886 (N. Y. State Geol. 5th Rept., p. 11) and 1893 (N. Y. State Geol. 12th Ann. Rept., pp. 9, 34). Results of recent investigations clearly show that Oneonta ss. rests upon well-marked Hamilton strata and is succeeded by strata carrying fossils of Chemung group. It is not=Catskill, as has been reported. [In 1894 (N. Y. State Geol. 13th Ann. Rept. pl. opp. p. 16) Hall correlated Oneonta with Portage.]

C. S. Prosser, 1893 (N. Y. State Mus. 46th Ann. Rept.). The Oneonta ss. of Vanuxem (Vanuxem's Oneonta or Montrose group) forms upper part of hill at Oneonta [Otsego Co.]. Consists of barren red and gray sss. and shales and is above Oneonta group of Conrad, which Vanuxem quite correctly regarded as belonging to Ithaca group. The Oneonta group of Conrad consists of red and gray shales and sss., and is well exposed in Susquehanna River Valley near Oneonta.

J. M. Clarke, 1894 (N. Y. State Mus. 47th Ann. Rept., p. 750), showed Oneonta ss. as younger than Ithaca and=Upper Portage or Portage sss. In 1897 (N. Y. State Geol. 15th Ann. Rept., p. 62), however, Clarke considered the Oneonta=upper part of Ithaca beds. In 1903 (N. Y. State Mus. Hdb. 19, p. 24) Clarke stated that Oneonta beds are "looked on as nonmarine, contemporaneous with later Portage time."

H. S. Williams, 1913 (U. S. G. S. P. P. 79), showed the fresh-water Oneonta ss. the time equiv. of upper part of marine Ithaca sh., and of middle Portage age.

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7) and 1933 (Sci., n. s., vol. 77, pp. 86–87). True Oneonta ss. is of Ithaca age. It is present in Catskill Mtns, type loc. of Catskill fm., but it is not basal ss. of Catskill fm., as erroneously correlated for many years. The basal ss. of the Catskill is of Hamilton age, according to writer's studies, which are verified by studies of G. A. Cooper, and is here renamed *Kiskatom red beds.*

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 858). To E. the Cincinnatus flags become almost at once the continental *Oneonta red beds.* The type Oneonta probably absorbs also the underlying Otselic.

Oneota dolomite. (In Prairie du Chien group.)

Lower Ordovician (Beekmantown): Iowa, southern Minnesota and Wisconsin, and northwestern Illinois.

W J McGee, 1891 (U. S. G. S. 11th Ann. Rept., pt. 1, pp. 331, 332). *Oneota ls.*—Aren. dol., with intercalations of ss. in upper part; dol. usually coarsely saccharoidal, frequently vesicular and cavernous, and generally of buff, yellow, or light-brown color. Thickness 200 to 300 ft. Corresponds to "Main body" of Lower Mag. ls. of Minn. and Wis., which underlies New Richmond ss. and overlies Jordan ss.

For many years the Iowa Geol. Survey used *Oneota ls.* to include the Shakopee at top. In 1906, however, S. Calvin recognized in Iowa the 3 subdivisions then recognized in Minn. and Wis., i. e., Shakopee ls., New Richmond ss., and Oneota ls., and since that time these names have been generally employed in Iowa also. Ulrich assigns the Oneota to his Ozarkian system, in view of which the U. S. Geol. Survey formerly classified it as "Camb. or Ord." It is lower fm. of Prairie du Chien group, all of which Trowbridge and Atwater would include in Lower Ord. (See under *Prairie du Chien group.*) The U. S. Geol. Survey at present classifies Oneota dol. as *Lower Ord.* (*Beekmantown*).

See also under *Shakopee dol.* and *New Richmond ss.*

In 1925 (Jour. Geol., vol. 33, pp. 706–713) C. R. Stauffer published a section of Oneota dol. and Jordan ss. in Minn. River Bluff and at adjacent quarries at Kasota, Minn., in which he transferred to Oneota dol. 6½ ft. of fossiliferous ss. which he stated had "always been included in Jordan ss., but which was probably reworked after deposition and should be included in the Oneota, where its fauna seemed to belong. L. H. Powell, 1935 (St. Paul Inst., Sci. Mus., Sci. Bull. 1), introduced *Kasota ss.* for this 6½-ft. bed, and named the overlying 6 in. to 3 ft. of "siltstone," as he called it, *Blue Earth siltstone*. Powell excluded both of these thin beds from the Oneota and treated them as distinct fms., stating that they occur only in region from Ottawa, Minn., to Mankato. The Rept. 9th Field Conf. Kans. Geol. Soc., 1935, fig. 1, shows "*Blue Earth and Kasota, local formations in Minn.*" as=basal part of Oneota dol., which is shown as underlain by Madison ss.

Named for exposures on Oneota River, Allamakee Co., Iowa.

Onion Creek marl.

Pleistocene: Central Texas.

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 252–254, 277). *Onion Creek marl.*—Faint yellow or salmon-yellow calc. marl, sometimes accompanied by fine-pebble cgl., all derived from Cret. ls. Thickness about 50 ft. Usually deposited in furrows eroded in Pliocene Uvalde fm. May ultimately be correlated with Leona fm.

Named for Onion Creek, Hays Co.

†Onondaga limestone series.

Devonian: New York.

T. A. Conrad, 1837 (N. Y. Geol. Surv. 1st Rept., pp. 178–181). *Onondaga ls. series.*—Numerous strata of blue and gray ls., hydraulic ls., shales and gyp. beds, which are linked together by paleontological affinities. Comprises the "calcareous slate," or "liasold rocks," "geodiferous" and "corniferous limerocks" of Eaton, stretching across the State from Helderberg Mtns to lake Erie, and appearing as a narrow belt, bordering Erie Canal on S. In descending the slope from village of Onondaga to Syracuse, we find, in succession, most of the rocks of this series, in the following order: (1) Gray sparry crinoidal ls. quarried near Auburn and on Onondaga Hill, near Syracuse; (2) alternating strata of blue and hydraulic ls.; (3) shales, with gyp. beds.

A much larger aggregate than Onondaga ls. of modern terminology.

Onondaga limestone.

Middle Devonian: New York, Pennsylvania, western Maryland and Virginia, and northern West Virginia.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 293–309). The "*gray crinoidal or Onondaga ls.*" underlies Seneca ls. and succeeds Oriskany ss. Consists of gray or grayish blue compact crystalline ls.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 378). *Onondaga ls.*—Is the ls. or marble so well known and extensively wrought from Auburn to Cherry Valley. In bottom layer pebbles of black ss. are often seen, having been derived from breaking up of Oriskany ss. [In this rept the following succession is given (descending) Marcellus shales, Seneca ls., Corniferous limerock, *Onondaga ls.*, Schoharie layers, Fucoides Cauda-Galli, and Oriskany ss. In his 1842 rept Vanuxem used same classification, and gave thickness of †Corniferous ls. as 60 to 80 ft. and of Onondaga ls. as 10 to 14 ft. He also stated that Onondaga ls. is †Gray Sparry ls. of earlier repts.]

J. Hall, 1843 (Geol. N. Y., div. 4, 4th Rept., p. 18, also W. W. Mather, 1843). *Onondaga ls.* overlies Schoharie grit and underlies Corniferous ls. Thickness 0 to 40 ft.

E. Emmons, 1846 (Agric. N. Y., vol. 1). *Onondaga ls.*—Dark-colored ls. which has been described in ann. repts. under names *Selenurus ls.*, *Seneca ls.*, and *Corniferous ls.* Underlies Marcellus sl. or shales and overlies Schoharie grit. [This is present commonly accepted definition of Onondaga ls. Hall, however, for many years followed his 1843 definition.]

J. M. Clarke and D. D. Luther, 1905 (N. Y. State Mus. Bull. 82). *Onondaga ls.*—Underlies Marcellus sh. and overlies Oriskany qtzite. Thickness 65 to 70 ft. Formerly the term was applied to the lower and purer layers and *Corniferous ls.* was attached to the chert-bearing upper deposits, but this distinction, while an important one locally, has given way to application of *Onondaga* to entire fm.

This fm. has also been called †*Upper Helderberg ls.* In western Md., Va., and W. Va. the beds of Onondaga age are now called *Onondaga sh. memb. of Romney sh.*

Named for exposures in Onondaga Co., N. Y.

†Onondaga group.

Name applied in some early N. Y. repts to the "Middle Silurian group," including all rocks btw. "Lower Helderberg group" [Helderberg group] and Niagara group.

†Onondaga saliferous group.

Silurian and Lower Devonian: New York.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 290–293, 304). *Onondaga saliferous group.*—The rocks btw. Lockport ls. below and *top* of "waterlime series" or base of "shell grit" of Eaton, which underlies Oriskany ss. [As thus defined the term includes Salina fm. at base and Helderberg group at top, and is of Sil. and Dev. age.]

†Onondaga salt group.

Silurian (Cayugan): New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 375–376, 378). *Onondaga salt group.*—Embraces all the salines of Onondaga and Cayuga, as well as all the gypsum beds of the State. Thickness in Onondaga about 700 ft. Divided into four parts or masses (descending): (1) Those rocks which abound in groups of needle form cavities originally occupied by sulphate of magnesia; (2) the gyp. deposit; (3) the lower gypsiferous shales; (4) red sh. Underlies Manlius water lime group and overlies Protean group, of which Lockport ls. is top div.

Essentially same as Salina fm. of present terminology.

Onslow syenite.

Pre-Cambrian: Quebec.

M. E. Wilson, 1924 (Canada Geol. Surv. Mem. 136, p. 40).

†Ontarian.

Name proposed by J. D. Dana in 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 40–41) for the rocks now called *Silurian system.* For definition see U. S. G. S. Bull. 769, p. 81.

†Ontarian.

Name proposed by A. C. Lawson in 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 176–177) for the *pre-Laurentian rocks* of NW. Ontario. In 1914 (Ont. Bur. Mines Rept., vol. 22, pt. 2, p. 127) W. G. Miller and C. W. Knight

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proposed to replace this name with *Loganian*, because of conflict with "Ontaric system" of N. Y. Geol. Survey, proposed by E. Emmons in 1842.

†Ontario group.

Name proposed by E. Emmons in 1842 (Geol. of N. Y. pt. 2, div. 4, geol. 2d dist., pp. 100–101, 429). For definition see U. S. G. S. Bull. 769, p. 81. Essentially synonymous with Silurian system, as it included Manlius "waterlime" at top and Medina ss. at base.

†Ontario division.

A variant of †Ontario group used in some early N. Y. repts. As used by L. Vanuxem in 1842 rept it included all beds btw. top of Niagara group and top of †Hudson River group. James Hall (1843 rept) included in it his Niagara group, Clinton group, and Medina ss.

†Ontario quartzite.

A local name that has been applied to Weber qtzite (Penn.) in Park City dist., Utah. See W. P. Jenney, 1906 (Min. and Sci. Press, vol. 92, p. 108), J. M. Boutwell, 1904 (U. S. G. S. Bull. 225, pp. 142–143), 1907 (Jour. Geol., vol. 15, pp. 434–458). Named for Ontario mine.

Ontario series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Ontario series* to "include Niagara, Clinton, and Medina" of N. Y.

Onteora red beds.

Upper Devonian: Southeastern New York (Greene County).

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 16, pp. 480, 483, 484). *Onteora red beds*.—Lower part (Tully to Oneonta in age) of Catskill fm. as I proposed (16th Int. Geol. Cong. Guidebook 9A, p. 4, 1933) to restrict that name, but proposed restriction now seems questionable. I therefore now propose *Katsberg red beds* for the upper (Enfield) part and *Onteora red beds* for the lower part, which overlies Kiskatom red beds. Onteora ("hills of the sky") is aboriginal Indian name for Catskill Mtns. Type section of Onteora fm. will be in vicinity of Haines Falls, Greene Co., N. Y., up the sides of the Kaaterskill "High Peak" and "Round Top" Mtns. Up the opposite slope is Onteora Park.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 4, p. 286). This expanded red mass, from Tully to Ithaca, embraces a good deal more than the Oneonta, under which name it has been passing, wherefore I have lately rechristened it *Onteora fm., or memb., of Catskill group* in its wider sense. On E. front of the Catskills the Onteora is bulk of what was recently being called (restricted) Catskill, in contradistinction to supposed "Oneonta" (now the Kiskatom beds, of Hamilton age).

Onwatin slate.

Pre-Cambrian (Huronian): Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept., vol. 14, pt. 3).

Oolithic.

Oolitic.

Terms applied by European geologists to Middle and Upper Jurassic combined.

Oologah limestone.

Pennsylvanian: Northeastern Oklahoma.

N. F. Drake, 1897 (Am. Phil. Soc. Proc., vol. 36, p. 377). *Oologah ls.*—Massive hard gray, rather unevenly textured ls., in places containing chert nodules. Forms east-facing escarpment, 50 to 100 ft. high, along W. side of Verdigris River Valley E. of Oologah.

In northern part of Rogers Co. the Bandera sh. thins out and Altamont and Pawnee lss. unite and continue southward under the name *Oologah ls.* The Oologah overlies Labette sh. and underlies Nowata sh.

Named for Oologah, Rogers Co.

[library stamp]

†Oostanaula shales.

†Oostanaula series.

Cambrian: Northwestern Georgia.

J. W. Spencer, 1893 (Ga. Geol. Surv., Paleozoic group, pp. 34, 37, 77, 87, 99, 108, 112, 115, 119, 123, 130). *Coosa Valley phase of Oostanaula shales.*—Reddish, yellowish, brownish, and greenish shales and thin-bedded lss. with shaly partings, thickness 3,000 to 6,000 ft. *Connasauga Valley phase of Oostanaula shales.*—Red, green, and variegated calcareous shales, thin beds of ss., sometimes qtzitic in lower members, and dark bedded lss. in higher strata; thickness 4,000 to 6,000 ft. Overlies Chilhowee series and underlies Knox dol.

Probably included Conasauga (†Coosa) sh., Rome fm. and Apison sh. of present classification of rocks of NW. Ga. Has also been called "Oostanaula series."

Named for exposures on Oostanaula River.

Opeche formation.

Permian? (may be Triassic): Western South Dakota, Wyoming, northwestern Nebraska.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 513). *Opeche fm.*—Red soft slabby sss. and sandy sh.; at top, for first few ft. below Minnekahta ls., there are shales of invariably deep-purple color; basal beds are usually red sss. varying in thickness from 4 to 15 in.; a few local gyp. beds. Thickness 90 to 130 ft. in Black Hills. Underlies Minnekahta ls. and overlies Minnelusa fm. Typically developed on Battle Creek, the Indian name of which is *Opeche*.

Opemiska series.

Pre-Cambrian: Quebec (Opemiska district).

C. Tolman, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, p. 232, and Pan-Am. Geol., vol. 55, pp. 316–317). *Opemiska series.*—A thick series of pre-Camb. sediments in Opemiska dist., about 300 mi. N. of Montreal. Their great interest is centered in their apparent conformity within the basal volcanics which in this part of Quebec have been termed Abitibi volcanics. Because of their position at base of pre-Camb. section they are generally assumed to be Keewatin. Appear to be at least 10,000 ft. thick. Are predominantly arkose, tending to be gritty and conglomeratic at a number of horizons; very little argill. material and only one narrow bed of ls.; near base some interbedded andesitic flows; schistosity generally developed throughout series. The underlying volcanics and Opemiska series have been closely folded. No structural discordance btw. underlying and overlying volcanics.

C. Tolman, 1932 (Jour. Geol., vol. 40, No. 4, pp. 356+). *Opemiska series.*—Metamorphosed arkose, cgls., and minor amounts of graywacke, sl., and ls. Overlain and underlain by volcanics that are generally referred to Keewatin.

Opemiska granite.

Pre-Cambrian: Northern Quebec (Opemiska district).

C. Tolman, 1932 (Jour. Geol., vol. 40, No. 4, p. 356). *Opemiska granite* (intrusive). Much later than Opemiska series.

Open Bay group.

Cretaceous or Jurassic: British Columbia.

J. A. Bancroft, 1913 (Canada Geol. Surv. Mem. 23, pp. 68, 145). [Assigned to upper Paleozoic, but Cairnes in 1914 assigned it to Cret. or Jurassic.]

Opex dolomite.

Cambrian (Upper?): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Opex dol.*—Variable beds, poorly exposed. Only continuous exposed section is along saddle W. of Eureka Peak, where fm. consists of (descending): (1) Dark shaly ls., mottled or thinly banded, with thin beds of true sh., 85 ft., resembles Herkimer ls. and parts of Opohonga ls.; (2) dark-gray granular dol., somewhat cross-bedded, 92 ft.; (3) light-gray granular dol. similar to Emerald memb. of Ajax ls., alternating with and grading upward into greenish and reddish sh., 26 ft.; (4) dark shaly ls., 13 to 18 ft.; (5) dark-gray dol., some beds mottled, some with short white spangles, some granular and finely cross-bedded, some spotted either with small dark included fragments or with carbonaceous spots left by destroyed fossils, 172 ft. Total 388 to 393 ft. Uncon. underlies Ajax ls. and overlies, with arbitrary bdy, Cole Canyon dol. Named for Opex mine.

Ophian.

Pre-Cambrian: General.

See under *Pelodian*.

Ophir formation.

Middle and Lower Cambrian: Central northern Utah (Tintic district and Oquirrh Mountains region).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107, pp. 25-27). *Ophir fm.*—Name proposed by B. S. Butler, for the shales (locally slates), with a little ss. and intercalated ls. beds, overlying Tintic qtzite as here restricted and underlying Teutonic ls. in the ranges of central Utah. Thickness 159 to 475± ft. Well exposed at Ophir, eastern Toole Co. Lower part of these beds (100 to 190 ft.) was included in Tintic qtzite as originally defined, but Tintic is herein restricted to the massive qtzites.

In U. S. G. S. 19th Ann. Rept., pt. 3, 1899, p. 620, footnote, G. W. Tower, Jr., and G. O. Smith stated that in Tintic folio the Camb. †Robinson qtzite would be named *Ophir fm.*, to avoid duplication of names. In Tintic folio, however, the Camb. †Robinson qtzite was renamed *Tintic qtzite*, and Ophir fm. was not used.

Opohonga limestone.

Lower Ordovician: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Opohonga ls.*—Mottled shaly ls.; bands or short lenses of medium- to light-gray ls. alternating with bands of yellow to red argill. material. These colors are due to weathering. In the underground workings the rock is uniformly light gray ("White lime"). A noticeable feature of the fm. is the great number of thin beds of cgl. it contains, most of them intraformational. Thickness 700 to 1,000 ft. Conformably underlies Bluebell dol. but with sharp contact. Grades into underlying Ajax ls. Named for Opohonga mine.

Oppello breccia.

Cretaceous (probably middle): Central northern Arkansas (Conway County).

C. Croneis and M. Billings, 1929 (Jour. Geol., vol. 37, pp. 543, 551), and 1930 (Ark. Geol. Surv. Bull. 3, pp. 155-158). The rock here described as *Oppello breccia* crops out about 1 mi. W. of Oppello, in N½SE¼ sec. 2, T. 5 N., R. 17 W., on farm of W. J. Sadler. Matrix is physically very strong but is nonresistant chemically. The igneous mass therefore does not crop out naturally, and its size can be inferred only from the distribution of the inclusions which remain behind after the groundmass has been completely weathered. Indications are that the igneous plug has a diam. of 300 to 500 ft. Macroscopically it is composed of both angular and rounded fragments of black sh., gray to reddish-brown ss., and ouachitite and of lesser amount of fragments of alkaline syenite and aegerite granite, set in a dense gray groundmass containing conspicuous crystals of biotite and, less commonly, black glassy grains of pyroxene. Fragments range from microscopic grains to pieces 4 in. in diam. The groundmass composes 25 percent of the rock. Probably middle Cret.

The town is spelled Oppelo on all maps consulted by compiler.

Oquirrh quartzite.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 37). *Oquirrh qtzites.*—Qtzites, 500 ft. thick, underlying Butterfield lss., and composing basal fm. of Weberian series, Mid Carbonic, in Utah. [Derivation of name not stated.]

Oquirrh formation.

Pennsylvanian (and Permian in some areas): Central northern Utah (Oquirrh Mountains region).

J. Gilluly, 1932 (U. S. G. S. P. P. 173). *Oquirrh fm.*—Interbedded lenticular qtzite and ls., becoming more qtzitic toward top, with very subordinate thin beds of sh. and dol. Thickness in Stockton and Fairfield quads. 16,000 to 18,000 ft. Top not exposed in this area. Contains fossils of Pottsville and later Penn. age. Grades into underlying Manning Canyon sh.; where lss. greatly predominate over sh. the beds are assigned to Oquirrh fm. Uncon. underlies Tert. cgl. and grit. Is most important strat. unit in Oquirrh Range, hence name. [This fm. was first defined by T. B. Nolan (Wash. Acad. Sci. Jour., vol. 20, No. 17, pp. 423, 431, 1930), in a paper on the Paleozoics of Gold Hill quad., Utah, he having correlated the rocks in Gold Hill quad. with those in Fairfield and Stockton quads. to which Gilluly was applying the name *Oquirrh fm.* in an unfinished rept.]

See also T. B. Nolan, 1934 (U. S. G. S. P. P. 177).

Orabai sandstone.

Upper Cretaceous: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 337). *Orabai sss.*—Sss., 250 ft. thick, constituting basal memb. of Montanan series as developed in NE. Ariz. Overlie Mancos shales and underlie Mesa Verde shales. Well exposed at Orabai Mesa, N. of Winslow, Apache Co.

Oran sandstone lentil. (In Graford formation.)

Pennsylvanian: Central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 96, 97, 99, 100). *Oran ss. lentil (of Brownwood sh. memb. of Graford fm.)*.—A fairly continuous ss. locally present in lower part of Brownwood sh. in Palo Pinto Co. [The town of Oran is in Palo Pinto Co.] Consists of (descending): (1) Light-brown massive thick-bedded ss., 3 ft. thick, weathering to dark rusty-brown massive irregular blocks, in most places loosely cemented; (2) massive brown ss., 50 ft. thick, loosely cemented in some portions, other portions very friable; slightly closer-grained than overlying bed. Rests on ss. very similar to No. 2 of Oran lentil, but containing much more iron. Top of Oran ss. lies 227 ft. below top of Brownwood memb. in escarpment due W. of Strawn oil field.

†Orange sand.

†Orange sand group.

Descriptive terms applied in early repts on Gulf Coastal Plain States to late Tert. and early Quat. deposits characterized by their bright color. Introduced by J. M. Safford, Geol. reconn. of State of Tenn., 1st Rept., p. 162, 1856. The *Orange sand* of Safford's 1856 rept included the Upper Cret. and Tert. deposits of western Tenn. In later Tenn. repts the name was applied to the Plio. and Eo. deposits of western Tenn. In still later Tenn. repts the name was applied to †Lagrange fm. (=Wilcox group and Jackson fm.), the overlying Plio. beds being the †Bluff lignite. The term was also widely used as a synonym of †Lafayette fm. The Plio. deposits to which the name was applied in the Gulf States are the Citronelle fm. of modern terminology. (See †*Lafayette fm.* and *Citronelle fm.*)

Orange phyllite.

Pre-Triassic: Western and western central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 86, 101–102, and map). *Orange phyllite.*—Sl. or phyllite, highly fissile, sericitic, and usually dotted with minute garnets. Toward W. is much more micaceous, in places approaching mica schist, and is also frequently feldspathic. Is minutely folded, contorted, and jointed. Beds of impure ls. or marble are interstratified at a number of places. The fm. is believed to have been originally a sh., more or less calc. In Orange and Woodbridge the fm. is 6 mi. wide. It lies btw. Prospect granite gneiss (Ord.) and Triassic ss. and sh.

†Orange group.

Lower Cretaceous to Pennsylvanian: Yukon-Alaska boundary, between Porcupine and Yukon Rivers.

D. D. Cairnes, 1912 (Canada Geol. Surv. Summ. Rept. 1911, pp. 27–32). *Orange group.*—Chiefly slates, phyllites, qtzites, sss., shales, and occasional dol. and magnesite beds. Overlies Raquet group (whether conformably or uncon. not ascertained) and underlies surficial deposits. Thickness at least 6,000 ft. Mesozoic, probably chiefly Cret. Named for Orange Fork of Black River, Yukon, to S. of which it outcrops and continues 40 mi.

Later work led to discovery that †Orange group included Mesozoic and Penn. rocks, and the term was abandoned by D. D. Cairnes in 1914 (Canada Geol. Surv. Mem. 67, p. 103).

Orange granite.

Devonian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Named for Orange Twp, Orange Co.

†Orangeburg formation.

Eocene (middle): Western and central South Carolina and southern Georgia.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 344, and chart opp. p. 334; also published in 1897 as House Doc. 5, 55th Cong., 2d sess.). *Tallahatta or Orangeburg fm.* [See quotation under *Tallahatta fm.*]

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). The deposits referred to are McBean fm., but latter name is better defined and is established. Dall designated as typical a locality in the old Orangeburg dist. (Lang Syne plantation, near Fort Motte, now in Calhoun Co.). *Orangeburg* has since been applied by U. S. Bureau of Soils to a series of soil types that is widely distributed and not restricted to any one geologic fm.

Orange-Martin limestone.

Mississippian: Indiana (Orange and Martin Counties).

D. D. and R. Owen, 1862 (Rept. of geol. reconn. of Ind., pp. 126–7). The upper sub-carboniferous ls., which might be also termed the *Orange-Martin ls.*, from its prevalence in those counties, is often characterized, in its [lower] submemb. "B," by abundant Bryozoa, of genus *Retepora*, *Fenestella*, *Ceriopora*, etc., and it is occasionally oolitic. The [upper] submemb. "A" is more frequently compact, with few fossils and a very clear ring when struck by hammer, sometimes more closely crystalline and containing *Archimedipora*, *Archimedes*, or spines and fragments of *Echinites*. [Section on p. 127 shows submemb. "B" to be 5 to 30 ft. thick, the submemb. "A" to be 3 to 20 ft. thick, and the two to be separated by 0 to 30 ft. of grindstone grit and sh. The upper ls. is overlain by Ferruginous ss. 50 to 100 ft. thick, and the lower memb. rests on 50 to 100 ft. of aluminous and calc. shale.]

Orangeville shale. (In Cuyahoga group, in Ohio.)

Orangeville shale member (of Cuyahoga formation in northwestern Pennsylvania).

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3, p. 63). *Orangeville shales.*—A group of shales, prevailingly blue, but often rusty or reddish brown on exposed surfaces, always more or less argill., seldom exhibiting sandy layers more than 6 in. thick, and containing considerable quantities of scattered iron-ore balls. Is lowest surface fm. in Mercer Co., Pa. About 75 ft. thick at Orangeville, near State line, where most of it is exposed. Underlies Sharpsville ss.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 83-90). *Orangeville sh.*—Usually 100 ft. thick in Crawford Co., Pa. Underlies Sharpsville ss. and overlies Corry [Berea] ss.

In NE. Ohio the Cuyahoga is treated as a *group* and Orangeville sh. as a *fm.* It rests on Berea ss.

†Orbitoides limestone.

†Orbitoidal limestone.

†Orbitoitic.

†Orbitolite limestone.

Names, of paleontologic derivation, used in early repts for all and for part of Ocala ls., of upper Eocene (Jackson) age, of Fla., and for Vicksburg group (Olig.) of Ala.

†Orbitolina limestone.

Paleontologic name for a part of Glen Rose ls. (Lower Cret.) of Tex.

Orca group.

Paleozoic and Mesozoic(?): Central southern Alaska (Prince William Sound region).

F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 404, 413). *Orca series.*—Thick-bedded brown and gray sss., black lss., and arkoses, interlarded with usually thin layers of dark sh. and sl. and occasionally some cgl.; arkoses form by far larger part of series, which is probably several mi. thick. Jointed, folded, faulted, and somewhat altered. Form N. shore of Prince William Sound and adjacent islands, beginning below Orca and extending N. to vicinity of Fidalgo Bay, and NW. Fragmentary plants indicate slight probability of Upper Cret. or Lower Tert. age.

See 1911, 1924, and 1926 entries under *Valdez group.*

Orcas group.

Mississippian and Upper and Middle(?) Devonian: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 217-222). *Orcas group.*—Highly metamorphosed and contorted marine sediments with some interbedded volcanic rocks (altered basalts and basic andesites). Chiefly light bluish-gray chert, badly fractured, and cherty qtzite, with intercalated beds of ls. and argillite. Thickness estimated at not less than 10,000 ft. Is oldest group exposed on Orcas and San Juan Islands, the underlying strata being covered by the waters of the straits. Is overlain by Leech River group. Forms basal div. of San Juan series. Is of Miss. and Middle or Upper Dev. age.

Named for exposures on Orcas Island.

Orchard gneiss.

Pre-Cambrian: Northeastern New York (Essex County).

J. F. Kemp, 1898 (Am. Inst. Min. Engrs. Trans., vol. 27, p. 178, map, and cross sections). *Orchard gneiss*, a light-colored granitoid gneiss occurring near Port Henry [Essex Co.]. Overlain by Barton gneiss and underlain by gabbro gneiss. [Apparently named for Orchard Pit, which is shown on map.]

Orchard Creek shale.

Silurian (early): Southwestern Illinois and southeastern Missouri.

T. E. Savage, 1909 (Am. Jour. Sci., 4th, vol. 28, p. 515). *Orchard Creek sh.*—Bands of bluish-gray sh. 4 to 6 in. thick, alternating with 2- to 4-in. layers of impure crystalline ls. Thickness 17 to 22 ft. Uncon. underlies Girardeau ls. and uncon. overlies Thebes ss. Included in Richmond stage and in Ord. system.

T. E. Savage, 1910 (Ill. Geol. Surv. Bull. 16). *Orchard Creek sh.*—On account of faunal differences these lower shaly beds are described as separate fm. from Girardeau ls. Should further study show sedimentation was continuous from Orchard Creek sh. into Girardeau ls., no especial confusion will have been caused by this discussion of the lower argill. horizon separate from that of overlying ls. memb. Fauna belongs to Maquoketa phase of Richmond. Included in Ord. [These beds were included in Ord. by Savage and all other geologists up to 1915. They apparently were excluded from Cape Girardeau ls. of Swallow in 1855, 1858, and other geologists, and included in "Hudson River sh." (See under *Girardeau ls.*)]

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4). [Orchard Creek sh. shown as post-Richmond and correlated with basal Albion.]

T. E. Savage, 1917 (Ill. Acad. Sci. Trans., vol. 10, pp. 261–265), removed Orchard Creek sh. from Richmond and designated it the "oldest fossiliferous marine fm. of Silurian age in U. S." "More recent study of fauna of Girardeau ls. and Orchard Creek sh. has convinced writer that affinities of Orchard Creek fauna are much closer with Girardeau ls. fauna than with that of any Richmond." Is known in Ill. at only a few places in Alexander Co. in a distance 4 or 5 mi. N. and S. of Thebes. Is younger than Thebes ss. [Savage now includes this sh. in his Alexandrian series.]

The age of this sh. seems now to be generally accepted as early Sil.

Named for Orchard Creek, 2 mi. S. of Thebes, Alexander Co., Ill.

Orcutt formation.

Pleistocene: Southern California (Santa Maria district).

H. W. Hoots and S. C. Herold, 1935 (Geol. of nat. gas, A. A. P. G., p. 156). *Orcutt fm.*—Gravels and fresh-water clays, 300± ft. thick. Uncon. overlies Schumann fm. (Plio.). [Derivation of name not stated.]

Ordovician period (or **system**).

The time (and the rocks) of the next to oldest period of the Paleozoic era, succeeding the Cambrian and preceding the Silurian.

In early repts was called "Lower Silurian," but for many decades Silurian has been restricted to the rocks originally called "Upper Silurian." The U. S. Geol. Survey and geologists generally include in the Ordovician the Beekmantown rocks at base and the Richmond rocks at top. Some geologists, however, exclude both the Richmond and the Beekmantown. For definition see U. S. G. S. Bull. 769, pp. 83–89.

Ordovicic.

A variant of *Ordovician* employed by some geologists.

Oread limestone. (In Douglas group, in Kansas.)

Oread limestone member (of Douglas formation, in Missouri).

Pennsylvanian: Eastern Kansas, southeastern Nebraska, central northern Oklahoma, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1894 (Kans. Univ. Quart., vol. 2, pp. 123, 124). *Oread ls.*—Very fossiliferous ls., light-blue, weathering buff; 10 ft. thick; capping all hills in vicinity of Lawrence, Kans. Overlies Lawrence shales and underlies 8 ft. of sh. [Kanwaka sh. memb.].

Was for many years treated as top memb. of Douglas fm. in Mo. In Kans. the Douglas is now treated as a group and the Oread as a fm. In Okla. the Oread ls. is treated as a memb. of Nelagoney fm. In Okla. thicknesses as high as 107 ft. have been assigned to it.

Since 1931 the Kans. Geol. Surv. has included this ls. in Shawnee group, q. v. This change of definition has not been considered by U. S. Geol. Surv. for its publications.

Named for fact it caps Mount Oread, at Lawrence, Douglas Co., Kans.

Oreana shale.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 80). *Oreana shales* are early Jurassic sediments, highly inclined, occupying W. flank of Humboldt Range, Nev., from Oreana Station southward. Consist of 1,000 ft. of shales overlying Muttleberry lss. and composing upper fm. of Lovelockian series.

Oreapolis limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 6, 10, 19, 34). *Oreapolis ls.*—Unweathered stone is light bluish gray and partly crystalline. Basal part weathers light gray. Upper 2 to 3 ft. is thin-bedded and slightly yellowish. Thickness 6 to 12 ft. Included in Andrew (Lawrence) sh. Lies 7 to 18 ft. below Weeping Water ls. Named for Oreapolis, Cass Co., Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). *Oreapolis ls.* abandoned, as another name has priority over it. [Does not state what name replaces it.]

†Oregon beds.

Miocene and Oligocene (?): Central northern Oregon.

E. D. Cope, 1879 (Am. Nat., vol. 13, p. 333), described fossils "from beds of *Truckee* epoch of White River fm." and said: "This name, introduced by King, has priority of publication over the term *Oregon beds* introduced by me [probably 1880 publication in press], hence the latter name must be abandoned."

E. D. Cope, 1880 (U. S. Geol. and Geog. Surv. Terr. Bull. 5, pp. 51, 52). *Oregon beds.*—The Oregon White River beds differ from those found E. of Rocky Mtns, although they contain a majority of same genera and many of same species. [Fossils listed. On p. 53 he assigned White River to Olig.]

E. D. Cope, 1884 (U. S. Geol. and Geog. Surv. Terr. Mon. 3, pp. 3, 13–20). *Oregon fm.* of Cope is same as Truckee beds (Mio.) of King, and Oregon fm. is abandoned.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 332). *Oregon beds*, named for State of Oreg., is=John Day group.

Oregon limestone.

Middle Ordovician (Lowville): Central Kentucky.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, p. 13). *Oregon substage.*—Even-bedded mag. ls., 25 ft. thick, in two beds. Middle part of Highbridge stage. Overlain by Tyrone beds and underlain by Camp Nelson beds. Is "Kentucky marble" of Linney.

Named for Oregon, Mercer Co.

Oregonia division. (In Arnheim formation.)

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

A. F. Foerste, 1910 (Denison Univ. Sci. Lab. Bull. 16, p. 18). *Oregonia div.*—Upper div. of Arnheim bed, characterized by introduction, at base, of characteristic Richmond fossils *Leptæna richmondensis-precursor*, *Rhynchotrema dentata-arnheimensis*, and *Dinorthis carleyi*. Included in Richmond. Overlies Sunset div. of Arnheim bed. Thickness 26 ft.

The U. S. Geol. Survey treats Fort Ancient div. of Foerste as top memb. of Arnheim fm. in Ohio and Ind.

Named for Oregonia, Warren Co., Ohio.

Ore Hill limestone member (of Gatesburg formation).

Cambrian (Upper): Central Pennsylvania (Blair County).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 527, 534, 537). *Ore Hill ls. memb.*—Thin-bedded blue ls. in middle of Gatesburg fm. Fauna related to Hoyt ls. of N. Y. Named for exposures in quarry 1 mi. SW. of Ore Hill, Blair Co.

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press). *Ore Hill ls. memb.*—Thin-bedded bluish to dark-gray, mostly fine-grained ls., but has a few layers of coarse-grained rock. Thickness 100±ft. "Occupies about the middle of the upper two-thirds of Gatesburg fm."

Orejon andesite.

Tertiary (?): Southern New Mexico (Dona Ana County).

K. C. Dunham, 1935 (N. Mex. School Mines Bull. 11, pp. 53, 54). *Orejon andesite*, thin flows, 600 ft. thick, in Organ Mtns. Named for Orejon mine, in which it occurs as the hanging wall of the main fault. Older than Cueva rhyolite. In absence of evidence assigned to Tert.

†Oreodon beds.

A paleontologic name that has been applied to lower and major part (*Oreodon* zone) of Brule clay (Olig.) western Nebr. and S. Dak.

Organ Rock tongue (of Cutler formation). (Also **Organ Rock member.**)

Permian: Southeastern Utah (San Juan County).

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1420, 1422, 1423, 1441, 1443, 1446). *Organ Rock tongue of Cutler fm.*—Red sandy sh. and sss., 380 to 550 ft. thick, underlying true DeChelly ss. memb. of Cutler and overlying Cedar Mesa ss. memb. Named for fact the beds compose the natural monument known as Organ Rock, San Juan Co., lying S. of San Juan River, btw. Moonlight and Copper Creeks. In earlier repts included in Moenkopi fm. (Lower Triassic).

In areas where the Organ Rock rocks can be separated from main mass of Cutler fm. they are called *Organ Rock memb.*

Oriana gypsum member (of Peacock formation).

Permian: Central northern Texas (Stonewall County).

L. T. Patton, 1930 (Univ. Tex. Bull. 3027, pp. 47+). About 100 ft. above Swenson gyp. memb. of Peacock fm. there occurs another rather prominent bed of gyp. which may be known as *Oriana gyp.*, as it is exposed near station of Oriana, on Stamford & Northwestern R. R. In places it consists of two ledges separated by 5± ft. of sh. The lower beds vary in thickness from 2 to 16 ft., and the upper from 3 to 5 ft. Well exposed in valleys of Double Mtn Fork and Salt Fork Rivers. Does not develop as prominent an escarpment as Swenson gyp., but is more resistant to weathering and erosion than the soft shales and sss. of Peacock fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). Relation of *Oriana gyp.* to Croton gyp. has not been determined. They may be the same.

Orient gneiss.

Pre-Cambrian (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 85; map). *Orient gneiss.*—Chiefly gneissoid and sheared granite and diorite; in places inter-laminated with coarsely crystalline light- to medium-colored lss. and highly foliated schists. Associated with these are masses of slightly altered granites and diorites, apparently intrusive. The typically gneissoid rocks were originally granites and diorites which were intrusive into a sed. series, and later both the intrusives and sedimentaries were subjected to intense dynamic metamorphism. Is older than Stevens metamorphic series and may be pre-Camb. Good exposures in railway cuts at town of Orient.

Orienta sandstone. (In Bayfield group.)

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield and Douglas Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 41). *Orienta ss.*—Basal fm. of Bayfield ss. group. Conformably overlies Amnicon fm. (of Oronto group) and underlies Devils Island ss. Consists of (descending): (1) Mainly white and red ss. with few ripple marks, 300 to 400 ft.; (2) upper brownstone (of Port Wing), 500 to 700 ft.; (3) Copper Creek beds, 75 to 100 ft.; (4) main beds (brown, red, and white sss., becoming progressively more feldspathic toward bottom, with thin beds of red sh., 1,800 to 2,000 ft. Named for exposures in quarries near Orienta, Bayfield Co.

Orinda formation.

Pliocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, p. 371 and map). *Orindan fm.*—Fresh-water cgls., sss., shales, clays, lss., and tuffs, with pebble cgl. at base. Thickness 800 to more than 2,400 ft. Basal fm. of Berkeleyan series. Rests on Monterey series and is overlain by rhyolite tuff that forms basal div. of Upper Berkeleyan.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Orinda fm.*—Fresh-water cgls., ss., clay shales, lss., some thin seams of lignite, and at a few horizons thin layers of brown decomposed volcanic tuff. Farther E., in Mount Diablo quad., it includes, in lower part, a few beds of pumiceous tuff similar to Pinole tuff. Thickness 2,000 to 2,500 ft. in San Pablo Ridge, but 6,000 ft. to SE., near S. border of Concord quad. Lies conformably on Pinole tuff, or, where that is absent, rests on San Pablo or older fms. Excluded from Berkeley group. Is overlain by Moraga fm., which is now treated as basal div. of Berkeley group. Named for exposures at Orinda, Contra Costa Co.

B. L. Clark (1921) and R. R. Morse and T. L. Bailey (Geol. Soc. Am. Bull., vol. 46, No. 10, 1935, pp. 1437–1455) assigned Orinda fm. to *lower* Plio. The latter authors correlate it with Petaluma fm.

†Orindan formation.

See *Orinda fm.*

Oriskanian.

A time term covering interval during which the rocks of Oriskany group were deposited. (See explanation under *Oriskany group.*)

Oriskany formation.

Oriskany group.

Oriskany sandstone.

Lower Devonian: New York, Pennsylvania, western Maryland and Virginia, and eastern West Virginia.

L. Vanuxem, 1839 (N. Y. Geol. Surv. 3d Rept., p. 273). White ss. occurring on hill at the falls of Oriskany, which for the present may be called *Oriskany ss.* Is well known to extend over several States. Is 30 ft. thick at Oriskany Falls; at quarries near Auburn it is a few inches to 2½ ft. thick; is 700 ft. thick in Pa. Rests on water-lime group of Manlius and is overlain by 8 to 12 ft. of gray sparry crinoidal ls.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 308–309). The *Oriskany ss.* is well characterized in 3d geol. dist., and described by Mr. Vanuxem. It appears but at one point in this [Ontario] county and not at all in Seneca, being either entirely wanting or deeply covered with superficial materials. Is overlain by "gray crinoidal" or Onondaga ls.

W. W. Mather, 1841 (N. Y. Geol. Surv. 5th Rept.). Downward succession of fms.: Onondaga ls.; Schoharie layers; grit rock characterized by fucoides caudagalli [Esopus grit]; Oriskany ss. (0 to 2 ft. of highly siliceous ls. sometimes approaching hornstone and chert and in places hard siliceous grit); Scutella ls. [Becraft ls.].

J. Hall, 1843 (Geol. N. Y., div. 4, 4th dist., p. 147). In Pa. and Va. the Oriskany ss. is an important fm. Is 700 ft. thick in former State. In N. Y. greatest thickness is not more than 30 ft. and usually much less.

For many years the name *Oriskany ss.* was commonly applied to the rocks below Esopus grit. The 1863, 1864, 1868, 1869, 1875, and 1895 editions of Dana's Textbook of geology used the time term *Oriskany period* to cover the Oriskany ss. only, excluding Esopus grit and pre-Oriskany ss. rocks. In 1898 F. J. H. Merrill (N. Y. State Mus. Bull., vol. 4, No. 19, p. 158) employed *Oriskany group* to include †Cauda Galli grit [Esopus grit] and underlying Oriskany ss., stating that only fossil of the grit is *Spirophyton cauda galli*, which also occurs in Oriskany ss. A. W. Grabau, 1898 (Buffalo Soc. Nat. Hist., vol. 6, p. xviii), included Schoharie grit and Esopus sh. in what he called *Schoharie stage*, and used *Oriskany stage* to cover Oriskany ss. only. In 1899 J. M. Clarke and C. Schuchert (Sci., n. s., vol. 10, pp. 874–878) introduced *Oriskanian period or group* to cover the Oriskany beds, which they defined as underlying Esopus grit and overlying Kingston beds [Port Ewen ls.]. In 1900 Schuchert, also J. M. Clarke, employed *Oriskanian* in latter sense, but Schuchert divided the *Oriskany* into Upper Oriskany and Lower Oriskany. In 1901 (N. Y. State Mus. Bull. 52) and 1902 E. O. Ulrich and C. Schuchert, also A. W. Grabau, applied *Oriskanian* to the pre-Esopus and post-Kingston beds, but also stated that the Esopus "is only a phase of the Oriskany." The same year F. J. H. Merrill (geol. map of N. Y.) included the Esopus in the *Oriskany*, while A. W. Grabau excluded both Esopus and Kingston from the *Oriskanian*. In 1903 (Am. Geol.) Schuchert included in *Oriskanian* the following (descending): Decewville, Esopus, Oriskany, Kingston. The same year (N. Y. State Mus. Bull. 69) G. Van Ingen and P. E. Clark, also J. M. Clarke, applied *Oriskanian* to Oriskany ss. (pre-Esopus and post-Port Ewen). In 1906 Grabau included in *Oriskanian group* the Esopus grit and Oriskany ss. In 1908 G. H. Chadwick (Science) divided the *Oriskanian* of N. Y. into Esopus, Glenerie ls., Connelly cgl., and Port Ewen (†Kingston), with statement that the Glenerie and Connelly are=the *Oriskany*, and that Oriskany fossils occur in the Esopus (Decewville), 40 ft. above its base, "so that at least lower part [of that fm. also] is Oriskany." In 1909 J. M. Clarke included the Port Ewen in the Oriskany. In 1911 (Geol. Soc. Am. Bull., vol. 22) E. O. Ulrich divided the *Oriskany* into Esopus, Glenerie, Connelly, and Port Ewen, and assigned the Decewville to the overlying group. In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel divided *Oriskanian group* of eastern N. Y. into Esopus, Glenerie, Connelly, and Port Ewen, and also used *Oriskany ss.* for the pre-Esopus and post-Becraft beds of east-central to western N. Y.

The U. S. Geol. Survey at present uses *Oriskany group* in broad sense, to include the Esopus at top and the Port Ewen at base, and where the undiff. deposits of Oriskany age are chiefly or wholly ss. it applies to them the term *Oriskany ss.* In central Pa., western Md., northern W. Va., and parts of Va. the Oriskany group is divided into Ridgeley ss. (above) and Shriver chert (below). The present N. Y. State Survey uses *Oriskanian* to include Esopus grit (above) and *Oriskany ss.* (below), and has transferred Port Ewen ls. to underlying Helderberg group. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 370.)

Orito limestone.

Cretaceous: Mexico.

G. E. Anderson, 1926 (Am. Inst. Min. and Met. Engrs. Trans. [preprint], No. 1551, p. 3).

Orizaba limestone.

Cretaceous: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, p. 124).

Orlando limestone. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, p. 147). *Orlando ls.*—Gray, somewhat shaly ls., 3 ft. thick, containing fossils probably of brackish- or fresh-water origin. Lies 10 to 30 ft. below Morgantown ss. and overlies Elk Lick coal. Exposed at Orlando, Lewis Co.

Orleans phyllite.

Ordovician: Northeastern Vermont (Orleans County).

E. C. Jacobs, 1923 (Vt. State Geol. Rept. 1921–22, pp. 93–108). *Orleans phyllite.*—Gray highly schistose rocks, formed from fine sediments, more or less completely recrystallized. Extends N. and S. across E. part of Orleans Co., according to writer's observations, and Richardson mentions belts of it in W. part of Co. Constitutes a distinct fm. and is entitled to a name. Richardson's rather inclusive term *Bradford schists* [Ord.] perhaps embraces it, although it is not a typical schist but a phyllite. No fossils.

C. H. Richardson, 1924 (Vt. State Geol. Rept. 1923–24, pp. 77–103). *Orleans phyllite* of Jacobs underlies Waits River ls. and is therefore older than Randolph phyllite, which is interbedded and interstratified with Waits River ls.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this phyllite to Ord.

Orofino series.

Pre-Cambrian (Belt series): Northern Idaho (Orofino region).

A. L. Anderson, 1930 (Idaho Bur. Mines and Geol. Pam. 34). *Orofino series.*—Assigned provisionally to Belt series is a series of highly metamorphosed igneous and sed. rocks with beds of exceptionally pure crystalline ls. or marble in lower Clearwater drainage near Orofino. These cannot be correlated with any of Belt members farther N. They must either be older or belong in lower part of the Prichard, whose counterpart in other places has not been exposed by erosion or is not present. The term *Orofino series* has been given to these rocks. This series as defined above is assigned to lower part of the Belt (Prichard fm.). It apparently lies beneath the known Prichard and conforms with it in strike and dip, although precise plane separating one from the other is unknown. The series is best exposed in Clearwater Canyon, near Orofino, the lower 11 mi. of Orofino Creek in lower canyon walls, and along lower course of N. Fork btw. Elk Creek and Ahsahka. It is composed of a great thickness of banded micaceous and hornblendic rocks including micaceous qtzites, mica schists, hornblendic gneisses, and intercalated beds of crystalline ls. or marble. Many of the gneisses and schists are undoubtedly of igneous origin, but much also has fairly distinct bedding planes. Probably much of the metamorphism was induced by the batholithic invasions, as the younger granitic bodies are numerous in vicinity of the series, and some is intercalated as injection gneiss, but part of the metamorphism was probably much earlier. Most of the schist and gneiss has scattered crystals of reddish garnets, more numerous than is ordinarily observed in the altered Prichard. The bedding is most distinct in the massive micaceous qtzites, and these are most prominent near the ls. members. The number of lss. is not known, but several beds are present, ranging in thickness from 10 ft. to over 800 ft.; they are more or less lenticular. Most of the lss. are near Orofino, beginning near mouth of Jim Fords Creek and lying parallel to the river to Ahsahka. The beds are thicker and purer farther S. above Orofino. No part of Wallace fm. has ls. members as pure, as thick, or as metamorphosed as these.

Oro Grande series.

Lower Cambrian: Southern California (San Bernardino County).

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 273–290). Nearly pure ls. underlain by pure qtzite. The alteration of *Oro Grande series* has destroyed all fossils, and its age can only be conjectured. Except for higher degree of metamorphism it is identical in character with Lower Camb. series described by Walcott from Inyo Co., and I believe the propriety of classing it as Lower Camb. will hardly be questioned.

†Orohippus beds.

A paleontologic name that has been applied to lower part (*Orohippus* zone) of Bridger fm. (middle Eo.).

Oronto group.

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield, Douglas, and Iron Counties).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 48). *Oronto group.*—Largely or wholly nonmarine arkosic sss., cgls., and red shales. Thickness 21,500± ft. No fossils. Top fixed at top of highest thick beds of red shales and well-marked arkosic sss. Divided into (descending) Amnicon fm., Eileen ss., Freda ss., Nonesuch fm., and Outer cgl. Conformably underlies Bayfield ss. group and overlies middle and lower Keweenawan traps. Named for exposures on Oronto Bay, Iron Co.

Oroville beds.

Jurassic (Upper?): Northern California (Oroville region).

W. M. Fontaine, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, p. 342). The plants described in this paper were collected in Sept. 1895, by Mr. Lester F. Ward, assisted by Mr. James Storrs. They were obtained near Oroville, Calif., from a fm. which for convenience of reference I will call the *Oroville beds*. They were collected from following 4 localities, all near together, and on same horizon: (1) Old dump at Banner mine, near Feather River, 5 mi. E. of Oroville; (2) the new dump, 300 yds farther N. than old dump; (3) bank of Feather River ½ mi. S. of Banner mine; (4) in bed of a ravine that leads from Banner mine to Feather River, from ¼ to ½ mi. S. of the mine. Mr. Ward says, in a note, that these Oroville beds closely resemble the Jurassic Mariposa slates, but identity is not made out. The beds contain no fossils besides the plants, and are not connected stratigraphically with any known fm. Their age must be determined from the plants. Judging from specimens collected by Messrs Ward and Storrs, most of the rock of Oroville beds that carries plants consists of alternations of sandy-looking beds with layers of sl.

C. H. Crickmay, 1931 (Am. Phil. Soc. Proc., vol. 70, p. 60), assigned Oroville flora to "undoubted Upper Jurassic," and R. W. Brown, of U. S. Geol. Survey, concurs in Jurassic age of the flora.

See also *Monte de Oro fm.*

The omission of this name from U. S. G. S. Bull. 191 (and consequently from U. S. G. S. Bull. 826) was discovered and reported by Mr. Lesh Forrest, of Stanford Univ., in Feb. 1937.

Orr formation.

Upper Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 10). *Orr fm.*—Gray, slightly aren. lss. and shales, 1,825 ft. thick, underlying Notch Peak fm. and overlying Weeks fm. Type loc., Orr Ridge, a spur extending E. from main mass of Notch Peak, on S. side of Weeks Canyon.

†Orthaulax bed.

Paleontologic term that has been applied, in early repts. to so-called "silex bed" of Tampa ls. of Fla.

†Orthis bed.

Paleontologic name used by J. M. Safford for beds in Tenn. later named *Hermitage fm.*

Orting gravel.

Pleistocene (pre-Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Orting gravels.*—Coarse gravel deposits, interbedded with orange-colored sands. Color frequently orange brown. In heterogeneous composition and varying structure resemble Vashon drift. Underlie Puyallup sands throughout Puyallup Valley. Well exposed on E. bank of Carbon River at Orting.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), gave thickness of *Orting gravels* as 40 to 140 ft.

Ortonville granite.

Trade name of a dark-red pre-Camb. granite that occurs at and in vicinity of Ortonville, western Minn., and has been quarried near that town. (See E. F. Burchard, U. S. G. S. Bull. 430, 1910, p. 281; and O. Bowles, U. S. G. S. Bull. 663, 1918, p. 68.)

Osage group.

Mississippian: Mississippi Valley region.

H. S. Williams, 1891 (U. S. G. S. Bull. 80, p. 169). *Osage group* proposed to include Keokuk and Burlington lss., whose faunas are closely allied and differ from those of underlying and overlying rocks.

The Fern Glen ls. is now generally included in Osage group, instead of in underlying Kinderhook group. The Ill. Geol. Survey includes the Warsaw in Osage group; the U. S. Geol. Survey includes it in overlying Meramec group.

Named for Osage River, Mo., along which both Keokuk and Burlington are exposed in vicinity of Osceola, St. Clair Co.

†Osage limestone.

Lower Ordovician (Beekmantown): Central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 366, 375). *Osage ls.*—Mag. lss. and chert, 270 ft. thick, underlying Moreau [Roubidoux] ss. and overlying Cole Camp ss.

Corresponds to all of Gasconade dol. restricted of present usage and all of Van Buren fm. above Gunter ss. memb.

Named for Osage Bluff, Cole Co.

†Osage limestone. (In Shawnee formation.)

Pennsylvanian: Eastern Kansas.

J. G. Hall, 1898 (Kans. Univ. Geol. Surv. vol. 3, p. 71), applied *Osage shales* to beds underlying Osage coal, and *Osage ls.* to ls. overlying Osage coal and occurring at a considerably lower level than Burlingame ls. On p. 73 of vol. cited E. Haworth stated that *Osage ls. of Hall* thins out and becomes unimportant, so that it cannot be used as a div. btw. the shales; Osage shales, therefore, may be considered to extend upward to Burlingame ls. (This definition includes Scranton sh. in *Osage shales.*)

Replaced by Howard ls. memb. of Shawnee fm.

Named for exposures at Osage City, Osage Co.

†Osage shale.

Pennsylvanian: Eastern Kansas.

See under †*Osage City sh.*

†Osage City shale. (In Shawnee formation.)

Pennsylvanian: Eastern Kansas.

E. Haworth, 1895 (Kans. Univ. Quart., vol. 3, p. 278 and pl. 20; Am. Jour. Sci., 3d, vol. 50, pp. 461–462). *Osage City sh.* proposed by G. I. Adams for shales with much ss., 100 ft. thick, overlying Topeka coal and including Osage coal at top. Separated from overlying Burlingame [Scranton] shales by a thin but persistent ls. [Howard ls.]. [As thus originally defined is practically same as Severy sh. memb.]

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, p. 73). *Osage ls. of Hall* thins out and becomes unimportant, so that it cannot be used as a division line btw. the shales. Osage shales, therefore, may be considered to extend upward to Burlingame ls. [As thus defined includes Scranton sh., Howard ls., and Severy sh.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 209–214). Osage sh. of Haworth (1898) included White Cloud sh., Happy Hollow ls., Cedarvale sh., Rulo ls., and Silver Lake sh., and is discarded. [See Kans.-Nebr. correlation chart by M. G. Wilmarth.]

Named for exposures at Osage City, Osage Co.

†Osage City limestone.

Pennsylvanian: Eastern Kansas.

J. G. Hall, 1896 (Kans. Univ. Geol. Surv., vol. 1, p. 104). *Osage City ls.* (No. 4) outcrops 6 mi. SE. of Burlingame, but can be traced only short distance. It is 60 ft. above No. 3 and of grayish-white color, very soft. Overlies Osage City sh. and underlies Burlingame sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 204). Osage City ls. of Hall is Howard ls. and is abandoned.

Osagian.

A time term employed by some geologists to cover the epoch during which the Osage group was deposited.

†Osborne limestone.

Upper Cretaceous: Central northern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 51). *Osborne ls.*—Ls., in rather thick courses, overlying Victoria sh. [also called *Victoria fm.* and *Victoria clays*] and constituting lower fm. of Niobrara. Overlain by Smoky Hill chalk, upper fm. of Niobrara. Named for exposures at Osborne and in Osborne Co.

Same as Fort Hays ls. memb. of Niobrara fm., the better established name.

Oscar sandstone.

Pennsylvanian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 11+). *Oscar ss.* (also *Oscar sand series*).—Largely sss. with intervening beds of brown and gray shales. Individual beds vary in thickness from 1 to 50+ ft. and are very lenticular. Certain beds contain cgl. phases of varied coarseness. The sss. are massive to thin-bedded, light gray to brown on fresh exposure, weathering darker gray, brown, and black. Large brown to black concretions common in upper members. In general the beds are hard and resistant. The lowest bed stratigraphically of Oscar series is exposed on Ketchum's Bluff along Red River, in sec. 24, T. 7 S., R. 6 W., and adjoining section to E. It is composed largely of cgl., the pebbles mostly chert fragments from small grains to 2 in. diam.; is ripple-marked and cross-bedded, and attains max. thickness of 50 or more ft. [On cross-section sheet this bed is called *Ketchum Bluff cgl. bed.*] The cgl. phases of the Oscar fade out to N. and NW. and become coarser to SE. Thickness 300 ft. Lies 100 to 125 ft. lower than *top* of Ryan ss., the interval being occupied largely by brown sh. with occasional thin sandy streaks. Is separated from underlying Pontotoc cgl. by a zone of brown and blue sh. and sandy shales with interbedded ss. (fine- to coarse-grained and locally with gravel streaks). Exposed at and near town of Oscar, Jefferson Co.

Osceola amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1894 (Lake Superior Min. Inst. Proc. 2d Ann. Meeting, pp. 79–96).

Belongs to Central Mine group. The mineralized part is the Osceola lode. Named for occurrence in Osceola mine, Houghton Co.

Osceola flow.

Includes Osceola amygdaloid and underlying trap.

Osceola glacial drift.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Osceola till.*—Till deposited by a lobe of Cascade glacier (which opposed Vashon glacier in E. part of Tacoma quad.) on the plain on which is situated the hamlet of Osceola. Consists of fine silt with numerous angular stones of volcanic rocks.

Osceola clay.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Osceola clays.*—Blue-gray clays of aspect and compact character of Osceola till, but unlike it in being evenly stratified. Lie 650 to 700 ft. above sea in bluffs which form N. bank of Carbon River, 2 to 3 mi. below Carbonado. Deposited in quiet water when Vashon and Cascade ice sheets enclosed a water body btw. their fronts and the hills to S. and SE.

Oscuro limestone.

Name applied by C. R. Keyes (Iowa Acad. Sci. Proc., vol. 16, pp. 159–163, 1909) to Penn. lss. uncon. overlying his Mosca ls. in Rio Grande region, N. Mex. Derivation of name not stated.

Osgood formation (in Kentucky and Tennessee).

Osgood shale (in Indiana).

Silurian (Niagaran): Southern Indiana and west-central Kentucky and Tennessee.

A. F. Foerste, 1896 (Cincinnati Soc. Nat. Hist. Jour., vol. 18, pp. 191–192). *Osgood phase of Laurel fm.*—Richly fossiliferous basal part of Laurel ls.

A. F. Foerste, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., pp. 217–218, 227–229). *Osgood beds.*—Underlie Laurel ls. and overlie [so-called] Clinton ls. [*Brassfield ls.*]. Thickness 15 to 25 ft. In places divisible into an upper clay, 3 to 5 ft. thick (called *Upper Osgood* clay); a middle ls. memb., 3 ft. thick (called *Osgood ls.*); and a lower clay, 6 to 16 ft. thick (called *Lower Osgood clay*).

Adopted by U. S. Geol. Survey as distinct fm. in southern Ind. and north-central Ky., underlain uncon. by Brassfield ls. and overlain by Laurel ls. In west-central Tenn. the rocks become *Osgood earthy ls. memb. of Wayne fm.*, and are overlain by Laurel ls. memb. of the Wayne and underlain by Brassfield ls. Contains Niagara fossils.

Named for Osgood, Ripley Co., Ind.

A. F. Foerste, 1935 (Denison Univ. Bull., Sci. Lab. Jour., vol. 30, pp. 150–152). In Adams and Highland Counties, Ohio, the clay sh. overlying Dayton ls. is here called *Osgood of Ohio*, since it appears to be an eastern continuation of clay sh. at top of Osgood fm. at Laurel, Ind., but there is no fossil evidence in favor of this correlation. Thickness S. of Yellow Springs, Ohio, on Bryan Farm State Park, is 35 or 40 ft. [Lists fossils of Dayton ls. and *Osgood of Ohio*, and discussed it under heading *Osgood clay*.] The typical Osgood fauna cannot be traced farther N. than Ripley Co., Ind. [Further details given on these and later pages.]

Osgood earthy shale member (of Wayne formation).

Silurian (Niagaran): West-central Tennessee.

See under *Osgood sh.*

Oshawanan series.

A term introduced by C. [R.] Keyes to designate a part of early Carbf. time. Named for "the old name Oshawano Mtns, which was once applied to the easternmost folds of the Ozark uplift in southern Ill. on the flanks of which the complete section reclines." (See Pan-Am. Geol., vol. 55, pp. 45, 50, 222, 1931.)

Oskaloosa shale. (In Deer Creek limestone.)

Pennsylvanian: Eastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). *Oskaloosa sh.*—Gray sh., largely argill., 4 to 7 ft. thick. Underlies Rock Bluff ls. and overlies Ozawkie ls., all included in Deer Creek ls. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 182–184). The sh. memb. of Deer Creek ls. that lies next below Rock Bluff ls. and above Ozawkie ls. is here named *Oskaloosa sh.* It is bluish-gray or yellowish blocky clay with one or two calc., somewhat ferruginous siltstones in outcrops in northern Kans., but S. of Coffey Co. parts of the memb. are distinctly sandy and micaceous, a prominent red zone appears, and there are one or two thin beds of nodular light bluish-gray impure ls. Thickness 5 to 10 ft. in northern Kans., but to S. it increases to 25 ft. Has been miscalled Larsh sh., but is older than true Larsh sh. of Nebr. Type loc., vicinity of Oskaloosa, Jefferson Co. The Oskaloosa and Ozawkie members are absent in Nebr., where Rock Bluff ls. is basal memb. of Deer Creek ls.

Osler series.

Pre-Cambrian: Canada (Rainy River district and Thunder Bay region).

T. L. Tanton, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 114, abstract). [See under *Kaministikwia group.*]

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Osler basic flows* of Thunder Bay region, Ontario, to Keweenawan.

Osos basalt.

Jurassic (?): Western California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Osos basalt.*—Dark, fine-grained, generally amygdaloidal basalt, which occurs in several areas, and from its relation to San Luis fm. [Franciscan] does not appear to be intrusive but to have cooled as surface flows. Other basalts occur in the area. Named for outcrops in Los Osos Valley, San Luis Obispo Co.

Osoyoos granodiorite.

Jurassic (?): Southern British Columbia and central northern Washington (Okanogan batholith).

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376).

Ost limestone. (In Tecumseh shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 47, 52). *Ost ls.* is proposed for the ls. next above Kenosha sh. and below Rakes Creek sh., the type loc. being on Ost farm, on South Fork Weepingwater Creek about 3½ mi. E. of Avoca, Cass Co., Nebr.

†Ostrea shales.

Upper Cretaceous: Northern and central Kansas.

A paleontologic name applied in early repts to the beds now known as *Fairport chalky sh. memb. of Carlile sh.*

Ostrea sellaeformis beds. (In Claiborne group.)

A paleontologic name applied in early repts to a bed in lower part of Yegua fm. of Tex., La., and Miss., and in Gosport sand of Ala., which is characterized by profusion of *Ostrea sellaeformis*, and is now called "*Ostrea sellaeformis* zone" by U. S. Geol. Survey.

Oswald lime. } Subsurface.
Oswald limestone. }

Pennsylvanian: Southwestern Kansas (Ness and Hodgeman Counties).

R. G. Moss, 1932 (Kans. Geol. Surv. Bull. 19, pp. 36–37). The beds locally known as "Oswald lime" consist of cream to gray-colored ls. containing some beds of gray sh.; one or two thin red shales occur in most places 300± ft. below top; the lss. contain cherty and oolitic beds, which in general are porous; these porous beds carry oil at Fairport, Gorham, and elsewhere, but in Ness and Hodgeman Counties only water and a small amount of gas. No identifiable fossils in upper 100 ft. of "Oswald lime" in these counties, but *Triticites* has been found in upper 30 to 50 ft. in Russell and Rush Counties. As that genus has not been reported below Missouri series, the upper part of "Oswald lime" is correlated with lower part of Missouri series and lower part with upper part of Des Moines series, and belongs to Marmaton and possibly Cherokee groups.

E. A. Koester, 1935 (A. A. P. G. Bull., vol. 19, No. 10, p. 1412). *Oswald ls.* refers to the fm. commonly known as "Oswald lime." Name derived from the farm name of the discovery oil well of western Kans. Top of the ls. probably represents a horizon in Lansing group, but, due to erosion, it is not same horizon at all places. Max. thickness on flanks of central Kans. uplift is 275± ft., where it is underlain by beds probably of Marmaton age. Is thinner on local "highs" where it overlies pre-Penn. rocks. In Gorham field 238 ft. of Oswald ls. overlies granite in one well. It is composed of alternating ls. and sh., latter of minor amount. Many of its members are oolitic. It is time equiv. of Lansing, Kansas City, and Bronson groups of E. Kans. surface section. Below Oswald ls., or below Marmaton beds, and extending to base of Penn. section, is Sooy cgl. of Edson.

Oswaldo formation. (Of Magdalena group.)

Pennsylvanian: Southwestern New Mexico (Santa Rita district).

A. C. Spencer and S. Paige, 1935 (U. S. G. S. Bull. 859). *Oswaldo fm.*—In descending order: (1) Banded ls., 80 ft.; (2) upper blue ls., 210 ft.; (3) marker sill of ss., 50 ft.; (4) middle blue ls., 85 ft.; (5) parting sh., 30 ft. Lower fm. of Magdalena group. Underlies Syrena fm. and overlies, probably uncon., Lake Valley ls. Named for Oswaldo patented mining claim, 1± mi. S. of Hanover P. O.

Oswayo formation.

Devonian or Carboniferous: Southwestern New York and northern Pennsylvania (?).

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 978–989, map). *Oswayo beds.*—Olive-green to rusty-colored sandy shales, with here and there thin ss. layers with limonitic seams or incrustations. Marine invertebrates. Thickness 160 to 250 ft. Underlie Knapp beds and overlie, probably uncon., Cattaraugus beds. Assigned to Carbonic. [Mapped near Oswayo Creek, in Olean quad.]

In Warren Co., Pa., the lithology of Oswayo and Cattaraugus deposits changes, so that they cannot be separated, as in N. Y., and C. Butts in 1910 named the combined unit *Conewango fm.*

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 88). *Oswayo beds* carry marine fauna, with *Camarotoechia allegania* as index species. Near base contain thin beds of ls. composed largely of fossil remains. In N. Y. recognized only in Allegany and Cattaraugus Counties. Named for exposures in vicinity of Oswayo Creek, Cattaraugus Co., N. Y. [In Olean quad.]

G. H. Chadwick, 1924 and 1933. See entries under *Conewango fm.*

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Oswayo sh. memb. (facies), (lower "Riceville," upper Chagrin)*, represents Riceville fm. [restricted], top fm. of Venango group, and includes Wild Cat coquinite. Is Upper Dev.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 23), proposed *Tioga magnafacies* to replace *Oswayo fm.* in Tioga and Elkland region of northern Pa., which he stated is not same fm. as typical Oswayo fm. of Olean region, N. Y., but older and of Chautauquan age. In chart opp. p. 61 he divided his *Riceville stage (Riceville monothem), Upper Dev.*, into *Oswayo sh. memb.* [restriction] and Roystone ("Wild Cat" discarded) coquinite, excluded it from his Venango group, and treated it as a distinct "stage."

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 861). Only the lower Cattaraugus extends as far as eastern Potter Co., Pa., being there included in top of Oswayo of Fuller (not Glenn), a continental mass of "Pocono" facies. The *Oswayo of Glenn* (not Fuller), which is marine and fossiliferous, goes no farther E. than western Potter Co., since Pottsville cgl. bevels down across these higher beds of Upper Dev. from Olean, N. Y., eastward.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 581). Writer doubts that there is any true Oswayo (or Elk Mtn) in NE. Potter or northern Tioga Co., Pa., and believes that what has been considered to be Oswayo there is green Coudersport memb. of Cattaraugus fm.

The U. S. Geol. Survey recognizes Oswayo fm. as originally defined, and at present classifies it as Dev. of Carbf.

†Oswegan period or group.

Silurian (early) and late Ordovician: New York.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Oswegan period or group.*—Basal div. of "Ontaric or Siluric" system. Includes Medina ss. (="Oswego ss." of Vanuxem) and underlying Oneida cgl. or Shawangunk grit. Underlies Niagaran and overlies Cincinnatian [in which Richmond was included at top]. This name is appropriate on account of widespread occurrence of Oneida and Medina fms. in Oswego Co., N. Y. Vanuxem employed "Oswego ss." for the fm. subsequently and by common consent called Medina ss. In reviving the name, though with a broader meaning than in its original use, it derives its title from its early date.

Subsequent studies developed fact that Oswego ss. and "Red Medina" of early repts (Queenston sh. of modern nomenclature) are of Ord. age, the Oswego ss. being of Maysville age and Queenston sh. of Richmond (latest Ord.) age. The term "Oswegan" has therefore fallen into disuse.

†Oswegatchie series.

Pre-Cambrian: Northern New York (St. Lawrence and Jefferson Counties).

C. H. Smyth, Jr., 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 687–692). *Oswegatchie series.*—White to gray crystalline ls., weathering nearly black, and interbedded gneiss of sed. origin but extremely metamorphosed. Uncon. underlies Potsdam ss. Base is a matter of doubt, because of uncertainty whether all gneiss of region belongs with the ls. and is a part of Oswegatchie series, or whether part of gneiss is older and uncon. beneath the Oswegatchie. Similarity of rocks suggests equivalency to Grenville series of Canada, as suggested by Van Hise, but local name seems desirable. Oswegatchie River flows through these rocks for many miles.

H. P. Cushing, 1899 (N. Y. State Geol. 16th Ann. Rept., pp. 5–26). *Grenville (Oswegatchie) series.*—The rocks of Smyth's Oswegatchie series are, in writer's opinion, so similar to those of typical Grenville series of Logan, and are separated by such a slight geographic distance, that Grenville might with perfect propriety be applied to them. Some gneisses of region are older than Grenville.

D. H. Newland, 1908 (N. Y. State Mus. Bull. 119, pp. 8–22). The *Grenville series* includes, so far as known, the oldest rocks of Adirondack region.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 621). Following the conclusions of the international committee in 1906, there is little doubt that this series may safely be correlated with Grenville series of the original Laurentian and Hastings districts. This being the case, the term Grenville has priority and "Oswegatchie" is unnecessary.

W. J. Miller, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 400–462). *Grenville series* comprises oldest rocks of Adirondack region.

H. L. Alling, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 47–68). The *Grenville series* of ancient sediments is oldest fm. of Adirondacks so far as known.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, pp. 120–126, 140). The *Grenville* is most ancient memb. of pre-Camb. of the Adirondacks. It consists of completely metamorphosed lss., shales, and sss., comprising paraschists, para-gneisses, qtzites, arkosites, and meta-lss. Is post-Keewatin.

See also under *†Dannemora fm.*

Oswego sandstone.

Upper Ordovician (Maysville): New York, Ontario, central Pennsylvania, and western Virginia.

In Geol. N. Y., pt. 2, div. 4, geol. 2d dist., 1842, E. Emmons included in top of "Champlain group" the *Grey ss.*, 100 ft. thick, underlying Medina ss. (included in overlying "Ontario group") and overlying Lorraine sh. In Geol. N. Y., pt. 3, geol. 3d dist., 1842, L. Vanuxem treated "Gray ss. of falls of Salmon River and Oswego," 0 to 107 ft. thick, as basal fm. of "Ontario div.," and as underlying Medina red ss. and overlying Pulaski shales of Hudson River group. In 1846 (N. Y. Nat. Hist. Agric., vol. 1) Emmons used "gray ss. of Oswego," and repeated his 1842 definition. In succeeding years "Grey ss. of Oswego" became confused with Oneida cgl., which led to recognition by J. D. Dana, in early editions of his Textbook of geology, of an "*Oneida epoch*" in Upper Sil., btw. Medina epoch and Hudson River epoch of Lower Sil.

C. S. Prosser, 1888 (Am. Inst. Min. Engrs. Trans., vol. 16), referred to this fm. as "Gray Medina or gray ss. of Oswego" on p. 942, and as "Medina or Oswego gray ss." on p. 947, and located it btw. Medina red ss. above and Hudson River below. In 1890 (Am. Geol., vol. 6, pp. 205–206) Prosser called the fm. "Oswego ss.," gave its thickness as 210 ft., and located it btw. Red Medina above and "Transition from Oswego ss. to Hudson shales" below, which was described as consisting of 170 ft. of gray ss. and blue shales. In 1893 (Geol. Soc. Am. Bull., vol. 4, pp. 91–117) Prosser gave thickness of *Oswego ss.* as varying from 83 ft. in western N. Y. to 210 ft. in west-central N. Y., and located it btw. Medina above and Lorraine sh. (of Hudson group) below.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878), abandoned Oswego ss. (which they stated was=Medina ss.), and used "Oswego period or group" for basal div. of their Ontaric or Siluric system, including in it only Medina ss. and the supposedly underlying Oneida cgl. In 1899 (N. Y. State Geol. 16th Ann. Rept., pp. 199–226) D. D. Luther used "Oneida cgl. or Oswego sss." for beds beneath Medina ss. and above Hudson River sl. In 1900 (N. Y. State Mus. Mem. No. 3, vol. 3) J. M. Clarke continued to use his 1899 classification. In 1901 (N. Y. State Mus. Bull. 45, pp. 20–21) and 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 4) A. W. Grabau placed "Oswego ss., Oneida cgl., or Shawangunk grit" beneath Medina ss., gave its thickness as 75± ft., and treated it as basal bed of "Siluric" and as younger than the Richmond. In 1902 (N. Y. State Mus. Bull. 52, table opp. p. 658) E. O. Ulrich and C. Schuchert used *Oneida* for the beds beneath Medina, and dropped Oswego ss., as did Schuchert in 1903 (Am. Geol., vol. 31), J. M. Clarke in 1903 (N. Y. State Mus. Hdb. 19), and C. A. Hartnagel in 1903 (N. Y. State Mus. Bull. 69). In 1905 (N. Y. State Mus. Bull. 80, p. 358) Hartnagel revived *Oswego ss.* for the beds beneath Medina in western N. Y., but correlated it with Oneida cgl. of Herkimer Co., as did Grabau in 1906 (N. Y. State Mus. Bull. 92), Grabau stating that in central N. Y. the Oswego ss. merges into Oneida cgl. In 1907 (N. Y. State Mus. Bull. 107) Hartnagel stated that Oneida cgl. is unquestionably of *upper* Medina age, and that although Oswego ss. is practically unfossiliferous he is inclined to correlate it with the Richmond, but that because of marked paleontologic break at close of the Lorraine he treated Oswego ss. as basal fm. of Ontaric [Sil.] system. The same year (N. Y. State Mus. Bull. 114) Hartnagel again included Oswego ss. in Sil., but stated "there is evidence which may show that the Oswego, and probably part of the Medina, could with propriety be included in Lower Siluric" [Ord.]. In N. Y. State Mus. Bull. 111, p. 404, he gave thickness of Oswego as 200 ft. In N. Y. State Mus. 59th Ann. Rept., vol. 1, p. 17, 1907, J. M. Clarke concurred in Hartnagel's recent opinions.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348), stated that *Oswego ss.* constitutes merely closing episode of Lorraine div., and that it is older than Lewiston [Queenston] sh. In 1909 (Sci., n. s., vol. 29, pp. 351–356) A. W. Grabau included Oswego and Queenston in the Ord. and in Lorraine, and the same year (Jour. Geol., vol. 17, pp. 234–252) he repeated his statement that Oswego ss. of western N. Y. is of Lorraine age, and correlated the Oneida cgl. with "Upper Medina."

In 1910 (N. Y. State Mus. Bull. 135) W. J. Miller described Oswego ss. of Port Leyden quad., Lewis Co., N. Y., as consisting of 100+ ft. of gray fine-grained thin-bedded ss.,=Gray ss. of Vanuxem, and named for Oswego Co., N. Y.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), placed Oswego ss. stratigraphically beneath Queenston sh. and correlated it with upper (McMillan) part of Maysville group of SW. Ohio, which underlies Richmond group.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), included Oswego ss. in "Ontaric or Siluric," but excluded it from Medina, and stated that it is found in Oswego, Oneida, Lewis, and Jefferson Counties and to W. extends beyond limits of State as a concealed fm. under Lake Ontario. He included the overlying Queenston sh. and Oneida cgl. in the Medina.

In 1913 (Canada Geol. Surv. Guidebook 4) F. B. Taylor and W. A. Parks put Oswego ss. in Ord., and E. O. Ulrich (12th Int. Geol. Cong., Canada) excluded it from *Medinan*, included it in underlying Maysville group, and stated that "it has so far proved practically unfossiliferous in both N. Y. and central Pa.;" that it "is possibly a land deposit or perhaps river silts laid down in a shallow bay;" and that "chiefly on account of its strat. position it is correlated with McMillan fm., but is not regarded as strictly conterminous with the McMillan."

In 1914 (Denison Univ. Sci. Lab. Bull., vol. 17, pp. 249–252) A. F. Foerste correlated Oswego ss. with upper part of Maysville of Ohio, as did R. S. Bassler in 1919 (Md. Geol. Surv. Camb. and Ord. vol., pp. 170–172). Bassler stated that the unfossiliferous gray Oswego ss. "actually occurs under the Red Medina," and is a "valid formation," overlying Pulaski sh., which contains lower Maysville fossils. In 1921 (Textbook of geol.) A. W. Grabau placed Oswego ss. btw. Queenston sh. above and Lorraine (Pulaski) shales and sss. below.

A. F. Foerste, 1924 (Canada Dept. Mines Geol. Surv. Mem. 138), stated that no identifiable fossils are known from Oswego ss.; that it is 150 ft. thick along W. slope of Tuscarora Mtn, Pa.; more than 107 ft. thick at Salmon River Falls, N. Y.; 75 ft. thick at Niagara, N. Y., westward of which it soon disappears. On Tuscarora Mtn, Pa., it rests on beds carrying a characteristic Fairview [lower Maysville] fossil, and is overlain by soft red unfossiliferous ss. and red sh. regarded as of Richmond age, and "it therefore corresponds to the upper or McMillan div. of the Maysville."

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258), correlated Oswego ss. with Maysville fm. of Ohio and showed it as resting on Pulaski sh., of Lorraine group. This is position assigned to it by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 268).

The U. S. Geol. Survey excludes *Oswego ss.* from Medina group, classifies it as Upper Ord., and uses the following names in central Pa. (descending): Clinton fm; Tuscarora qtzite (=Albion ss.); Juniata fm. restricted (=Queenston sh.); Oswego ss. (=†Bald Eagle cgl.); Reedsville sh. (=Lorraine group and Utica sh.). In 1933 (Int. Geol. Cong. Guidebooks of western Va.) C. Butts reported 250 to 400 ft. of *Oswego ss.* in Little North Mtn, Va., and as far N. as Harrisonburg, Va., but reported it as absent throughout most of Valley of Va. In Va. it underlies Juniata fm. and overlies Martinsburg sh.

†Oswego limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 105–107, 116). *Oswego ls.*—Compact light-buff fossiliferous ls., 28 to 55 ft. thick, separated into two parts by 8 to 10 ft. of sh. Overlies Cherokee shales and underlies Laneville shales.

Same as Fort Scott ls., older name.

Named for Oswego, Labette Co.

Oswego lime.

Drillers' name for Fort Scott ls.

Oswego moraine.

Pleistocene (Wisconsin stage): East-central New York. Named for Oswego. See Jour. Geol., vol. 32, pp. 644, 655, 1924.

Otero formation.

Tertiary (?): Southeastern New Mexico.

C. L. Herrick, 1904 (Am. Geol., vol. 34, pp. 179, 186). *Otero fm.*—Marls, great saline beds, gyp., etc., 200+ ft. thick. Of Tert. (?) age. Sharply separated from overlying Tularosa fm. Overlies Cret. ss. and sh. [Derivation of name not stated, but rept in which it is described is on Lake Otero, an ancient salt-lake basin in SE. N. Mex., btw. Sacramento and San Andres Mtns.]

Otero limestone.

A name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 65, No. 1, Feb. 1936, pp. 39, 42, 46) to "upper black ls." of Shumard and Girty (later called "Frijole ls." by some geologists), which forms top memb. of Delaware Mtn fm. (Perm.) in Guadalupe Mtns, western Tex. Derivation of name not stated.

Otis limestone.

Middle Devonian: Central eastern Iowa.

W. H. Norton, 1894 (Iowa Acad. Sci. Proc., vol. 1, pt. 4, pp. 22-24). *Otis beds.*—Nearly pure nonmag. ls., some macrocrystalline and some noncrystalline and compacted or impalpable calc. silt, with some thin-bedded mag. ls. at base. Separated from overlying Kenwood beds by 5 ft. of bluish or greenish sh. believed to represent Independence sh. Thickness 30 ft. Overlie Coggon beds (Sil.).

In all later repts these beds are included in lower part of Wapsipinicon ls.

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, p. 373). *Otis lss.*, a zone of transition (btw. Independence sh. above and Sil. Bertram beds) demarked because of its distinctive fauna. About 80 ft. thick at Cedar Rapids. Comprises lowest beds that can be assigned to Dev. with certainty. Divided into Cedar Rapids phase, Vinton phase, Coggon phase, and Westfield phase. Named for railway junction of Otis, E. of Cedar Rapids, where typically displayed in both its mag. and nonmag. phases, and in immediate contact with the Independence.

Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, shows Independence sh. as lying btw. Cedar Valley and Wapsipinicon lss., and divides latter fm. into following members (descending): Davenport, Spring Grove (new name), Kenwood, *Otis*, and Coggon. On p. 251 M. A. Stainbrook includes Bertram beds of Norton in Otis, which he places above the Coggon. The Bertram was originally assigned to Sil. and placed below the Coggon.

†Otis limestone.

A name applied by B. K. Emerson (U. S. G. S. Bull. 159, pp. 54, 57, 1899) to Coles Brook ls. as exposed at Otis and vicinity, in eastern Berkshire Co., Mass.

Otisco member.

Middle Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 11, 45). *Otisco memb.*—Basal memb. of Ludlowville fm. At some localities it is a mass of relatively homogeneous and comparatively fine gray sh., softer and more thinly bedded than underlying and overlying members. In places one and sometimes two coral beds or zones occur about 50 and 90 ft. respectively above base of the memb. Lower coral bed is underlain by a hard platform. Otisco memb. rests on Centerfield memb. of Skaneateles fm. with sharp contact. Underlies Ivy Point memb. with definite contact. Marine fauna. Lower 10 or 15 ft. highly fossiliferous. Thickness 150± ft. Type section in Millers Place ravine, on W. side of Otisco Lake, 1 mi. NW. of the causeway.

Otisville moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. See U. S. G. S. Mon. 53. Named for Otisville, Genesee Co.

Otisville shale member (of Shawangunk formation).

Silurian: Southeastern New York (Orange County).

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 651, 652, 656, 660). *Otisville sh. memb.*—Upper memb. of Shawangunk fm. at Otisville, Orange Co., N. Y. Interbedded greenish-gray arkosic ss. and aren. sh.; some of ss. is conglomeratic. Thickness 484 ft. Overlies the massive conglomeratic beds of the Shawangunk. Both faunal and strat. evidence combine to show that the Shawangunk is the united Clinton and Tuscarora at Delaware River. What the relationship of Otisville sh. memb. is to the deposits observed elsewhere is unknown. A similar sh. occurs above the cgls. of the Shawangunk at Delaware Water Gap. [On p. 660 they correlated the part of Shawangunk below Otisville sh. memb. with Rose Hill fm. (lower Clinton) and Tuscarora, and correlated their Otisville sh. memb. with Rochester sh. (post-Rose Hill).]

†Otozoum beds.

See under †*Connecticut ss. group.*

Otsego member (of Marcellus shale).

Middle Devonian: Eastern New York (Berne quadrangle).

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 544, 548). In Unadilla and Chenango Valleys *Bridgewater memb.* is used to define the soft aren. shales btw. Chittenango and Solsville members of Marcellus fm., but on each side of Otsego Lake N. of Cooperstown the rocks btw. the Solsville and Chittenango are divisible into 2 parts, a lower portion characterized by a definite fauna and an upper part that is transitional to the Solsville. *Otsego memb.* is proposed for this lower part with characteristic fossils. In places the upper part of the Otsego is a heavy ss. or gray cross-bedded ss. containing *Cornellites flabellus* and other fossils. Type section is in the "Dugway" on E. side of Otsego Lake. Thickness at Otsego Lake 256 ft., in Schoharie Valley 385 ft., and in Berne quad. 505 ft. Overlies Berne memb. and underlies Panther Mtn sh. and ss. [Diagram on p. 544 shows Otsego is=Bridgeport.]

Otselic shale and sandstone.

Upper Devonian: Central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 24 and chart). [See first entry under *Cincinnatus ss.*]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 81–82 and chart). *Otselic sands and sh. (1897 Clarke).* [The compiler does not find that Clarke used this term in 1897, although he described the rocks of Otselic region.] Along Otselic River in Chenango and Cortland Counties the members of the Ithaca are excellently exposed. The lower or *Otselic memb.*, above the Sherburne ss., contains earliest manifestations of Ithaca fauna with Hamilton types strongly emphasized. The upper memb. is Cincinnatus flags.

G. H. Chadwick, 1932 (Eastern States Oil and Gas Weekly, vol. 1, No. 17, p. 7). *Lower Ithaca or Otselic* underlies Oneonta, turns red in crossing Schoharie Valley, and becomes the supposed "Oneonta" of Catskill front. Overlies Kiskatom red beds.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 3, p. 191). Otselic=lower part of Ithaca, underlies Oneonta red beds, and overlies "Sherburne."

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 858). Oneonta red beds is=Cincinnatus flags and probably also underlying Otselic.

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 804, 828). Btw. Tioughnioga and Chenango Valleys the Ithaca sediments above Sherburne fm. have been divided into *Otselic memb.* (below) and Cincinnatus flags (above). The Otselic (585 ft. thick in Otselic Valley and 500 ft. in Chenango Valley) is characterized by large number of Hamilton sp. and absence of *"Spirifer" mesistrialis*, and Cincinnatus contains *"Spirifer" mesistrialis.* Three mi. S. of Sherburne the Otselic is 87 ft. thick and rests on Sherburne.

Otsquago sandstone.

Silurian: East-central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Otsquago ss.*—Heavily cross-bedded red laminated ss. typically seen in and near Otsquago Creek (spelled also Otsquak and Squak) below Vanhornsville [Herkimer Co.], whence it extends westward, with gradual loss of color, to near New Hartford, where it seems to merge into supposed Martville [ss.]. It may be a distinct memb. [of lower part of Clinton fm.] wedging in above the "Martville," or=the Bear Creek; probably latter is correct.

Ottauquechee formation.

Lower Cambrian: Southeastern Vermont (Windsor County).

E. L. Perry, 1927 (15th Rept. Vt. State Geol., p. 161). *Ottauquechee fm.*—A black phyllite with shaly parting, interbedded with massive gray qtzite streaked with white quartz veinlets. Lies stratigraphically below Bethel schist and above Pinney Hollow schist. Assigned to Camb.(?). Type exposures on Ottauquechee River in Bridgewater [Windsor Co.].

E. L. Perry, 1929 (16th Rept. Vt. State Geol., pp. 1–61). Most typical exposure of *Ottauquechee phyllite and qtzite* is in Ottauquechee River Valley about halfway btw. West Bridgewater and Bridgewater Corners. Is probably late Camb. Grades into overlying Bethel schist.

E. J. Foyles and C. H. Richardson, 1929 (p. 288 of rept. cited above), assigned this fm. to Lower Camb.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 406), tentatively assigned *Ottauquechee phyllite* to Lower Camb.

Ottawa gneiss.

Pre-Cambrian: Ontario and Quebec.

A. R. C. Selwyn, 1879 (Canada Geol. Surv. Rept. 1877–78, p. 10A).

See also U. S. G. S. Bull. 360, 1909, by C. R. Van Hise and C. K. Leith.

Ottawa beds.

Ordovician: Ontario.

H. M. Ami, 1880–1883 (Ottawa Field Nat. Club Trans. 1879–83, vol. 1, pp. 63–65). Included in Utica. [Only recorded use.]

Ottawa limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth, 1894 (Kans. Univ. Quart., vol. 2, pp. 121–122, 124). *Ottawa ls.*—Ls., 10 ft. thick, quarried at Ottawa. Overlain by Lawrence shales and separated from underlying Garnett ls. by 40 ft. of sh. with some ss.

According to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 131, 154), †Ottawa ls. is same as Stanton ls. "Ottawa is preoccupied and abandoned."

Otter shale member (of Quadrant formation).

Mississippian (upper): Central northern Montana (Great Falls-Fort Benton region).

W. H. Weed, 1892 (Geol. Soc. Am. Bull., vol. 3, p. 307), published a detailed section on Belt Creek, Mont., in which he gave following succession in lower part: (1) Cgl. and ss. containing Jurassic fossils, 215 ft.; (2) white ls., red earthy patches, Paleozoic facies, 90 ft.; (3) *Otter Creek shales* (alternating gray, purple, green, and black shales and earthy lss. yielding Carbf. fossils), 212 ft.; (4) black chert belt, 8 ft.; (5) lss. and shales, 80 ft.; (6) gyp., 3 ft.

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). In this quad. lowest beds of Quadrant fm. are the gypsiferous Kibbey ss., which is overlain by *Otter shales*, the upper memb. of the Quadrant, consisting of 303 ft. of dark-gray or purplish shales near base, becoming a bright coppery-green color higher up, and interbedded with lss., the latter seldom more than 1 or 2 ft. thick, frequently oolitic, and carrying lower Carbf. fossils. Assigned to Carbf. The Otter sh. is overlain by Ellis fm. [Quadrant fm. is mapped over large area along Little Otter Creek, down to near where it flows into Otter Creek, in Fort Benton quad.]

The U. S. Geol. Survey adopted *Otter sh. memb. of Quadrant fm.* in 1907.

See under *Big Snowy group*, of which H. W. Scott (1935) treats this as middle fm.

Otter granite.

Miocene: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 110) and 1913 (Canada Geol. Surv. Mem. 26, p. 99).

Otter sand.

A subsurface sand in New Providence fm. of eastern Ky.

†Otter Creek shale.

See 1st entry (1892) under *Otter sh. memb.*

Otter Creek granite.

Pre-Cambrian: South-central Wisconsin (Baraboo district).

J. T. Stark, 1932 (Jour. Geol., vol. 40, No. 2, pp. 120, 121, 133). *Otter Creek granite*, pre-middle Huronian. Dark reddish gray to light pink, medium- to fine-grained. Ledges outcrop on both sides of Otter Creek, Sumpter Twp, SE¼ sec. 32 and SW¼ sec. 33, T. 10 N., R. 6 E., a short distance N. of old Myers mill.

Otterdale sandstones. (In Newark group.)

Upper Triassic: Eastern Virginia (Richmond Basin).

N. S. Shaler and J. B. Woodworth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, pp. 435–436). *Otterdale sss. (Araucarioxylon beds).*—Coarse sss., often feldspathic, with silicified trunks of *Araucarioxylon*. Thickness 500+ ft. Top div. of Chesterfield group, of Newark system. Overlies Vinita beds. Well developed N., S., and W. of Otterdale, Chesterfield Co.

Otter Lake moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for lake in Lapeer Co.

Ottertail white quartzite.

Huronian: Canada.

A. Winchell, 1888 (4th Int. Geol. Cong. Am. Comm. Repts., p. A14).

Ottertail formation.

Cambrian: British Columbia.

C. D. Walcott, 1912 (Smithsonian Misc. Coll., vol. 57, No. 7, p. 230).

Ottertail limestone.

Cambrian: British Columbia.

J. A. Allan (also R. A. Daly), 1913 (12th Int. Geol. Cong. Guidebook 8, pp. 179, 120). [Several geologists have assigned this fm. to Upper Camb., others have assigned it simply to Camb.]

†Ottertailian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). *Ottertailian series.*—Lss. 1,700 ft. thick, composing uppermost subdivision of Late Cambric in Alberta. [Apparently same as Ottertail ls.]

Otterville limestone member. (Of Dornick Hills formation.)

Pennsylvanian: Central southern Oklahoma (Carter County).

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull., vol. 6, p. 8). *Otterville ls., memb. of Glenn fm.*—Solid brown ls., of oolitic texture, which grades locally into several beds of brown ls. separated by blue shales. Thickness 70 ft. Forms low ridge running SE. from Otterville. Underlies Cup Coral memb. and overlies Springer memb.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 4, pp. 331–347). *Otterville ls.* of Goldston does not belong to Glenn fm. It is older than Glenn. The Otterville correlates with beds which in some places have been included in Wapanucka and in other places in upper part of Caney sh., but would probably better be excluded from both of those fms. It was not included in typical Wapanucka ls. as delimited in Atoka folio.

H. D. Miser, 1925 (Okla. Geol. Surv. Bull. 35, p. 26, footnote). [See entry under *Hoxbar memb.*]

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 29–30). *Otterville memb. of Dornick Hills fm.*—Goldston applied *Otterville ls.* to different ls. ledges as much as 2,400 ft. apart stratigraphically, though he described it as a single ls. only 70 ft. thick. It is desirable to confine term to the ls. from which Girty and Roundy made their "Otterville" collections. This is probably, though not quite certainly, identical with the Otterville of Goldston's type loc., in sec. 3, T. 3 S., R. 1 W., near site of abandoned hamlet of Otterville. It attains an observed thickness of 25 ft., and may locally, including shaly layers, reach Goldston's figure of 70 ft. Most characteristic facies is a slightly ferruginous, platy granular ls. composed chiefly of tiny shell fragments; but oolite is common, and in Love Co. it locally carries ls. cgl. Lies 750 ft. below Bostwick memb. and 300 to 1,000 ft. above Jolliff memb. Correlates faunally with lower part of Wapanucka ls., with part of Morrow group, and with part of Marble Falls ls. of Tex.

Ottosee shale (also **Ottosee limestone**). (In Blount group.)

Lower Ordovician (late Chazy): Eastern Tennessee and southwestern Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 453, 538, 539, 551, 555, 556, 557, pl. 27). *Ottosee sh.*—Mainly shales and thin lss.; in one area includes an 80-foot bed of massive pink marble. Thickness 35 to 1,200 ft. Has hitherto been referred to Sevier sh. Uncon. overlies Holston marble in part of Knoxville trough and overlies Tellico ss. in Athens trough and part of Knoxville trough. Underlies Lowville. Top fm. of Blount group.

At Sevier type loc. this sh. is basal calc. memb. of Sevier sh. In Va. it is now treated as a distinct fm., called *Ottosee ls.*, because it is there a ls., underlying the Lowville and overlying Athens sh. Is of late Chazy age. Named for exposures at Ottosee Lake, in park at Knoxville, Tenn.

Ottumwan epoch (and series).

Term proposed by G. F. Kay (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 449–452, 1931) to include Yarmouth (interglacial) and Kansan (glacial) stages of Pleistocene epoch (and series), which Kay would elevate to *Pleistocene period* (and *system*). Named for Ottumwa, Iowa, where both Kansan and Yarmouth stages are well developed.

†Ouachita shale.

Lower and Middle Ordovician: Southwestern Arkansas.

A. H. Purdue, 1909 (Slates of Arkansas, Ark. Geol. Surv., pp. 30, 33). *Ouachita sh.*—Chiefly dark-colored clay sh., but not uncommonly the dark layers alternate with green ones. In many places slaty cleavage is developed, when the alternating dark and green layers produce ribboned sl. Thin layers of ls. are interbedded in lower part. Quartz veins and thin layers of hard flinty material are common. Thickness probably not less than 900 ft. Grades into underlying Crystal Mountain ss. [which at this time included Blakely ss., according to H. D. Miser, 1917]. Uncon. overlain by 75 to 150 ft. of sh. called Stringtown sh. [only a part of typical Stringtown sh.], which separates it from overlying Bigfork chert.

H. D. Miser (1917) interpreted †Ouachita sh. as=Mazarn sh., Blakely ss., and lower part of Womble sh. of present terminology. (See 1917 entry under *Blakely ss.*)

Named for Ouachita Mountains, Ark., the pronunciation of which is *Washita*.

Ouachita stone.

Commercial term for a bed of novaculite in lower part of Arkansas novaculite of SW. Ark. and SE. Okla.

Ouray limestone.

Upper Devonian: Southwestern Colorado.

W. Cross and A. C. Spencer, 1899 (U. S. G. S. La Plata folio, No. 60, p. 8). [See 1st entry under *Hermosa fm.*]

A. C. Spencer, 1900 (Am. Jour. Sci., 4th, vol. 9, pp. 125–129). *Ouray ls.* is name proposed for only memb. of pre-Carbf. section of San Juan region, SW. Colo., which is definitely shown by its fossils to be of Dev. age. Named for prominent occurrence in vicinity of Ouray at junction of Canon Creek with Uncompahgre River. The fm. consists of 100 to 300 ft. of massive ls. In places it is one massive layer; in other places it consists of 2 or 3 heavy bands separated by greenish crumbling marls. The ls. is usually white, but sometimes is stained red or pink. Certain strata are somewhat coarsely crystalline, but as a rule the ls. is fine-grained. The Dev. fossils (identified by G. H. Girty) were found a short distance below top. Neither extreme upper nor lower layers have yielded fossils. Rests on 0 to 100 ft. of Dev. sh., and, in places, on Algonkian; and underlies, apparently conformably, rocks containing, a few ft. above Ouray ls., Upper Carbf. fossils. The Lower Carbf. appears to be absent, but possibly a few ft. of unfossiliferous ls. above the true Dev. and not differentiated from it may be of Lower Carbf. age.

A. C. Spencer, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 37–78). *Ouray ls.* (Dev.) is overlain by Hermosa fm. (Penn.). The sh. on which Ouray ls. rests may be pre-Dev.

W. Cross, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 245–252). *Ouray ls.* of San Juan region is a lithologic unit, and contains Miss. fossils in upper part and Dev. fossils in lower part. It overlies Elbert fm. (Dev. sh.).

W. Cross and E. Howe, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 470–496). *Ouray ls.* of SW. Colo. is uncon. overlain by Molas fm. (Penn.).

W. Cross, A. C. Spencer, and F. L. Ransome, 1905 (U. S. G. S. Rico folio, No. 130). *Ouray ls.*, 100 to 300 ft. thick, is of Miss. and Dev. age. When defined by Spencer it was supposed to be all Dev. Is a lithologic unit and the Miss. and Dev. can not be separated. The Miss. fauna is found also in Leadville ls.

W. S. Burbank, 1930 (Colo. Sci. Soc. Proc., vol. 12, No. 6). The *Ouray ls.* is chiefly of Miss. age, the Dev. part being 65 to 70 ft. thick, and the Miss. part 180 to 235 ft. thick. Fossils 15 to 20 ft. above base are pronounced by Kirk to be Upper Dev. No other fossils found in Dev. part of the ls. The Dev. part is chiefly gray, buff, or white lss. of medium grain; the Miss. part is largely gray or brownish-gray crystalline ls. alternating with beds of ls. breccia containing red shaly seams. The top of Dev. part in Ouray dist. is drawn at base of a blue-gray thin-bedded ls. that commonly contains nodules of black chert. An inconspicuous ls. breccia occurs at places in overlying beds. At Box Canyon the dark-colored chert-bearing beds and the breccia are both absent, but base of Miss. ls. seems to be marked by ss. layers containing calc. cement.

E. Kirk, 1931 (Am. Jour. Sci., 5th, vol. 22, p. 224). *Ouray ls.* here restricted to Dev. part of Ouray ls. as previously used, the Miss. part to hereafter be called *Leadville ls.* It is understood that *Ouray* will not be applied outside of SW. Colo. [See under *Chaffee fm.*]

Oursan sandstone. (In Monterey group.)

Miocene (middle): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Oursan ss.*—Rather fine-grained ss., 600 ft. thick. A fm. of Monterey group. Underlies Tice sh. and overlies Claremont sh. Named for exposures on Oursan Ridge, Concord quad., Contra Costa Co.

Outer conglomerate. (In Copper Harbor group.)

Keweenawan (late): Northern Michigan and Wisconsin.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 186, etc., pls. 17 and 18). *Outer cgl.* consists of red ss. and cgl. underlying Nonesuch sl. belt and overlying Lake Shore trap. Thickness about 1,000 ft.

According to C. R. Van Hise and C. K. Leith (U. S. G. S. Bull. 360, p. 346, 1909) the Outer cgl. has been traced a distance of btw. 175 and 200 mi., and its estimated thickness varies from 350 to nearly 5,000 ft.

Is top fm. of Copper Harbor group.

Named for fact that at Keweenaw Point, Mich., it is the outer cgl., the supposedly thicker Great cgl. being the inner cgl.

Well established in literature of Michigan geology.

†Outer Copper Harbor conglomerate.

A name that has been applied to Outer cgl., of Copper Harbor group.

Outlet Tunnel quartz latite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). Is a chaotic aggregate of lava flows and breccia beds. Found in only two small bodies in canyon of East Willow Creek a short distance N. of Ridge mine and has not been recognized in reconn. of adjoining region. Is basal fm. of Alboroto group of Potosi volcanic series. Uncon. underlies at least a part of Willow Creek rhyolite. Thickness 250 to 350+ ft. Named for development at Outlet tunnel.

†Overbrook granite gneiss.

Pre-Cambrian: Southeastern Pennsylvania (Philadelphia region) and Maryland.

F. Bascom, 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143). *Overbrook porphyritic granite gneiss* is included in Hall's Philadelphia gneisses.

In U. S. G. S. Phila. folio, No. 162, 1909, the rocks at and around Overbrook are mapped as granite gneiss (unnamed). According to E. B. Knopf (letter dated June 21, 1922) this granite gneiss is same as Port Deposit gneiss, the older name.

Overbrook sandstone member (of Springer formation).

Pennsylvanian: Central southern Oklahoma (Carter and Love Counties).

R. Roth, Feb. 1928 (Econ. Geol., vol. 23, pp. 45, 53). Three oil-bearing sss. of Springer fm. were expected at a depth of 1,000 to 3,500 ft. in N. C. Jolliff well No. 1, in sec. 24, T. 5 S., R. 1 E. They are as follows: *Primrose ss. series*, which was not expected to produce oil, at a depth of 100 ft.; *Lake Ardmore ss.* at 750 ft.; *Overbrook or City Lake ss.* at 1,250 ft.; and *Castle Rock ss.* at about 2,250 ft.

C. W. Tomlinson, Sept. 1928 (Okla. Geol. Surv. Bull. 40Z, p. 13). About 1,000 ft. above Rod Club memb. (basal memb. of Springer fm.) is the white massive *Overbrook ss.*, ranging in thickness from 45 to 100 ft., which is thoroughly saturated with asphalt along several miles of its outcrop in T. 3 S., R. 1 W., where it possesses its max. thickness and was formerly quarried for asphalt. From 300 to 500 ft. higher in section is Lake Ardmore memb. of Springer fm.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 17). *Overbrook ss. memb.* is named for outcrop across middle of N½ sec. 6, T. 6 S., R. 2 E., ¼ mi. E. of village of Overbrook, at N. edge of Love Co.

Overton fanglomerate.

Cretaceous and Tertiary (?): Southeastern Nevada.

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 52) and 1928 (U. S. G. S. Bull. 798). *Overton fangl.*—Coarse, heavy alluvial-fan deposit that includes fragments of all older local rocks. In large part is coarse ls. fragments cemented by calcium carbonate—a lime fangl. Fragments are not rounded, and many hardly show signs of wear by transportation. In all its features it is a series of fossil alluvial fans. Thickness 0 to 3,500 ft. Exposures indicate the deposit once covered practically every part of Muddy Mtns area, but subsequent deformation and erosion have reduced its extent. No fossils. Assigned to *Tert.* (*Mio?*). Grades into overlying Horse Spring fm. and rests uncon. on Jurassic(?) cross-bedded bright-red ss.

The finding, later, of a Cret. flora in lower part of Overton fangl. led to reclassification (in March 1936) of the Overton as *Cret. and Tert.* (*?*). (See American Cret. ferns of genus *Tempskya*, by C. B. Read and R. W. Brown, U. S. G. S. P. P. 186F, 1937.)

Owasco member.

Middle Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 11, 50). *Owasco memb.*—Cross-bedded calc. and finely aren. rock, 7 in. to 2 ft. 9 in. or 2 ft. 10 in. thick. Is the important *Spirifer tullius* zone, which overlies Spafford memb. of Ludlowville fm. and underlies Portland Point or basal memb. of Moscow fm. Is top memb. of the Ludlowville. On W. side of Owasco Lake Valley it outcrops in Edgewater Ravine at a level about 200 ft. above Owasco Lake and just below the new cement road, also in Willow Point Ravine just below a bridge near junction of old and new roads, and at other places.

Owen substage or beds.

Upper Devonian: Central northern Iowa.

W. H. Norton, 1897 (Iowa Geol. Surv. vol. 6, p. 148). [Only definition is use of *Owen substage* in a table, in which it is applied to upper part of Lime Creek sh., or to beds overlying Hackberry substage of Lime Creek sh.]

S. Calvin, 1897 (Iowa Geol. Surv. vol. 7, pp. 144, 163–164). *Owen substage* (*of Lime Creek sh. or stage*).—In type section consists of 20 ft. of light-gray calc.

beds carrying *Acervularia*, underlain by 30 ft. of mag. shales and argill. dolomites carrying *Naticopsis gigantea*, and, at base, 4 ft. of ls. carrying *Idiostroma*. Overlies Hackberry substage [restricted, apparently] of Lime Creek sh.

According to C. L. Fenton (Am. Jour. Sci., 4th, vol. 48, 1919) these beds were included in Hackberry group of Webster, 1889. The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, treats *Owen memb.* as top div. of Lime Creek sh.

Named for exposures on Owen Creek, Cerro Gordo Co.

Owenyo limestone.

Permian: Eastern California (Inyo Range).

E. Kirk, 1918 (U. S. G. S. P. P. 110). *Owenyo ls.*—Mainly massive grayish crystalline to compact lss. Basal 2 ft. blue-gray compact ls. carrying irregular lenses and stringers of ss. whose grains were apparently derived from underlying Reward cgl. Here and there, particularly in upper third, are layers carrying rounded chert pebbles. Thickness 125 ft. The lss. carry a Perm. (*Spiriferina pulchra*) fauna throughout, and according to G. H. Girty are probably to be correlated in part with Park City, Phosphoria, and Embar fms. of Utah, Idaho, and Wyo. Only two exposures of Owenyo ls. are known, both of which lie btw. Reward mine and Union Wash. One shows the base and the other the top of the fm. It is uncon. overlain by Lower Triassic shales and uncon. underlain by Reward cgl. Named for exposures about 3½ mi. N. of Owenyo Station on Southern Pacific, btw. Union Wash (the first large canyon to N.) and Reward mine.

Owl Creek formation.

Upper Cretaceous: Northeastern Mississippi and southwestern Tennessee.

E. W. Hilgard, 1860 (Rept. geol. and agric. Miss., pp. 79, 84–91, 102). *Owl Creek marl.*—Dark-bluish micaceous fossiliferous marl, more or less clayey in different portions. Thickness at Owl Creek Bluff 20 ft. Overlain by [Eocene] concretionary ls. Included in Ripley group.

B. Wade, 1917 (Johns Hopkins Univ. Circ., n. s., No. 3, p. 74). *Owl Creek horizon.*—A fossiliferous horizon that can be traced from southern Tenn. southward into Miss. to Owl Creek, Tippah Co. Overlain by Eocene and underlain by McNairy sand memb. [restricted].

In 1926 and subsequent years the marine beds designated *Owl Creek marl* by Hilgard were treated by U. S. Geol. Survey as a tongue of typical Ripley deposits, overlying the near-shore deposit called *McNairy sand memb. of Ripley fm.* (See B. Wade, 1926, U. S. G. S. P. P. 137.) In 1937 the name was changed to *Owl Creek fm.*, and Ripley fm. was restricted to underlying deposits, the overlying chalk (heretofore designated "Oktibbeha tongue of Selma chalk") to hereafter be treated as a part of Prairie Bluff chalk (expanded), and *Oktibbeha* to be discarded. (See L. W. Stephenson and W. H. Monroe, A. A. P. G. Bull., 1937.)

Named for exposures on Owl Creek, 3 mi. NE. of Ripley, Miss.

Owls Head granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., pp. 26, 34, and Moosilauke map). *Owls Head granite.*—Pink medium-grained rock, somewhat foliated near its margins, but more massive in interior. Intrudes Ammonoosuc volcanics. Occurs on and around Owls Head Cliff, SW. corner Moosilauke quad. Is late Dev. or late Carbf. Only representative of Oliverian magma series in this region.

Owosso moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Owosso, Shiawassee Co.

Owyhee basalt.

Miocene: Southeastern Oregon (Malheur County).

K. Bryan, 1929 (U. S. G. S. W. S. P. 597A) and B. C. Renick, 1930 (Jour. Geol., vol. 38, p. 494; named by Renick). *Owyhee basalt.*—Normal (augite-hypersthene-labradorite) basalt, of black, greenish-black, to reddish colors, including scoriaceous and cindery types; contains a few beds of volcanic tuff. Thickness 1,200 to 1,500 ft. Underlies Payette fm. and overlies Tert. (Mio.?) rhyolite porphyry and sediments.

Named for occurrence in bluffs along lower part of Owyhee River, in Malheur Co.

Owyhee rhyolite.

Tertiary (upper Miocene or lower Pliocene?): Southwestern Idaho.

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 6, p. 579). *Owyhee rhyolite (extrusive).*—A widespread sheet of acidic lavas which extends over southern Idaho and parts of adjacent States. Probably at same time occurred intrusion of one or more small batholiths in Payette fm. and Columbia River basalt. Contains some aggl. and tuffaceous phases with massive flows. Thickness 1,850 ft.

†Oxford type.

†Oxford gneiss.

Pre-Cambrian: Northern New Jersey.

F. L. Nason, 1889 (N. J. Geol. Surv. Ann. Rept. 1889, pp. 30+). *Oxford type.*—Is in part probably the syenite gneiss of Prof. Smock and the hornblende gneiss, in part, of Dr. Britton. Occurs typically in Van Nest Gap tunnel of Delaware, Lackawanna & Western R. R. at Oxford Furnace. [In text he calls it *Oxford gneiss.*]

Is a facies of Byram gneiss, for which a geographic name is considered unnecessary.

Oxford schist.

Carboniferous: Eastern Massachusetts (south of Worcester city).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60–68 and map). *Oxford schist.*—Lead-gray mica schist full of large black crystals of garnet and staurolite and containing tourmaline derived from the granite. Eastward from Worcester trough it grades into Worcester phyllite. In places it is silvery white, from absence of graphite and biotite. Named for town of Oxford.

Oxford gravel.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). *Oxford gravel.*—Scattered gravels and boulders left by meandering streams on graded terraces during post-Durango and pre-Wisconsin interglacial stage. Covers the lowland surrounding village of Oxford, La Plata Co.

†Oxmoor sandstone and shales.

Mississippian: Northern Alabama.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, pp. 155–157, section opp. p. 162, map). [For definition see under *Bangor ls.* As defined it included equivalents of all Mississippian fms. of Ala. above Fort Payne (†Lauderdale) chert, but Fort Payne chert as defined in this same book included the rocks later named *Tuscumbia ls.* (see under *Fort Payne chert*); and Smith also applied "Oxmoor" to the 100 ft. of ss. in the midst of the Bangor, which is the Hartselle ss. of present classification. The Oxmoor ss. of C. W. Hayes (Geol. Soc. Am. Bull., vol. 2, pp. 141–152, Feb. 9, 1891) in NE. Ala. is Hartselle ss.]

Named for Oxmoor, Jefferson Co.

Oyster Ridge sandstone member (of Frontier formation).

Upper Cretaceous: Southwestern Wyoming (Uinta County).

A. C. Veatch, 1906 (U. S. G. S. Bull. 285, pl. 12). *Oyster Ridge ss.*, in Colorado fm. [Text states that 400 ft. below top of Colorado fm. in southern Uinta Co. is a pronounced bed of coarse ss., occasionally conglomeratic, containing numerous large oysters and known as "Oyster Ridge ss."]

A. C. Veatch, 1907 (U. S. G. S. P. P. 56). *Oyster Ridge ss. memb. of Frontier fm.*—Pronounced bed of coarse ss., occasionally conglomeratic and containing numerous large oysters; in upper part of Frontier fm. Forms pronounced ridge named Oyster Ridge by Hayden in 1872. Thickness usually 200± ft. [Mapped and fossils listed.]

Ozan formation.

Upper Cretaceous (Gulf series): Southwestern Arkansas (Sevier, Howard, and Hempstead Counties) and southeastern Oklahoma.

C. H. Dane, 1926 (U. S. G. S. Press Bull. 8823, Sept. 10, 1926). *Ozan fm.*—Sandy micaceous marl, with, at base, a bed of sandy marl or marly sand, 3 to 8 ft. thick, containing as much as 50 percent of coarse glauconite grains, and 50 ft. higher in section another bed of glauconitic sand marl. Toward top some beds of poorly bedded and cross-bedded marly sand; also a few beds of hard ls. Thickness 150 to 250 ft. in Hempstead Co., but gradually thins eastward. Heretofore included in Brownstown marl, but is uncon. separated from underlying beds, to which name *Brownstown marl* is now restricted. Is conformably overlain by Annona chalk. Named for exposures along middle fork of Ozan Creek and for town of Ozan, Hempstead Co., which is located on its outcrop. [See also C. H. Dane, 1929, Ark. Geol. Surv. Bull. 1.]

According to L. W. Stephenson, 1937 (U. S. G. S. P. P. 186G, p. 135), Ozan fm. is = lower part of Annona chalk of Red River Co., NE. Tex., which lower part of Annona is = lower part of Taylor marl.

†Ozark marble.

Upper Cambrian: Southeastern Missouri.

G. C. Broadhead, 1889 (Am. Geol., vol. 3, pp. 7-8). *Ozark marble.*—Marble, 20 ft. thick, underlying Fourth Mag. ls. and overlying 90 ft. of ss. and cgl. resting on Archean granites and porphyries. Is basal part of Potsdam in Madison Co.

J. Bridge, 1930 (personal communication), stated that this marble consists of lenses in lower part of Bonneterre ls.

Named for Ozark uplift.

†Ozark series.

Lower Ordovician and Upper Cambrian: Southeastern Missouri.

G. C. Broadhead, 1891 (Am. Geol., vol. 8, p. 33). *Ozark series.*—Includes (descending): First Mag. ls.; First or Saccharoidal ss. (St. Peter's ss.); Second Mag. ls.; Second ss.; Third Mag. ls.; Third ss.; Fourth Mag. ls.; Ozark marble; and basal ss. and cgl. (90 ft. thick). Rests on Archean granites and porphyries. [This definition of *Ozark series* appeared in many Mo. repts up to 1898. The Ozarkian system of Ulrich as defined in 1911 included Cotter dol. at top and Potosi dol. at base. Ulrich's 1929 definition of his Ozarkian system extends from top of Gasconade dol. down to base of Potosi dol. There have been many other definitions of †Ozark. (See Mo. chart.)]

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106-1108), proposed that *Ozark series* be used to cover rocks occupying time interval btw. base of Beekmantown and base of Little Falls dol. of N. Y.

Named for development of the rocks in Ozark Mtns of southern Mo.

†Ozark sands.

Pleistocene: Southern Alabama.

E. A. Smith, 1892 (Sketch of geology of Ala., Birmingham, Ala., Roberts & Son. pam. of 36 pp.). *Ozark sands.*—Gray sands with pebbles at base. Thickness 4 to 5 ft. or more. Occur especially in S. part of State, overspreading the country btw. the watercourses up to altitudes as high as 150 to 200 ft. above sea level. Correspond to interfluvial phase of Columbia fm. of McGee. Usually lie uncon. on red loam of Lafayette fm. In two instances I think I have seen the gray Ozark sands overlying the second-bottom loams, but in neither case could I be perfectly certain of the identifications.

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala., explanatory chart). *Ozark or Geneva sands.*—In southern counties the Ozark or Geneva sands form terraces along small streams and are also spread over the divides up to altitudes of 100 ft.

or more. Pebbles in lower part of these sands. Formation not separately shown on map. Ozark sands cover 2,000 sq. mi. in Henry, Dale, Geneva, Covington, Escambia, Mobile, and Baldwin. [See also E. A. Smith, Am. Jour. Sci., 3d, vol. 47, pp. 285–296, 1894.]

E. A. Smith, L. C. Johnson, and D. W. Langdon, Jr., 1894 (Ala. Geol. Surv. Rept. Coastal Plain, pp. 27, 56–57). [*Ozark or Conecuh sands; also Ozark or Geneva sands.*]

Name is preoccupied and undesirable because of other conflicting uses of Ozark.

Derivation of name not stated. May have been suggested by presence of the sands at Ozark, Dale Co.

Ozark sandstone.

Pennsylvanian: Western Arkansas coal field.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Ozark ss.*—Ss., 0 to 500 ft. thick, composing basal memb. of Sebastian stage. Underlies Belva sh. and overlies Spadra stage. [Is a part of Fort Smith fm.]

Probably named for Ozark, Franklin Co.

†Ozark group.

Mississippian: Mississippi Valley region.

H. S. Williams, 1922 (Pan-Am. Geol., vol. 37, No. 1, pp. 36–40; posthumous paper; written for publication in Bull. 3 of Mo. Geol. Surv., published in 1890, but withdrawn from page proof and suppressed). *Ozark group.*—A group proposed to include the fms. heretofore described as Encrinital ls., Burlington ls., Keokuk group, and their equivalents in Mo., Ill., and Iowa, and part if not all of Siliceous group of Tenn., all the faunas of which indicate close paleontologic relationship. It is possible that some of the fms. heretofore referred to as Warsaw group may more properly belong to this group.

Replaced by Osage group.

Named "for prominent development of the fms. constituting the group on the southern and western margins of Ozark uplift."

Ozark stone.

Name formerly applied locally in SW. Ark. and SE. Okla. to a Dev. rock known commercially as *Ouachita stone*.

†Ozarkian.

Pliocene and Quaternary: Time term.

O. H. Hershey, 1896 (Sci., n. s., vol. 3, pp. 620–622). A marked period of elevation and subaerial erosion instituted by the great post-Tert. epeirogenic uplift of North America, and terminated by Kansan epoch of widely extended glaciation. Preceded by Lafayette epoch of deposition. Assigned to Pleist.

See *Sierran*.

Ozarkian system.

Name proposed by E. O. Ulrich in 1911 (Geol. Soc. Am. Bull., vol. 22) to include rocks now classified as late Upper Camb. and early Lower Ord. (Beekmantown). For definition see U. S. G. S. Bull. 769, pp. 89–92.

See also under †*Ozark series*.

†Ozarkian series.

A term proposed by C. [R.] Keyes in 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 147–151) to include Shakopee dol., New Richmond ss., and Oneota dol.

†Ozarkian stage.

A term employed in some Iowa repts to cover "bog and other deposits" underlying Nebraskan drift and overlying Cret., and assigned to Plio. (See Iowa Geol. Surv. vol. 27, 1916.)

†Ozarkic.

A variant of *Ozarkian system* of E. O. Ulrich.

Ozaukee formation.

Middle Devonian: Southeastern Wisconsin.

See under *Thiensville fm.*, 1929 and later entries.

Ozaukee member.

Devonian: Southeastern Wisconsin (Ozaukee County).

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 260, 262, 263). *Ozaukee memb.* (*novum*).—Upper and major part of Lake Church fm. Is firm, fairly thick-bedded brown to dark-gray pyritiferous dol. with strong basal cgl. Fauna differs somewhat from that of underlying Belgium memb. of Lake Church fm. (0 to 8 ft. thick), but is closely related to Belgium fauna. Thickness 27 ft. Overlain by basal cgl. of Thiensville fm. Rests on Niagara dol. Is cut out S. of Milwaukee-Ozaukee Co. line, where Thiensville fm. overlaps onto Niagaran. Named for Ozaukee Co.

Ozawkie limestone. (In Deer Creek limestone.)

Pennsylvanian: Eastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). *Ozawkie ls.*—Basal memb. of Deer Creek ls. fm. Dark-gray to bluish-gray dense ls. 5± ft. thick. Underlies Oskaloosa sh. and overlies Tecumseh sh. fm. [Derivation of name not stated.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 182–184). The ls. here termed *Ozawkie ls. memb. of Deer Creek ls.* is "lower Deer Creek" of Kans. geologists. It is brown massive or thick-bedded ls., somewhat sandy and impure. Av. thickness, 5 ft., but near Lyndon it is 15± ft. Has been called *Rock Bluff ls.*, under misapprehension it was same as Rock Bluff ls. of Nebr.; but it is an older ls. than the Rock Bluff, from which it is separated by 5 to 25 ft. of sh., here named *Oskaloosa sh. memb. of Deer Creek ls.* The Ozawkie and Oskaloosa members are absent in Nebr., where Rock Bluff ls. is basal memb. of Deer Creek ls. Type loc., Ozawkie, in road cut in NE¼ sec. 31, T. 9 S., R. 18 E., Jefferson Co.

Ozuluama series.

Tertiary: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, p. 146). [Assigned to Tert. In 1924 W. A. VerWiebe assigned it to Olig.]

Pabos formation.

Upper Ordovician: Quebec (Gaspe Peninsula).

C. H. Kindle, 1935 (Geol. Soc. Am. Proc. 1934, p. 354).

C. H. Kindle, 1936 (Eastern Geol., No. 1, April 1936, p. 1). *Pabos fm.*—Shales and impure lss., very sparingly fossiliferous, but the fossils found on W. bank near head of Little Pabos Bay and elsewhere are Upper Ord.

Pabst member (of Tyler slate).

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Gogebic district).

W. O. Hotchkiss, 1919 (Eng. and Min. Jour., vol. 108, pp. 501, 506). *Pabst memb.*—Cherty and fragmental and ferruginous sl. beds, containing a "flatwise" cgl. that is believed to represent an uncon. Thickness 67 ft. Is a memb. of Tyler graywacke sl. Can hardly be defined with accuracy because of scarcity of information concerning it. Is known in few places except in diamond-drill holes, and whether it should include the whole of the heavily ferruginous basal portion of Tyler fm., or be limited to the dominantly cherty portions, it is difficult to determine. As drawn in the sections it includes only the dominantly cherty parts of lower portion of Tyler fm. Named for Pabst mine, E. of Ironwood.

†Pacific sandstone.

Lower Ordovician: Central eastern Missouri.

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., p. 79). *Pacific ss.*—Thin beds of ss., chert, and cherty ss., 0 to 50 ft. thick, called First

Saccharoidal ss. by Swallow. Uncon. overlies Jefferson City fm. and uncon. underlies Chouteau ls. in Miller Co.

Discarded in 1907 as a synonym of St. Peter ss.

Named for Pacific, Franklin Co.

Pacific quartz latite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). Alternating thin tuffs and thick flows, 0 to 700 ft. thick. Older than Mineral Creek andesite and younger than Cooney quartz latite. Contemp. with upper part of Cranktown ss.

Named for outcrops near Pacific mine, in W. part of Mogollon dist.

Packard rhyolite.

Tertiary (post-Eocene): Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, map). [Exposed on Packard Peak.]

Packard shale.

Upper Cretaceous: Mexico (Sonora).

See under *Cabullona group.*

†Packer clay.

Pleistocene (late Illinoian): Southeastern Pennsylvania.

E. H. Williams, Jr., 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 281–288). *Packer clay.*—Varies from perfectly clean clay to clayey sand. Is generally a reddish-brown unstratified sandy deposit, with a burden of glaciated angular and river-rolled material scattered irregularly through it. Thickness 3 to 39 ft. Is a local deposit existing btw. Easton and the Topton divide and below level of 500 ft. with exception of the part of Saucon Valley W. and S. of Hellertown. A lake formed by damming of the Lehigh by the glacier was noted on the map within contour line of 500 ft. It is proposed to call this lake Packer, in honor of late Asa Packer, of Mauch Chunk. The clays are the work of the ice in slack water. No signs of life found in them so far. Deposited immediately after retreat of the ice. The oldest are at W. part of lake.

F. Leverett regards this clay as a surface deposit of Illinoian drift and not a ponded deposit.

Packsaddle schist.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvii, lviii, 276–281). *Packsaddle series.*—Metamorphosed shaly beds and marble forming top div. of Texan system. Uncon. underlies Cambrian Hickory series and overlies Llano series [restricted sense].

S. Paige, 1911 (U. S. G. S. Bull. 450, pp. 14–23). *Packsaddle schist.*—Dominantly basic rocks, generally of dark color, including biotite, amphibolite, and graphitic schists and crystalline ls., also lighter-colored, more feldspathic bands resembling qtzite. Intruded by granite, which is not easily separated [but which is not a part of fm.]. Upper fm. of Llano series in Llano and Burnet Counties. Grades into underlying acidic Valley Spring gneiss by a transition zone. Uncon. overlain by Hickory ss. [Adopted definition.]

Named for Packsaddle Mtn, Llano Co.

Packsaddle Mountain granodiorite.

Probably Cretaceous or Jurassic: Northern Idaho (Pend Oreille district).

J. L. Gillson, 1927 (Jour. Geol., vol. 35, No. 1). *Packsaddle Mtn granodiorite.*—Markedly porphyritic granodiorite, of darker color than Bayview granodiorite. Named for fact it composes Packsaddle Mtn, Bonner Co.

†Packsand beds.

A term applied in a titular sense in some early Tex. repts to upper part of Trinity group, or to the beds later named *Paluxy sand.*

Paddock shale. (In Sumner group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 61). *Paddock sh.*—Top memb. of Enterprise fm., overlying Krider ls. and underlying Herington ls. Typically olive-drab to bluish-gray massive argill. sh., usually containing some platy argill.-calc. stringers which locally become quite prominent. Weathers buff to yellowish. Thickness 9 or 10 ft. in southern Kans.; 14± ft. in northern Kans. and Nebr. Named for Paddock Twp, southern Gage Co., Nebr. Type loc., road cut ¼ mi. S. of Krider, Gage Co.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), discarded Enterprise and treated *Paddock sh.* as middle memb. of his Nolans fm. (new).

Paducah formation.

Pleistocene: Western Kentucky.

F. J. Fohs, 1907 (Ky. Geol. Surv. Bull. 9, p. 67). *Paducah fm.*—Brown gravels, firesand, and ss., 5 to 30 ft. thick, composing upper part of Lafayette fm. Overlies Tennessee River gravels (lower part of Lafayette fm.) and underlies Port Hudson clays.

Probably named for Paducah, McCracken Co.

Paget formation.

Age (?): Bermudas.

A. E. Verrill, 1907 (Conn. Acad. Arts and Sci. Trans., vol. 12, pp. 189, 195).

Paget limestone.

Upper Cambrian: British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 3). *Paget fm.*—Bluish-gray oolitic lss., usually thin-bedded. Thickness at Mount Bosworth 360 ft. Type loc. on SE. slope of Paget Peak, beneath Sherbrooke fm., which forms the high cliffs of Paget Peak and Mount Daly. Overlies Bosworth fm. Contains Upper Camb. fauna.

Pageton sandstone.

Mississippian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 243). *Pageton ss.*—Massive, medium-grained, brownish gray, micaceous, 40 ft. thick. Lies 10 to 25 ft. below top of Mauch Chunk series and about 250 ft. below Pocahontas No. 3 coal. Quarried at Pageton, McDowell Co. Included in Mauch Chunk series.

Pagoda oolite.

Upper or Middle Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 37 and passim). *Pagoda oolite.*—Most striking character is oolitic texture. Consists of (descending): (1) Cream-colored to chocolate-gray thick-bedded, massive oolitic ls., entirely free from clay, 56 ft.; (2) thin- to medium-bedded fine-grained chocolate-colored ls. in beds 1 to 3 inches thick, all carrying small amounts of buff-colored clay disseminated in flakes, 30 ft.; (3) thin-bedded cream-gray platy oolitic ls. that weathers white gray, 75 ft. Thickest (400 ft.) in Dearborn section; thinnest (87 ft.) in Wall Creek section; at type loc. 168 ft. Type loc. is on E. side of peak lying N. 20° E. of top of Pagoda Mtn, in SW¼ sec. 3, T. 22 N., R. 13 W. Named for Pagoda Mtn, but is not present on the peak that forms very top of that mtn. Underlies Pentagon sh. and overlies Steamboat ls.

Pagoose.

See under *Union Valley ss.*

Pagwa River formation.

Silurian: Ontario.

W. S. Dyer, 1930 (Ont. Dept. Mines 38th Ann. Rept., pt. 4, p. 51).

Pahala basalt.

Pleistocene (?): Mauna Loa and Kilauea, Hawaiian Islands.

W. O. Clark, L. F. Noble, and H. S. Washington, 1923 (Am. Jour. Sci., 5th, vol. 6, p. 119). *Pahala series.*—Characterized chiefly by thick beds of stratified yellow ash which are interbedded with the lava flows. Ash bed [30 to 55 ft. thick] at top. In general the rocks are medium to rather light bluish gray, lighter in color than most of the historic and recent flows, but much darker than most of the pre-Pahala lavas [Ninole basalt], and lacking the pinkish tints of many of the pre-Pahala rocks. Separated from pre-Pahala rocks by a profound angular and erosional uncon. Thickness probably over 300 [600] ft.

According to H. T. Stearns, 1930 (U. S. G. S. W. S. P. 616), the *Pahala basalt* comprises all lava beds that are uncon. on Ninole basalt and that were laid down before end of deposition of ash-bed memb. at its top, and is overlain by Kamehame basalt.

Named for occurrence around Pahala, Mauna Loa, Hawaiian Islands, which is built at edge of extensive fields of yellow ash that form top memb. of Pahala basalt.

Pahasapa limestone.

Mississippian (lower): Western South Dakota and northeastern Wyoming (Black Hills).

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 509). *Pahasapa ls.*—Massive gray ls., 250 to 500 ft. thick, heretofore called Gray ls. Underlies Minnelusa fm. and overlies Englewood ls. Name (which is Dakota [Sioux] Indian name for Black Hills) was suggested by T. A. Jaggar.

Pahranagat limestone.

A name introduced by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 80), "to cover the Ordovicic part (500 ft.) of Hague's Lone Mountain ls." "Named for Pahranagat Mtns, N. of Las Vegas," SE. Nev.

Paicines formation.

Pliocene: Southern California (San Benito County).

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 470 and 476 and map). Continental Plio. is herein given local formational name *"Paicines,"* pending more exact correlation. Consists of yellow, loosely consolidated ss. interbedded with sh.; soft gray ss. colored by fragments of Franciscan metamorphics; occasional peat seams. Fresh-water fossils. The age of the Paicines is in all probability Plio. It lies uncon. on Etchegoin fm., and is overlain, probably uncon., by San Benito gravels. [Apparently named for extensive development W. of Paicines, Benito Co.]

Paine shale member (of Madison limestone).

Mississippian (lower): Central northern Montana (Fort Benton quadrangle) and central southern Montana (Little Belt Mountains quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). At base of Madison ls. the strata are thin-bedded and darker in color than upper part of fm., owing to presence of much argill. material forming the *Paine sh.* Outcrops are frequently stained pale orange or red by iron oxide. In great cliffs along both Belt Creek and Dry Fork the section shows a ribboned structure, due to differences of weathering, the harder and more massive beds of Woodhurst ls. projecting in relief. [Derivation of name not stated, but Madison ls. is mapped over broad area at and around Paine Gulch, in SW. corner of this quad.]

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Lower third of Madison ls. consists of thin-bedded shaly lss. named *Paine sh.* They are commonly of gray color, and are overlain by Woodhurst ls. memb. of the Madison.

Painesville moraine.

Pleistocene (late Wisconsin): Northern Ohio and northwestern Pennsylvania. Included in Lake Escarpment morainic system. Named for Painesville, Ohio. See U. S. G. S. Mon. 41.

Paint slate.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Iron County).

R. C. Allen, 1910 (Mich. Geol. and Biol. Surv. Pub. 3, geol. ser. 2, pp. 100–101). *Paint slates*.—Mainly graywacke and arkose. Vary in texture from conglomeratic to fine-grained and in structure from massive thick-bedded rocks to micaceous schists. Occur in Iron River dist., N. and W. of Iron River and Crystal Falls dists. Same as Michigamme sl.

R. C. Allen and L. P. Barrett, 1915 (Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, pp. 131–139). *Paint sl. fm.*—Unknown but undoubtedly great thickness of graywacke, graywacke-sl., and gray sl., associated with basic intrusive and extrusive igneous rocks occupying a large but ill-defined area N. and W. of Iron River and Crystal Falls dists. and S. of W. end of Marquette iron range. Uniformly gray or grayish green in weathered exposures. "Is a large part of what has been described as Michigamme sl. series." Named for Paint River, Iron Co.

Paint limestone.

A name employed by C. [R.] Keyes instead of Paint Creek fm. of other geologists. (See Pan-Am. Geol., vol. 39, No. 4, 1923, p. 320.)

Paint Creek formation. (Of Chester group.)

Mississippian: Southern Illinois and western Kentucky.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 125). *Paint Creek fm.*—Upper part largely ls. with sh. partings; lower half or more almost wholly sh., with bed of deep-red compact clay about 20 or 25 ft. above base. Thickness 60 to 80 ft. Overlies Yankeetown chert and underlies Ruma fm.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41), redefined this fm., by including in its top the lower part of †Ruma fm., the upper part of the †Ruma being Cypress ss., which now limits Paint Creek fm. at top.

Named for Paint Creek, Monroe Co., Ill. Typically developed in a tributary of Paint Creek about 5½ mi. NE. of Prairie du Rocher.

†Painted Desert formation.

Jurassic and older (?): Northern Arizona, southwestern Utah, and northwestern New Mexico.

L. F. Ward, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 401–413). *Painted Desert beds*.—Consist of (descending): White sss., 100 ft.; brown sss., 200 ft.; variegated sss., regularly stratified and brilliantly colored, 800 ft. (the well-known Painted Cliffs); and red-orange sss., 100 ft. Overlie Le Roux beds. Occur in Little Colorado Valley.

Now divided into (descending) Morrison fm. (Upper Jurassic), Navajo ss., Kayenta fm., and Wingate ss., the latter 3 of Jurassic (?) age. The Leroux beds of Ward comprise upper part of Chinle fm. of present nomenclature. The Painted Desert fm. of E. Huntington and J. W. Goldthwait (Jour. Geol., vol. 11, 1903, pp. 46–63), of Toquerville dist., SW. Utah, is Chinle fm., according to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr. (U. S. G. S. P. P 183, 1936), who also show Painted Desert fm. of N. H. Darton, 1910 (in NW. N. Mex. and northern Ariz.), included (descending) Morrison, Summerville, Curtis, Entrada, Carmel, Navajo, Kayenta, and Wingate fms.

Named for Painted Desert, Coconino Co., Ariz.

†Painterhood limestone.

Pennsylvanian: Southeastern Kansas.

F. C. Schrader and E. Haworth, 1905 (U. S. G. S. Bull. 260, p. 447). *Painterhood ls.*—Fine-grained fossiliferous ls., 12 ft. thick, underlying 10 ft. of ss. regarded as probably Elgin ss., and overlying Buxton fm. in Independence quad. Probably same as Oread ls.

Same as Oread ls., older name, and discarded many years ago.

Named for Painterhood Creek, Elk Co.

Paint Lick limestone. (In Eden group.)

Upper Ordovician: East-central Kentucky and southwestern Ohio.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 19, 212, 215). *Paint Lick bed or Upper Eden.*—Lss., 40 to 60 ft. thick, containing large percentage of siliceous material, with often less than 1 percent of carbonate of lime but with 6 to 10 percent of alumina. Overlies Million bed (Middle and Lower Eden) and underlies Mount Hope (basal bed of Maysville fm.). Equiv. to lower part of Garrard ss. of Richmond folio.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, pp. 289–324). *McMicken or Paint Lick beds* consist of 66 ft. of massive argill., more or less siliceous fine-grained lss., overlying Southgate memb. and forming top div. of Eden group. Underlie Mount Hope beds.

Probably named for Paint Lick Creek, Madison and Garrard Counties, Ky., as later repts state beds are traceable from Bath Co. to Boyle Co., Ky.

Paint Rock bed. (In Wichita group.)

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 428). *Paint Rock bed.*—Largely dark-colored shaly, slightly carbonaceous ls. interstratified with thin layers of carbonaceous argill. lime sh. Fossiliferous. Thickness 150 ft. Top memb. of Albany [Wichita] div.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 8, 9, 30–41, map). *Paintrock fm. (redefined).*—As here considered begins with No. 128 of general section and extends to top of No. 141. This leaves a thickness of 81 ft. for the fm.; Drake's thickness was 150 ft. He began Paintrock beds much lower than base here used, judging from his map, showing lower limit along Pony Creek. [These lower rocks must have been transferred to underlying Talpa ls.] The rocks of this fm. are more evenly bedded and somewhat more resistant than those of the two underlying fms. [Talpa and Grape Creek]. The fauna is more sparse and less varied. Upper limit is rather hard to determine before fauna of whole section is worked out, since lithologic changes are not sharp at any point. Underlies Lueders fm., which contains a larger proportion of sh. and nearly impure lss. All included in Wichita stage.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 197–198). [As Clyde fm. was defined in this rept it did not include Paint Rock bed of Drake, but the Paint Rock appears to be included in Wichita group, for authors state (p. 198, footnote) "the Talpa [top memb. of their Clyde fm.] and Paint Rock beds are two fms. sufficiently closely related to go in one and the same group."]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). *Paint Rock beds of Drake* are basal part of Lueders fm. as defined in this rept. Named for Paint Rock, Concho Co.

Paisley limestone.

Miners' local name for an ore-bearing ls. in lower part of Oquirrh fm. (Penn.) of Stockton dist., central northern Utah. Lies 2,000± ft. below their Larsen ls. and 550± ft. above their Galena King ls. Outcrops in Paisley claim. (See U. S. G. S. P. P. 173, 1932.)

Pakan formation.

Upper Cretaceous: Alberta.

J. A. Allan, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 12). Included in Belly River series.

Pakowki formation.

A series of Upper Cret. marine shales and sss., 100 to 300 ft. thick, underlying Foremost fm. and overlying Milk River fm. in southern Alberta, Canada. Named by D. B. Dowling (Canada Geol. Surv. Summ. Rept. 1915, and Canada Geol. Surv. Mem. 93, 1917), from exposure in Pakowki Coulee. Correlated with Claggett fm. of Mont.

Pala conglomerate.

Pleistocene: Southern California (San Diego County).

A. J. Ellis, 1919 (U. S. G. S. W. S. P. 446). *Pala cgl.*—Coarse valley-fill cgl. of type not common in this area. It is a conglomeratic mass of boulders and residuum, having thickness of about 200 ft. above and extending to undet. depth below present level of river. Is older than the valley fill which underlies present valley floors, and it may be as old or even older than San Pedro fm. Occurs in valley of San Luis Rey, in vicinity of Pala, San Diego Co.

Palaeozoic. See *Paleozoic*, the modern spelling.

Palafox sandstone member (of Mount Selman formation).

Eocene (middle): Southern Texas (Webb County) and northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1370, 1371, 1377, 1381, 1385). The upper Mount Selman (which overlies Bigford memb.) has the massive *Palafox ss.* as its basal memb. This prominent ridge-forming ss. can best be seen on the American side, where it forms a high cliff down E. bank of Rio Grande from mouth of Espada Creek to bluffs E. of Palafox [Webb Co., Tex.]. Can be traced from Rio Grande to Rio San Juan, Tamaulipas. Thickness 150 to 184 ft.

Pale beds.

A term applied by D. B. Dowling (Canada Geol. Surv. Summ. Rept. 1915, and Canada Geol. Surv. Mem. 93, 1917) to the alternating gray and greenish-gray sss., shales, and sandy shales, of continental origin and Judith River (Upper Cret.) age, conformably underlying the marine Bearpaw sh. and overlying Foremost fm. in southern Alberta, Canada. Thickness 740± ft.

†Paleocene.

A European name applied to basal part of Eocene series as used by U. S. Geol. Survey and most other American geologists, but some American geologists separate these basal rocks from the Eocene and treat them as a distinct series. For definition see U. S. G. S. Bull. 769, pp. 54–56.

Paleogene.

A term employed by many European geologists to include pre-Mio. Tertiary time and deposits, which they divide into Paleocene (=lower part of Eocene of most American geologists), Eocene (restricted to upper part of Eocene of most American geologists), and Olig. (See also *Neogene*.)

Paleozoic era.

A major time term, meaning old or ancient life, that covers (descending order) Carboniferous, Devonian, Silurian, Ordovician, and Cambrian periods. For definition see U. S. G. S. Bull. 769, 1925, pp. 10–14.

Palestine sandstone. (Of Chester group.)

Mississippian: Southwestern Illinois and western Kentucky.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 128). *Palestine fm.*—Aren. fm., 75 ft. thick, consisting in part of heavy beds of ss. suitable for building purposes and in part of thinly bedded ripple-marked sss. or aren. shales, with, locally, argill. shales. Uncon. overlies Menard ls. and conformably underlies Clore ls.

Named for Palestine Twp, Randolph Co., Ill., where fm. is well developed along some tributaries of Tindall Creek.

Pali volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Pali volcanics.*—Basalt and breccia, mapped separately. Included in lower part of Honolulu volcanic series [q. v.]. Crops out along the road down the famous Nuuanu Pali, for which the fm. is named.

†Palisade porphyry.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 262–268). *Palisade porphyry.*—The porphyry of Beaver Bay group (of Keweenaw series), which forms the Great Palisades of Minn. coast of Lake Superior. Thickness 300 ft.

Palisade diabase.

Upper Triassic: Eastern New York and northern New Jersey.

N. H. Darton, 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 134–139). *Palisade trap.*—Best exposed instance of intrusion on large scale in N. J. In greater part an essentially conformable sheet throughout. Exposed for many mi. along Hudson River in contact with underlying strata. [In U. S. G. S. Bull. 67, 1890, Darton gave thickness 30 to 850 ft.]

W J McGee, 1894 (Geol. map of N. Y., prepared under direction of James Hall). *Palisade diabase, Juratrias.*

N. H. Darton, 1902 (U. S. G. S. New York City folio, No. 83). The *Palisade diabase*, a great sheet of igneous rock intruded among the lower sss. and shales of Newark group, forms the Palisades of the Hudson.

The U. S. Geol. Survey treats this intrusive fm. as distinct from Newark group. That group, however, includes some interbedded basalt flows.

†Palisade andesite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado.

Field name (preoccupied) used by E. S. Larsen for rocks he formally named *Conejos fm.* This field name crept into print in Colo. Geol. Surv. Bull. 13, 1917, simultaneously with the adopted name.

Palisades conglomerate.

Pliocene(?): Southwestern Alaska (Yukon gold district).

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3). *Palisades cgls.*—Pure-white clean sand and well-washed pebbles, strongly cross-bedded and containing much woody matter—sticks, logs, etc.—in condition btw. wood and lignite. Occur on left bank of Yukon, about 35 mi. below mouth of Tanana, at base of cliffs, 150 ft. high, that have been named *the Palisades.* Overlain by Pleist. silts (Yukon silts). Are Plio. or possibly upper Mio.

Palma Real.

Oligocene: Mexico.

J. A. Villatoro, 1932 (Bol. Petrolo, vol. 34, Nos. 1–3, p. 8, and Nos. 4–6, p. 204).

†Palm Beach limestone.

Pleistocene: Southern Florida.

S. Sanford, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 209–211). *Palm Beach ls.*—Nonoolitic marine lss., of white to yellowish color, containing variable proportion of fine to medium quartz sand. The lime cement is not coarsely crystalline, nor does rock contain, like other lss. of southern Fla., many patches and streaks of coarsely crystalline calcite, replacing amorphous material or filling cavities left by solutions of shell fragments. Its hardness varies greatly; in some places it is compact, dense, and rings under the hammer; in others, the proportion of sand is so great that the rock becomes a friable calc. ss. Thickness probably 5 to 50 ft. Scattered outcrops are found throughout a considerable extent of country in E. part of Palm Beach Co., but the ls. is not exposed near city of Palm Beach. Typical exposure is in T. 45, R. 41, 12 mi. W. of Lantana. It probably extends northward into St. Lucie Co. Is overlain by the sands of the pineland and the sands and peat of the Everglades, and is underlain, so far as can be told from well records, by marl and sand.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). "Palm Beach ls." is local facies of Anastasia fm. that marks transition into Miami oolite, and name is unnecessary.

Palmer gneiss.

Pre-Cambrian (Laurentian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., p. 514). *Palmer gneiss.*—Light-gray, dark-gray, and pinkish schists, fine-grained; sometimes homogeneous like a chert; at other times show little eyes of quartz in a hydromicaceous matrix, like a devitrified and schistose quartz porphyry. All varieties highly foliated. Typical exposures W. of Palmer Lake. Is Archean.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360), 1911 (U. S. G. S. Mon. 52), and subsequent repts assigned Palmer gneiss to Laurentian, as did C. K. Leith, 1934 (Geol. Soc. Am. Proc., p. 176). Mon. 52 showed that some rocks included in Palmer gneiss are middle Huronian sediments.

C. A. Lamey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, p. 1155). It has been shown [after a special study] that original Palmer gneiss belt contains both Middle and Lower Huronian rocks (Ajibik qtzite, Kona dol., and Mesnard qtzite). Since much of Palmer gneiss has been shown to be Huronian sediments, and since the Republic granite, in addition to being a younger intrusion than the diorite, has batholithic proportions, there appears to be good reason to conclude that a large part of the gneiss within the original belt represents Lower Huronian fms. much metamorphosed by Republic granite. [On pp. 1160-61:] It has been shown *Palmer gneiss* is in reality a variety of Huronian sediments—cgls., qtzites, dol., graywacke, and sl.—intruded by granite which writer believes is post-Upper Huronian, instead of Laurentian, as formerly believed.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Palmer gneiss* to Laurentian.

Palmer volcanics.

Tertiary (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 103, map). *Palmer volcanics.*—Tuffs, lavas, breccias, and intercalated bands of gravels the pebbles of which attain nearly 12 in. diam. Tuffs and breccias predominate. May be in part = Phalen Lake volcanics. Rest uncon. on Colville qtzite and covered by glacial drift. Form residual patch observed at only one place, W. of town of Palmer. Assigned to Tert.

Palmetto formation.

Lower Ordovician: Southwestern Nevada.

H. W. Turner, 1902 (Am. Geol., vol. 29, pp. 261-272). *Palmetto fm.*—Rocks of Ord. age, consisting of dark thin-bedded cherts with layers of gray graptolite slates, smaller amounts of reddish slates, and an occasional ls. layer. Conformably overlies Emigrant fm. Contains graptolites of Normanskill and Quebec [Beekmantown] age. Thickness not stated. Exposed in Palmetto Mtns, Esmeralda Co.

Palms quartzite.

Pre-Cambrian (middle Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic district).

C. R. Van Hise, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, p. 338). *Palms fm.*—Quartz sl. Underlies Ironwood fm. and uncon. overlies Bad [River] ls. (Lower Huronian). Is basal fm. of Upper Huronian. Named for exposures just S. of Palms mine, on Palms property, near Bessemer, Mich.

Later repts give thickness 400 to 800 ft. Some repts have used *Palms quartz sl.*

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360) and 1911 (U. S. G. S. Mon. 52) assigned this fm. to upper Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), changed name to *Palms qtzite* and assigned the fm. to middle Huronian.

Palm Spring formation.

Miocene (middle or upper): Southeastern California (Imperial County).

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, p. 10). *Palm Spring fm.*—Unconsolidated or poorly consolidated nonmarine sands and light chocolate-brown and faint brick-red silts 1,000± ft. thick. Of middle or upper Mio. age. Conformably overlies marine Imperial fm. in Carrizo Mtn and vicinity, Imperial Co. Named for spring on lower part of Vallecito Creek, a southeastward-flowing tributary entering Carrizo Creek about 1 mi. above the old stage station.

Palm Spring member.

Miocene (?): Mexico (Baja California).

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 208).

†Palo Duro beds.

Pliocene: Panhandle of Texas.

W. B. Scott, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 594–595). *Palo Duro beds.*—Latest of three horizons of Loup Fork, characterized by first appearance of genera *Equus* and *Hippidium*, while *Protohippus* and *Aphelops* continue up from Nebraska or Loup Fork proper. Underlie Blanco beds and overlie Nebraska or Loup Fork proper.

Same as Goodnight fm. of W. F. Cummins (older name), which, according to J. W. Gidley, 1903 (Am. Mus. Nat. Hist. Bull. 19, p. 632), is same as his Clarendon beds.

Named for Palo Duro Canyon, W. part of Panhandle of Tex.; but later repts state the beds do not occur within 10 mi. of Palo Duro Canyon, which is in Randall and Armstrong Counties.

Is part or all of Ogallala fm. (all of Plio. age in Tex.).

Palomas gravel.

Pleistocene: Southwestern New Mexico.

C. H. Gordon, 1907 (Sci., n. s., vol. 25, pp. 824–825; and Jour. Geol., vol. 15, pp. 91–92). *Palomas fm.*—Stratified deposits of gravels and sands, 1,500 to 2,000 ft. thick in Sierra and Grant Counties, N. Mex. In western Sierra Co. they are cemented into cgl. comparable to Gila cgl. of Ariz.

Named for exposures on Palomas River, Sierra Co.

Palomasan series.

A term introduced by C. [R.] Keyes to cover 200 ft. of Quat. till in N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 10.) Probably same as *Palomas gravel* of other geologists.

Palo Pinto limestone. (In Canyon group.)

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Palo Pinto fm.*—Everywhere easily recognized in well logs and in field, because it forms lowermost series of thick lss. in section above Strawn sands. The lower memb. is a massive ls. that forms a prominent scarp dividing the Strawn area from the Canyon. Overlies Strawn div. and underlies Graford fm. Is basal fm. of Canyon div. [group].

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 34). *Palo Pinto ls.*—Crystalline rock, dark gray, made up of beds 2 to 6 inches thick. Is basal fm. of Canyon group. Thickness 50 to 100 ft. Underlies Graford fm. and overlies Mineral Wells fm.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 44). *Palo Pinto fm.* was named by Plummer and Moore, and made to include only the massive ls. ledges conformably overlying Strawn group and conformably underlying the thick marl bed in base of Graford fm. at its type loc. along Highway No. 1 W. of Palo Pinto. The fm. includes a thin ls. above, 10 to 15 ft. of marl, and a massive ls. below.

Named for Palo Pinto, Palo Pinto Co.

Palos Verdes sand.

Pleistocene (upper): Southern California (Los Angeles County).

A. J. Tieje, 1926 (A. A. P. G. Bull., vol. 10, No. 5, pp. 502–512). *Palos Verdes fm.*—Name suggested by W. S. W. Kew for "Upper San Pedro" fm. of Arnold, the name *San Pedro fm.* being restricted to the [uncon. underlying] "Lower San Pedro" fm. of Arnold. The Palos Verdes consists of massive gray-green, very coarse to gravelly quartzose and loosely cemented marine sands, of several varieties, containing pebbles up to ½ in. diam. Thickness 50 ft. Sand dollars (*Echinarachnius excentricus* Esch.?) amazingly abundant, and the pelecypods and gastropods are typically Palos Verdes, with some 70 species thus far identified.

Rests on 104 ft. of unfossiliferous sands of beach type, and is overlain by 150 ft. of unfossiliferous sands assumed to be of fresh-water origin. Assigned to Pleist. Younger than San Pedro sands.

J. E. Eaton, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 124), introduced *Hall Canyon fm.* for beds uncon. overlying San Pedro fm., restricted and uncon. underlying *Palos Verdes fm.* in Ventura Basin.

According to W. P. Woodring (16th Int. Geol. Cong. Guidebook 15, pl. 2, 1932) the *Palos Verdes sand* of San Pedro Hills is separated from San Pedro sand by "older terrace deposits," which rest uncon. on the San Pedro.

†Palouse formation.

Palouse soil.

Pleistocene: Southeastern Washington (Palouse Hills).

R. C. Treasher, 1925 (Sci., n. s., vol. 61, p. 469). Throughout east-central Wash., especially that region known as the "Palouse wheat country," is a large area underlain by basalt, which is a part of Columbia lava plateau. Above this basalt is a covering of very fine sand, 250 ft. or more thick, which has the characteristics of loess. For these sed. beds writer proposes *Palouse fm.* The fertile soil of Palouse region is largely a residual modification of Palouse fm. and has locally been redeposited by wind and surface wash.

R. C. Treasher, 1926 (Pan-Am. Geol., vol. 46, pp. 306–314). Of all the evidences with reference to Palouse loess [mapped], by far the greater part indicates (1) water deposition, rather than eolian; (2) that the laminated phase is older than the massive phase. The laminated loess may have been deposited either in a lake, or on a flood plain, or a combination of both. While glacial origin of the loess seems now most reasonable to writer, much further investigation is needed to establish its verity. Since no mention is made of a widespread laminated phase of the loess in Palouse region, and this phase seems to be the originally deposited material, writer proposes for it the name *Palouse fm.* Most reasonable explanation of its origin at present time is that it was laid down on retreat of the continental ice sheet, pre-Spokane in age, probably Illinoian or Iowan age, as suggested by Bretz. The Palouse Hills are composed of the two phases of the loess.

K. Bryan, 1927 (U. S. G. S. Bull 790B). Treasher has proposed "Palouse fm.," but the common origin of the material is doubtful, and it seems best therefore to use the popular and local term "Palouse soil" without any implication that a fm. name is being established.

Paluxy sand. (In Trinity group.)

Lower Cretaceous (Comanche series): Eastern Texas.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 504). *Paluxy sands.*—Fine white, gray, to yellowish packsand, stratified and occasionally cross-bedded, oxidizing red at surface. Resembles Trinity sands and hitherto confused with them, but differs by absence of fine pebbles and by being rather calc. and argill. in places, while Trinity sands are more ferruginous. Thickness 15 to 100 ft. Tentatively included in Fredericksburg div., but may prove to be inseparable from Trinity. Overlies Glen Rose or alternating beds and underlies *Gryphaea* Rock and Walnut clays.

This fm. was transferred to Trinity group by J. A. Taff in 1892 and by Hill in 1894, as explained under *Fredericksburg group*, and under *Trinity group*. The subdivisions of Trinity group at present generally recognized are (descending) Paluxy sand, Glen Rose ls., and Travis Peak sand.

Named for town and creek in Somervell Co.

Pamelia limestone.

Lower Ordovician: Northern New York (Jefferson County).

H. P. Cushing, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 155+). *Pamelia ls.*—Chiefly blue and dove ls. with intercalated mag. lss., and in upper half much whitish impure ls. and some yellow waterlime; at base 10 to 20 ft. of thin ss. overlain by greenish sh. Thickness 40 to 150 ft. Probably of Stones River age. Overlain by Lowville ls. and uncon. underlain by Theresa fm. (Camb.). The

Depauville waterlime of Emmons is in lower part, but he thought the beds were later than Birdseye, and abandoned name when he discovered his error. It seems better to introduce *Pamelia* than to rehabilitate *Depauville*, since latter represented only small part of Pamelia. The Pamelia occupies strat. position btw. Valcour ls. and Crown Point ls. of the Chazy of Champlain Valley.

H. P. Cushing, 1910 (N. Y. State Mus. Bull. 145). *Pamelia (Stones River) ls.*—Both the rocks and contained fossils differ from the Chazy, and the fm. is known as *Stones River*. Notwithstanding difference of name the two fms. represent substantially same time interval. Is of upper Stones River age. Stones River is of Chazy age but laid down in separate basin. In Thousand Islands region rests uncon. on Tribes Hill fm. and is uncon. overlain by Lowville ls.

H. P. Cushing, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135–144). *Pamelia ls.*, of supposed Chazy age, has length of outcrop of some 70 mi. in N. Y. and probably even greater in Canada. Cannot be successfully correlated with any of Champlain Chazy, either lithologically or faunally, and seems to represent a deposit in a wholly separate basin. According to Ulrich's correlations, the Pamelia is in age intermediate btw. middle and upper Chazy of Champlain Valley, [and occurs btw. Valcour and Crown Point lss.]. Rests on Tribes Hill, Theresa, Potsdam, and pre-Camb.

P. E. Raymond, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 353), 1913 (12th Int. Geol. Cong. Guidebook 3, p. 141) and 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 348), assigned Pamelia to Black River (instead of Chazy).

G. M. Kay, 1929 (A. A. P. G. Bull., vol. 13, No. 9, p. 1214), placed *Pamelia ls.* in Chazyan and showed it as considerably older than and uncon. with Lowville ls. He continued to include it in Chazyan in 1931 (Jour. Geol., vol. 39, No. 4, p. 362).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 278). *Pamelia ls.* is of age intermediate btw. middle and upper Chazy.

A. E. Wilson, 1932 (Am. Jour. Sci., 5th, vol 24, pp. 135–146), assigned Pamelia to Black River.

G. M. Kay, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 227). *Pamelia fm.*, commonly classified as Chazyan, may belong in [Middle Ord.] Black River group below the Lowville, according to Alice E. Wilson. [In his tables he included it in Black River.]

The U. S. Geol. Survey classifies *Pamelia ls.* as Lower Ord.

Named for exposures at Pamelia, Jefferson Co.

Pamlico formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

W. B. Clark, 1910 (Geol. Soc. Am. Bull., vol. 20, p. 651). Name proposed by L. W. Stephenson in unpublished ms. In N. C. the Talbot terrace divides into two terraces, constituting Chowan and Pamlico fms.

L. W. Stephenson, 1912 (N. C. Geol. Surv. vol. 3, pp. 286–290). *Pamlico fm.*—Fine sandy loams, sands, and clays, and to a limited extent gravels. In the swamp lands the soils consist in large part of accumulations of peaty matter, which are of later origin than main body of deposits. Thickness 15 or 20 ft. The Pamlico terrace has been traced N. through Va. into Md. The upper surface of Pamlico beds forms a low, nearly level plain whose elevation above sea level nowhere exceeds 25 ft. Younger than Chowan fm., whose surface lies at elevations varying from 25 to 70 ft. above sea level. Top fm. of Columbia group in N. C. Named for Pamlico Sound, in eastern N. C., "away from whose shores the terrace plain forming the surface extends as broad, nearly level stretches of lowland."

C. K. Wentworth, 1930 (Va. Geol. Surv. Bull. 32, pp. 67–83), divided Pamlico fm. of Stephenson into *Princess Anne fm. and terrace* (at 25 ft. elev.), of marine origin, and *Dismal Swamp fm. and terrace* (at 12 ft. elev.), largely of marine origin, as explained under *Princess Anne fm.* and *Dismal Swamp fm.*

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 1931), proposed following reclassification of younger Pleist. terrace fms. of Md., Va., and N. C.:

Pamlico fm., 25-foot level.

Talbot fm. *restricted*, 40-foot level. (Same as *typical* "Chowan," abandoned but not same as "Chowan" *as defined*.)

Penholoway terrace (deposits not yet named), 70-foot level. [These deposits have heretofore been included in Wicomico to N. and in Chowan to S.]

Wicomico fm. *restricted*, 100-foot level.

As "Dismal Swamp" terrace has identically same shore line (25 ft.) as the Pamlico, the name Pamlico, which has many years priority, should be retained. The

"Princess Anne" terrace was separated from the "Dismal Swamp" because of presence of a low scarp above 12 ft. in neighborhood of Norfolk and elsewhere in Va.

See also 16th Int. Geol. Cong. Guidebook 5, pp. 34–35, 1932, and Guidebook 12, 1932, where Cooke states †Dismal Swamp terrace is same as Pamlico terrace and recognizes Princess Anne terrace (and fm.) at 12-ft. level. The terrace fms. (including the Pamlico) shown on pp. 2 and 5 of Guidebook 12 (and herein enumerated under *Columbia group*) are now recognized by Cooke from Del. to southern Ga. and probably into Fla. He includes *Princess Anne* in *Pamlico*.

Pamunkey group.

Eocene: Eastern Virginia and Maryland.

N. H. Darton, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 431–450, map). *Pamunkey fm.*—A representative of the Eo. restricted to Md. and Va. Named for extensive exposures on Pamunkey River, Va. Consists of a homogeneous sheet of fine-grained materials, mainly glauconitic sands, usually profusely fossiliferous. Includes locally a few beds of clay, secondary lss., and at base some gravels. Thickness 150 ft. Uncon. underlies Chesapeake fm. [group] and uncon. overlies Severn fm. (Cret.).

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Pamunkey group.*—Divided into Nanjemoy fm. above and Aquia fm. below. Uncon. underlies Chesapeake group and uncon. overlies Cret.

Considered to be of Wilcox (lower Eo.) and Claiborne (middle Eo.) age.

Panaca formation.

Tertiary (Pliocene?): Eastern Nevada (Pioche region).

C. Stock, 1921 (Geol. Soc. Am. Bull., vol. 32, pp. 146–147; Am. Jour. Sci., 5th, vol. 2, pp. 252–257). Near village of Panaca, Lincoln Co., Nev., the deposits in which mammalian remains occur consist of red-brown and green sands and clays. Cross-bedded sands and gravels as well as tuffaceous materials are also present. The beds are slightly folded. Several series of terraces are developed in them. Fauna [listed] suggests Plio. age. The mammal-bearing sediments of Meadow Valley may be known as *Panaca beds*.

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. Met. Engrs. Trans., No. 1647, p. 8) and 1932 (U. S. G. S. P. P. 171). *Panaca fm.*, named by Stock, includes a series of water-laid tuffs of Tert. (probably late Plio.) age, well shown in badlands E. and W. of Panaca, and lying today in essentially same position as when they were deposited. The beds range in color from snow-white through cream color and brown to terra cotta, the most common color being light brown, and in grain from almost impalpable powder to sand. In a few places distinctly bedded and cross-bedded. Concretions (dark-gray or brownish-gray flinty bodies) occur in middle and upper parts of Panaca tuffs in buttes in N. part of village of Panaca. Exposed only in Meadow Valley and its tributary Patterson Wash. Thickness at least several hundred ft.

Panama conglomerate.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_3, pp. 58, 60, 70, 124). *Panama cgl.*, a massive cgl. of quartz pebbles (almost always lens-shaped) and sand, the proportion of sand to pebbles being much larger than in many purely conglomeratic masses of NW. Pa. The rock at Panama, Chautauqua Co., N. Y., where it is best exposed, is made up, from top to bottom, of alternating layers of ss. and cgl., and is 69 ft. thick. It rests on bluish-green shales of Chemung group. Assigned to Chemung. [Now considered to be younger than Chemung.] Horizon is 200 to 300 ft. lower than Salamanca cgl.

This cgl. is now generally considered to correspond to Wolf Creek cgl. lentil of Cattaraugus fm., although it has been correlated by some geologists with the younger Salamanca cgl. G. H. Chadwick stated (Geol. Soc. Am. Bull., vol. 36, p. 457, 1925) that Panama cgl. can be traced into Le Boeuf ss. of Pa. and that it underlies his Amity sh. K. E. Caster, 1933 (Geol.

Soc. Am. Bull., vol. 44, No. 1, p. 203) and 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 77–83), also said it is same as Le Boeuf cgl., Venango 3d oil sand, and Wolf Creek cgl., and that it underlies Amity sh. of Chadwick and rests on Chemung group.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 580). Panama cgl. makes base of true Cattaraugus fm. in McKean and western Potter Counties, Pa.

Panama formation.

Miocene: Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 244). [Age not given. Later repts by several other geologists assign the deposits to Mio.]

Panamint metamorphic complex.

Pre-Cambrian and lower Paleozoic (?): Southeastern California (Inyo County).

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Panamint metamorphic complex.*—A series of metamorphic crystalline rocks, including gneisses, schists, marble, ls., qtzite, etc., of unknown thickness, presumably in large part sedimentary. The only metamorphic rocks of known igneous origin are sheared granite gneiss and hornblende schist. The rocks have been injected by granite and aplite and cut by diabase dikes. Oldest fm. in S. part of Panamint Range, where it covers large area. Is pre-Camb. and lower Paleozoic (?). Underlies—probably uncon.—Marvel dolomitic ls.

Panamintan series.

A term applied by C. [R.] Keyes, 1923 (Pan.-Am. Geol., vol. 40, pp. 51, 53, 80), to 2,400 to 3,000 ft. of qtzites and sss. in eastern Calif., Nev., and Utah, said to be of early Camb. age and much older than Prospect Mtn qtzite. Named for Panamint Mtns, eastern Calif.

Pandermitan series.

Lower Cambrian: Great Basin (Utah and Nevada).

C. [R.] Keyes, 1927 (Pan-Am. Geol., vol. 48, p. 68). Taconic section [Lower Camb.] of Great Basin divided into (descending): Uncon.; Uintan series (7,000 ft. of qtzites); uncon.; Monon series (3,000 ft. of lss.); uncon.; *Pandermitan series* (3,000 ft. of qtzites); uncon.; Pintoan series (2,000 ft. of lss.); uncon. [Derivation of names not stated.]

†Panhandle beds.

Pliocene: Panhandle of Texas.

J. W. Gidley, 1903 (Am. Mus. Nat. Hist. Bull., vol. 19, pp. 634–635). *Panhandle beds.*—Deposits, which seem to be at least partially of lacustrine origin, of nearly uniform thickness [thickness not stated], forming practically whole area of Staked Plains and westward to Rocky Mtns in N. Mex. Underlie Clarendon beds and overlie Triassic. Fossils indicate middle or lower Mio.

W. D. Matthew, 1925 (Geol. Soc. Am. Bull., vol. 36, p. 221). *Panhandle beds* of Gidley are almost barren of fossils, but recent work by Am. Mus. party showed that their base is in places Lower Pleist., and that in other places they are contemp. in upper part with Blanco beds [middle Plio.] and in lower part with Clarendon beds [upper Mio. and Plio.]; also that they are earlier than Rock Creek beds and are uncon. on Triassic. "We consider this fm. essentially a consolidated eolian loess."

May be named for Panhandle of Tex. or for town in Carson Co., where the beds are exposed.

Replaced by *Ogallala fm.* (*Plio.*). No Mio. in this part of Tex., according to more recent studies.

Panoche formation.

Upper Cretaceous: Southern California (Diablo Range).

R. Anderson and R. W. Pack, 1915 (U. S. G. S. Bull. 603). *Panoche fm.*—Lower fm. of Chico group. Rests uncon. on Franciscan fm. and is conformably overlain by Moreno fm., the upper fm. of Chico group. Consists of alternating beds of dark thin-bedded clay sh. and massive gray concretionary ss. aggregating 9,500 to over 20,000 ft. in thickness. The fm. also includes some aren. sh., platy ss., and beds of coarse cgl., which locally attain great thicknesses. The lowest beds here included in Panoche fm. are nonfossiliferous and may represent Knoxville fm., which, however, is believed to be absent. Named for development in Panoche Hills, Fresno Co.

Panola formation.

Devonian and Silurian: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 2). *Panola fm.*—Coarse yellow ss., 0 to 30 ft. thick, at base; fine blue sh., usually interbedded with thin beds of rusty brown impure ls. carrying Niagara fossils, in middle; heavy-bedded brown ls. of Dev. age at top. In places whole fm. is only 1 ft. thick; in other places appears to be absent. Where fully represented is 70 ft. thick, and corresponds to Clinton and Niagara groups, Oriskany ss., and Corniferous ls. of earlier Ky. repts. Underlies Chattanooga sh. and overlies Richmond fm.

Named for Panola, Madison Co.

Panther conglomerate. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 185). *Panther cgl.*—Massive cgl. to heavy- and current-bedded grayish-white to brown ss. Carries large white quartz pebbles, ovoidal and rounded. Is prominent cliff maker. Thickness 40 to 100 ft. Lies 1 to 5 ft. below Lower Douglas coal and 0 to 10 ft. above Iaeger B coal. Exposed at Panther, McDowell Co. [W. Va. Geol. Surv. Fayette Co. Rept., 1919, says this is Upper Nuttall ss.]

Also called *Panther ss.*

Panther tongue (of Star Point sandstone).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Panther tongue.*—Basal part of Star Point ss. First appears in outcrop in Soldier Creek, Wellington quad., where it consists of impure ls. concretions and thin beds of buff ss. and sandy sh. Thickens to W. and material gets coarser and more sandy. At W. edge of Wellington quad. it is 30 to 40 ft. thick, and consists of friable, sugary cliff-forming ss., massive at top and grading down through sandy sh. to sh. Varies in thickness from 0 to 125 ft. Probably laid down in Mancos sea, but to W. and SW. it unites with Star Point ss. of Mesaverde group. Exposed in Panther Canyon, SE. of Castlegate, Carbon Co.

Panther Creek limestone member (of Ochelata formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

P. V. Roundy, K. C. Heald, and G. B. Richardson, 1922 (U. S. G. S. Bull. 686Z, p. 397, pl. LV). *Panther Creek ls.*—Either rests on Torpedo ss. or is separated from it by a thin sh. Is named for Panther Creek, in SW. part of T. 26 N., R. 12 E., where it is well exposed along valley rim to E. and to W. This ls. was called "Stanton (?) ls." in rept on T. 26 N., R. 11 E., but from evidence now at hand it appears to be considerably lower than true Stanton ls. of Kans. In some sections it attains a thickness of 14 ft. Usually the lower part is a rather siliceous impure ls. that weathers to orange color. The upper part is a purer and lighter-colored ls., in places almost white. The entire ls. contains abundant crinoid-stem segments and some other fossils. At top is a very fossiliferous bed, partly argill.

Panther Mountain shale and sandstone.

Middle Devonian: Eastern New York (Schoharie, Susquehanna, Cherry, and Unadilla Valleys).

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 544, 550). *Panther Mtn sh. and ss.* is suggested for an interval of rock having a slightly different age along its range from Schoharie Valley to Unadilla Valley. In Schoharie Valley this name is to include rocks btw. Otsego memb. below and Portland Point memb. above. It thus includes upper part of Marcellus and overlying Skaneateles and Ludlowville, which cannot be separated lithologically. For convenience it is suggested this name be used in Susquehanna and Cherry Valleys also, for interval btw. Solsville and Portland Point members, where the Pecksport and Mottville are lithologically indistinguishable, and Skaneateles and Ludlowville fms. cannot be separated on this basis. In Unadilla Valley the Mottville clearly defines base of the Skaneateles, but it is not possible to separate this fm. lithologically from the Ludlowville, and it is therefore proposed to use *Panther Mtn* in this valley also. This broad definition includes a succession of aren. shales, sss., and cross-bedded sss. In Schoharie Valley there are fingers of continental beds at several levels in the Panther Mtn. Estimated thicknesses of the Panther Mtn are: Susquehanna Valley, 830 ft.; Bear Gulch, 1,097 ft.; Schoharie Valley, 1,303 ft.; and Berne-Durham quads (where much of section is composed of red beds), 1,400 ft. Type section is in face of Panther Mtn along the "Towpath" about ½ mi. S. of Fultonham and up Panther Creek to its head, where the Portland Point is exposed on property of T. Wayman, 3½ mi. E. of Summit. Replaces Moheganter shales and sss. of Grabau. (See under *Moheganter*.)

Panuco gray limestone.

Upper Cretaceous: Northern Mexico.

E. A. Trager, 1926 (A. A. P. G. Bull., vol. 10, No. 7, pp. 679–681, 688). [Name applied to a very light-gray hard, dense, slightly sandy microcrystalline ls., 100 to 200 ft. thick (but absent in Boca del Abra region), forming middle memb. of his Lower San Felipe (=lower part of San Felipe fm.).]

Paoli limestone.

Mississippian: Southern Indiana and central northern Kentucky.

M. N. Elrod, 1899 (Ind. Acad. Sci. Proc. for 1898, pp. 258–267). *Paoli ls.*—Massive close-textured ls., slightly broken at top by beds of calc. sh. and near middle by included chert nodules; generally the groundmass is lithographic. Includes all rocks below first Kaskaskia ss. and above Lost River chert. On paleontologic ground assigned to St. Louis group. Thickness 60 to 90 ft.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 408, 506–507, 515). Elrod's *Paoli ls.* includes Ste. Genevieve ls. and Gasper oolite. It is proposed here to restrict name to the representative of lower Gasper in Ind. Extreme top of the Mitchell appears to be a memb. of Gasper oolite and is here called *Paoli ls.* It is lowest memb. of Chester series in Ind., and consists of compact oolitic ls. of dark-gray to nearly white color. Very fossiliferous in places. Overlies Fredonia oolite and underlies Mooretown ss.

Named for Paoli, Orange Co., Ind.

Paoli limestone.

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Iola ls.*]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 51–54). *Paoli ls.*, basal memb. of Iola ls. Underlies Muncie Creek sh. memb. Consists of single layer of very dense dark bluish-gray ls., very brittle, weathering in angular blocks. Upper surface highly irregular and pitted. Thickness uniformly 1½ ft. Named for Paoli, Miami Co., Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 114). *Paoli ls.*, basal memb. of Iola ls., is identified near Independence, southern Kans., and persists N. as far as the Iola is known.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Paonia shale member (of Mesaverde formation).

Upper Cretaceous: Central western Colorado (Delta County region).

W. T. Lee, 1909 (U. S. G. S. Bull. 341, pp. 20, 23). *Paonia sh. memb. of Mesaverde fm.*—Sh. (carbonaceous in places) and ss. with plant remains and fresh-water invertebrates. Thickness 400+ ft. Top is 2,000± ft. below top of Mesaverde fm. Rests conformably on Bowie sh. memb. of Mesaverde at E. end of Grand Mesa coal field, but is uncon. on older Rollins ss. memb. of the Mesaverde in central part of field. At W. end of field the Paonia is uncon. on Bowie sh. Named for Paonia, Delta Co.

Papagallos formation.

Cretaceous: Mexico.

E. T. Dumble, 1911 (Sci., n. s., vol. 33, p. 233).

This name has had considerable usage, but Trager states (A. A. P. G. Bull., vol. 10, No. 7, 1926, p. 681) it is now called "Mendez fm." by Tampico geologists, and that it is Upper Cret.

Papagayos formation.

Cretaceous: Mexico.

J. L. Tatum, 1931 (A. A. P. G. Bull., vol. 15, p. 875).

Papantla formation.

Miocene: Mexico (Vera Cruz).

H. E. Thalmann, 1935 (Eclogae geol. Helvetiae, vol. 28, No. 2, p. 545).

Papoose sand.

A subsurface sand, of Pocono (Miss.) age in SW. Pa. that is lower than Squaw sand and higher than Murrysville sand.

Papoose sand.

Name applied to an oil-bearing sand in Papoose oil field, Okfuskee and Hughes Counties, Okla. Top lies at depth ranging from 3,250 to 3,350 ft. Thickness 60 to 80+ ft. Has been correlated by some geologists with Wapanucka ls. (Penn.) and by other geologists with Pitkin ls. (Miss.), the former correlation being based on strat. position, the latter on fossils found in well samples. According to L. Roark, 1926 (Okla. Geol. Surv. Bull. 36), it is Miss., correlates with Pitkin ls., has been correlated with Cromwell sand and with Lyons-Quinn sand, and is main producing sand of Papoose field. According to A. I. Levorsen, 1927 (A. A. P. G. Bull., vol. 11, No. 7), Cromwell sand is older than Pitkin ls. According to A. I. Levorsen, 1928 (Okla. Geol. Surv. Bull. 40BB, pp. 17, 43), the Cromwell sand is basal sand of the Penn. J. P. Boyle, 1929 (Okla. Geol. Surv. Bull. 40KK), assigned both Cromwell and Papoose to basal Penn. (Morrow) horizon. According to J. P. Boyle, 1930 (Okla. Geol. Surv. Bull. 40XX), the *Papoose-Cromwell horizon* (200 to 400 ft. thick) is older than Wapanucka ls. and uncon. above Caney sh. to S. and Pitkin ls. to N. According to R. V. Hollingsworth (Geol. Soc. Am. Proc. 1933, p. 364, 1934) the Papoose, Cromwell, and Lyons-Quinn sands are same, and are middle memb. of Wapanucka ls. (early Penn.).

†Parachucla marl.

†Parachucla shale.

Miocene (lower): Southeastern Georgia and southwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 15–16, 18, names only, not defined); 1908 (S. C. Geol. Surv. ser. 4, Bull. 2, pp. 435, 464, 466). *Parachucla phase.*—This phase [of his Olig. period] is made to comprise a marl and its immediately overlying sh. The Parachucla marl has been definitely discriminated at two points—Porter's Landing [Ga.] and Marl Lake. It consists of approx. 5 ft. of a light-yellow porous marl which includes numerous discoidal quartz pebbles, and fossil shells (notably *Carolia floridana*). It rests on undulating surface of Combahee shales [a facies of Alum Bluff]. The Parachucla shales are exposed along W. bank of Savannah River interruptedly from Marl Lake to vicinity of Purysburg. It is well exhibited at Porter's Landing overlying the Parachucla shales [marls] and underlying the Mark's Head marl, on which is superimposed the Edisto phase of the marl. The Parachucla shales constitute an alumino-siliceous sh., more or less indurated by siliceous solutions, and slightly stratified; in color they range from dove to dark gray. The mass includes indurated portions with a concentric structure. No fossil forms sufficiently defined for discrimination have been observed.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). These beds are lower Mio. and compose part of Hawthorn fm. Names are abandoned.

Named for exposures along Savannah River in vicinity of Parachucla, a locality in SE. Ga.

Parachute Creek member (of Green River formation).

Eocene: Northeastern Utah (Uinta Basin) and northwestern Colorado (Garfield and Rio Blanco Counties).

W. H. Bradley, 1931 (U. S. G. S. P. P. 168). *Parachute Creek memb. of Green River fm.*—Contains most of the rich oil sh. beds of Green River fm. Thickness 175 to 1,000+ ft. Divided into: (1) Upper oil sh. group, 87 to 730 ft. thick, consisting of 29 to 38 percent of oil sh. and the rest slightly organic marlstone and paper sh., and including the "mahogany ledge," the principal oil sh. horizon of the Green River; (2) transitional beds, 43 to 118± ft. thick, consisting chiefly of marlstone, nearly barren of organic matter, weathering buff to gray, and, locally, some ls. and ss.; (3) lower oil sh. group, 45 to 200 ft. thick, chiefly hard platy marlstone with smaller amount of somewhat softer flaky sh. and a small amount of ls. Underlies Evacuation Creek memb. and overlies Garden Gulch memb. Reaches max. thickness, and probably also max. richness, in vicinity of Parachute Creek, Garfield Co., Colo., hence name.

Paradise conglomerate.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 295–298). *Paradise coarse cgls.*—The continuous exposures of the coarse cgls. forming E. side of Eastons Point terminate northward at Sachuest Beach. The same series farther N. forms Paradise Rocks.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped the rocks of the areas mentioned as Purgatory cgl.

†Paradise limestone.

Silurian (Niagaran): Northeastern Utah (northern Wasatch Mountains).

E. Blackwelder, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 517–542), in a paper on geol. of Wasatch Mtns, mentioned E. M. Kindle's identification of a ls., containing Sil. fossils, conformably underlying Jefferson ls., and in table on p. 519 he called this fm. *Paradise ls.*, but he did not describe it, nor give its thickness or type loc., and no geographic feature bearing that name is shown on his maps or mentioned in his paper. In 1913 G. B. Richardson applied *Laketown dol.* to the Sil. of northern Wasatch Mtns, and fully defined the fm.

F. F. Hintze, Jr., 1913 (N. Y. Acad. Sci. Annals, vol. 23, pp. 107–108). No name has yet come into general use for the Sil. strata of the northern Wasatch, as they have been little studied, but the one employed by Blackwelder, viz, *Paradise ls.*, might serve. In the central Wasatch this is apparently wanting altogether.

Same as Laketown dol., which was fully defined by G. B. Richardson in 1913.

Paradise formation.

Mississippian (upper): Southeastern Arizona (Chiricahua Mountains).

A. A. Stoyanow, 1926 (Am. Jour. Sci., 5th, vol. 12, pp. 316–320). *Paradise fm.*—A group of strata markedly different, both lithologically and paleontologically, from anything so far described from Carbf. of Ariz. Occurs on E. face of Chiricahua Mtns, not far from Paradise, an abandoned mining camp 45 mi. NE. of Bisbee and 10 mi. W. of N. Mex. line. Consists of black and gray moderately thick- and thin-bedded crystalline ls. that weathers olive and yellow, alternating with ss., sh., oolite, cross-bedded calc. ss., and aren. ls. Preponderant color of fm. is yellow. Thickness 134 ft. Fossils prove its upper Miss. age (late Meramec and early Chester). Underlies Naco ls. (Penn.) and overlies Escabrosa ls. (lower Miss.).

R. M. Hernon, Dec. 1935 (Jour. Pal., vol. 9, No. 8, pp. 653–694), divided Paradise fm. of Stoyanow into 8 lithologic members; gave detailed sections of the fm.; described, listed, and figured its fauna; and correlated its members with Miss.

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Valley, Ark., and Okla. fms. ranging in age from St. Louis(?) ls. up to Glen Dean ls. of Chester group.

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 509–511), gave very detailed section of his Paradise fm. and listed its fossils.

Paradox formation.

Pennsylvanian (lower): Southeastern Utah and western Colorado.

A. A. Baker, 1933 (U. S. G. S. Bull. 841). *Paradox fm.*—Salt, gyp., and anhydrite, with interbedded black and brown sh. and some ls. Exposed in a few small areas in Moab dist., Utah, where overlying rocks were relatively thin and have been ruptured by upward movement of the relatively plastic salt and gyp. Base not exposed. Type loc. is Paradox Valley, Montrose Co., SW. Colo. In Moab dist., Utah, it underlies Hermosa fm. (Penn.), but it may be=basal part of typical Hermosa fm. of SW. Colo. although its lithology is totally different from Hermosa lithology. Is believed to be younger than Molas ls. of SW. Colo.

This is an intrusive fm. Also described in U. S. G. S. Bull. 863, 1935, by C. H. Dane. Has been itentified in parts of western Colo. as far E. as central part of Eagle Co., according to J. B. Reeside, Jr. (personal communication, 1935).

Parian group.

Tertiary or Cretaceous: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trindad, pp. 33–60). [Divided into older group and newer group, and assigned to Tert.]

H. B. Milner, 1921 (Min. Mag., vol. 25, p. 144), assigned these deposits to Cret.

Paris formation.

Middle Ordovician: Central Kentucky.

J. M. Nickles, 1905 (Ky. Geol. Surv. Bull. 5, p. 15). [*Paris* used (in table only, without any description or thickness) for fm. in Lexington group underlying Perryville and overlying Wilmore of Lexington group.]

According to A. F. Foerste (Ky. Geol. Surv. Bull. 7, 1906) the Paris is 75 ft. thick and overlying Perryville is 0 to 35 ft. thick. According to Foerste, 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21), the Paris includes Benson, Brannon, and Bigby lss. of his classification.

Named for Paris, Bourbon Co.

†Paris shale.

Pennsylvanian (Allegheny): Western Arkansas coal field.

A. J. Collier, 1907 (U. S. G. S. Bull. 326, pp. 12, 20–21, map). *Paris sh.*—Sandy sh. with thin beds of shaly ss.; Paris coal 200 to 300 ft. above base and about 400 ft. below top. Thickness 600 to 700 ft. Underlies Savanna ss. and overlies Fort Smith fm. Top fm. of McAlester group.

Named for Paris, Logan Co.

This name has been discarded, as explained under *McAlester fm.*

Paris moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Parita formation.

Age (?): Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 263).

Park shale.

Middle Cambrian: Central northern Montana (Fort Benton quadrangle) and central southern Montana (Little Belt Mountains quadrangle and to west).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Park shales and ls. cgls.*, several hundred ft. thick, overlie Meagher ls. and underlie Pilgrim ls.; all included in Barker fm.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Park sh.*—Very thin-bedded soft, crumbly rock, often containing glistening grains of mica, mostly of greenish-gray color, but also showing various shades of red and purple. Overlies Meagher ls. and underlies Pilgrim ls.; all included in Barker fm. [Derivation of name not stated, but Barker fm. is mapped over large part of Belt Park, in NW. corner of Little Belt Mtns quad. and SW. corner of Fort Benton quad., and is also mapped on E. and W. sides of Big Park, same quad.]

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 286). Greater part of Camb. rocks seen in mtn area of Little Belt Mtns probably belong to *Park sh.* Lower strata are gray or greenish micaceous shales. Higher up these contain intercalated thin layers of impure lss., which often consist of flat ls. pebbles—a true intraformational cgl. Well exposed in road cuttings at head of Sheep Creek, in valleys of Dry Wolf, Pilgrim, and Tenderfoot Creeks, and near Barker. Estimated thickness 800 ft.

Park granite.

Tertiary: Southern British Columbia and central northern Washington (Okanogan batholith).

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). Very conspicuous on N. spurs of Park Mtn [B. C. or Wash.?].

Park sandstone.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 37). *Park ss.*—Sss., 300 ft. thick, underlying Heber lss. and overlying Argenta lss. Middle fm. of Aubreyan series in Utah. [Derivation of name not stated.]

Park City formation.

Permian and Pennsylvanian: Northeastern Utah (northern and central Wasatch Mountains).

J. M. Boutwell, 1907 (Jour. Geol., vol. 15, pp. 439–458). *Park City ls.* (also *Park City fm.*).—Largely calc., but includes several sss. and qtzites. In general it comprises a thick ls. in its lower part, several minor lss. in its upper part, and a number of thin calc. beds toward base, with intercalated qtzites and sss.; some cherty lss. in lower part. Thickness of fm. 590 ft. Conformably underlies Woodside sh. and conformably overlies Weber qtzite. Named for Park City dist., Utah, in recognition of fact that it has yielded the bonanzas that have made that dist. famous.

This name was later used in SW. Wyo. and SE. Idaho, but in 1912 the Perm. beds of SE. Idaho that represent the upper 2 members of typical Park City fm. of Park City dist., Utah, were named *Phosphoria fm.*, the underlying Penn. rocks were named *Wells fm.*, and the use of *Park City fm.* in SE. Idaho and adjacent parts of northern Utah was discontinued. Later the name *Park City fm.* was discontinued by U. S. Geol. Survey in SW. Wyo., where the rocks formerly designated by that name are now called *Phosphoria fm.* and *Wells fm.* (The Wells fm. includes the equiv. of the Penn. part of Park City fm. and the underlying Weber qtzite, also Penn.) *Phosphoria fm.* has been applied (by A. A. L. Mathews, 1931) to upper (Perm.) part of Park City fm. in its typical region, and *Park City fm.* to lower (Penn.) part, but this usage has not been adopted by U. S. Geol. Survey.

Parker slate.

Lower Cambrian: Northwestern Vermont (Franklin County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 371). *Parker sl.*—This fm. is named for its excellent exposures around the sides of Parker Cobble and on old Parker farm, where it contains large numbers of Lower Camb. fossils and is the celebrated locality from which Walcott was able to make his first analysis of Taconic system of Emmons and demonstrate the existence of beds older than Upper Camb. It has long been the most important Camb. fm. of region. It is the same as that previously called "*Colchester*" by writer, and is renamed because of the poor exposure of the fm. in Colchester and, indeed, anywhere S. of Parker Cobble, where a full section of fm. is exposed, together with overlying and underlying fms. It is uncon. overlain by Milton dol. and underlain by Mallett dol. [According to Keith (personal communication) Parker Cobble is 2 mi. NW. of Georgia Center, which would locate it in St. Albans quad.]

Parker formation.

Pennsylvanian: Southwestern Indiana (Knox County) and adjacent parts of Illinois.

M. M. Fidlar, 1933 (Ind. Acad. Sci. Proc., vol. 42, pp. 137, 139), gave following succession (downward order) of outcropping fms. in Knox Co., Ind., and adjacent parts of Ill.: *St. Wendell ss.*, 45 ft.; *Parker fm.* (underclay, coal, black sh., ls.), 20 ft.; Merom ss., 60 to 100 ft.; Ditney fm., 0 to 10 ft.; West Franklin fm., 15 ft. Derivation of new names *St. Wendell ss.* and *Parker fm.* not indicated.

Parker quartz diorite.

Late Jurassic (?): Southern California (San Gabriel Mountains).

W. J. Miller, 1934 (Univ. Calif. at Los Angeles, Pub. in Math. and Phys. Sci., vol. 1, No. 1, map, pp. 37–65, 83). *Parker quartz diorite.*—Typical occurrence in Parker Mtn, W. of Acton. Of different mineralogical composition from Lowe granodiorite and Wilson diorite, but may be a facies of the Lowe. Assigned to late Jurassic (?).

Parker Hill schist.

Pre-Devonian (?): Northwestern New Hampshire (Ammonoosuc River region).

F. H. Lahee, 1916 (Jour. Geol., vol. 24, pp. 366–381). *Parker Hill white schist* is taken as representative of the "tuff-like schists" of Lyman group. It is associated with *Parker Hill dark schist*, and is undoubtedly a metamorphosed clastic; it certainly was never a normal clastic in ordinary sense of term. Locally contains angular blocks and sometimes isolated pebbles. Grades into fine variety of Lyman cgl. schist, which is not younger than Dev. and may be older. Might be called an arkose schist, because of abundant clastic feldspar. I classify the rock as metamorphosed tuff.

Probably named for the Parker Hill in NW. corner of Moosilauke quad.

Parkhead sandstone member (of Jennings formation).

Upper Devonian: Northeastern West Virginia and western Maryland.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Parkhead ss. memb. of Jennings fm.*—Fine quartz cgl. and gray and red ss. interbedded with buff sh. Thickness 400 to 800 ft. Is a memb. in middle of Jennings fm. Contains Portage fossils. Underlain by thin band of dark-red sh. Named for exposures at Parkhead Station, Washington Co., Md.

Parkman sandstone member.

Upper Cretaceous: Northern Wyoming and southern Montana.

N. H. Darton, Nov. 17, 1906 (U. S. G. S. P. P. 51, pp. 13, 58, etc.). *Parkman ss.*—Soft massive buff ss. with harder darker concretions. Thickness 300 to 500 ft. Grades into overlying Piney fm. and rests on Pierre sh. Supposed to represent Fox Hills ss. Named for Parkman Station.

This name also appeared in the following other repts by Darton, published in 1906: Geol. Soc. Am. Bull., vol. 17, Dec. 31, 1906, p. 544; U. S. G. S. Bald Mtn-Dayton folio, No. 141, and Cloud Peak-Fort McKinney folio, No. 142. As thus originally defined the Parkman was treated as a distinct fm. Later it was treated as a memb. of Pierre fm. in Salt Creek and neighboring oil fields in Wyo. In 1917 it was treated as top memb. of Claggett fm. in N. part of Bighorn Basin. Later it was decided to treat it as a distinct fm. in Crow Indian Res., Mont., where it is overlain by Bearpaw sh. and underlain by Claggett sh. (See U. S. G. S. Bull. 856, 1935.) In central Wyo. the Parkman ss. is basal memb. of Mesaverde fm., as traced northward from Colo.

Named for exposures near Parkman, Sheridan Co., Wyo.

Parks Creek limestone. (In Pottsville formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307-316). *Parks Creek ls.*—Cap rock above Seville (No. 1) coal of Pottsville fm. in Fulton Co. Thickness 0 to 20 ft. There is erosional uncon. at top of this ls. in Fulton Co., and it is proposed to treat that uncon. as div. line btw. Carbondale and Pottsville fms. Fossils correspond closely with those of Curlew ls. of SE. Ill. [Derivation of name not stated, but is probably a creek in Fulton Co.]

Parks Mountain sandstone member (of Thrifty formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 410). *Parks Mtn bed.*—Massive ss. and cgl., 10 to 70 ft. thick. Memb. of Cisco div. Overlies Lohn bed and underlies Chaffin bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132), include this bed in Thrifty fm., of Cisco group.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, p. 232). Parks Mtn cgl. of Drake is a conglomeratic phase of Avis ss.

Wallace Lee and C. O. Nickell (Univ. Tex. Bull. soon to be published) adopted *Parks Mtn ss. memb. of Thrifty fm.* for Colorado River region, underlying Chaffin ls. memb. and overlying Lohn sh. memb., and adopted Avis ss. for basal memb. of Thrifty fm. of Brazos River region.

Named for Parks Mtn, Coleman Co., in Waldrip quad.

†Parkville limestone. (In Kansas City formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 51). *Parkville ls.*—Many bedded cherty fossiliferous ls. forming cap rock of coal No. 1.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 105), placed *†Parkville ls.* under synonymy of Cement City ls., but stated: Identifiable only by reference to localities cited. Appears to be erroneously placed in section or miscorrelated with other lss.

Named for exposures at Parkville, Platte Co.

†Parkville shale.

Pennsylvanian: Northwestern Missouri and southwestern Iowa.

C. R. Keyes, 1898 (Am. Geol., vol. 21, p. 349). *Parkville sh.*—Shales, 75 ft. thick, best exposed near station of Parkville, N. of Kansas City. Underlies Plattsburg ls. and overlies Iola ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 118). †Parkville sh. of Keyes included beds btw. top of Argentine ls. (his Iola) and base of Plattsburg ls.

Named for exposures at Parkville, Platte Co., Mo.

Parkwood formation.

Mississippian (upper 500 ft. may be Pennsylvanian): Northern Alabama.

C. Butts, 1910 (U. S. G. S. Bull. 400, pp. 15, 20; U. S. G. S. Birmingham folio, No. 175, p. 8). *Parkwood fm.*—Prevailingly gray or greenish sandy sh. and ss.; no calc. beds. Thickness, knife edge to 2,000 ft. Overlies Pennington sh. and uncon. underlies Brock coal bed, basal bed of Pottsville fm. in Cahaba coal field, northern central Ala. Occurs in Shades Valley. Its basal memb. is the ss. that makes Little Shades Mtn and Bald Ridge.

Is now considered by C. Butts (Ala. Geol. Surv. Spec. Rept. No. 14, 1926) to be=upper part of Pennington sh. of Tenn.; also to correspond to hiatus btw. the Pennington and the Pennsylvanian in northern Appalachian region.

Named for exposures at Parkwood, Jefferson Co.

Parma sandstone.

Pennsylvanian (Pottsville): Southern Michigan.

A. Winchell, 1861 (Mich. Geol. Surv. 1st Bien. Rept. Prog., pp. 112, 138). *Parma ss.*—White or slightly yellowish quartzose glistening ss. containing occasional traces of vegetable remains. Overlies the Carbf. ls. [Bayport ls.], and underlies Coal Measures [Saginaw fm.]. Thickness 24 to 105 ft. [Later repts give thickness 0 to 200 ft.]

Named for exposures at Parma, Jackson Co.

Parnell limestone.

A name applied locally (see Am. Inst. Min. and Met. Engrs. Trans., vol. 70, 1924, pp. 859–883, by R. N. Hunt; pp. 884–889, by A. N. Winchell; and pp. 908–926, by O. A. Peterson) to a ls., 30 to 50 ft. thick, in upper part of Bingham qtzite (Penn.) of Bingham dist., Utah. Lies 300 ft. below York-Petro ls. and 220 ft. above Bullard ls. Probably named for Parnell mine.

Parrish limestone lentil (of Cashaqua shale).

Upper Devonian: West-central New York.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, pp. 31–32). *Parrish ls.*—Singular concretionary ls., continuous in character, in a mass of red and greenish kramenzel abounding in goniatites and *Orthoceras*. Thickness 6 in. Named because it is distinctive in color, contents, and composition. Exposed in Parrish Gully at Parrish, Ontario Co. Is a lentil in Cashaqua sh. about 50 ft. below its top. [On map accompanying this rept. the town is spelled *Parish*, but the ls. has been consistently spelled *Parrish* in the literature.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 75). *Parrish ls.* is recognized from type section in Canandaigua Lake region to Seneca Lake.

Parrsboro formation.

Pennsylvanian: Nova Scotia.

H. C. Hyde, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 395) and 1915 (Summ. Rept. 1914, pp. 107–108).

Parson Bay group.

Triassic: British Columbia.

J. A. Bancroft, 1913 (Canada Geol. Surv. Mem. 23, p. 75).

Parsons formation. (In Pleasanton group.)

Pennsylvanian: Southeastern Kansas.

G. I. Adams, 1903 (U. S. G. S. Bull. 211, p. 33). *Parsons ls.*—In Iola quad. consists of 8 to 15 ft. of ls. underlying Dudley sh. and overlying Bandera sh. To S. thickens and consists of two lss. separated by 15 ft. of sh. [In Independence quad. the fm. is 80 ft. thick, the upper ls. being 20 ft. thick, the middle sh. 45 ft. thick, and the lower ls. (Altamont ls.) 15 ft. thick.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 64). Parsons fm. (discarded) included Altamont ls. at base and Lenapah ls. at top.

The U. S. Geol. Survey has not yet had occasion to consider abandonment of Parsons fm.

Named for Parsons, Labette Co.

Parting quartzite member (of Chaffee formation).

Upper Devonian: Leadville district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230), 1883 (U. S. G. S. Leadville Atlas), and 1886 (U. S. G. S. Mon. 12). A descriptive term applied to the white qtzite, 10 to 70 ft. thick, separating Blue [Leadville] ls. above from White ls. [Ord.] below.

In some repts has been treated as upper memb. of †Yule ls., but is now considered to be of Dev. age.

E. Kirk, 1931 (Am. Jour. Sci., 5th, vol. 22, pp. 228–229). *Chaffee fm.* introduced for the Dev. rocks of Colo. to N. and E. of areas (in SW. Colo.) where *Ouray ls.* and *Elbert fm.* have been applied. In Leadville dist. the Chaffee fm. includes Parting qtzite memb. and overlying lss. of Dev. age which have formerly been included in Leadville ls. The name Parting Spur has been applied to the spur extending NW. from Dyer Mtn toward West Dyer Mtn. It is in Lake Co. and E. of Leadville. The Parting qtzite is exposed on this spur.

The descriptive term *parting qtzite* has been applied to qtzites in other parts of Colo., without intending to imply correlation with the well-known Parting qtzite of Leadville dist.

Partridge slate.

Pre-Silurian (Upper Ordovician?): Northwestern New Hampshire (Ammonoosuc River region).

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55-56). *Partridge sl.*—Black sl., 0 to 2,000 ft. thick, of pre-Sil. (Upper Ord.?) age. Uncon. underlies Clough cgl. and overlies Ammonoosuc volcanics in Littleton and Moosilauke quads. [Appears to replace what he called *West Bath sl.* in his Feb. 1933 paper (Am. Jour. Sci., 5th, vol. 25, No. 146, p. 149).]

M. Billings, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 413-415), mapped *Partridge sl.* at and around Partridge Lake, Littleton quad., and other parts of Littleton and Moosilauke quads.

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps and pp. 12, 21). *Partridge fm.* is proposed for a group of black slates that overlie Ammonoosuc volcanics and underlie Clough and Fitch fms. Named for Partridge Lake, Littleton Twp. The fm. is largely sl., although locally somewhat sandy. Lower 25 ft. in some places consists of interbedded black sl. and fine-grained light-colored qtzite, in beds ¼ to 1 inch thick, and in other places this basal memb. has thin beds of schistose soda-rhyolite tuff similar to those in Ammonoosuc volcanics. Believed to be Upper Ord.

Partridge Point formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524-526). *Partridge Point fm.*—Gray and bluish argill. lss. and gray calc. shales, containing many crinoids and blastoids. Thickness exposed, 14 ft. Separated from overlying Squaw Bay ls. by 3-ft. covered interval and from underlying Potter Farm fm. by covered interval of 70 ft. Is top fm. of Thunder Bay stage of Traverse group. Type loc., E. shore of Partridge Point, 3 mi. S. of Alpena.

Pasadena formation.

Miocene: Southern California (San Gabriel Mountains).

R. Arnold and A. M. Strong, 1905 (Geol. Soc. Am. Bull., vol. 16, p. 188). *Pasadena fm.*—A conformable series of cgls., sss., and shales of either lower or middle Mio. age. Flanks San Rafael Hills on S. and underlies S. part of city of Pasadena. The cgls. rest on and are composed of the San Gabriel plutonic and metamorphic rocks.

Pasayten formation.

Cretaceous (Lower): Central northern Washington.

G. O. Smith and F. C. Calkins, 1904 (U. S. G. S. Bull. 235). *Pasayten fm.*—Proposed as a substitute for *Similkameen fm.* of Russell (Cret.), which is preoccupied. *Consists of sed. rocks without contemp. volcanic material.* East of main fork of Pasayten River ss. appears to be dominant rock. Most instructive exposures are along main divide N. of Barron, where fm. consists of (ascending): (1) At least 1,000 ft. of black sh. exposed along crest of Hozomeen Range; (2) sandy cgl. with pebbles from 1 to 8 in. diam., 500 ft. exposed; (3) ss.; (4) black sh. Thickness of fm. 6,000± ft. It contains a few thin and discontinuous beds of ls. Assigned to Lower Cret.

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329-376). *Pasayten Lower Cret. beds* are 30,000 ft. thick btw. Pasayten and Skagit Rivers. In part composed of debris from the granodiorites.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 14, 120° 30′ to 121°), mapped *Pasayten series* (*Shasta-Chico*), as consisting of (downward): Memb. L (black argillite); memb. K (green and gray ss. with interbeds of sh. and cgl.); memb. J (coarse cgl.); and members B to I, crossed by Pasayten River (chiefly arkose and ss., with cgl. and sh.). He also mapped *Pasayten volcanic fm.* (*Lower Cret.*), consisting of andesitic breccia, crossed by Pasayten River. This volcanic fm. apparently was not included in Pasayten fm. of Smith and Calkins. In 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 479-506) R. A. Daly used *Pasayten volcanic fm. or memb. A of Pasayten series*, and stated that it occurs in only one part of Bdy belt, on densely thicketed slopes of Pasayten River Valley.

Pasayten volcanic formation.

See 1912 entry under *Pasayten fm.*

Pasayten andesite.

Lower Cretaceous: Southern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 14, 120° 30′ to 121°). *Pasayten volcanic fm.*—Andesitic breccia; Lower Cret. [Pasayten River, B. C.-Wash., crosses this mass.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 474). *Pasayten andesite*, Cret., Wash. and B. C.

Pascagoula clay.

Miocene (upper): Mississippi, southwestern Alabama, and Louisiana.

W J McGee, 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, p. 409). Name selected by L. C. Johnson. In SE. Miss., particularly along Pascagoula River, Johnson has brought to light a series of deposits resembling somewhat in material the typical Grand Gulf fm., though the bedding is more definite, and alternating layers of sand and clay partially replace the prevailing mudstones. The series appears to correspond in strat. position either with upper part or with whole of the Grand Gulf, and carries a moderately abundant fauna of rather recent (apparently late Neocene) aspect, which has not yet been studied in detail. Pending determination of precise relations, [L. C.] Johnson has designated this series of deposits *Pascagoula fm.* Still farther eastward the deposits characteristic of the Pascagoula Basin disappear, but whether by feathering out or by gradual transition has not been ascertained. [As thus defined probably included Hattiesburg and Pascagoula clays of current nomenclature, although Hattiesburg clay is not developed along Pascagoula River, but occurs a short distance N. of that river.]

E. A. Smith, 1892 (Sketch of geology of Ala., Birmingham, Ala., Roberts & Son, pam. of 36 pp.). Among materials brought up by an artesian boring in Mobile recently are some shells that have been recognized as characteristic of the Mio. Inasmuch as no marine shells have as yet been found in Grand Gulf beds, it seems best to give a distinct name to this Mobile shell-bearing stratum. A fossiliferous stratum with the same shells as those from the Mobile boring has lately been discovered by L. C. Johnson, of U. S. Geol. Survey, on Pascagoula River, in Miss. This bed lies immediately over strata of undoubted Grand Gulf characters, and may be a marine phase of the Grand Gulf but withal so entirely different from the other beds of this fm. as to be worthy of a name of its own, and Mr. Johnson has suggested *Pascagoula*, from the original locality. Mr. Johnson has also recently traced the Mio. fossiliferous deposits of Alum Bluff, on Chattahoochee River, Fla., westward and northward to within a few mi. of S. bdy of Covington Co. It seems altogether probable this phase of the Mio. will be found to extend into Ala., and it may turn out to be identical with our Pascagoula, as above defined. [The Alum Bluff group is now known to be older than Pascagoula clay, and to be of middle and lower Mio. age.]

L. C. Johnson, 1893 (Sci., vol. 21, pp. 90-91). A fourth phase of the Mio. or Grand Gulf group manifests itself below Leakesville on the Chickasawhay, on Lower Leaf River and Pascagoula, being clays of a more tenacious quality, abounding in specks and nodules of calc. material, and in a few places holding shells of mollusks. One locality of the last, where first discovered, is the Shell Landing below Roberts Bluff, 4 mi. SW. of Vernal P. O. This is the *Pascagoula phase or fm.* It extends into Ala. in wells, being reached at 600 ft. in Mobile wells. [Appears to consider Pascagoula younger than Hattiesburg clay.]

W. H. Dall, 1903 (Wagner Free Inst. Sci. Phila. Trans., vol. 3, pt. 6, pp. 1541-1620), definitely classified Pascagoula clay as younger than Hattiesburg clay.

G. C. Matson, 1916 (U. S. G. S. P. P. 98). *Pascagoula clay*, in part marine, uncon. underlies Citronelle fm. (Plio.) and uncon. overlies Hattiesburg clay. Consists of a series of blue, green, and gray clays, locally calc., with interbedded sands and, more rarely, sss. Thickness 250 ft. in Ala., 450 ft. in western Miss. and eastern La., and 250 or 300 ft. in western La. and eastern Tex. Pascagoula clay as here used differs from Johnson's Pascagoula phase or fm. by including the portion of his Fort Adams or Ellisville phase extending from Tunica, La., to Columbia, Miss.

Type loc. is, however, the same, and the difference is largely due to a more thorough understanding of distribution of fm. [This is present approved definition, except that the use of the name in Tex. has been discontinued.]

Named for exposures along Pascagoula River, in Jackson Co., Miss.

Paskapoo formation.

Upper Cretaceous and Eocene (?): Alberta and Saskatchewan, Canada.

J. B. Tyrrell, 1887 (Canada Geol. Surv., n. s., vol. 2, pp. 74E, 84E, 127E, 135E–137E). *Paskapoo series.*

Some Canadian geologists assign this fm. to Tert., others to Cret. It is considered=Lance fm. or Lance and Fort Union fms. of Mont.

†Paskenta formation.

Lower Cretaceous (Shasta series): Northern California (Tehama County).

F. M. Anderson, 1902 (Calif. Acad. Sci. Proc., 3d ser., Geol., vol. 2, No. 1, pp. 43–47). *Knoxville (Paskenta) horizon, the true Knoxville.*—The 4,000 ft. of dark or yellowish Cret. clay sh. forming upper part of Knoxville of previous repts contains a typical subtropical fauna with abundant *Aucella*, which are apparently confined to this interval. The underlying 15,000 ft. of beds heretofore included in the Knoxville are probably pre-Cret., and for lack of better name are here designated *sub-Knoxville*. Few organic remains other than *Aucella* have been obtained from these beds. It is not yet possible to say where exact limits btw. this sub-Knoxville and the Knoxville horizon may be drawn, and it may not be possible to establish one more than theoretically in Tehama and Shasta Counties. But there appears to be sufficient evidence that the Knoxville as here restricted was inaugurated by some profound movements felt elsewhere if not in this basin. The sub-Knoxville has not yet been clearly recognized outside of Sacramento Valley, either in Calif. or Oreg. Nearly if not quite all occurrences of *Aucella*-bearing rocks in Coast Ranges have shown themselves by their fossil remains other than *Aucella* to belong wholly to Knoxville (Paskenta) horizon. The true Knoxville rests conformably on the sub-Knoxville, and the latter rests uncon. on Franciscan series. The Paskenta horizon is especially well represented in vicinity of Paskenta, Tehama Co.

J. P. Smith, 1909 (Sci., n. s., vol. 30, pp. 346–351), divided *Knoxville fm.* into Upper Knoxville beds (Neocomian) and Lower Knoxville beds (Portland and Aquilonian).

F. H. Knowlton, 1910 (Am. Jour. Sci., 4th, vol. 30, pp. 33–64), expressed opinion, based on fossil plants, that most of *Knoxville fm.* is Jurassic.

J. P. Smith, 1910 (Jour. Geol., vol. 18, No. 3, pp. 217, 220), 1915 (Nature and sci. on Pacific coast, Elder & Co., p. 51) and 1916 (Calif. State Min. Bur. Bull. 72), treated the Knoxville as a unit and assigned it to Lower Cret. (Neocomian).

The name *Knoxville fm.* continued to be applied to all beds btw. Horsetown fm. above and Franciscan fm. below. In 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770) B. L. Clark called attention to Anderson's name *Paskenta* for the upper part of Knoxville and restriction of *Knoxville* to lower part of the Knoxville of previous repts, and stated: "Although use of *Paskenta* has not been generally recognized, yet in writer's opinion this horizon is very important. Several paleontologists, including J. P. Smith and F. H. Knowlton, have held that line btw. lower and upper Knoxville is true line btw. Jurassic and Cret. But this is a debatable point. Over large areas, owing to lack of detailed work, *Knoxville* and *Paskenta* have not been differentiated, and in such cases the undiff. series has been called *Knoxville*."

F. M. Anderson, 1932 (Min. in Calif., vol. 28, Nos. 3 and 4, pp. 313–323), included *Paskenta beds* in Shasta group, gave their geographic distribution, assigned them to Valangian and Infravalangian of European classification, and gave their thickness as 4,880 ft. "Overlie Knoxville group [restricted] and underlie Horsetown beds."

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, pp. 79–122), described and mapped the rocks of part of northern Calif., and applied *Paskenta fm.* to upper part of Knoxville of the literature and restricted *Knoxville fm.* to lower part of Knoxville. He stated that neither base nor top of Paskenta fm. (Lower Cret.) has been determined in this region, although F. M. Anderson stated [see Pan-Am. Geol., vol. 60, No. 3, pp. 175–188, 1933] that there is a conspicuous uncon. btw. Paskenta and underlying Knoxville [restricted], which latter he assigned to Upper Jurassic.

F. M. Anderson, 1933 (Min. in Calif., vol. 28, Nos. 3 and 4, pp. 311–326), assigned his *Paskenta beds* to Valangian and Infravalangian of Lower Cret. European classification, gave their thickness as 4,880 ft., and discussed their geographic distribution and probable relations to underlying *Knoxville group*, as he would restrict it. He gave thickness of his restricted Knoxville as 14,280 to 16,000 ft., and assigned it to the Aquilonian and Portlandian of Upper Jurassic of European classification.

N. E. A. Hinds, 1934 (Am. Jour. Sci., 5th, vol. 27, p. 185), recognized Horsetown and *Paskenta fms.* (Lower Cret.) and *Knoxville fm.* (?) (Upper Jurassic).

These proposed modifications of terminology have not yet been adopted by U. S. Geol. Survey.

Paskenta horizon.

See 1st entry under *Paskenta fm.*

Paso Robles formation.

Pliocene and lower Pleistocene (?): Western California (San Luis Obispo County and neighboring areas).

H. W. Fairbanks, 1898 (Jour. Geol., vol. 6, pp. 565–566). *Paso Robles fm.*—Fresh-water cgls. and sandy and marly clays, usually slightly consolidated. Overlap uncon. upon upturned and sharply folded San Pablo fm. Fill Salinas Valley as far up as Atascadero. Are characteristically exposed about town of Paso Robles [San Luis Obispo Co.], from where they extend W. toward Santa Lucia Mtns and for many miles N. and E. of that place, filling valley of the Estrella and its tributaries, and may reach into the Great Valley. Are of later Neocene age.

Paspotansa greensand marl member (of Aquia formation).

Eocene: Eastern Maryland and Virginia.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Paspotansa memb. or substage.*—Upper 10 to 17 ft. consists of thick-bedded layers and interstratified greensand marl; lower 30 ft. consists of light greenish-gray greensand. Top memb. of Aquia fm. Overlies and is faunally separable from Piscataway memb. or substage. Named for Paspotansa Creek, Va.

B. L. Miller, 1912 (U. S. G. S. Choptank folio, No. 182). *Paspotansa greensand marl memb.*—Top memb. of Aquia fm. Overlies Piscataway indurated marl memb.

Patapsco formation. (In Potomac group.)

Lower Cretaceous: Eastern Maryland, Delaware, and Virginia.

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 156, 191). *Patapsco fm.*—Chiefly highly colored and variegated clays which grade over into lighter-colored sandy clays. Sandy bands of coarser materials are at times interstratified. The sands frequently contain much decomposed feldspar and rounded lumps of clay occur at times. The sands are often cross-bedded, and all deposits give evidence of shallow-water origin. Thickness 200± ft. Rich Cret. flora. Uncon. underlies Raritan fm. and uncon. overlies Arundel fm., all included in Potomac group. Named for occurrence in valley of Patapsco River.

The Raritan fm. has been proved to be of Upper Cret. age, and is no longer included in Potomac group. The Patapsco fm. is therefore now topmost fm. of Potomac group.

Patara schist (also Patara series).

Pre-Cambrian: Ontario (Abram Lake region).

F. J. Pettijohn, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 3, pp. 481–483). [On p. 481: *Patara series*, 0 to 2,500 ft. of cgl., breccia, and sed. schists, of pre-Abram age, included in Keewatin, but "in part post-Keewatin." On pp. 482–483 these rocks are called *Patara schists*, from Patara Lake.]

F. J. Pettijohn, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 12, pp. 1895, 1896, map, etc.). *Patara sedi-volcanics*, 1,250 to 1,500 ft. thick.

Patillas quartz monzonite.

Age (?): Puerto Rico.

C. R. Fettke, 1924 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 2, p. 161).

Pato red member (of Vaqueros formation).

Miocene (lower): Southern California (Cuyama Valley).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215). *Pato red memb.*—Gray and red clay sh. and ss., 1,300 ft. thick, forming basal memb. of Vaqueros fm. Upper 500 ft. are of brilliant crimson color and composed of material eroded from adjacent land at time the red beds were being deposited. Conformably below these bright-red beds is about 800 ft. of gray and red clay, which forms lower part of memb. The Pato memb is overlain, in places uncon., by massive white ss. of the Vaqueros. Rests with marked uncon. on pre-Monterey sh. Named for exposures in Pato Canyon, Cuyama Valley.

According to W. S. W. Kew (Calif. Univ. Pub., Dept. Geol. Bull., vol. 12, pp. 1–21, 1919) the *Pato red memb.* is older than true Vaqueros and corresponds to Sespe fm., of Olig. and upper Eo. age.

Patoot beds.

A name long in use for Upper Cret. rocks in Greenland that overlie Atane beds (also Upper Cret.).

Patrician drift.

A name that has been applied to red drift of Patricia ice sheet of Wisconsin stage of Pleist. in Patricia dist., Canada.

Patrick greenstone.

Cretaceous (?): Northwestern California (Del Norte County).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, p. 134 and map). *Patrick greenstone.*—Fine-grained intrusive diorites and andesites containing green hornblende and sodic plagioclase with smaller amounts of sericite and pyrite. Intrudes Siskiyou granodiorite (Jurassic). Is believed to be of Cret. age. [Map shows Patrick Creek cutting across this fm.]

Patriot limestone. (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio.

D. D. Condit, 1909 (Ohio Nat., vol. 9, p. 484). *Patriot ls.*—Thin, nodular, fossiliferous ls., 6 to 18 inches thick, separated from underlying Patriot coal by 3 ft. of black sh.

Probably named for Patriot, Gallia Co.

Patsy gas sand.

A subsurface sand, of Perm. age, 10± ft. thick, in central southern Okla., which is correlated with a part of Wichita fm.

Patterson limestone member (of Shady dolomite).

Lower Cambrian: Southwestern Virginia (Wythe County region).

C. Butts, 1933 (Va. Geol. Surv. Bull. 42, p. 3 and columnar section on geol. map of Appalachian Valley of Va.). Shady dol. is almost wholly dol., much like the Tomstown, but has rather more of the coarse light-gray rock (saccharoidal memb.) and in basal part considerable ls. (*Patterson ls. memb.*) that varies much in thickness and distribution. At the top in vicinity of Ivanhoe, Wythe Co., is a thick ls. (*Ivanhoe ls. memb.*).

L. W. Currier, 1935 (Va. Geol. Surv. Bull. 43). *Patterson ls. memb.*—Chiefly dark-gray dense ls. and dol., both with characteristic type of "ribbon" structure; ribbon ls. and dol. mutually gradational in all directions. At base transition beds of dark-gray sandy dol. or of light-gray crystalline dol. Thickness 700 to 800± ft. Basal memb. of Shady dol. in SW. Va. lead and zinc region. Rests conformably on Erwin qtzite. Grades into overlying saccharoidal dol. memb. of Shady dol. Named by C. Butts, for extensive exposure at Patterson, Wythe Co., where 100± ft. of it is exposed in bluff on W. side of Little Reed Island Creek.

Patterson sand.

A subsurface sand, of Upper Cret. age, in Greasewood field, Weld Co., NE. Colo. Tentatively correlated with Muddy sand of drillers.

Patton shale member (of Pocono formation).

Mississippian: Western Pennsylvania.

M. R. Campbell, 1904 (U. S. G. S. Latrobe folio, No. 110). *Patton sh. memb. of Pocono ss.*—Red or green sh., 0 to 80 ft. thick, not known in outcrop in this quad., but believed to correspond to a bed of red sh. cropping out on Redbank Creek, at Patton, near W. line of Jefferson Co. It is first bed of red material below top of Pocono ss., lying 350 to 500 ft. below top of that ss. Carries Pocono flora.

C. Butts, 1904 (U. S. G. S. Kittanning folio, No. 115), introduced *Burgoon ss.* for the massive sss. of Pocono fm. that overlie Patton sh. memb.

Patton limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450, 480). *Patton ls.*—Shaly and sandy at top, but in middle and lower portions it is hard and blue, weathering gray with occasional nodules of black chert. Scattered marine fossils; plants in middle. Thickness 100 to 275 ft. Underlies Lower Taggard sh. and overlies Patton sh.; all members of Greenbrier series [ls.]. Type loc. on S. side of Second Creek, just S. of Patton, Monroe Co. Also observed in Mercer Co., W. Va. Present in Giles Co., Va., and increases in thickness to SW. until it reaches 475 ft. in Washington Co., Va. Recognized as far N. as head of Greenbrier River, Pocahontas Co., W. Va.

Patton shale. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450, 483). *Patton sh.*—Gray and highly calc.; abundant plants, also marine fossils; 10 to 25 ft. thick. Underlies Patton ls. and overlies Sinks Grove ls.; all members of Greenbrier series [ls.]. Named for association with Patton ls., but was not observed at type loc. of latter. Type loc. may be considered as in Monroe Co., NE. of Union, along Pickaway-Hillsdale road 0.8 mi. SE. of Pickaway, where it is 25 ft. thick and consists partly of yellow shaly ls. and partly of calc. sh. Also observed in Giles Co., Va., and as far to SW. as Washington Co., Va., where it is 180 ft. thick.

Patuxent formation. (In Potomac group.)

Lower Cretaceous: Eastern Maryland, Delaware, and Virginia.

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 156, 190). *Patuxent fm.*—Mainly sand, sometimes quite pure and gritty, but generally containing considerable kaolinized feldspar, producing a clearly defined arkose. Clay lumps in considerable numbers are scattered through the aren. beds. The sands frequently pass over gradually into sandy clays, and these into argill. materials, commonly of light color, but often highly colored and locally not unlike the variegated clays of Patapsco fm. The more aren. deposits were cross-bedded, and whole fm. gives evidence of shallow-water origin. Underlies Arundel fm. and overlies crystalline rocks of Piedmont Plateau. Named for development in upper valleys of Little and Big Patuxent Rivers.

Paulian till.

A term that has been applied to a till sheet of early Wisconsin age "having its ground moraine in central Minn. down to the vicinity of St. Paul." (See C. [R.] Keyes, Pan-Am. Geol., vol. 58, pp. 203, 217, 1932, and vol. 60, p. 55, 1933.)

Paupack sandstone. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania (Wayne and Pike Counties).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 59, 68, 169, 170, 199, 200). *Paupack ss.*—Greenish-gray or sometimes bluish-green serpentinelike rock, 25 ft.

thick, in layers 4 to 8 in. thick. Quarried extensively. Named for Paupack Falls, on Wallenpaupack Creek, Palmyra Twp, Pike Co. Underlies Montrose red sh. and overlies Paupack shales.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 94, 99–101). In Pike and Monroe Counties the *Paupack ss.* cannot be differentiated but forms a part of *Delaware River flags*, which underlie Montrose red sh. and rest on New Milford red sh. [See under *Delaware River flags*.]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 585–587), retained *Paupack ss.* for upper memb. of his Shohola fm., and replaced White's Paupack shales with *Barryville memb.*, the lower memb. of his *Shohola fm.* He stated: Paupack ss. is wholly or partly post-Chemung and—part or all of the New Milford.

Paupack shales. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania (Wayne and Pike Counties).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 68). About 200 ft. of greenish-gray current-bedded sss. interstratified with green, olive, and occasionally red shales, underlie Paupack quarry rock and spread throughout the dist. in a manner so uncharacteristic that I hesitate to propose a name for them. [In table on p. 59 he applied *Paupack shales, red and green, and ss.* to the 200 ft. of beds underlying his Paupack ss. and overlying his New Milford group.]

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 94, 99–101). [See quotation under *Delaware River flags*.]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 586). *Barryville memb. of Shohola fm.* is introduced for the 200 ft. of red and green sss. and shales underlying Paupack ss. and which White described as "so uncharacteristic that I hesitate to propose a name for them."

Pawhuska limestone. (In southern part of area **Pawhuska formation.**)

Pennsylvanian: Northeastern and central northern Oklahoma.

J. P. Smith, 1894 (Jour. Geol., vol. 2, p. 199). *Pawhuski ls.*—Massive fossiliferous ls., 100 ft. thick, in Upper Coal Measures. Overlies heavy-bedded sss. and caps hills 3 mi. NW. of Pawhuski [Osage Co.].

G. I. Adams, 1903 (U. S. G. S. Bull. 211, pp. 61–65). *Pawhuska ls.* of Smith consists of 3 distinct members. It is possible they are—Lecompton, Deer Creek, and Hartford fms.

L. C. Snider, 1911 (Okla. Geol. Surv. Bull. 7, pp. 208–226). *Pawhuski ls.*, 165 ft. thick, overlies Elgin ss. and is basal fm. of Ralston group.

K. C. Heald, 1918 (U. S. G. S. Bull. 691C). *Pawhuska ls.*—A series of ls. beds separated by sh., with some associated lenses of ss. It rests on Elgin ss., and consists of (descending): (1) Ls. ("red lime"), 7 to 10± ft.; (2) sh. with in places ss. and a thin ls., 20 ft.; (3) a succession of light-gray lss. and shales with lenses of ss., 100 to 123 ft.; (4) red sh. which probably corresponds to Tecumseh sh. of Kans.; (5) Lecompton ls. memb., 6 to 14 ft.; (6) sh. and thin red ss., 20 to 35 ft. Is overlain by a series of sss.

L. C. Snider, 1920 (Oil and gas in Midcontinent fields, pp. 78–84). *Pawhuska ls.*, 130 to 180 ft. thick, rests on Elgin ss. It consists of lss. with intervening shales and some ss. lenses. The ls. at Pawhuska is about midway of the series.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 78). *Pawhuska fm.*—Consists of 3 beds of heavy gray lss. with intervening shales; ss. and sh. constitute large part of fm. near S. end of its exposure. Thickness varies up to 180 ft. Includes all beds btw. Elgin ss. below and Buck Creek fm. above.

The top of the "red lime," or its approx. equiv. where the "red lime" is not identifiable, is top of Pawhuska fm. This div. line lies from 46 to 66 ft. below Turkey Run ls. memb. of Buck Creek fm. (See U. S. G. S. Bull. 686 (M and R), 1919.)

The town for which this fm. was named is now spelled *Pawhuska*.

Pawhuska sand.

A subsurface sand, of Penn. age, in central northern Okla. that is correlated with upper part of Cherokee sh.

Pawhuska lime.

A subsurface ls. bed, 10 to 40 ft. thick, lying in midst of Pawhuska fm. of central northern Okla.

Pawhuska series.

Pennsylvanian: Northeastern Oklahoma.

D. A. McGee and W. W. Clawson, Jr., 1932 (A. A. P. G. Bull., vol. 16, No. 10). "Pawhuska" is field name for a very prominent and persistent series of beds that occur at approx. 3,200 ft. depth in Oklahoma City oil field, NE. Okla. Overlies Hoover sand and lies 930 ft. below Neva ls. Consists of (descending): (1) Massive white to gray finely crystalline ls., 30 ft.; (2) gray bedded sh. with a 20-foot sand near top and thin ls. and ss. stringers in basal part, 110 ft.; (3) ls. like No. 1, 70 ft.; (4) gray bedded sh., 30 ft.; (5) medium- to coarse-grained angular sand with white angular chert fragments, 70 ft.; (6) ls. like No. 1, 45 ft.; (7) gray bedded sh., 60 ft.; (8) sand and chert cgl. at base.

Pawhuski limestone.

See *Pawhuska ls.*, present spelling of town in Okla. for which the ls. was named.

Pawling gneiss.

Pre-Cambrian: Southeastern New York.

T. N. Dale and L. M. Prindle, 1904 (N. Y. State Mus. 23d Ann. Rept., map; text is by F. J. H. Merrill). *Pawling gneiss (pre-Camb.)*.—[Mapped over part of Pawling Twp. Dutchess Co., but not near village of Pawling. The rept. is on Beekman and Pawling Twps of Dutchess Co. The text description, by F. J. H. Merrill, does not mention Pawling gneiss, but describes the *Precambrian gneiss* as "a great formation of banded gneiss, cut and injected at many points by later eruptives," and as extending from N. Y. City northward through Dutchess Co. and into Conn.]

Pawling limestone.

See under †*Poughquag ls.*, where is cited only record of name.

Pawnee limestone. (Distinct formation in Kansas and Oklahoma.)
Pawnee limestone member (of Henrietta formation) in Missouri.

Pennsylvanian: Northwestern Missouri, eastern Kansas, and northeastern Oklahoma.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 24). *Pawnee ls.*—Heavy-bedded porous and compact coarse and fine drab, brown, and bluish-gray cherty, concretionary, and mottled fossiliferous ls., 20 to 25 ft. thick, forming bed No. 203 of geol. section of eastern Kans. and top memb. of Pawnee ls. series. Overlain by Marais des Cygnes coal series. [This is Pawnee ls. of current classification.]

The generally accepted definition treats Pawnee ls. as top memb. of Henrietta fm. in Mo., overlying Labette sh. memb. and underlying Bandera sh. memb. of Pleasanton fm. In Kans. the Henrietta is treated as a group by U. S. Geol. Survey and the Pawnee ls. as a fm. In Okla. also the Pawnee ls. is treated as a distinct fm. The Kans. Geol. Surv. has recently abandoned Henrietta fm. and now treats Pawnee ls. as a fm. in its Marmaton group. (See R. C. Moore, Kans. Geol. Surv. Bull. 22, 1936.) This changed classification has not been considered by U. S. Geol. Survey for its publications.

Named for exposures on Pawnee Creek, near village of Pawnee, Bourbon Co., Kans.

†Pawnee limestone series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., pp. 24–25). *Pawnee ls. series*.—Series of fossiliferous lss., sl., and shales, 112½ ft. thick, including beds 203 to 211, inclusive, of geol. section of eastern Kans. Underlies Marais des Cygnes coal series, overlies Fort Scott ls., and includes Pawnee ls. as its top memb.

Includes Pawnee ls. and Labette sh.

Probably named for its top memb., the Pawnee ls.

Pawnee limestone.

Pennsylvanian (?): Central northern Oklahoma (Pawnee County).

N. F. Drake, 1897 (Am. Phil. Soc. Proc., vol. 36, pp. 326–387). *Pawnee ls.*, 2 to 4 ft. thick, included in Perm. Separated from underlying Pawhuska ls. by 100 ft. of gray clay sh. Named for Pawnee, Pawnee Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 62). Pawnee ls. of Drake probably corresponds to Foraker ls. of present classification.

†Pawnee Creek beds.

Miocene (middle) and lower Pliocene: Northeastern Colorado.

W. D. Matthew, 1900 (Am. Mus. Nat. Hist. Bull., vol. 12, pp. 24–25). *Pawnee Creek beds* would be a better geographic name for lower horizon (*Cyclopidus* beds) of Loup Fork in Colo.

W. D. Matthew, 1901 (Am. Mus. Nat. Hist. Mem., vol. 1, pt. 7, pp. 355–374, 444). *Pawnee Creek beds.*—Upper beds are clearer and coarser sand, sometimes hardly consolidated and sometimes consisting of coarse cross-bedded gray sss.; lower beds are fine muddy sand, semiconsolidated, with sometimes one or more layers of coarse shingle; in places a shingle layer separates upper beds from lower beds. Uncon. overlies White River fm.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 114). *Pawnee Creek beds* belong to middle Mio. *Ticholeptus* zone.

H. F. Osborn 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, p. 19). *Pawnee Creek series* appears to include 2 levels. The "Upper Pawnee Creek" occurs at Sand Canyon, also at localities W. of Grover, Colo. It belongs to *Protohippus-Hipparion* zone (Lower Plio.). The typical "Pawnee Creek" is true *Meryohippus* zone (upper Middle Mio.).

Named for Pawnee Creek, Logan and Weld Counties.

Pawpaw sandy member (of Denison formation).

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 302, 303, 328–335). *Pawpaw shales or clays.*—Fossiliferous light-drab, very thinly laminated clays, inseparable from Quarry ls. (in top of underlying North Denison sands). Overlain by Main Street ls. [broad sense], top memb. of Denison beds.

R. T. Hill, 1901. (See under *Weno clay memb.*)

The so-called "Quarry ls." mentioned above is treated by U. S. Geol. Survey as basal bed of Pawpaw memb., which rests on Weno clay memb. and is overlain by Main Street ls. memb. of the Denison. (See L. W. Stephenson, U. S. G. S. P. P. 120H, 1918.) This is definition followed by Tex. Geol. Surv. (See Univ. Tex. Bull. 3232, 1933, p. 375.)

Named for Pawpaw Creek, in southern and eastern part of Denison, Grayson Co., Tex.

Pawtucket shale.

Pennsylvanian: Eastern Rhode Island (Providence County).

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 159–164). *Pawtucket shales.*—Chiefly coal-bearing shales exposed in several troughs [described] about Providence. Thickness of beds here included under this term (if we place here all soft beds in the troughs described) cannot be safely stated but may reach 3,500 ft. Well exposed in banks of Blackstone River on Division St., Pawtucket, and at Valley Falls. Underlie Sockanosset sss. Both Pawtucket shales and Sockanosset sss. belong to Cranston beds, the basal div. of Rhode Island Coal Measures.

Is a part of Rhode Island fm.

†Pawtucket formation.

Pennsylvanian: Eastern Rhode Island.

C. H. Warren and S. Powers, 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 439–475). *Pawtucket fm.*—Name introduced to replace "Coal Measures" of Woodworth. Largely sss. and shales with some cgls. Underlies Dighton group and overlies Wamsutta fm.

Named for Pawtucket, R. I.

Replaced by *Rhode Island fm.* (See U. S. G. S. Bull. 597, 1917, p. 54.)

Paxton quartz schist.

Carboniferous: Central Massachusetts, northern Connecticut, and central southern New Hampshire.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*Paxton whetstone schist* appears in Worcester County column of strat. table.]

B. K. Emerson and J. H. Perry, 1903 (Geol. of Worcester, with map). *Paxton schist.*—Quartzose mica schist of brownish-gray color and frequently containing alternating lighter bands of greenish color. Because of abundance of this mixture of mica and hornblende schists in the ledges of Paxton the mixture may be called *Paxton schist.* The Paxton schist and Bolton gneiss are equiv., or simply parts of one extensive fm.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60–62, 86–87, 234, and map). *Paxton quartz schist.*—A chocolate-colored, highly micaceous whetstone, which contains small green hornblendic lenses, also small beds of mica schist and ls. It is distinctly qtzitic and some of it is highly graphitic. To W. is divided into Quabin qtzite and Ewing hornblende schist. To E. grades into Oakdale qtzite. Considered to be older than Brimfield schist. Named for development at Paxton, NW. of Worcester, Mass.

E. Callaghan, 1931 (N. Y. Acad. Sci. Annals, vol. 33, pp. 29, 63, 64, 67, 73, 74). *Paxton schist* redefined and given significance as a fm. rather than a rock type. Retained for the 2 thick members of feldspathic biotite schist and the thin middle memb., which in its easternmost exposure in Wachusett-Coldbrook tunnel is largely feldspathic but which is mainly biotite schist to W. Thicknesses: Upper feldspathic biotite schist to E., 1,300 ft., to W., 275 ft.; middle memb., 400 ft. to E., 175 ft. to W.; lower feldspathic biotite schist, 450 to 1,600 ft. Overlies Ware schist; underlies Brimfield schist as here restricted and redefined.

The U. S. Geol. Survey has not yet had occasion to consider, for its publications, Callaghan's redefinition.

Payette formation.

Miocene: Southeastern Oregon and western Idaho.

W. Lindgren, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 632–634). During earlier part of Neocene (Mio.) a large fresh-water lake occupied at least lower part of Snake River Valley, and its sediments are now prominent features of region. For these lake beds *Payette fm.* is proposed, and their age is determined as upper Mio. This fm. is probably not same as Cope's *Idaho fm.*, to which a Plio. age was assigned and which appears to be connected with later basalt flows. (Footnote: From results of more extended surveys during summer of 1897, it has become evident that the Payette and Idaho fms. represent two successive stages of the lake, the often deformed shore line of former being found at elevations of 4,200 to 5,000 ft., and those of latter at max. elev. of 3,000 ft. To separate the deposits of the two fms. is not always easy.) The extent of the fm. is shown in pl. 57, from which it is seen that it lies in front of Boise Mtns and occupies whole lower part of ridge btw. the Boise and the Payette. It extends over large areas to N. of the Payette, along the flood plains of Snake River, and is seen to occupy vast areas in Oreg. btw. mouth of Owyhee River and Weiser, where Snake River Canyon begins. On both sides of lower Snake River the bluffs of Payette fm. attain height of over 800 ft. In Payette Valley S. of Emmett the sharply defined bluff of Payette beds rises 600 ft. above the alluvium. Smaller masses, detached by erosion, or uplifts, lie in intermontane valleys as far E. as Idaho Basin. Along Boise Mtns the Payette beds rest against the irregularly eroded and sharply sloping surface of the granite, and top stratum attains height of 4,100 ft. A total thickness of 1,000 ft. is exposed near Boise, and wells bored show several hundred ft. of similar strata below the surface. Over larger part of its extent the fm. lies nearly horizontal or dips only a few degrees. The sediments consist chiefly of granitic light-colored sands, locally cemented by hot-spring deposits to hard sss. (as at Table Mtn near Boise) or clayey semiconsolidated sss. Heavy masses of cgls. and gravels begin to appear at Table Mtn and reach their greatest development opposite mouth of Boise River, in high ridge extending westerly. Purely clayey deposits are rarer, occurring only in convenient sheltered locations near the shore line or in places where volcanic eruptions took place. In basal part of fm., at Horseshoe Bend, Jerusalem, and other localities along the Payette, are small coal seams. Fm. rests uncon. on granite. F. H. Knowlton identifies the fossil plants from it as upper Mio. During time of max. extension of Payette Lake its surface stood at present elev. of 4,200 ft. Its deposits, over 1,000 ft. thick near the shore, rested against abrupt slope of Boise Mtns and filled old canyon of the Boise to same depth. The canyon must have formed a fiord, the branches of which reached as far back as Idaho Basin. The data are not at present sufficient to determine extent of Payette Lake, though it is probable it was confined to Snake River Valley, enclosed on W. by Blue Mtns and on E. by divide toward Salmon River. Near base of Payette fm. sheets of rhyolite and rhyolite tuff occur, but this eruption was of limited extent. These flows are contemp. with the lake beds and are interbedded with them. After attaining its highest stage Payette Lake was drained by establishment of present course of Snake River below Weiser. The lake receded as the canyon was rapidly cut by the mighty volume of water, and erosion has steadily proceeded since end of Mio. or beginning of Plio. The broad valleys of the Boise, the Payette, and the lower Snake were eroded in the soft lake beds. A new course was established for Payette River, which evidently did not debouch at its present position before Payette epoch. The Boise River, on contrary, maintained its old course. The accumulated gravels were scoured out from its canyon, and before the Plio. basaltic eruptions its channel in the canyon was deepened nearly to its present level. There was, however, at least one temporary check in this process of draining. For considerable interval of time the lake remained stationary at present elev. of 2,800 to 3,000 ft. The deposits and basalt flows of this epoch are regarded as late Neocene (Plio.) and belong to *Idaho fm. of Cope.*

F. H. Knowlton, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, p. 736), assigned fossil plants of Payette fm. to upper Mio.

W. Lindgren, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 93–94, 97–98). The highest (Mio.) stage of the lake near Boise reached elev. of 4,200 ft., while the lower (Plio.) stage is indicated by terrace of shore gravels at 3,000 ft. The beds deposited by the lake at its high stage were named *Payette fm.* in U. S. G. S. 18th Ann. Rept., pt. 3, pp. 632, 665, et seq.), while for the lower beds the name *Idaho fm.*, proposed by Cope, was retained, as all fossils studied by him were evidently found in this division. Near Prospect Peak, 20 mi. NW. of Boise, the upper lake beds reach elev. of 4,600 ft. North of Emmett, on the Payette, the lower stage is indicated by shore gravels at elevations of 2,800 ft. It is clear that a certain amount of post-Mio. deformation has taken place, and position of the old shore lines, whenever determinable within reasonable limits of error, will measure the relative amount of this deformation. Naturally the upper line is easier to determine than the lower stage, the latter being carved in soft lake beds and disintegrating gravels. As a consequence of this, the distinction btw. the older and younger lake beds, or in other words, btw. Payette (Mio.) and Idaho (Plio.) fms., is often difficult. It is rarely possible to draw exact contact lines, and the two fms. have been indicated on map by one color. The younger beds were laid down nearly conformably on the older, and in fact largely consist of their detritus.

I. C. Russell, 1902 (U. S. G. S. Bull. 199), mapped Tert. lake beds over broad area in SW. Idaho, extending from N. of Weiser SE. through Canyon, Ada, SW. Elmore, northern Owyhee, and western Lincoln Counties, to within 20 mi. of Shoshone Falls.

J. C. Merriam, 1917 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 10, No. 22, pp. 431–443). Idaho fm. is not yet satisfactorily separated from Payette (Eo. or Mio.) and from *a Mio. or Plio. stage which may intervene btw. the Payette and the Idaho.* The Idaho is either latest Plio. or earliest Pleist.

J. P. Buwalda, 1923 (Idaho Bur. Mines and Geol. Pam. 5). Payette fm. in Snake River Valley of SW. Idaho is overlain by 1,000 ft. of rhyolite flows. These rhyolite flows are immediately overlain by *Poison Creek fm.*, of lower Plio. or later age. The mammals of Idaho fm. (which lies in middle and flatter part of the valley) indicate Pleist. age. The Idaho fm. is generally made up of cream-tinted silt and volcanic ash, and rests uncon. on underlying fms. [Idaho fm. as used in previous repts included all Plio. beds overlying Payette fm. (Mio.), from which it was "separated with difficulty."]

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 198–201, 235–239). [See 1931 entry under *Idaho fm.*]

Whether Payette fm. is upper, middle, or lower Mio. is still a debated question among paleontologists. The Idaho fm. is Plio. and Pleist.

Payne sandstone.

Permian: Central Oklahoma.

C. T. Kirk, 1904 (Okla. Dept. Geol. and Nat. Hist. 3d Bien. Rept., pp. 9–11). *Payne ss.*—Ledge of red ferruginous ss., which in Payne Co. and to S. replaces and is a continuation of Wreford ls. Roughly nodular in places, in other places smoothly bedded. In many places known as "iron rock," from its red and almost vitrified appearance, due to ferric oxide. Thickness 10 to 30 ft. Basal fm. of Perm. in Okla.

C. N. Gould, 1927 (Obsolete Okla. names: Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 6, pt. 2, p. 235). *Payne ss.* proposed by Kirk for ss. assumed to represent Penn.-Perm. contact in Okla. red beds. The name never came into popular use.

Named for Payne Co.

Payne Branch sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 352). *Payne Branch ss.*—Usually greenish gray or reddish brown and shaly, 20 to 35 ft. thick. Underlies Lower Avis sh. and overlies Payne Branch sh.; all members of Hinton group [fm.]. Type loc. on N. side of Payne Branch of Fivemile Creek 0.8 mile SW. of Caperton School and 2.2 mi. N. of Hatcher, Mercer Co. Also observed in Summers Co.

Payne Branch shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 353). *Payne Branch sh.*—Red and variegated, 15 to 20 ft. thick. Underlies Payne Branch ss. and overlies Hackett ss.; all members of Hinton group [fm.]. Type loc. same as Payne Branch ss. Also observed in Summers Co.

Paynes Creek basalt.

Late Pleistocene or Recent: Northern California (Chico quadrangle).

H. Hamlin, 1921 (Dept. Int., U. S. Reclamation Service in cooperation with State of Calif. and Iron Canyon Project Association, App. 1, pp. 47, 50, 58, pl. 2). *Paynes Creek basalt.*—A very porous fm. of basaltic lava, few ft. thick at edges of flow to 70 ft. thick in old valley of Paynes Creek. It flowed down old valley of Paynes Creek, completely filling it, and also filling Iron Canyon for at least 1 or 2 mi. and possibly much farther. Paynes Creek has since cut a new canyon through the basalt and underlying fms. down to and nearly through aggl. No. 1. The basalt is underlain by old stream gravels, which rest on upper tuff, which in turn rests on aggl. No. 1.

C. A. Anderson, 1933 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 23, No. 7, pp. 240, 243, 245). *Paynes Creek basalt* followed present course of Paynes Creek to Sacramento River, possibly filling Iron Canyon for short distance. Since then all traces have been removed from Iron Canyon. Paynes Creek was displaced by the lava, and has since cut a new canyon through the basalt and into underlying Tuscan fm. for depth of 50 ft. This flow is much later in age than Red Bluff fm. and many of the other basalt flows of region. It may be very late Pleist. to Recent.

†Peabody granite.

Devonian or Carboniferous: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.), applied *Peabody granite* to granite which he in 1921 (U. S. G. S. Bull. 704) included in Quincy granite, as did B. K. Emerson in 1917 (U. S. G. S. Bull. 597). The Quincy granite covers a large part of Peabody Twp, Essex Co., where it is quarried under name "Peabody granite."

†Peaceable sand.

See under *Gerty sand.*

Named for exposures along Peaceable Creek, Pittsburg Co., Okla.

†Peace Creek beds.

Pliocene (lower): Southern Florida.

W. H. Dall, 1891 (Phila. Acad. Nat. Sci. Proc. for 1891, p. 120). *Peace Creek beds.*—Have been exploring Peace Creek, where the fossil bones are found, and have determined strat. relation of beds they come from. They are under marine Plio. beds corresponding to part of Caloosahatchee beds and overlie or are mixed with older Plio. phosphatized rock which has many of the Caloosahatchee shells in it but which on the whole seems rather older. The bones from Peace Creek, which are derived from one original stratum not over 2 ft. thick, are older Plio. beyond question.

A local facies of Alachua fm. (See G. C. Matson and F. G. Clapp, Fla. Geol. Surv. 2d Ann. Rept., p. 133, 1909.)

Named for exposures on Peace Creek, De Soto Co.

Peace River sandstone.

Cretaceous: Alberta.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 216). [Assigned to Cret. or Tert., but all later Canada Geol. Surv. repts assign it to Cret., and Allan and Rutherford, Alberta Research Coun. Rept. 30, 1934, p. 14, assign it to Lower Cret.]

Peach Bottom slate.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania and western Maryland.

J. P. Lesley and P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_5, map of Lancaster Co.). *Peach Bottom roofing sl.* [Shown as older than Chikis [Chickies] qtzite and younger than chlorite schist.]

J. P. Lesley, 1885 (2d Pa. Geol. Surv. Rept. X, map 35), mapped *Peach Bottom roofing sl.* in Lancaster Co., Pa., as overlying chlorite schist and underlying Chikis qtzite.

E. B. Mathews, 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143), showed *Peach Bottom slates* overlying Cardiff quartz cgl.

W. B. Clark, 1904 (Md. Geol. Surv. map of Harford Co., Md.) *Peach Bottom.*—Blue-black roofing slates, bedding obscured by cleavage. Thickness 1,000 ft. Overlie Cardiff.

E. B. Knopf and A. I. Jonas, 1922 (Am. Jour. Sci., 5th, vol. 5, pp. 45–49, 61–62). *Peach Bottom sl.* is top fm. of Glenarm series, and overlies Cardiff cgl.

Named for exposures at Peach Bottom, York Co., Pa.

The Glenarm series was formerly classified by U. S. Geol. Survey as "Algonkian," but, that term having been discarded as a time term, the Glenarm is now classified as *pre-Camb.*

Peach Lake diorite.

Age(?): Eastern New York (Dutchess County).

R. Balk, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pl. 1, etc.).

Peach Orchard sandstone. (In Pottsville formation.)

Pennsylvanian: Northeastern Kentucky (Morgan County).

L. C. Robinson, 1927 (Ky. Geol. Surv., ser. 6, vol. 26, p. 239). *Peach Orchard ss.*, a cliff-forming ss. memb. of Pottsville series of Morgan Co. that is well developed where the "Fossil Lime" is found. Is rather dense and fine grained ss. overlying the "Fossil Lime." Lies lower in Pottsville than Homewood ss. [Type loc. not stated.]

Peacock formation. (Of Double Mountain group.)

Permian: Central northern Texas (Stonewall and adjacent counties).

L. T. Patton, 1930 (Univ. Tex. Bull. 3027, p. 45). *Peacock fm.*—The part of Double Mtn group lying above Blaine fm. and below Triassic. Named for exposures at town of Peacock, in W. part of Stonewall Co. A prominent gyp. memb. (Swenson gyp. memb.) is taken as base of fm. The Peacock consists almost entirely of brick-red sandy sh., argill. fine-grained friable sss., a few gyp. beds, and very few thin and nonpersistent beds of dol. Some gray and blue shales and sss. occur. About 100 ft. above Swenson gyp. occurs Oriana gyp. memb. With exception of these two gyp. members there are no other prominent gyp. beds in Peacock fm. Upper fourth of fm. has been eroded away all over county except in SW. part, where it is protected from erosion by overlying Triassic and Cret. Thickness 700 to 850 ft., the upper 300 ft. of which has been removed by erosion over most of county. [Some geologists apply name *Blaine fm.* to all beds below Whitehorse ss. (which overlies Dog Creek sh.) and above Chickasha fm.]

N. H. Darton, 1932 (unpublished statement). The division btw. Dog Creek sh. and Peacock fm. is at top of the Dog Creek, which intergrades with the Blaine, and the two cannot be separated. [This definition is the one adopted by U. S. G. S. See 1937 geol. map of Tex.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). Swenson gyp. of Patton is apparently same as Childress dol. and gyp. memb. of Blaine fm. and is discarded.

Peacock sand.

Local name for 1,400-foot sand (in Shawnee group, Penn.) of Cowley Co., Kans.

Peale formation.

Mississippian: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Peale fm.*—Of variable character. Reddish to brown slaty sh., sometimes gray or greenish, passing into tuffaceous ss. and fine cgl., is most common. The fine cgl. contains much volcanic material, with occasional red lapilli and small lenses of calc. matter. Thin beds of gray qtzite also occur, and masses of black, gray, or red chert form prominent ledges. The tuffaceous beds are well exposed and fossiliferous on horse trail from Wards Creek to Peale diggings, also beyond Hosselkus and to within about a mile of Lucky S road. The chert is best exposed near forks of road just E. of Hosselkus, where there is a prominent ledge of red-banded chert full of quartz veins, but no considerable amount of hematite with it, as on Houghs Peak. Red siliceous sl. and chert occur near summit along trail from Wards Creek to Peale diggings, as well as in divide at head of Hinchman Ravine. [Fossils listed.] The fm. is almost completely surrounded by igneous rocks, meta-andesites, and is in part made up of pyroclastic material of same sort. It evidently represents an epoch of volcanic activity, although the immediately enveloping rock may be in large part intrusive. Thickness 1,400 ft. Is overlain by Reeve meta-andesite. Is older than Robinson fm. and younger than Shoofly fm.

Pearisburg limestone.

Lower and Middle (?) Ordovician: Southwestern Virginia.

R. S. Bassler, 1907 (Min. res. of Va., by T. L. Watson, pp. 137–138, 144, 148). *Pearisburg ls.*—At Pearisburg, [Giles Co.,] Va., consists of (descending): (1) Light-gray compact ls. with gastropods abundant in lower beds and Ostracoda in upper part, 60 ft.; (2) fine-grained dove ls., 20 ft.; (3) embedded mag. ls., 25 ft.; (4) light- to dark-gray, moderately fine-grained ls. in lower part and massive cherty beds in upper div., 65 ft.; (5) dark bluish-gray ls., subcrystalline or earthy in upper part and slightly cherty in lower beds, with a *Girvanella* very abundant, 50 ft.; (6) dark-gray, mottled massive fossiliferous ls. leaving a deep-red chert upon weathering, 250 ft. Underlies Moccasin ls. and overlies Knox dol.

R. S. Bassler, 1909 (Va. Geol. Surv. Bull. 2A, p. 171). In northern part of SW. Va., in place of the marbles and thin-bedded lss. of the Holston, heavily bedded gray and dark-blue ls. is found, the exact equivalency of which has not been determined, and in "Min. res. of Va." the provisional new name *Pearisburg ls.* was employed. It is a ms. name of M. R. Campbell several years ago.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). *Pearisburg ls.* occurs in Pearisburg trough. Largely contemp. with Heiskell sh. Underlies Moccasin ls. Uncon. overlies Holston ls. Is of late Chazyan (post-Stones River) age.

†Pearl shale. (In Sumner group.)

Permian: Eastern Kansas and southeastern Nebraska.

J. W. Beede, 1909 (Kans. Acad. Sci. Trans., vol. 21, pt. 2, p. 255). *Pearl shales.*—Succession of red, blue, and green shales, 70 ft. thick, overlying Herington ls. and underlying Abilene cgl. All included in Marion stage.

In 1927 the beds previously called "Pearl sh. memb. of Marion fm." were transferred to overlying Wellington fm., because of difficulty of separating them from the Wellington, and Pearl sh. memb. was abandoned by both Kans. Geol. Survey and U. S. Geol. Survey. (See under *Wellington fm.*, N. W. Bass, 1929.) However, the 1932 revised classification of Perm. rocks of Kans. and Nebr. by R. C. Moore and G. E. Condra excluded Pearl sh. from Wellington and treated it as a distinct fm., as did

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12). Moore also restricted *Wellington sh.* to upper part of the Wellington of prior usage and applied new name *Donegal ls.* (divided into 3 members) to the beds overlying Pearl sh. (also restricted) and underlying his restricted Wellington fm.

See Kans.-Nebr. Perm. chart compiled by M. G. Wilmarth, 1936.

Named for exposures at Pearl, Dickinson Co., Kans.

Pearlette ash.

Pleistocene: Southwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 53, 54). *Pearlette ash.*—Widespread horizon of white to brownish, rarely greenish, volcanic ash, 13 ft. thick, underlying Kingsdown marls and overlying Meade gravels. Supposed to be late Plio. and to belong to Tule div. of Cummins (*Equus* beds of Cope). Named for old post office of Pearlette, Meade Co.

E. Haworth, 1897 (Univ. Geol. Surv. Kans. vol. 2). As it is yet open question regarding true nature of material of Pearlette ash of Cragin, and much more so regarding its mode of deposition, it is hardly desirable to draw many conclusions from their supposed origin, and it is less desirable to group the little isolated patches together and assign them to a geologic terrane including nothing else.

Pearl Harbor series.

Pliocene: Hawaiian Islands.

C. H. Hitchcock, 1912 (Geol. Soc. Am. Bull., vol. 23, p. 71).

Pearl River series.

Pliocene: Hawaiian Islands.

C. H. Hitchcock, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 31–34).

Peay sandstone member (of Frontier formation).

Upper Cretaceous: Northern Wyoming (Bighorn County) and southern Montana (Carbon, Bighorn, Stillwater, and Yellowstone Counties).

F. F. Hintze, Jr., 1915 (Wyo. State Geol. Bull. 10, p. 21). *Peay ss.*—Light-gray and light-brown ss., with large sandy concretions in central part and conglomeratic layer at top, but no interbedded cgls. Thickness 150 to 200 ft. Is *ss. A* of Washburne. Separated from overlying Torchlight ss. (top bed of Benton) by 350 to 400 ft. of Upper Benton sh. (consisting of black adobe sh. and sandy sh. with bentonite, and, at base, a thin bed of rather fine cgl.), with which it is discon. Rests conformably on Lower Benton sh., which contains Mowry sh. near top.

C. T. Lupton, Jan. 21, 1916 (U. S. G. S. Bull. 621, pp. 167, 169, 171, etc.), treated *Peay ss.* as a *memb.* of Frontier fm.; stated that it is 45 ft. thick in Basin oil field, where it lies 292 ft. below Torchlight ss. memb. and 138 ft. above Mowry sh.

Named for Peay Hills, Bighorn Co., Wyo.

Peay sand.

Drillers' name for subsurface sands lying at or near horizon of Peay ss. memb. of Frontier fm.

Pecan Gap chalk member (of Taylor marl).

Upper Cretaceous: Northeastern Texas and (?) southeastern Oklahoma (McCurtain County).

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, p. 156). *Pecan Gap chalk memb. of Taylor marl.*—About 50 ft. of bluish-gray, slightly bituminous, more or less argill. and sandy chalk, weathering light gray and white. Lower 10 ft. is typically exposed in a cut of Gulf, Colorado and Santa Fe Ry ½ mi. E. of Pecan Gap, Delta Co. Rests on Wolfe City sand memb.

C. W. Honess, 1927 (Okla. Geol. Surv. Bull. 40R). *Pecan Gap chalk* and associated shales and sands are at present concealed, but undoubtedly are present across southern tip of McCurtain Co., Okla.

C. H. Dane and L. W. Stephenson, 1928 (A. A. P. G. Bull., vol. 12, pp. 41–58), changed name to *Pecan Gap tongue of Annona chalk,* and defined it as resting on Wolfe City sand memb. of Taylor marl.

L. W. Stephenson, 1929 (A. A. P. G. Bull., vol. 13, p. 1330). *Pecan Gap tongue of Annona chalk* in NE. Tex. is separated, both from Wolfe City sand memb. of Taylor marl below and from typical Taylor marl above, by unconformities, marked everywhere by phosphatic nodules and casts of fossils.

The name of this unit now in use by U. S. Geol. Survey is *Pecan Gap chalk memb. of Taylor marl.*

Pecatonica dolomite member.

Middle Ordovician (Black River): Northwestern Illinois, southern Wisconsin, northeastern Iowa, and southeastern Minnesota.

O. H. Hershey, 1894 (Am. Geol., vol. 14, p. 175). The *Buff ls.* underlies a narrow strip skirting St. Peter ss. of NW. Ill. on S. and W. sides. It is moderately thick bedded buff or light-brown dol., argill., and nearly free from fossils. Thickness 20 ± ft.; thins out to NE. Grades into overlying Blue ls. and down into St. Peter ss. Designation *Buff ls.* is deceptive, for under cover it is as frequently blue as the Trenton above it. Perhaps *Pecatonica ls.* would be more appropriate, as it is best exposed in Pecatonica Valley, near Wis. line, and northward.

O. H. Hershey, 1896 (Am. Geol., vol. 18, p. 72), used, in table, *Pecatonica ls., 40 ft. thick,* beneath Trenton ls. and above St. Peter ss.

See also O. H. Hershey, 1897, Am. Geol., vol. 20, pp. 66–67.

This name appears not to have been again used until revived by A. C. Trowbridge et al., 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., figs. 1, 2, pp. 64, 70, 71), who divided their expanded *Platteville ls.* near Dubuque and at other places in Iowa into (descending) Spechts Ferry sh. memb., McGregor ls. memb., *Pecatonica dol. memb.* (*"Lower Buff"*), and Glenwood sh. memb. Thickness of *Pecatonica memb.* 16 ft. at Guttenberg and McGregor, Iowa; 30 ft. near Dubuque, Iowa; absent in southern Minn. On p. 286 of this Conf. Rept. G. M. Kay described *Pecatonica or Lower Buff memb. of Platteville fm.* as composed of heavy ledges, up to 7 ft. thick, of rather dense blue, buff-weathering mag. ls. or dol., which in northern Ill., SW. Wis., and NE. Iowa succeed Glenwood memb. of Platteville fm. and underlie McGregor memb. of the Platteville. From max. of 30± ft. in northern Ill., it thins to 15 ft. in Winnebago Co., Ill., and is absent at Preston, Minn. On p. 286 he gave thickness of *Pecatonica* (*"Lower Buff"*) *memb.* near Platteville, Wis., as 21 ft. 8 in. Kay also stated that Pecatonica ls. of Hershey is Lower Buff ls., and that it was named for Pecatonica River, Winnebago Co., Ill. On p. 297 of this Conf. Rept. C. A. Bays and G. O. Raasch stated: Writers are opposed to use of *Pecatonica* for *Lower Buff.* As originally proposed Pecatonica included Glenwood horizon and had no specific type loc. It seems preferable that a new term with a specific description and no confusing antecedents be introduced for this memb. [but they do not propose a substitute].

Pecatonica till.

A term applied by C. [R.] Keyes to a pre-Wisconsin till sheet in Ill. (See Pan-Am. Geol., vol. 58, pp. 203, 217, 1932.)

Pecksport member.

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 134, 219, etc.). *Pecksport memb. of Marcellus fm.*—The hard resistant Solsville memb. of Marcellus is succeeded by Pecksport memb., consisting of soft aren. sh. that crumbles to small fragments when exposed. In Morrisville quad. this bed is characterized by *Leiorhynchus laura* in association with many typical Hamilton fossils. Type section is in Livermore Gully, 1 mi. E. of railroad switch at Pecksport, where it is 153 ft. thick. Eastward the memb. thins to 90 ft. at Button Falls, S. of Leonardsville. At this place it is a coarse sandy sh. abounding in typical Hamilton pelecypods, especially *Grammysia alveata.* Grades into overlying Mottville memb. of Skaneateles sh. The Peckport can be identified to W. of type section only as far as Pine Woods. It is thus coextensive with the Solsville. To W. of Pine Woods it grades laterally into fine aren. shales characterized by *Leiorhynchus laura*, forming upper part of Cardiff sh. and not divisible from it.

Pecos shale.

Permian (?): New Mexico.

C. R. Keyes, 1909. [See under *Cimarronian series*. Derivation of name not given.]

†Pecos formation.

Permian: Southeastern New Mexico (Roswell artesian basin).

A. G. Fiedler and S. S. Nye, 1933 (U. S. G. S. W. S. P. 639). *Pecos fm.*—A lithologic unit consisting chiefly of red beds, gyp., anhydrite, impure ls., light-colored fine sand, and intercalated thin beds of mag. or dolomitic ls. and dol. Uncon. underlies the Triassic E. of Pecos River and overlies Picacho ls., with uncon. locally. Base of fm. varies considerably in strat. position, being lower N. of Salt Creek and notably higher a few mi. S. of mouth of Seven Rivers than it is within the artesian basin. Near top, in Seven Rivers region, it is penetrated laterally by Carlsbad ls. tongue of Capitan ls., which is underlain by Seven Rivers tongue of Pecos fm., which to S. becomes replaced laterally by Capitan ls. Upper part of Pecos fm. has been eroded away W. of Pecos River, but lower part extends a few mi. W. of river. Thickness of fm. 1,066 ft. in one section. Named for exposures E. of Pecos River. The strata constituting the Pecos fm. are represented on Darton's 1928 geol. map of N. Mex. as *Chupadera fm.* N. of Lake McMillan and as Castile fm. SE. of Lake McMillan. The beds here named *Picacho ls.* are believed by geologists working in this region to be strat. equiv. of San Andres ls. of Lee and Girty, and have been referred to by that name for years.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Pecos fm.* abandoned, being here divided into (descending): Pierce Canyon red beds, Rustler fm., Salado halite, Castile anhydrite (thin lateral extension of upper part of Castile anhydrite of Delaware Basin), and Chalk Bluff fm. Latter fm. includes equivalents of (descending) Seven Rivers gypsiferous memb., Queen ss. memb. and underlying beds that are=Dog Canyon ls. Picacho ls. is here abandoned for San Andres ls. The Pierce Canyon redbeds are now classified as Triassic.

Pecos Canyon sandstone.

Permian: Northeastern New Mexico (Santa Rosa to Tucumcari).

J. K. Knox, 1920 (A. A. P. G. Bull., vol. 4, pp. 99–101). *Pecos Canyon ss.*—A massive ss. that divides the red beds, which overlie Magdalena group into two groups—the *upper "Red Beds"* and the *lower "Red Beds"*—in Santa Rosa-Tucumcari region.

Pecosan series.

Pecosian series.

Terms introduced by C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 14, pp. 223–228, 1907) to cover his late Tert. *Llano Estacado sands* along Rio Pecos of western Tex. and eastern N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 10. "Includes essentially all of the Plio. section of the Llano Estacado region.")

†Pecos Valley red beds.

Permian and Triassic: Southeastern New Mexico.

J. W. Beede, 1910 (Am. Jour. Sci., 4th, vol. 30, pp. 131+). *Pecos Valley red beds.*—Thin lss. and covered slopes apparently composed of soft sss. or clays. Overlies Guadalupian series in Carlsbad region.

C. L. Baker, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 99–126). The *Pecos Valley red beds* outcrop along foot of E. flank of Sacramento Mtns and underlie alluvium in lower Pecos Valley. The N. limit of outcrop is not known at present. They extend S. into Toyah Basin, Tex., and E. under Llano Estacado. Near E. base of Guadalupe Mtns the Capitan ls. changes along the strike into *Pecos Valley red beds*. The transition is well seen in walls of Rocky-Arroyo, 20 mi. W. of Carlsbad. On E. flank of Sacramento Mtns and N. flank of Guadalupe Mtns the Pecos Valley red beds lie on San Andres ls.

Includes †Pecos fm. (Perm.) and overlying Triassic red beds.

Pecursian series.

Picursian series.

Terms introduced by C. [R.] Keyes to cover upper part of old pre-Camb. rocks in N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 10.)

Pedee group.

Peedee group.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 97). *Peedee group.*—Sh. and thin ls. up to 100 ft. or more thick locally, that overlie Stanton ls. and underlie pre-Virgil uncon. Includes (descending) Hardesty sh., Iatan ls., and Weston sh. The Weston and Iatan are defined as previously. The sh. overlying the Iatan and occurring beneath the uncon. is designated *Hardesty sh.*, from a locality in Smithville quad., Mo. In some places, as along Kansas River, no representative of Peedee group remains, and basal ss. and cgl. of Virgil series rests directly on Stanton ls.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 79). For the dominantly shaly strata btw. Stanton ls. and base of overlying Virgil series Moore is introducing *Pedee*, from stream near Weston, opp. Leavenworth, on Missouri River. [In letter dated Sept. 3, 1935, Newell stated this *creek* is spelled *Pedee* (not Peedee).]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 137–138). The strata btw. top of Stanton ls. and discon. that defines top of Missouri series are included in Pedee group. These beds were formerly included in Douglas group, but it is clear they should be separated from the rocks that discon. overlie them. The Pedee beds are designated a separate group, rather than an addition to Lansing group, because latter beds are a well-characterized compact strat. unit consisting mainly of ls., and because the conformable upper bdy of Lansing group, as previously drawn and here accepted, is a more usable strat. datum in mapping and in subsurface studies than the uneven surface of the post-Missouri discon. The Pedee group contains 2 fms., Weston sh. below and Iatan ls. above. It is probable that in some places where Iatan ls. is present there is a certain thickness of sh. above the Iatan that belongs below the post-Missouri discon. and therefore should be included in Pedee group. Such conditions may exist along Missouri River in vicinity of Iatan and Weston, where part of the poorly bedded sandy and clayey beds btw. top of Iatan ls. and base of Sibley coal possibly belong to Missouri series. Evidence of exact position of bdy btw. Missouri and Virgil deposits is lacking here, but inasmuch as thickness of zone in which bdy belongs is only 5 to 20 ft., this uncertainty is not of great importance. In any case the bdy at top of Iatan ls. is practically the most useful, and accordingly Pedee group is regarded as including no beds above Iatan ls. The term *Hardesty sh.* is therefore abandoned. It was not properly defined. Thickness of Pedee group 100± ft. SE. of St. Joseph, Mo.; it has been removed by erosion throughout much of Platte Co., Mo., and in Kansas River Valley; in southern Kans. it is 200 ft. thick in places; is well represented in east-central and SE. Kans.

Pedro bentonite bed. (In Pierre shale.)

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Pedro bentonite bed.*—Hard white massive clay and tuff, locally 20 ft. thick, but not widespread. Lies at base of Gammon ferruginous memb., the basal memb. of Pierre sh. in NE. Wyo. and SE. Mont. Named for exposures near Pedro, sec. 5, T. 45 N., R. 63 W., Weston Co., Wyo.

Pedroian.

A time term used by J. E. Eaton (A. A. P. G. Bull., vol. 12, p. 138, 1928) to cover San Pedro fm. as restricted by him (to basal part of original San Pedro) and his overlying Hall Canyon fm., or to all of lower Pleist.

Peebles dolomite.

Silurian (Niagaran): Southwestern Ohio (Adams and Highland Counties).

A. F. Foerste, 1929 (Ohio Jour. Sci., vol. 29, No. 4, pp. 168–169). *Peebles dol.* of Highland and Adams Counties is=Guelph of Canada, and therefore belongs above the Cedarville of Springfield area, which is=Racine of Wis., the Racine being directly under the Guelph in that State.

A. F. Foerste, 1931 (Ky. Geol. Surv. ser. 6, vol. 36, p. 191). *Peebles fm.* is typically exposed at Peebles, Ohio, where it includes the part of the Niagaran which intervenes btw. top of the Bisher W. of town and base of the Greenfield 2 or 3 mi. eastward. At Hillsboro the Lilley fm. intervenes btw. the Bisher and the Peebles. Fossils listed. Fauna is Guelph. Peebles fm. can be traced S. as far as Ohio River, in Adams Co., where characteristic Guelph fossils occur on the hills facing the river. Not exposed S. of Lewis Co.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 134), stated *Peebles dol.* underlies Greenfield dol. (Cayugan) and overlies Bisher fm., and that none of them is known S. of Lewis Co., Ky. On p. 138 he stated Niagaran section at Hillsboro, Ohio, consists of (descending) Peebles dol., Lilley fm., Bisher fm., Ribolt sh., Alger clay sh., and Dayton ls. Other details are given on other pp. of this paper, especially 137–144. On p. 143 he stated type section is btw. Peebles, Ohio, and base of Greenfield dol. several mi. to E.

Peedee formation.

Upper Cretaceous: Coastal Plain of eastern South Carolina (Florence and Horry Counties) and North Carolina.

E. Ruffin, 1843 (Agric. Surv. S. C., 1st Rept., pp. 6–7, 24–27). The marls of S. C. which are sufficiently abundant to be valuable for use are of four different fms. or geological ages, and each of distinct and marked character in regard to certain minor pecularities, though all agreeing in main chemical and agricultural characteristics, as defined above, and which only are of importance to the value of marl. That which I shall term *Peedee bed* is oldest marl, and is part of great secondary fm. (and that div. called the Cret., and which is so fully developed in N. J.), as is manifest from its characteristic fossils (principally *Belemnites Americana* and *Exogyra costata*). This bed, so far as I have yet ascertained, is limited to land bordering on part of great Peedee River and some of its tributaries, as Black River; all the fm. being connected and lying in Marion, Williamsburg, and Georgetown districts. The next oldest fm. of marl is that which I shall designate *Great Carolinian bed.* It extends from E. of the Santee to far across the Savannah. Though this fm. is separated from the Mio. marl (or middle Tert.) in the geological series, or in regard to age, by the interval of two entire periods, or intervening successive fms. (the newer Cret. and the Eocene or lowest and oldest of the Tert., both of which are here entirely wanting), still the former two are so united in position near the Peedee that it would be difficult to describe either alone without referring continually to the other. Therefore, in the description that will be given of the secondary or Peedee bed, the overlying and connected bed of Mio. marl will be also embraced, so far as regards its position and visible thickness; leaving its other characteristic to be considered separately, as part of the whole Mio. fm. of the State. It is the secondary fm. in that vicinity only to which I give the name of *Peedee bed.* This peculiar fm. is known as low on Peedee River as Britton's ferry, at line dividing Georgetown and Williamsburg districts. The Peedee bed is of peculiar character and very different in appearance from all other fms. in S. C. It occurs in alternate layers of hard marlstone and soft marl, sundry of which are to be seen in one section. Both these, wherever they underlie the Mio., and also higher up than the latter extends, are of a dark bluish-gray color; and each is of homogeneous texture, the marl like an impure clay and the marlstone like a compact and close-grained hard stone. Lower down the river than any Mio. is seen, the upper marlstone of the secondary or Peedee bed is yellowish. The marl is poor compared to most of those of the great Carolinian bed and to the adjacent Mio., usually not more than from 30 to 40 percent. The marlstone, however, is rich, varying from 66 to 68, and the little that has been tried burnt to white and excellent lime. The characteristic fossils, *Belemnites* and *Exogyra costata,* are not found diffused generally, but are very abundant at particular places, of which the bluff at Birch's ferry is the best supplied.

The present definition of Peedee fm. corresponds to Ruffin's definition in lithology and paleontology. It is uppermost of the Upper Cret. fms. of S. C. and N. C.; it uncon. overlies Black Creek fm. and is everywhere uncon. overlain by Tert. or Quat. deposits; and it consists chiefly of dark-green or gray, finely micaceous, more or less glauconitic and argill.

sands, many layers of which are calc. and some sufficiently calc. to form an impure ls. Irregular concretionary masses of impure calcium carbonate occur in places. Dark marine clays are interstratified with the sand. Thickness 0 to 886 ft. In some repts it has been called *Peedee sand*, but that lithologic term is not strictly applicable. It is a marine fm., of Ripley age. (See L. W. Stephenson, N. C. Geol. Surv., vol 3, 1912.)

Named for exposures on Great Peedee River, S. C., the exposure at Burches Ferry, on W. side of Peedee River in Florence Co., being a typical one. According to C. W. Cooke (U. S. G. S. Bull. 867, 1936), Burches Ferry may be taken as type loc. of Peedee fm., although the beds containing *Exogyra cancellata*, which in N. C. form base of Peedee fm., are absent at Burches Ferry.

†Peedee marl.

Miocene (upper): Northeastern South Carolina (Darlington and Florence Counties).

E. Ruffin, 1843 (Agric. Surv. S. C. 1st Rept., p. 28). [Although on earlier pages of above rept Ruffin distinctly stated that he applied *Peedee bed* to the secondary [Cret.] marl, on p. 28 he referred to the marls along Peedee River as *Peedee miocene marl* and *Peedee secondary marl*, "the two being difficult to separate."]

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, 19). *Pee Dee marls* (also *Pee Dee phase*).—This phase is interruptedly exhibited along Pee Dee River area from Darlington to Allisons Ferry; it also extends very interruptedly up Lynches River to Sparrow Swamp. At Davis Bluff it comprises 9 ft. of marl, in two layers, overlying 5 ft. of Goose Creek marl. The layer immediately resting on Goose Creek marl presents about 3 ft. of tough porous yellow marl consisting of a matted mass of shells (principally *Chama congregata* and *Arca incile*); the upper 6 ft. has been indurated in places almost to crystalline form (comprises large numbers of *Pecten eboreus*, etc.). The *Arca incile* layer is the one principally observed along Lynches River.

Name conflicts with Peedee fm. of the Cret. The Mio. bed is Duplin marl, according to studies of C. W. Cooke.

Named for exposures in Peedee River region, NE. S. C., from Darlington to Allisons Ferry.

Peedee group, Pennsylvanian, Kans. See *Pedee group*.

†Peedee River marls.

Upper Cretaceous: Eastern South Carolina.

F. S. Holmes, 1870 (Phosphate rocks of S. C., pp. 12, 13).

Same as Peedee fm.

Peeker sand.

The subsurface Second Cow Run or Peeker sand of Washington Co., Ohio, is Lower Freeport ss., and the Peeker sand of Morgan, Athens, and western Washington Counties is Lower Freeport ss. (W. Stout et al., Geol. of nat. gas, A. A. P. G., 1935, pp. 900-901.)

Peekskill granite.

Pre-Cambrian: Southeastern New York (east of Peekskill).

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, p. 377). [*Peekskill granite* mentioned only in table, where it is placed below Cortlandt series and above Harrison diorite, and both Peekskill granite and Cortlandt series are assigned to "*Lower Siluric*" (Ordovician).]

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146, p. 53). *Peekskill granite*.—White or pink massive, very coarse-grained, soda granite, occupying about 4 sq. mi. 2 mi. E. of Peekskill. Believed to be genetically related to Cortlandt series.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, map and passim). *Peekskill granite*.—Light-gray medium- to coarse-grained acid granite composed of quartz, white feldspar, striated and nonstriated, muscovite, and biotite. Of same age as Cortlandt series. Cuts Manhattan schist. [In many places is called *Peekskill or Mohegan granite.*] Type loc. about 3 mi. E.-NE. of Peekskill.

Peekskill phyllite.

Ordovician: Southeastern New York (Peekskill region).

C. R. Fettke, 1914 (N. Y. Acad. Sci. Annals, vol. 23, pp. 245–257). *Peekskill phyllite.*—Dark-gray to black phyllite, of rather fine texture. Well exposed on NW. side of Peekskill Creek Valley. Thickness probably much more than 1,000 feet. Rests on 1,000 ft. of blue to white crystalline ls. believed to be Wappinger ls. If the ls. is Wappinger ls., then the phyllite correlates with Hudson River series, but there is possibility the Peekskill phyllite may represent a less metamorphosed phase of Manhattan schist, the age of which is still in doubt. [The age of Manhattan schist is now rather generally accepted as pre-Camb.]

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226), mapped the rocks on NW. side of Peekskill Creek Valley as *Hudson River shales and phyllites,* and the underlying ls. as *Wappinger ls.*

Peekskill diorite.

Same as Peekskill diorite gneiss.

Peekskill diorite gneiss.

Pre-Cambrian: West Point quadrangle, southeastern New York.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225–226, p. 28). *Peekskill diorite gneiss or Pochuck gneiss.*—An old injection or impregnation type of diorite gneiss of uncertain relation to the other types except that it is intimately associated with the Grenville and is judged to be the oldest intrusive [in West Point quad.]. [In most places in rept the rocks are called either *Pochuck gneiss* or *Pochuck diorite,* while the name *Peekskill* is applied to a younger granite.]

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this gneiss as of post-Glenarm pre-Camb. age.

Type loc. along Peekskill Creek, Westchester Co.

Peekskill norite.

Age (?): Eastern New York (Dutchess County).

R. Balk, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 5, pl. 1, etc.).

Peekskill Creek limestone.

Name casually applied by C. R. Fettke (N. Y. Acad. Sci. Annals, vol. 23, p. 201, 1914), in 2 places, to Wappinger ls. of Peekskill Creek section of eastern N. Y. In 1921 (N. Y. State Mus. Bull. 225–226) C. P. Berkey and Marion Rice mapped this ls. as Wappinger ls.

Peerless sandstones. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., pp. 281, 282). *Peerless ss.*—Bluish-gray fine-grained, frequently micaceous ss. or sandy sh., 80 to 150 ft. thick, lying 5 to 10 ft. below Cedar Grove coal and frequently including Campbells Creek ls.; lies higher than Peerless coal. *Lower Peerless ss.*—Massive bluish-gray ss., 25 ft. thick, lying 10 ft. below Peerless coal and 27 ft. above No. 2 Gas coal. The Peerless coal was named for small mining village (now abandoned) on S. side of Kanawha River just E. of Lewiston, Kanawha Co.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 103, 183). *Peerless ss.*—Massive, persistent, 10 to 46 ft. thick. Underlies Little Alma coal and lies 1 to 5 ft. above Campbell Creek ls.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., p. 274). *Peerless ss.*—Usually massive, medium-grained, micaceous, greenish gray to bluish gray, 25 to 70 ft. thick. Is same as Lower Cedar Grove ss. of Logan-Mingo Co. Rept. Overlies Alma coal, the Alma A coal being absent. The ledge in *Logan and Mingo Counties* that was erroneously correlated with Peerless ss. is here renamed *Lower Monitor ss.*

Peerless shale member (of Sawatch quartzite).

Upper Cambrian: Central Colorado.

C. H. Behre, Jr., 1932 (Colo. Sci. Soc. Proc., vol. 13, No. 3, p. 58). *Peerless sh. memb. of Sawatch qtzite.*—Sandy and shaly dolomitic beds and calc. shaly beds, with prominent fucoid markings, forming top memb. of Sawatch qtzite in Weston Pass dist. In earlier repts called "transition sh." Thickness at Weston Pass 50 ft. Typical occurrence on NW. slope of Peerless Mtn, 6 mi. E.-SE. of Leadville. Grades into overlying Manitou ls. (Ord.). Underlain by qtzites.

The "transition sh." of Alma dist. consists of (descending): (1) Shaly beds, 12 to 27 ft.; (2) dolomitic and sandy ls. with sh. partings, 15 to 30 ft.; (3) shaly beds, 18 to 30 ft.; (4) dolomitic ls. with sh. partings, 15 to 30 ft.; (5) purple qtzite containing tiny angular quartz pebbles, 2 to 15 ft.; the aggregate thickness of the memb. being 62 to 132 ft.

Peers Spring formation.

Mississippian (lower and middle ?): Eastern Nevada (Pioche district).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171, pp. 7, 20, map, etc.). *Peers Spring fm.*—Outcrops are mainly black dense fine-grained aphanitic ls., weathering gray or white; some bands weather rusty. Brown calc. sh. is probably the more common facies, but outcrops of it are not so numerous. Gray thick-bedded ls. is interbedded in lower part. Is separated from other Carbf. fms. by fault boundaries, but in Dutch John Mtn section its strat. position btw. Bristol Pass ls. (below) and Scotty Wash qtzite (above) is clearly shown. Thickness at least 500 ft. and may be 2,500 ft. Fossils (of Madison age) are listed. Named for occurrence in hills E. and N. of Peers Spring, 3 mi. NW. of Bristol Pass.

Pegram limestone.

Middle Devonian: Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 400, 425). In valley of Harpeth River, btw. Newsom and bridge W. of Pegram, all exposures of Louisville fm. are overlain by Dev. ls., the *Pegram ls.* Its thickness increases toward W. At Newsom it is 3 ft. thick; at bridge 1½ mi. W. of Pegram it is 8 ft. thick; at its most western exposure, in quarry N. of railroad, the total thickness is 12 ft. In Harpeth River region it is usually very white and crystalline. At bridge W. of Pegram this white ls. is overlain by 6 to 12 in. of dark earthy rock, and above that lies the Black sh. Top of Pegram ls. seems to correspond to Sellersburg ls. of Ind. and Hamilton of N. Y., while lower part indicates at least one characteristic Corniferous [Onondaga] fossil.

Overlies Camden chert uncon., and uncon. underlies Hardin ss. memb. of Chattanooga sh. See C. O. Dunbar, 1919 (Tenn. Geol. Surv. Bull. 21).

E. R. Pohl, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 195; Tenn. Acad. Sci. Jour., vol. 5, pp. 54–63), divided Pegram ls. into Sellersburg ls. (above) and Jeffersonville ls. (below) and discarded *Pegram*.

Named for exposures at Pegram, Cheatham Co.

Pekanatui series.

Pre-Cambrian: Canada (Northwest Territories).

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 376).

Pekin formation. (In Newark group.)

Triassic (Upper): Central North Carolina.

M. R. Campbell and K. K. Kimball, 1923 (N. C. Geol. and Econ. Surv. Bull. 33, pp. 20–25). *Pekin fm.*—Prevailingly red ss. and sh., with a remarkable gray cgl. at base, called millstone grit and composed of white quartz pebbles up to 2 in. in diameter. Rocks carry considerable hematite. Is lowermost fm. of Newark group. Underlies Cumnock fm. Rests uncon. on ancient schist and sl. Has generally been referred to as "Lower red ss." Thickness 1,000 to 2,000 ft.

Named for exposures at Pekin, Montgomery Co., which lies in midst of the fm.

†Pelham limestone.

Upper, Middle, and Lower Ordovician: Alabama.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 152, section opp. p. 162, and map). *Trenton or Pelham ls.*—Lower part usually impure shaly ls. with great numbers of *Maclurea magna*, characteristic Chazy fossil. Upper part mostly pure ls., with Trenton fossils. In places the pure ls. is overlain by calc. shales and shaly lss. often full of graptolites. Max. thickness 800 ft. or more. Overlies Knox dol. and underlies Clinton or Red Mountain fm.

As defined is same as Chickamauga ls. The ls. at Pelham, type loc., is now, however, known to include beds of Trenton and Chazy age and in addition 1,200 ft. of beds of Beekmantown age, according to studies of C. Butts. The latter beds belong to Knox dol. as defined and elsewhere used. *Chickamauga ls.* is an almost simultaneous name for the lss. of Trenton, Black River, and Chazy age in southern Appalachians, which had been mapped under that name in many repts before their essential equivalency to †Pelham ls. of Ala. was established.

Named for Pelham, Shelby Co., in Bessemer quad.

Pelham granite.

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 48). [Shows *Pelham gneiss* in SW. wall of Pelham asbestos quarry, and describes the *gneiss of Pelham* on pp. 42–45.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 94, 127–128, 248–250, and map). *Pelham granite.*—Gray biotitic gneissoid granite. Covers large part of Pelham Twp.

†Pelham quartzite.

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18, and map, pl. 34). *Pelham qtzite.*—Aren. actinolitic qtzite. Crosses Pelham Twp.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 250–252 and map). [The rocks mapped as "Pelham qtzite" in Mon. 29 were in Bull. 597 mapped as "Northfieldite (pegmatitic, aplitic, or vein quartz border on Pelham granite)," and the name "Pelham qtzite" was discarded.]

†Pelham saxonite.

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pp. 47–55, and map, pl. 34). *Pelham saxonite.*—Black olivine-enstatite-magnetite rock with serpentine and steatite beds.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 209, 215–217). [The patches of rock in Shutesbury and Pelham Twps which were mapped as "Pelham saxonite" in Mon. 29 were here mapped as *saxonite and peridotite*, and the geographic name was discarded.]

†Pelham serpentine.

Name applied by B. K. Emerson (U. S. G. S. Mon. 29, 1898, p. 55) to an exposure of serpentine at "asbestos" mine in Pelham, Mass., and later discarded by him. Not mentioned in his U. S. G. S. Bull. 597, 1917.

Pelican shale.

Pelican sandstone.

Upper Cretaceous: Alberta.

R. G. McConnell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 28D to 29D). [Both included in Colorado group.]

Pella beds.

Mississippian: Central southern and southeastern Iowa.

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 318). *Pella beds or substage.*—Clay marls, clay shales, and ls., 75 ft. thick, forming top memb. of St. Louis fm. in SE. Iowa. Overlie Verdi beds (middle memb. of St. Louis) and uncon. underlie Coal Measures.

According to later repts, by S. Weller and F. M. Van Tuyl, these beds carry a Ste. Genevieve fauna and are discon. separated from underlying true St. Louis ls.

Named for exposures near Pella, Marion Co.

Pellisier granite.

Age (?) : Central eastern California (Inyo Range).

G. H. Anderson, 1935 (Pan-Am. Geol., vol. 64, No. 1, p. 66). The batholith which forms core of northern Inyo Range is composed chiefly of 2 granites which are designated *Pellisier* and *Boundary Peak granites*. The Pellisier is of variable composition and texture, but may be described as hornblende granite with monzonitic tendencies. The Boundary Peak granite, of more uniform appearance and composition, contains no hornblende and has a lower percentage of other ferromagnesian minerals. [Age and derivation of names not stated.]

Pellville sand.

A subsurface sand, of Chester (Miss.) age, in S. part of Hancock Co. and N. part of Ohio Co., Ky.

Pelly gneiss.

Pre-Cambrian: Northeastern Alaska and Yukon Territory, Canada.

A. J. Collier, 1903 (U. S. G. S. Bull. 218, p. 16). Oldest rocks in Yukon River region are of gneissoid character, and for these *Pelly gneisses* has been suggested by Brooks and accepted by McConnell. These gneisses are an intricate series of crystalline rocks whose genesis is doubtful. A part are altered intrusives, and further study will undoubtedly show that some of them are younger than the sediments they are supposed to underlie. Everywhere show profound metamorphism. Uncon. overlain by quartz schists and qtzites called by Spurr the *Birch Creek series*.

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Pelly gneiss* intrudes Birch Creek schist. Consists mainly of granitic rocks, but locally includes darker varieties of monzonitic, dioritic, and even gabbroic character. Probably pre-Camb. but possibly Paleozoic.

Named for exposures on Pelly River.

Pelodian.

Pre-Cambrian: General.

J. D. Whitney and M. E. Wadsworth, 1884 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 7, geol. ser. vol. 1, No. 11, p. 562), proposed the following "chronological arrangement of crystalline (Azoic) rocks" (descending): *Pelodian* (argillites); *Glacian* (cgls.); *Taconian* (lss.); *Crystallian* (qtzites, quartz schists); *Montalban* (mica schists); *Huronian* (diorites, diabases, melaphyrs, chlorite schists); *Porphyrian* (porphyrites); *Arvonian* (felsite, quartz porphyry, petrosilex, jaspilite); *Norian* (gabbros, coarse diabases, and diorites); *Ophian* (peridotites, including serpentines); *Siderian* (magnetite, hematite, menaccanite); *Laurentian* (granites, gneisses, syenites). Derivation of names not stated.

Pelona schist.

Pre-Cambrian (?) : Southern California (Los Angeles County).

O. H. Hershey, April 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [*Pelona schists* on legend of map lie btw. gneiss below and Archean gneiss above.]

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 273–290). *Pelona schist series*.—Three thousand ft. of dark-colored and more schistose mica schist underlain by 2,000 ft. of light-yellowish coarse angular mica schist. Assigned to pre-Camb. (?). Named for Sierra Pelona, Los Angeles Co.

O. H. Hershey, 1912 (Am. Jour. Sci., 4th, vol. 34, pp. 271–273). Another area of *Pelona series* constitutes greater part of Rand Mtns near Randsburg, Kern Co. This series is youngest important Archean series. I propose to extend the name over Abrams and Salmon fms. of Klamath region.

E. C. Simpson, 1934 (Calif. Jour. Mines and Geol., vol. 30, No. 4). *Pelona schist series*, 7,500+ ft. thick in Elizabeth Lake quad., is probably Archean. Identical in lithology and structure with Rand schist of Randsburg quad.

Pelton basalt member (of Deschutes formation).

Late Tertiary (Miocene or Pliocene) or early Pleistocene: Central northern Oregon (Deschutes Basin).

H. T. Stearns, 1931 (U. S. G. S. W. S. P. 637, p. 139). *Pelton basalt memb. of Deschutes fm.*—Name suggested by Ira A. Williams. The memb. usually consists of several beds laid down in rapid succession, and it is not unlikely they were all poured out during a single eruption. Thickness 130 to 150+ ft. Lies near lower part of Deschutes fm. Exposed in Deschutes Canyon from line btw. Twps 12 and 13 S., R. 12 E., to N. bdy of area. Not traced beyond this point but known to continue several mi. downstream. In N. part of T. 11 S., R. 12 E., it forms bench nearly ¼ mi. wide on both sides of Deschutes River. Also extends N. and underlies former R. R. station of Pelton.

Pembina beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 130).

Pembina Mountain.

Name applied by G. M. Dawson (Geol. and res. 49th par., 1875, p. 81) to Pierre sh.

Pembroke formation.

Silurian: Southeastern Maine.

E. S. Bastin and H. S. Williams, 1913 (Maine Water Storage Comm. Third Ann. Rept., p. 168; Geol. Soc. Am. Bull., vol. 24, pp. 378, 379). [Name mentioned but not defined. Refers to Eastport folio.]

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, p. 6). *Pembroke fm.*—A conformable alternation of rhyolitic and diabasic volcanic rocks with gray and dark-red shales. Southeast of Leighton Point the sed. rocks are subordinate in amount. Northwest of Leighton Point the fm. consists chiefly of two sh. members, Leighton gray sh. memb. below and Hersey red sh. memb. above. Thickness about 6,000 ft. Conformably overlies Edmunds fm. and conformably underlies Eastport fm. Fossils indicate Rondout age. Named for exposures near Pembroke, Washington Co.

Pembroke moraine.

Name applied to a Pleist. moraine in N. Y. (See F. Leverett, U. S. G. S. Mon. 41, pp. 685–688, 1902, who described them as *Pembroke ridges*, but H. L. Fairchild (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627–662, 1932) refers to the deposit as *Pembroke moraine*.)

Pemigewasset series.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region) and White Mountains.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 142–148, 257–261). *Labrador system or Pemigewasset series of granites, ossipytes, compact feldspars, etc.*—Chiefly eruptive. In vol. 1 I stated I believed the following belong to one grand system, arranged according to age, youngest at top: (1) Compact and crystalline feldspars or porphyries, 600 ft.; (2) ossipyte or labradorite rocks; (3) Chocorua granite; (4) Albany granite, 1,000 ft.; (5) Conway granite, 600 ft.; (6) breccia granite, 300 ft. I find that there are difficulties in way of accepting these views and desire to investigate subject further before committing the rept to this view. The Pemigewasset granites cut the andalusite slates and are of later origin, either Eozoic or Paleozoic. The series overlies Franconia breccia, which is younger than Montalban group, and older than Pequawket or Mount Mote breccias and porphyries. Named for Pemigewasset River, along which the rocks are exposed over large areas. The Conway granite caps Mount Pemigewasset. The Labrador system is considered the probable equiv. of Labrador system of Logan and Hunt.

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, No. 3, pp. 67–137), assigned the granites enumerated above, also the Pequawket and "Mount Mote" (Moat) breccias and porphyries, to Dev. (?), and stated that Pequawket breccia of Hitchcock consists of clastic rocks interbedded with quartz porphyry and trachyte flows. In 1935 he assigned all these intrusives to late Dev. or late Carbf. (See under names of subdivisions.)

Pemmican River formation.

Upper Cambrian (?): Greenland.

C. Poulsen, 1927 (Meddelelser om Grønland, Bd. 70, pp. 244, 341).

Peña Blanca marls.

Oligocene: Panama.

E. Howe, 1907 (Isthmian Canal Comm. Rept., p. 113).

Pen Argyl beds. (In Martinsburg shale.)

Upper Ordovician: Southeastern Pennsylvania (Northampton County).

C. H. Behre, Jr., 1926 (Jour. Geol., vol. 34, pp. 485–487) and 1927 (Pa. Geol. Surv., 4th ser., Bull. M9, pp. 33, 104–107, and maps). By studying in detail the beds laid bare in the quarries, it has been possible to divide the uppermost or soft sl. memb. of Martinsburg fm., 3,000 ft. thick, into two parts. As lower part has been quarried at Bangor it is distinguished as *Bangor beds*. The upper part is exposed at Pen Argyl and is designated *Pen Argyl beds*. The only difference is that the slates of Bangor beds are slightly harder than those of Pen Argyl beds and do not attain such great thickness. [Jour. Geol. paper gave 1,500 ft. as thickness of each.] The two sets of beds are separated by a somewhat more sandy phase of sedimentation, which is shown on Slateford Creek, about 1 mi. W. of Slateford, and which is with difficulty recognized; it is assigned to Bangor beds.

Penasco quartzite.

Pre-Cambrian: Central northern New Mexico (Santa Fe region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 10). *Penasco qtzite.*—Main body of siliceous section exposed near Pecuris, N. of Santa Fe. Thickness 400 ft. [Derivation of name not given.]

Pence ferruginous slate member (of Ironwood formation).

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Gogebic district).

W. O. Hotchkiss, 1919 (Eng. and Min. Jour., vol. 108, pp. 501, 505). *Pence ferruginous sl. memb.*—Dominantly thin- and even-bedded ferruginous sl.; at base a "flatwise" cgl. believed to represent uncon. Thickness 80 to 130 ft. Is a memb. of Ironwood fm., underlying Anvil ferruginous chert memb. and uncon. overlying Norrie ferruginous chert memb. Named for Pence mine, W. of Hurley, Wis.

Pencil Cave.

A descriptive term applied by drillers to certain clay or shale fms. which cave in drilling and which have a tendency to break up easily into long pencil-like forms. The name has been applied in western Pa. to beds, 5 to 40 ft. thick, in midst of Mauch Chunk sh. or Greenbrier ls. (both Miss.), underlying Little lime and overlying Big lime of that region. The Pencil Cave of drillers of central Tenn. (Crossville region) is a volcanic ash (bentonite) of Ord. age, lying near bdy btw. lss. of Trenton and Black River age. It is also called "Green Pencil Cave." The Pencil Cave of W. Va. is, according to D. B. Reger, without much doubt the Lillydale sh. (in the Mauch Chunk).

Pendleton sandstone.

Middle Devonian: Indiana.

E. T. Cox, 1879 (Ind. Geol. Surv. 8th, 9th, and 10th Ann. Repts., p. 62). *Pendleton ss.*—Heavy-bedded soft white ss., 15 ft. thick, upper part containing Schoharie fossils, according to James Hall; assigned to Corniferous. Overlain by buff sandy Corniferous ls. and underlain by Niagara ls.

E. M. Kindle, 1901 (Ind. Dept. Geol. and Nat. Res. 25th Ann. Rept., pp. 558–561). *Pendleton ss.*, 15 ft. thick at Pendleton, is strat. equiv. of Jeffersonville ls. Locally there is a cgl. bed in top.

E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4, Sep. Pub. 21, p. 464). *Pendleton ss.*—The Schoharie is represented in Ind. by a single outcrop of ss. at Pendleton [Madison Co.]. Underlies Jeffersonville ls.

W. N. Logan, 1923 (Pan-Am. Geol., vol. 40, btw. pp. 111 and 136). *Pendleton ss.*—Locally conglomeratic. Is evidently a true basal ss. Very doubtful whether it is actually the western representative of Schoharie grit. [In tables this ss. is placed beneath Jeffersonville ls.]

Pendleton zone.

Name applied by C. B. Claypool (The Wilcox group of central Tex., Abstract of thesis, Univ. Ill., 1933, pp. 6, 10), to a marine zone in the Wilcox group of La., which he correlated with Holly Springs sand of Miss., Tuscahoma fm. of Ala., and the nonmarine Rockdale fm. of Tex. Geol. Survey. Named for outcrops at Pendleton Bluff, on Sabine River, where large marine fauna was collected.

Pend Oreille group.

Carboniferous (?) and older (?): Southern British Columbia and northeastern Washington (Stevens County).

O. E. Le Roy, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 142).

R. A. Daly, 1912 (Canada, Geol. Surv. Dept. Mines Mem. 38, maps 7, 8, 117° to 118°). *Pend D'Oreille ls.* (Carboniferous?) overlies *Pend D'Oreille schist* (?Carboniferous to Ordovician).

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 271). *Pend d'Oreille group.*—Schistose sediments and lss. that are believed to be mainly of upper Paleozoic age. Thickness 5,500 ft. The lower schists may include sediments of any age from Carbf. to Sil. inclusive. The group can be divided into two parts, *Pend d'Oreille schists* (including greenstone and amphibolite as well as phyllite and qtzite) and *Pend d'Oreille marbles.* They are primarily not strat. subdivisions so much as purely lithological ones. Rests conformably on Summit series and uncon. underlies Rossland and Beaver Mtn groups of sediments and volcanics. No fossils. The wild canyon of Pend d'Oreille River in lower 20 mi. of its course has been excavated in rocks of this group. [Pend d'Oreille River empties into Columbia River just N. of Wash.-B. C. bdy.]

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 48). *Pend Oreille group.*—Group of qtzites, amphibolites, Stevens Co., Wash. No fossils. Lie in zone of intense deformation and crushing. In many ways difficult to distinguish from older Summit series. Because of lithologic similarity to Cache Creek group of B. C., of Carbf. age, is tentatively correlated with Penn., but lower schists may include sediments of any age from Carbf. to Sil. inclusive. On W. side of Columbia River the group underlies Rossland volcanic series. Overlies Summit series, with no apparent uncon. but rather with possible gradation.

Penholoway formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Florida (?) to Delaware.

In 1925 (Ga. Geol. Surv. Bull. 42, pp. 24–26) C. W. Cooke named and described the Penholoway terrace, citing as type an area in Wayne Co., Ga., extending from Hortense northeastward to Penholoway Bay and Penholoway Creek. In 1931 (Wash. Acad. Sci. Jour., vol. 21, pp. 509–510) he stated that the Penholoway terrace was formed when the sea stood about 70 ft. higher than its present level, and that its shore line can be traced for long distances in both directions from type loc. In 1932 (16th Int. Geol. Cong. Guidebook 12, pp. 5, 8) he applied the name *Penholoway fm.* to the deposits formed when the sea stood 70 ft. above its present level. The other Pleist. terrace fms. now recognized across the Atlantic Coastal Plain from Del. to Fla., as explained on pp. 2 and 5 of Guidebook 5 and in Guidebook 12, 1932 (table opp. p. 4, pp. 14, 15, etc.), are enumerated under *Columbia group.*

Peninsula formation.

Lower Cretaceous: Southwestern British Columbia (Harrison Lake region).

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of Dissert. 1924–26, vol. 1, p. 132).

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, pp. 487, 488). *Peninsula fm.*—Ss., 1,200 ft. thick, yielding *Aucella canadiana.* Assigned to Lower Cret. Underlies Brokenback Hill fm. and uncon. overlies Agassiz Prairie fm. (Upper Jurassic).

†Peninsular limestone.

Eocene (upper): Northern Florida.

W. H. Dall, 1903 (Wagner Inst. Sci. Trans., vol. 3, pt. 6, p. 1554). In order to promote clearness and avoid confusion it is probably advisable to adopt a distinct name for the Orbitoidal phase or fm., for which I would suggest the term *Peninsular ls.* This is intended, not as a permanent fm. name, but as a general term for the fundamental plateau ls. of Fla., in which a close and thorough study in the future may result in discrimination of more than one horizon or zone. It seems probable the Orbitoidal ls., which has in this work and in the literature generally been called *Vicksburg ls.*, may really form a different horizon altogether from the typical Vicksburgian and be intermediate btw. the latter and the nummulitic Ocala ls.

Later work by C. W. Cooke has proved this ls. to be the upper Eocene Ocala ls. The latter name has priority. (See Fla. Geol. Surv. 20th Ann. Rept., 1929.)

Named for development in peninsular Fla.

Has also been called †*Peninsula ls.*

†Pennell sandstone.

Upper Cretaceous: Eastern Utah.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 64, 65). *Pennell ss.*—Sss., 200 ft. thick, composing basal fm. of Laramian series in Utah. Underlie 1,000 ft. of unnamed shales, and uncon. overlie Masukian shales. Is Masuk ss. of Gilbert, which is replaced because Masuk is retained for the shales. Named "from Mount Pennell, overlooking as its piedmont the Masuk Plateau," eastern Utah.

Penney sand.

Name applied to a subsurface sand, of probable Dev. age, in SW. N. Y. See N. Y. State Mus. Bull. 239, 240, map opp. p. 16, 1922. (See also *Penny sand.*)

Pennine system.

Name proposed by H. S. Williams (U. S. G. S. Bull. 80, 1891, pp. 75–82) as geographic designation for *Carboniferous system*. Named for Pennine Range of northern England, where all of Carbf. system and overlying so-called "New Red ss." are present and exposed, resting on the underlying "Old Red ss." [Dev.]. The Pennine Range was type loc. of Carbf. system of Conybeare, 1822.

Pennington shale (also **Pennington formation**).

Mississippian (late Chester): Southwestern Virginia, eastern Kentucky and Tennessee, northern Alabama, and northwestern Georgia.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 37). *Pennington sh.*—Red and green shales, with beds of ss., 1,100 ft. thick, forming upper fm. of Miss. series in Bigstone Gap coal field of Va. and Ky. Overlies Newman ls. and underlies Lee cgl. Named for Pennington Gap, Lee Co., Va., where it is 1,025 ft. thick. It has same thickness at Big Stone Gap.

In some subsequent repts several hundred ft. of calc. beds properly belonging to Newman ls. were erroneously included in Pennington sh. According to C. Butts (Ky. Geol. Surv., ser. 6, vol. 7, 1922, pp. 125, 161, 168, 178) the Newman ls. includes St. Louis ls. at base and Glen Dean ls. at top, and Pennington sh. should be [and now is] restricted to beds of post-Glen Dean age. It includes equivalents of Bluestone fm., Princeton ss., and Hinton fm., according to some geologists, but C. Butts (Va. Geol. Surv. Bull. 42, 1933, pp. 44, 46) expressed opinion that Pennington and Hinton are same fm. In some repts *Pennington group* has been used to include Bluestone fm., Princeton cgl., Hinton fm., and Bluefield sh., but that usage has been discontinued.

The Newman ls. of SW. Va. and adjacent areas in SE. Ky. and NE. Tenn. is now divided into several fms., the upper of which is Glen Dean ls.; in Early Grove region of SW. Va. it is the Cove Creek ls. In Crossville quad. of central Tenn. the Pennington sh. is 250± ft. thick and rests on 350 ft. of Bangor ls. restricted. In northern Ala. it reaches a max. thickness of 200± ft. and rests on Bangor ls. restricted. In NW. Ga. and in Chattanooga region of SE. Tenn. its thickness has been reported as 500± ft., and there also it rests on Bangor ls. restricted. C. Butts (Ala. Geol. Surv. Spec. Rept. No. 14, p. 199, 1926) described Pennington fm. of Ala. as consisting of 200± ft. of mainly argill., partly cherty ls., with beds of sh., some of which are red, "the red sh. being the striking and characteristic feature of Pennington fm. to N."

Pennsylvanian epoch (or **series**).

The middle epoch of Carboniferous period and the rocks formed during that epoch. For definition see U. S. G. S. Bull. 769, pp. 72–73. Some geologists now treat the Penn. deposits as a system.

Penny sand.

A subsurface sand, of probable Dev. age, in western N. Y., lying higher than Bradford and Richburg sands. (See also *Penney sand.*)

Penobscot formation.

Cambrian (?): Central southern Maine (Penobscot Bay quadrangle).

G. O. Smith, E. S. Bastin, and C. W. Brown, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 3). *Penobscot fm.*—Metamorphosed shaly sediments (slates, schists, qtzites) typically developed along nearly whole length of W. shore of Penobscot Bay. Vary from light gray through steel gray and purplish gray to black, the darker grays being predominant. Locally injected and metamorphosed by granite and diorite. Weathered surfaces usually rusty. In a few places only the rock exhibits a very perfect slaty cleavage, highly inclined to bedding planes. Conformably overlies Battie qtzite. Assigned to Camb (?). Named for exposures along W. shore of Penobscot Bay, especially btw. Belfast Bay and Sandy Point, Waldo Co.

On 1933 geol. map of Maine, by A. Keith, this fm. is included in Ord. and Camb. block.

Penobscot Bay granite.

Silurian (late) or early Devonian: Maine.

F. W. Toppan, 1932 (Geol. of Maine, Dept. Geol. Union Coll., Schenectady, p. 44).

†Penokee series.

Pre-Cambrian (upper Huronian): Northwestern Wisconsin and northwestern Michigan.

E. T. Sweet, 1876 (Wis. Acad. Sci., Arts, and Lett. Trans., vol. 3, pp. 40–55). *Penokie series*, of the Huronian, lies directly below the Copper-bearing series. Consists of 4,000 ft. of siliceous schists, black slates, iron-bearing beds, siliceous marble, and fine-grained white quartz. Rests uncon. on granitic and gneissic rocks supposed to be=Canadian Laurentian.

T. C. Chamberlin, 1883 (Geol. Wis., vol. 1, pp. 81–84). *Penokee series*, of the Huronian, is 13,000 ft. thick in Penokee region, Wis. Consists of (descending): (1) Mica schists, 8,000 ft.; (2) black slates, schists, and diorites, 3,500 ft.; (3) iron-bearing and siliceous schists and qtzites which now form crest of Penokee iron range, 800 ft.; (4) quartz schist and argill. mica schist, 400± ft.; (5) white granular qtzite; (6) crystalline mag. ls., 130 ft.—lowest memb. exposed to view.

Applied to all of Huronian series in Penokee dist. In some later repts the Bad River ls. was both excluded from and included in †Penokee series.

†Penokee-Gogebic series.

A term applied in some early repts (see U. S. G. S. 21st Ann. Rept., pt. 3, 1901) to the upper Huronian rocks of NE. Wis. and NW. Mich.

Penrod sand.

A subsurface sand in upper part of Chester group (Miss.) of Muhlenburg Co., western Ky. Composed of two members separated by about 10 ft. of sh. Occurs at depth of about 650 ft.

Pensauken formation. (In Columbia group.)

Pleistocene: New Jersey.

R. D. Salisbury, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 57–60, 67–72). *Pensauken fm.*—The second stage of the yellow gravel. Consists of gravel, sand, loam, clay, and marl derived from underlying Beacon Hill fm. and Cret. beds. Thickness 0 to 60± ft. Named for exposure at mouth of Pensauken Creek, at Hylton's pits. Uncon. overlies Beacon Hill sand and gravel and uncon. underlies Jamesburg [Cape May] fm.

R. D. Salisbury, 1898 (N. J. Geol. Surv. Ann. Rept. State Geol. 1897, pp. 13–15), introduced *Bridgeton fm.* for beds underlying Pensauken fm. [restricted] and overlying Beacon Hill gravel. He stated that in some places the Bridgeton fm. "seems not to be clearly separable from Beacon Hill fm., which preceded, while in others it is not easily distinguishable from Pensauken which follows," but that in other places "it is distinctly separable from the Pensauken and in still others from the Beacon Hill."

R. D. Salisbury, 1901 (N. J. Geol. Surv. Ann. Rept. State Geol. 1900), stated that Bridgeton fm. was included in Pensauken fm. of 1895 and earlier repts, and that Pensauken fm. is uncon. overlain by Cape May fm. and uncon. underlain by Bridgeton fm. This is present accepted definition of Pensauken fm., which is now classified as middle fm. of Columbia group in N. J. It is of nonglacial origin, and considered to be approx.=in age to Jerseyan drift.

Pentagon shale.

Upper or Middle Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 38 and passim). *Pentagon sh.*—Is sh. and shaly lss. only in immediate vicinity of Pentagon Mtn. but in all other sections it is generally massive ls. Thickest (290 ft.) at type loc.; thins most rapidly S.-SE. to Prairie Reef-White Ridge area, where it consists of tan to chocolate-gray massive thick-bedded ls. with small amount of clay disseminated as flakes. Lower 92 ft. is calc. gray to buff-gray, rather thick-bedded platy sh. interbedded with platy blue-gray argill. lss. in thin beds. Overlying 150 ft. is platy, irregularly bedded argill. ls., blue gray to tan gray in upper part. Above these platy lss. come 22 ft. of black-gray paper sh. interbedded with a few thin lss. in lower part. Top of fm. consists of 26 ft. of nodular platy interbedded chocolate and white-gray argill. lss. Overlies Pagoda oolite and underlies Gordon Mtn ls. Type loc. on Continental Divide in NE¼ sec. 24, T. 25 N., R. 12 W. Named for Pentagon Mtn., which lies approx. 2 mi. NW. of type loc.

†Pentamerus limestone.

Silurian (Niagaran): New York.

T. A. Conrad, 1839 (N. Y. Geol. Surv. 2d Rept., pp. 62–63). Underlies Rochester shales and overlies green sl., lenticular iron ore, etc. Contains *Pentamerus elongatus* (*P. oblongus?*).

Paleontologic name of a ls. in Clinton fm.

Has also been called "First Pentamerus ls." and "Lower Pentamerus ls."

†Pentamerus limestone.

Lower Devonian: New York.

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 237–238). Pentamerus ls. overlies Tentaculite ls. [Manlius ls.], which rests on the Water lss.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 376). Pentamerus ls. overlies Manlius waterlime group and underlies Delthyris shaly ls. [New Scotland ls.].

Paleontologic name of ls. later named *Coeymans ls.*

Penters chert.

Devonian (probably Lower): Central northern Arkansas (Batesville district).

H. D. Miser, 1920 (U. S. G. S. Bull. 715G). *Penters chert.*—Gray and bluish chert, upper part dark-colored at places. Thickness 0 to 91 ft. Uncon. underlies Chattanooga sh. and uncon. overlies Lafferty ls. No fossils. Named for exposures at Penters Bluff Station, Izard Co.

Pentozoic.

A time (life) term applied by E. Hitchcock (Geol. Vt., 1861, vol. 1, p. 19) to the Tertiary.

†Pentremital limestone.

Pennsylvanian: Northwestern Arkansas.

Paleontologic term now replaced by Brentwood ls. memb. of Bloyd sh.

Peñuelas shale.

Cretaceous: Puerto Rico.

G. J. Mitchell, 1922 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 3, p. 251).

Penyon Blanco agglomerate.

Probably lower Mesozoic: Sierra Nevada, California.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Penyon Blanco aggls.*, 9,000 ft. thick, are included in Tuolumne group (probably lower Mesozoic). Underlie Agua Fria slates, lss., cherts, and tuffs and overlie Hunter Valley cherts and tuffs.

Peoples sand.

A subsurface sand, of Penn. age and 100± ft. thick, in central northern Okla. Originally correlated with part of Ochelata fm. In Cleveland and Hominy pools it lies 200 to 500 ft. above Layton sand. N. W. Bass and L. E. Kennedy show (Subsurface geol. of Osage Co., Okla.) this sand belongs in Nellie Bly fm., instead of in Ochelata fm.

Peorian stage of deglaciation, also **Peorian loess** (Pleistocene).

Peorian stage is name which for many years has commonly been applied to the interglacial stage succeeding Iowan stage of glaciation and preceding Wisconsin stage of glaciation. The name was proposed by F. Leverett (Jour. Geol., vol. 6, pp. 244–249, 1898), in the form of *Peorian soil and weathered zone*, also *Peorian interglacial stage*, with statements that the name was applied "to the interval between the Iowan loess and the Shelbyville till sheet, a till sheet which appears to be the earliest of the Wisconsin series" [stage], and that it is "best displayed east of Peoria, Tazewell Co., Ill." Subsequently the loess was included in Peorian interglacial stage, and the name *Iowan* was restricted to the preceding glacial stage. Later work led Leverett to opinion that "this weathering interval, and also the time of the loess deposition, are parts of the third [Sangamon] interglacial stage," and that the Iowan stage of Keewatin ice sheet may be of same age as Illinoian stage of Labrador and Patrician ice sheets. This, however, is still a moot question.

G. F. Kay and M. M. Leighton (1933) included Peorian loess and Iowan glacial stage in Wisconsin stage, and somewhat modified the definition of Peorian. See under *Wisconsin stage.*

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, pp. 350–351). *Peorian loess* occurs as an almost unbroken mantle of yellowish eolian silt and clay over 42,000 sq. mi. of Nebr. It mantles the eroded Loveland fm., on an irregular surface.

Thickness in eastern Nebr. 10 to 100 ft.; in south-central Nebr. 30 to 200 ft.; to N. of Platte River 30 to 250 ft. Writer is not in agreement with recent suggestions to eliminate Peorian as a stage of the Pleist., as proposed by M. M. Leighton (Jour. Geol., vol. 39, pp. 45–53, 1931, and Sci., n. s., vol. 77, 1933) and by G. F. Kay and Leighton (Geol. Soc. Am. Bull., vol. 44, pp. 669–674, 1933).

Pepino formation.

Miocene: Puerto Rico.

R. T. Hill, 1899 (Nat. Geog. Mag., vol. 10, p. 109).

Pepper formation.

Upper Cretaceous (Gulf series): Eastern Texas (Trinity and Brazos River regions).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 417–422). *Pepper fm.*—The basal noncalc. blue-purplish clay sh. that extends southward from the Woodbine outcrop proper in McLennan Co. and underlies the *Acanthoceras flags* (Tarrant fm.) of the Eagle Ford. It is a distinct strat. unit, separated from underlying Grayson (Del Rio) by an uncon. represented by a pebble cgl. Its top is marked by a sharp break in character of sedimentation, the overlying Tarrant fm. being an aren. flaggy ls. containing much fish debris, phosphatic bodies, and fossil wood, and showing many evidences of shallow-water deposition. The Pepper sh. has a distinct fauna. In the past it has been referred to either Woodbine or Eagle Ford. It may be a part of Woodbine. Type loc., an exposure on a small branch of Pepper Creek just S. of Belton-Temple highway, Bell Co., and 1.6 mi. E. of easternmost of two underpasses of the highway under Santa Fe Railway.

Peppersauce sandstone.

Peppersauce Canyon sandstone.

Upper Cambrian: Southeastern Arizona (Santa Catalina Mountains).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 476–477, 480, 481, 482). *Peppersauce Canyon ss.*—Thin-bedded alternating brown porous siliceous ss. and hard pinkish qtzite, 21 ft. thick; Upper Camb. fossils near top. Overlies Abrigo fm. [restricted] in Peppersauce Canyon, Santa Catalina Mtns. [In table on p. 477 he calls it *Peppersauce ss.*] Correlated with Rincon ls. of Whetstone Mtns and with Copper Queen ls. of Bisbee dist. The 3 fms.—*Copper Queen ls.*, *Rincon ls.*, and *Peppersauce Canyon ls.*—are of very limited depositional areas, each with its own faunal and lithological aspect, which are altogether different from anything observed with the Abrigo fm. [as here restricted].

Pepple sand.

A subsurface sand, lying at 1,850 and 1,900 ft. depth, in Lawrence Co., Ill.

†Pequanac shale.

Middle Devonian: Northern New Jersey.

H. B. Kümmel, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). *Pequanac sh.* introduced to replace "Monroe sh." [preoccupied] of repts of N. J. Geol. Survey. Extensively developed along upper Pequanac River. Thickness 1,000 ft. Overlies Kanouse ss. Contains Hamilton fossils.

Cornwall sh. having been published in 1907, as a name to replace "Monroe shales" in N. Y., the name "Pequanac" was in 1914 (U. S. G. S. Raritan folio, No. 191) discarded in favor of *Cornwall sh.*, now in use in both States.

Pequawket breccia.

Devonian (?): Northern New Hampshire (North Conway quadrangle, White Mountains).

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 235, 239, 262, 675, pl. 11, etc.). The last of the groups of rock among White Mtns to be considered are *Mount Pequawket or Mount Mote breccias and porphyries*. The breccia was formed by dismemberment of the andalusite sl., and the feldspathic injection was of later origin. The Pequawket and Mote areas are alike in composition and may have been parts of same original mass, cut in two subsequently by Saco River. In W. part of Albany and Waterville are other breccias, perhaps to be referred to same eruptive period.

If so, the porphyry period is probably coeval with it. There is an extensive area of brecciated porphyries similar to those just described upon the two mtns W. of North Conway, btw. Saco and Swift Rivers, known as Mote Mtns. [The mtns referred to by Hitchcock are now known as North *Moat* Mtn and South *Moat* Mtn. See U. S. G. S. North Conway topog. map, 1927.] The identity of the Mount Mote with Mount Pequawket breccia seems well established. The breccia is younger than Albany, Conway, and Concord granites.

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, No. 3, map, pp. 72, 89, 98, etc.). *Pequawket breccia*.—A group of clastic rocks, varying greatly in composition and appearance, and interbedded with the quartz porphyry and trachyte flows of Moat volcanics. On Mount Pequawket the whole southern slope and the two main peaks are zones of clastic rocks. [On map *Pequawket group* is used, bracketed opp. two blocks, the upper one labeled *breccia (rich in clay sl.)* and the lower one *tuffs and breccias (includes some comendite)*.] Pequawket breccia as here used=Pequawket breccia of Hitchcock, and the South Moat flows of this rept is=quartz porphyry of Hitchcock. [See under *Moat volcanics*, which he assigned to Dev. (?).]

Percé formation.

Lower Devonian: Quebec (Percé).

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 204). *Perce fm.*, Silurian, Canada.

J. M. Clarke, 1908 (N. Y. State Mus. Mem. 9, p. 62). *Percé massive*, Dev., Quebec.

J. M. Clarke, 1915 (N. Y. State Mus. Bull. 177, p. 149). *Percé ls.*, Dev., Quebec.

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 173–175). *Percé fm.* is Oriskanian (Lower Dev.).

Percha shale.

Upper Devonian: Southern New Mexico to southwestern Texas.

C. H. Gordon, 1907 (Am. Jour. Sci., 4th, vol. 24, pp. 58–64; Sci., n. s., vol. 25, pp. 824–825; Jour. Geol., vol. 15, pp. 91–92). *Percha sh.*—Sh. underlying Lake Valley ls., overlying Mimbres ls., and carrying an Upper Dev. fauna in lower part. Is 200 ft. thick in Sierra Co. and 500 ft. thick in Grant Co. At Lake Valley it consists of 60 ft. of grayish-yellow and blue shales underlain by 100 ft. of black fissile sh.

Named for Percha Creek, Sierra Co., N. Mex.

Perchan series.

See under *Martinian series.*

Perdrix shale.

Upper Devonian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 294, 295, 300). *Perdrix sh.*—Black fissile sh. with occasional thin beds of ls. and some concretions. Thickness 600 ft. Overlies Flume dol. (Middle Dev.) and underlies Boule dolomitic ls. (Upper Dev.). Named for Roche à Perdrix, but typical section is on Roche Miette.

Perkasie shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1893 (Pa. Geol. Surv. geol. and topog. map of Bucks and Montgomery Counties) and 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, pp. 2589–2638). *Perkasie sh.*—Green and dark-red or gray shales, 2,000 ft. thick near Perkasie tunnel. Underlie Pottstown shales and overlie Lansdale shales.

Corresponds to middle part of Brunswick sh. of Newark group. (See also under *Sanatoga memb.*)

Perkins volcanics.

Cretaceous: Canada (Yukon).

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 50). [Age not assigned, but Cockfield, Canada Geol. Surv. Summ. Rept. 1922, pt. A, 1923, p. 2, assigned these rocks to Cret.]

Perkins group.

Devonian (?): British Columbia.

D. D. Cairnes, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 34).

Permian epoch (or **series**).

The last epoch of Carboniferous period and the rocks formed during that epoch. For definition see U. S. G. S. Bull. 769, pp. 70–72. Some geologists now classify the Perm. deposits as a system.

†Permo-Carboniferous.

A term employed in early geologic repts to include Perm. and Penn. rocks.

Perris quartz diorite.

Late Jurassic (?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 501). *Perris quartz diorite* is most common and widespread rock type of Perris block, parts of Elsinore and Corona quads., Riverside Co.

Perry formation.

Upper Devonian: Southeastern Maine and New Brunswick.

C. H. Hitchcock, 1861 (Maine Bd. Agr. 6th Ann. Rept., pp. 247–256). *Red sss. of Perry and vicinity.*—In vicinity of Perry there is a fine deposit of red sss. and cgls. which indisputably belongs to highest part of Dev. At Point Pleasant, in SE. part of Perry, the Sil. strata crop out from beneath the red sss., illustrating the complete unconformability of the two sets of strata, also the small thickness of the Dev. strata. [In a few places author casually uses *Perry rocks* and *Perry sss.*, but he evidently did not propose Perry as a fm. name.]

N. S. Shaler, 1886 (Am. Jour. Sci., 3d, vol. 32, pp. 48–51). *Perry series.*—Series of coarse red sss., cgls., and reddish shales, certainly over 2,000 ft. thick. Overlies Cobscook series, but in places rests on the older Campobello series. Appears to be much less cut up by dikes than underlying Cobscook series. Was clearly formed in shallow water in immediate proximity to land. May be of upper Dev. or Sub-carbf. age.

G. O. Smith and David White, 1905 (U. S. G. S. P. P. 35, pp. 10, 25, 28). *Perry fm.* as exposed in towns of Robbinston and Perry is divisible into four members. Two members consist of sedimentary strata, while the other two are interbedded lavas and associated volcanic breccia. Members are: (1) Upper lava (green lava with columnar parting and amygdaloidal texture, including one bed of cgl. and ss.); (2) Upper ss. (coarse red and brown ss. and cgl., with small amounts of sh., including one flow of lava near base); (3) Lower lava (basaltic lava and breccia, including one thin bed of cgl. near top); (4) Lower cgl. (coarse cgl. and red ss., with thin beds of sandy sh.). Thickness of members undet. At N. end of Perry Basin the Perry fm. is in contact with granite; at S. end it uncon. overlies strata believed to belong to "Cobscook series" of Shaler and "Mascarene series" of Bailey and Matthew. The Perry is an estuarine fm., is distinctly Dev., and probably Chemung. Named for development at Perry, Washington Co., and elsewhere in Perry Basin.

E. S. Bastin, 1914 (U. S. G. S. Eastport folio, No. 192). *Perry fm.* is Upper Dev. and correlates with Chemung and Catskill fms.

On 1933 geol. map of Maine, by A. Keith, these rocks are assigned to Mississippian.

Perry formation.

Middle Devonian: Central Pennsylvania (Perry County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 1236–1237). The name *Perry fm.* would be unexceptionable for the middle ss. div. of the Hamilton, because in Perry Co. it is magnificently developed as mountainous outcrops. [He also suggests using *Ludlow ss.* for this ss., "an abbreviated form of Ludlowville sh. of N. Y."]

†Perry limestone.

Silurian and Devonian: Eastern Missouri, along Mississippi River.

C. R. Keyes, 1896 (Mo. Geol. Surv. vol. 11, p. 41). *Perry ls.*—Light-grayish or bluish ls., some clay, 300 ft. thick, exposed only in E. part of Mo. along Mississippi River. Some beds doubtless=so-called Niagara of other parts of Mississippi Basin, but faunas are not closely enough related to admit of covering both sets of strata by a common name. Name *Perry ls.* seems preferable to reviving Worthen's name *Clear Creek*, though it covers nearly same space. Underlies Grand Tower ls. and overlies Girardeau ls. (Ord.). Assigned to Sil.

Preoccupied. Includes several fms. (See Mo. chart.)

Named for Perry Co.

Perryman sand.

A subsurface sand, of Penn. age and 28 to 30 ft. thick, in Okla., lying lower than Oswego lime and higher than Bartlesville sand. Correlated with Squirrel and Prue sands.

Perryville formation.

Middle Ordovician (Trenton): Central Kentucky.

J. M. Nickles, 1905 (Ky. Geol. Surv. Bull. 5, p. 15). [*Perryville* used (in table only, without any description or thickness) for topmost part of Lexington group, overlying Paris [fm.] and underlying Winchester group.]

According to A. F. Foerste (Ky. Geol. Surv. Bull. 7, 1906) the *Perryville* is 0 to 35 ft. thick, underlies Greendale bed, and overlies Paris bed. According to E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22, pp. 416–417, 1911) *Perryville ls.* underlies Catheys fm. and overlies Flanagan ls. According to A. F. Foerste (Denison Univ. Sci. Lab. Bull. 17, 1912) *Perryville memb. of Lexington ls.* in Boyle and Mercer Counties, Ky., consists of 5 to 8 ft. of fine-grained dove-colored ls. above and more richly fossiliferous fine-grained whitish ls., termed Faulconer div., below, and is overlain by Cornishville ls. memb. of Lexington ls. and underlain by Paris bed of Lexington. In 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21) Foerste (also A. M. Miller) included Cornishville ls. in Perryville fm., dividing the Perryville into (descending) Cornishville ls. memb., 5 ft.; Salvisa ls. memb.; and Faulconer ls. memb. In 1924 (Canada Dept. Mines Geol. Surv. Mem. 138, geol. ser. No. 121, chart opp. p. 58) Foerste divided the Perryville into Cornishville ls. (above) and Faulconer ls. (below), without explaining in which division the Salvisa ls. memb. was included; but Miller up to 1925 (Ky. Geol. Surv., ser. 6, vol. 21, pp. 126–142) continued to divide Perryville into Cornishville, Salvisa, and Faulconer members, and to exclude it from Cynthiana fm.

Named for Perryville, Boyle Co., Ky.

Perseverance slate.

Triassic or older: Southeastern Alaska (Juneau region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 93–94). *Perseverance sl.*—Unfossiliferous clay sl., possibly 3,000 ft. thick, underlying Gastineau volcanic group and overlying Clark Peak schist. Is of Triassic or older age.

Named for Perseverance Camp, just E. of Juneau.

Peru limestone.

Middle Devonian: Central Pennsylvania (Juniata County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, p. xix). *Peru ls.*—The bottom layers of the corniferous sh. (which underlies Upper Helderberg ls.) take on a special aspect for several mi. E. and W. of Peru [Juniata Co.], in Tuscarora Valley, that of a hard thin-bedded ls. breaking up into long, narrow blocks.

Peru sandstone.

Middle or Lower Devonian: Central Pennsylvania (Juniata County).

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. F, p. xix). *Peru ss.*—A 3-foot layer of fragile rock occurs at Peru, Juniata Co., overlying typical Oriskany ss., but very distinct from it. It has yielded no fossils and therefore cannot be named Caudagalli grit. Southwest of Peru fragments of it, scattered upon the surface, contain pebbles as large as a chestnut and from that down to a grain of sand. Pockets of iron ore have been found in this rock at Orbisonia and elsewhere.

Peru beds.

Pleistocene: Northeastern Illinois.

C. O. Sauer, 1916 (Ill. Geol. Surv. Bull. 27). *Peru beds.*—A type of stratified drift along sides of valley W. of Peru [near W. line of La Salle Co.] unlike that common at surface elsewhere. Suggests pre-Wisconsin drainage. Consists of (descending): (1) Rotted gravels, coarse and fine, sharply separated from overlying fresh high-level gravel by a line of rust that marks oxidized surface of older bed, 30 to 40 ft.; (2) loess, 2 ft.; (3) fine gravel and sand, 15 ft.; (4) clay silt, dark blue [thickness not stated]. Is uncon. on Coal Measures.

Peru sand.

A subsurface sand, of Penn. age and 0 to 50± ft. thick, in Okla., which is correlated with upper part of Labette sh. The name has also been misapplied to a higher and to a lower sand in same region.

†Pescadero series.

Upper Cretaceous, Eocene, Miocene: Western California (Santa Cruz Mountains region).

G. H. Ashley, 1895 (Jour. Geol., vol. 3, pp. 435–439). *Pescadero series.*—A great series of sss., shales, and cgls. having considerable prominence in Santa Cruz Mtns. They consist in part of the San Francisco ss. of previous writers. The section near Pescadero gives questionable thickness of over 10,000 ft. The rocks have been greatly disturbed and faulted. Their age has been shown to be in part Mio., and is thought to extend down through the Eo. and possibly into Cret. Uncon. underlies Monterey series and rests, probably uncon., on pre-Cret. metamorphic ss.

Named for exposures at Pescadero Point and near Pescadero, San Mateo Co.

Peshastin formation.

Pre-Tertiary: Central Washington (Mount Stuart and Snoqualmie quadrangles).

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Peshastin fm.*—Black sl., with grit or cgl., bands of black chert, and lenses of light-gray ls. interbedded. No fossils. Tentatively assigned to Paleozoic, possibly Carbf., based on resemblance to the Carbf. rocks of Sierra Nevada and B. C. Uncon. underlies Swauk fm. (Eocene). Is younger than Easton schist.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Peshastin fm.* rests on Hawkins fm. without any marked evidences of uncon., but in places rests uncon. on Easton schist. Is of great thickness. Named for canyon of Peshastin Creek, near mouth of Negro Creek, Mount Stuart quad.

C. E. Weaver, 1911 (Wash. Geol. Surv. Bull. 6). *Peshastin fm.* seems to correspond most closely to Cache Creek series of B. C. and Calaveras fm. of Calif. and is therefore tentatively assigned to Carbf. or older.

W. S. Smith, 1915 (School Mines Quart., vol. 36, pp. 154–169). There is fossil evidence that the ls. of *Peshastin series* is Paleozoic.

W. S. Smith, 1916 (Jour. Geol., vol. 24, pp. 559–583). *Peshastin fm.* correlates with a series of sed. rocks containing definite Trenton fossils that occur in Skykomish Basin, to west.

Petaluma formation.

Pliocene (lower): Northern California (north of San Francisco Bay region).

R. E. Dickerson, 1922 (Calif. Acad. Sci. Proc., 4th ser., vol. 11, No. 19, with maps). *Petaluma fm.*—Chiefly lacustrine deposits of clays, clay sh., and sss. Characterized by great abundance of clays, but only in certain stream canyons is there opportunity to observe them. Is a fresh-water and brackish-water phase of marine San Pablo fm., and is confined to NE. corner of Petaluma quad. and SE. corner of Santa Rosa quad. Is uncon. overlain by Merced group or its correlative the Sonoma group. Is probably underlain by Monterey group at many localities. [Apparently named for exposures in vicinity of Petaluma, Sonoma Co.]

R. R. Morse and T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 10, pp. 1437–1455). *Petaluma fm.*, 4,000+ ft. thick, is divided into 2 mapped units, called *Upper Petaluma fm.* and *Lower Petaluma fm.* The *Upper Petaluma* is of fluviatile or lacustrine origin, consisting chiefly of poorly stratified clays with thick lenses of ill-sorted sands and gravels. The characteristic gray-green clays are only indistinctly bedded. The sands are usually greenish gray and intricately cross-bedded; irregular lenses of sands, up to 200 ft. thick, are common, and often grade laterally into gravels of predominantly Franciscan material. Small nests of gravel and scattered boulders are common throughout. Grades into *Lower Petaluma fm.*, which is 500 to 600 ft. thick; of estuarine origin; consisting of dark laminated clay shales and thin sands with, at several horizons, an abundance of smooth-valved ostracodes and fish debris, and with, locally, thin beds of gray ls. interbedded in the sh.; at base a transition zone, of alternating volcanics and ostracode sh., 122 to 168 ft. thick, which grades into underlying Tolay volcanics. Is overlain, with angular uncon., by Sonoma volcanics (of upper or middle Plio. age), and is correlated with Orinda fm. in its broader sense, as recognized in Mount Diablo region. Assigned to Lower Plio. A better description of Petaluma fm. could scarcely be given than in Lawson's words describing the Orinda.

Pete terrane.

Cretaceous: Kansas.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 255). *Pete terrane*, shales, 50 ft. thick. Underlies Brookville terrane (sss.) and uncon. overlies Mentor terrane, top of Comanchean. Included in Dakotan. [Derivation of name not stated.]

†Peter sandstone.

An abbreviation of *St. Peter ss.* introduced by C. [R.] Keyes. (See Pan-Am. Geol., vol. 38, No. 4, 1922, pp. 313–326, and subsequent volumes.)

Petermann series.

Lower Cambrian: Eastern Greenland.

C. Teichert, 1933 (Meddelelser om Grønland, Bd. 95, No. 1, p. 26).

Petersburg formation.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84, p. 2). *Petersburg fm.*—Alternating sss. and shales with persistent bed of ls. at top. Thickness 80 ft. Underlain by Brazil fm. and overlain by Millersburg fm. Limited below by base of Petersburg coal, and above by base of Millersburg coal (No. 7).

Redefined by E. R. Cumings in 1922 (Ind. Geol. Surv. Sep. Pub. 21) so as to include coal No. 7 at top, and at base all beds down to top of coal No. 4. As thus redefined it is discon. overlain by Shelburn fm. and discon. underlain by Staunton fm.

This name was used by F. W. DeWolf in Ill. (Ill. Geol. Surv. Bull. 16, 1910, pp. 178–181) for beds extending from top of coal No. 6 to base of coal No. 5, the underlying beds down to base of coal No. 2 being called by him *LaSalle fm.* The Petersburg and LaSalle of DeWolf comprise Carbondale fm. of present nomenclature.

Named for Petersburg, Pike Co.

Petersburg granite.

Pre-Cambrian: Eastern Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Petersburg granite.*—Coarse to fine gray biotite granite with coarse pink porphyritic facies intruded by fine bluish granite in Fredericksburg, Richmond, and Emporia areas. Mapped over large area including Petersburg.

Petersburg sand.

A subsurface sand in Mooretown ss. (Miss.) of Cumings in Ind.

Peters Creek schist.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania, northern Maryland, and northeastern Virginia.

A. I. Jonas and E. B. Knopf, 1921 (Wash. Acad. Sci. Jour., vol. 11, p. 447). An upper member of Wissahickon fm. that is less highly anamorphosed than the Wissahickon itself has been separated and named by the writers the *Peters Creek schist*. It may represent Harpers schist memb. of Mont Alto qtzite of central Pa.

E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 40–62). [See quotation under *Wissahickon fm.*]

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped *Peters Creek qtzite* over a large but disconnected area in NE. Va.

Named for exposures along Peters Creek, which enters Susquehanna River at Peach Bottom, Lancaster Co., Pa.

Peters Mountain sandstone. (In Pocono formation.)

Mississippian: Central Pennsylvania.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 573). Pocono fm. is usually tripartite. At its base occur locally Griswolds Gap cgl. or, to W., Knapp cgl. or ss. Overlying these is massive conglomeratic "Berea" ss. A similar massive pebbly memb., the Burgoon ss., forms highest third of fm. A middle platy div., *Peters Mtn ss.*, intervenes btw. the "Berea" and the Burgoon. This trifid character is distinctive throughout central Pa. *Peters Mtn ss.* was proposed by writer in rept. on Miss. system of Pa. submitted in 1935 to National Research Council. Named for Peters Mtn, Dauphin Co.

Peterson limestone. (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 82). *Peterson ls.*—Massively bedded near top; very persistent throughout region, forming prominent ridges that can be followed by the eye for miles from some of higher summits. Thickness 205 ft. Underlies Bechler cgl. and overlies Ephraim cgl.; all in Gannett group. Named for exposures E. of Peterson's ranch, along Tygee Creek, sec. 34, T. 7 S., R. 46 E., Boise meridian. May be Jurassic.

Peterson Creek syenite.

Jurassic (?): British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 82).

Petersville shale.

Mississippian: Northeastern Kentucky.

W. C. Morse and A. F. Foerste, 1912 (Ky. Geol. Surv. Bull. 16, p. 24). *Petersville sh.* proposed as substitute for hyphenated term *Bedford-Berea sh.*, because S. of Vanceburg, Lewis Co., the Bedford and Berea cannot be separated.

Named for Petersville, Lewis Co.

†Pethtle rocks.

A name applied locally in W. Va. to Gilmore ss. memb. of Greene fm. (See I. C. White, W. Va. Geol. Surv., vol. 1, 1899, pp. 197–213.)

Petit-Bourg series.

Age (?): West Indies.

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 513).

Petitcodiac series.

Pennsylvanian: New Brunswick.

W. J. Wright, 1922 (Canada Geol. Surv. Mem. 129, p. 25). [Assigned to Carbf. by Wright; but G. W. H. Norman, 1932 (Canada Geol. Surv. Econ. Geol. ser. No. 9, p. 172) assigned it to Penn.]

Petoskey limestone.

Middle Devonian: Michigan (northwestern part of Lower Peninsula).

A. W. Grabau, 1902 (Mich. Geol. Surv. Rept. 1901, pp. 201, 210). *Petoskey ls.*—Lss. and dolomites, 360 ft. thick, underlying 45 to 50 ft. of chert beds forming top div. of Traverse group and overlying *Acervularia* and *Stropheodonta nacrea* beds, all of which are included in Traverse group.

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14). *Petoskey fm.* was first applied by Grabau, to beds largely equiv. to the fm. herein proposed, but without proper delimitation. Since the term is particularly applicable it has been here adopted to the usage proposed. Thickness 13 to 100+ ft. Consists of lss. with some beds of sh. Forms top div. of Traverse group in northern counties of Lower Peninsula. Overlies, with uncon. and overlap, Charlevoix stage of Traverse group. [Gives details of beds and faunal zones. See also under *Charlevoix stage.*]

Probably named for exposures at Petoskey.

†Petro limestone lentil (of Bingham quartzite).

A name inadvertently used on map and in places in text of U. S. G. S. P. P. 38, 1905, for the Tilden ls. lentil of Bingham qtzite in Bingham dist., Utah. The Tilden is the ls. in Petro mine.

Petro oil sand.

Name locally applied to a sand (in Carbondale or in Pottsville fm.) lying about 230 ft. below Herrin (No. 6) coal, in Wamac field of Centralia area, Marion Co., SE. Ill. It is 30 ft. thick.

Petrolia 1st sand.

Drillers' term for a sand in Pocono fm. of Butler Co., Pa., which lies about 120 ft. above Butler 2d sand.

Petrolia shale.

Devonian: Ontario.

C. R. Stauffer, 1915 (Canada Geol. Surv. Mem. 34, pp. 4, 192).

Petrolia shale member (of Hamilton formation).

Devonian: Ontario.

W. Malcolm, 1915 (Canada Geol. Surv. Mem. 81, p. 42).

Pettus sand.

A subsurface sand in the upper Eocene of Driscoll pool, Duval Co., Tex. It is said to belong to Yegua fm. (See A. A. P. G. Bull., vol. 15, No. 7, pp. 778–782, 1931.) A. Deussen and E. W. K. Andrau (A. A. P. G. Bull., vol. 20, No. 5, 1936, p. 540) assign it to uppermost part of Yegua fm. in Pettus dist., where it lies 170 ft. above Tuleta sand.

Petty Hill moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County). Named for Petty Hill. See N. Y. State Mus. Bull. 187, 1916.

Pewabic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. Pumpelly, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 21–25, 28). [Called *Pewabic copper-bearing bed.*]

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 58, 86, and chart). [Called *Pewabic lode* and *Pewabic cupriferous bed,* and said to consist of amygdaloid.]

Belongs to Ashbed group. The mineralized part is the Pewabic lode. Named for occurrence in Pewabic mine, Houghton Co.

Pewabic flow.

Includes Pewabic amygdaloid and underlying trap.

Pewabic quartzite.

Pre-Cambrian (Huronian): Northeastern Minnesota (Gunflint Lake region).

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept., pp. 79, 86). *Pewabic qtzite.*—A great qtzite near top [?] of the Animikie in region of Gunflint Lake to Ogishke Muncie Lake. Named for Chippewa word meaning *iron.*

N. H. Winchell, 1891 (Minn. Geol. Nat. Hist. Surv. 18th Ann. Rept.). *Pewabic qtzite* is considered to overlie Animikie black sl., unless there are two great qtzites.

N. H. and H. V. Winchell, 1891 (Minn. Geol. Nat. Hist. Surv. Bull. 6). At base of Animikie series is a fragmental quartz ss. 300 ft. thick—the *Pewabic qtzite*. Includes iron ore beds.

N. H. Winchell, 1893 (Minn. Geol. Nat. Hist. Surv. 20th Ann. Rept.) *Pewabic qtzite* at base of Animikie series lies uncon. on all older rocks. In many places it is conglomeratic. It includes the qtzite of Pokegama Falls, on Mississippi River, and of Pipestone Co.

H. V. Winchell, 1893 (Minn. Geol. Nat. Hist. Surv. 20th Ann. Rept.), correlated *Pewabic qtzite* of Gunflint Lake with Pokegama qtzite of Mississippi River.

A. H. Elftman, 1894 (Minn. Geol. Nat. Hist. Surv. 22d Ann. Rept., pp. 150–180). The so-called *Pewabic qtzite* btw. Birch Lake and Gunflint Lake belongs to middle memb. (iron-bearing) of the Animikie. The *Pewabic qtzite* is lower memb. of the Animikie. It disappears entirely in vicinity of Iron Lake.

J. E. Spurr, 1894 (Minn. Geol. Nat. Hist. Surv. Bull. 10). So far as yet definitely known the *Pewabic qtzite* is basal memb. of Animikie series.

U. S. Grant, 1894 (Minn. Geol. Nat. Hist. Surv. 22d Ann. Rept., pp. 67–78). The name "Pewabic qtzite" was proposed for and applied to the iron-bearing rocks of Akeley Lake (N. H. Winchell, 16th Ann. Rept., p. 86, 1888). [Akeley Lake lies W. of Gunflint City.] Subsequently this term has been applied quite extensively to qtzite memb. at base of Animikie on western Mesabi range, so that now the term Pewabic usually refers to this qtzite, which, however, in the Minn. repts has been considered as=the iron-bearing rocks of Akeley Lake. Writer would refer these rocks to the iron-bearing memb., if they belong to the Animikie.

U. S. Grant, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, pp. 166–190). Pokegama qtzite is called at times *Pewabic qtzite*. It is a persistent horizon at base of Animikie series.

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, pp. 181, 398). *Pewabic qtzite* belongs with Keewatin, but whether to Lower or Upper Keewatin is not known. Pokegama qtzite belongs to the Animikie. It blends into the iron fm. and to E. is replaced by Pewabic qtzite. The Pokegama is associated with taconitic iron ore and the Pewabic with jaspilitic. The Pokegama is not known to be titaniferous; the Pewabic is usually distinctly titaniferous. The Pokegama qtzite is never associated with the peculiar muscovadyte, but the Pewabic is never without it. The Pokegama qtzite, with its taconitic companion, is known to be overlain by the black slates of the Animikie, and occurs only westward from Iron Lake. The Pewabic qtzite is overlain and underlain invariably by muscovadyte, or by "gabbro," where the alteration was intense, and occurs only eastward from vicinity of Iron Lake.

Pewabic West conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 82 and chart). *Pewabic West cgl.* is cgl. No. 16 of Houghton Co.

Is in Ashbed group.

Probably named for occurrence in old Pewabic West mine, Houghton Co.

Peyotes division.

Cretaceous: Mexico.

E. Ordóñez, 1908 (Min. and Sci. Press, vol. 96, p. 363).

Pfeifer shale member (of Greenhorn limestone).

Upper Cretaceous: North central Kansas.

N. W. Bass, 1926 (Kans. Geol. Surv. Bull. 11, p. 32). *Pfeifer sh. memb.*—Chalky sh. interbedded with soft thin chalky lss.; the "fence-post ls." forms top bed. Thickness 19 to 21 ft. Top memb. of Greenhorn ls. in Russell to Hamilton Counties. Overlies Jetmore chalk memb. of Greenhorn ls. and underlies Fairport chalky sh. memb. of Carlile sh.

Named for exposures 2½ mi. NW. of Pfeifer, Ellis Co.

Phalen Lake volcanics.

Tertiary (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 101; map). *Phalen Lake volcanics.*—Series of lavas, tuffs, and breccias over 1,000 ft. thick. Do not resemble

Rossland volcanics, but may possibly be in part correlative with Rossland. Not metamorphosed and, except for surficial alteration, appear relatively fresh. Tuffaceous phases light-colored and have grayish-white tint, fine-grained, and greatly indurated. Occupy 11± sq. mi. in north-central part of county, 7 mi. S. of Rossland volcanics. Rest uncon. on upturned and eroded edges of Mission argillites and Northport ls. Form steep escarpment overlooking W. side of Phalen Lake. Assigned to Tert. [See *Rossland volcanic fm.*]

Phanerozoic eon.

A term that has been proposed (see C. Schuchert and C. O. Dunbar, Textbook geol., pt. 2, p. 70, 1933) to include Cambrian and all subsequent time. Derived from the Greek *phaneros*, visible.

†Phelps sandstone.

Devonian (?): Southwestern Missouri.

E. M. Shepard, 1898 (Mo. Geol. Surv. vol. 12, pt. 1, pp. 49, 77–82). *Phelps ss.*—Soft, irregularly bedded coarse-grained ss., 0 to 4 ft. thick, uncon. overlying Sac. ls. and uncon. underlying so-called (not typical) Louisiana ls., of Kinderhook group. Top fm. of Hamilton stage of Dev. in Greene Co., Mo.

S. Weller, 1901 (Jour. Geol., vol. 9, pp. 130–148), included *Phelps ss.* in Kinderhook.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 41–42), assigned *Phelps ss.*, 10 ft. thick, to Hamilton (Dev.), and correlated it with Sylamore ss. of Ark.

G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 67), assigned *Phelps ss.* to Hamilton, as did Otto M. Smith and Paul C. Standley, 1907 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, pp. 73–74).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29), correlated *Phelps ss.*, Sac ls., and King ls. with Louisiana ls., and assigned all to Kinderhook.

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser., p. 177), assigned *Phelps ss.* to Miss. In southern and western Mo. it occupies a strat. position near that of Hannibal sh. of NE. Mo.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.), assigned *Phelps ss.* to Kinderhook group.

E. B. Branson, 1923 (Mo. Bur. Geol. and Mines vol. 17, 2d ser.), stated *Phelps ss.* is=Sylamore ss.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., p. 108). Sylamore ss. was called *Phelps ss.* in earlier Mo. repts.

Named for Phelps mines, Greene Co.

Phi Kappa formation.

Ordovician (Lower and later?): Central Idaho (Hailey quadrangle).

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10, 18). *Phi Kappa fm.*—Upper 4,600 ft. consists of a series of dark shales and interbedded yellow shaly sss.; lower 4,800 ft. consists of medium and fine-grained qtzitic sss. and flinty argillites, commonly black, weathering to rusty slabs. Graptolites of lower and upper parts indicate late Chazy age. Uppermost 25 ft. contains fauna that may be late Middle or Upper Ord. In fault contact with overlying Trail Creek fm. (Sil.). Rests on argillites carrying Lower Ord. (Beekmantown) fossils. Named for exposures along Phi Kappa Creek, Hailey quad.

Philadelphia brick clay.

Pleistocene: Southeastern Pennsylvania and southwestern New Jersey.

H. C. Lewis, 1881 (Phila. Acad. Nat. Hist. Sci. Proc., vol. 32, pp. 258–272, 296–309). *Philadelphia brick clay.*—Of large extent and with numerous boulders. Is confined to river valley. Rests uncon. on both Philadelphia red gravel and the Fossiliferous gravel, now called Glassboro gravel. Philadelphia is in part built on this clay. Thickness about 15 ft.

F. D. Chester, 1884 (Am. Jour. Sci., 3d, vol. 27, pp. 189–199). Yellow brick clay, sand, loam, or loamy gravel, 5 to 20 ft. thick, which "we shall call *Philadelphia clay*, after Prof. H. C. Lewis." Overlies the Red Gravel.

Is a part of Cape May and Pensauken fms., according to U. S. G. S. Philadelphia folio (No. 162), 1909, and both underlies and overlies the "Red gravel."

†Philadelphia mica schists and gneisses.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6, map and pp. 28–31). *Philadelphia mica schists and gneisses* [on map], *Philadelphia group* of mica schists and gneisses [in text]. Extends from Delaware River at Trenton westward across Schuylkill River into Delaware Co.

Replaced in part by Wissahickon fm.

Philadelphia red gravel.

Pleistocene: Southeastern Pennsylvania.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc., vol. 32, pp. 258–272, 296–309). *Philadelphia red gravel.*—Stratified clayey gravel composed of pebbles on the Fossiliferous gravel (Glassboro gravel) mixed with fragments of Triassic red sh. and other rocks brought down Delaware Valley. Rests on decomposed gneiss. Philadelphia is in part built on this gravel. It might be called *University gravel* for distinction, as good sections of it are seen near University of Pa. Thickness 20 ft. Uncon. underlies Philadelphia brick clay.

Is a part of Pensauken fm., according to U. S. G. S. Philadelphia folio (No. 162), 1909.

Philadelphia moraine.

Pleistocene (Wisconsin stage): Northwestern New York (Jefferson County).

Named for Philadelphia, Jefferson Co. (See Jour. Geol., vol. 32, 1924, pp. 645, 660.)

A. F. Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 44–45). Extends from near Philadelphia, Jefferson Co., to 1 mi. E. of Antwerp, Jefferson Co.

Philipsburg series.

Phillipsburg series.

Lower Ordovician and older (?): Southern Quebec and northwestern Vermont.

W. E. Logan, 1863 (Geol. Surv. Canada, pp. 273–280, 844–854), described the rocks of Philipsburg, Quebec, region, but did not definitely name them. Assigned them to Quebec group.

R. W. Ells, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 16J to 17J, 30J to 32J). *Phillipsburg series*, Cambro-Silurian, Quebec, Canada. Included in Quebec group. Includes Lower Phillipsburg (Calciferous), Upper Phillipsburg (Chazy). [Later Canada repts spell this name with one *l*.]

H. W. McGerrigle, 1931 (17th Rept. Vt. State Geol., pp. 184–186). The term "*Philipsburg series*" is meant to include a group of 13 fms. ranging in age from Ozarkian to Chazy and extending from about latitude of Highgate Springs, Vt. northward across Quebec-Vt. bdy for about 20 mi. Named for village of Philipsburg, Quebec, where the lower fms. of the series are well exposed. Logan has given most complete account of Philipsburg series, and his table of fms. (p. 273 of rept cited above) has been the standard of reference for other workers in the field. Following outline of his table is given (descending):

D3. Gray and black striped slates, 1,500.
D2. Black and greenish argill, slates, 1,000.
D1. Ls. cgls., at least 2 bands, separated by slates, 300.
C2. Black slates or thin-bedded black lss., 170.
C1. Black massive, pure lss., 150.
B5. Black lss., mag. beds at base, 350.
B4. Black slaty thin-bedded lss., 300.
B3. Dark bluish-gray thin-bedded lss., 150.
B2. Dark lss., some mag. beds, 120.
B1. White and dove-gray pure lss., some mag. beds, 120.
A3. Reddish gray and black dolomites, some thin-bedded black lss., 200.
A2. White and dove-gray pure compact lss., 100.
A1. Dark-gray and yellowish-white dolomites, 400.
Total thickness, 4,860 ft.

In this rept only fms. A1 to B3 inclusive are considered. During writer's work on Philipsburg series N. of Int. Bdy it was found advisable to make some changes over Logan's section from A1 to B3, as outlined below:

Logan's section:		Revised section (all mapped in Vt.):
B3, 150		Luke Hill 160
B2 (summit bed)	120	Naylor Ledge 30
B2 (below summit bed)		Hastings Creek 260
B1, 120		
A3, 200		Morgans Corners (dol.) 150 Wallace Creek fm. (interstratified thin-bedded shaly lss. with thicker bedded lss.) 200-250
A2, 100		Strites Pond 400
A1, 400		Rock River 500

Philipsburg series is older than his Highgate Springs series. [Type localities of all of above newly named fms. are in Quebec.]

†Philipsburg formation.

Lower Ordovician: Northwestern Vermont and eastern New York.

R. P. Whitfield, 1890, suggested this name for same beds that have been called "Cassin fm." and "Fort Cassin fm." (See explanation under *Beekmantown group*.)

Phillips formation.

Pre-Cambrian: Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 2, 114°30′ to 115°). *Phillips fm.*—Purplish to red thin-bedded metargillite and qtzite. Underlies Roosville fm. and overlies Gateway fm.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 108, table at p. 178). *Phillips fm.*—Chiefly dark-purplish or brownish-red fine-grained to compact metargillite and metasandstone in alternating thin beds. At base 3 massive beds of gray qtzitic ss., 4, 10, and 20 ft. thick, are intercalated. Thickness 550 ft. Conformably underlies Roosville fm. and grades into underlying Gateway fm. Named for occurrence on two summits about 2 mi. N. of Phillips Creek.

Phillips sand.

A subsurface sand lying 600± ft. below top of Colorado sh. in Bowdoin dome, NE. Mont. See under *Martin sandy zone*.

Phillips moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County). Named for Phillips place. See N. Y. State Mus. Bull. 187, 1916.

Phillipsburg series. See *Philipsburg series*.

Philson limestone. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Somerset County).

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, pp. 286, 292). *Philson ls.*, underlies Philson (or Rose) coal, and lies about 40 ft. above Gallitzin coal. Thickness 3 ft.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q. pp. 303–305). Brush Creek ls. is same as *Philson ls.* of Somerset Co.

J. D. Sisler, 1925 (Pa. Geol. Surv. 4th ser., Bull. M_2, pp. 268, 331). [Gives following downward sequence of beds in Conemaugh of Somerset Co.: Elk Lick coal, Elk Lick ls., Berlin coal, Berlin ls., Platt coal, Price coal, Coleman coal, Coleman ls., Philson (Rose) coal, *Philson ls.*, Johnstown iron ore, Brush Creek (Gallitzin) coal, Mahoning ss.]

Probably named for exposures at or near Philson, Somerset Co.

Phipsburg limestone.

Age (?): Maine.

C. T. Jackson, 1838 (Rept. on geol. of Maine, vol. 2, pp. 61–62), refers in several places to *Phipsburg ls.* of Phipsburg Basin. This is an econ. rept.

Phoenix beds.

A name that has been used, but not defined, by F. M. Anderson (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 1-62, 1902) for a part of lower beds of Chico age in southern part of Oregon Basin.

Phoenix limestone lentil (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 44, map, and sections). *Phoenix ls. lentil of Bingham qtzite.*—White or light-colored siliceous marble. Thickness 0 to 300 ft. [Sections show it some distance above Tilden ls. lentil. Crops out at mouth of Phoenix mine.]

Phoenix volcanic group.

Mesozoic (?) and older (?): Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 9, 10, 118° to 119°). *Phoenix volcanic fm.*—Flows and pyroclastic deposits of augite andesite, etc. Carbf. to Triassic.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 383, 385, 377-388). *Phoenix volcanic group.*—Pyroclastic flows (?) and contemp. intrusions of porphyrite. The town of Phoenix is in midst of this large though interrupted area of basic volcanics. *Phoenix volcanics* are possibly largely Mesozoic and contemp. with andesitic members of Rossland group. Uncon. is believed to exist btw. Phoenix group and Attwood series. [See *Rossland volcanic fm.*]

Phoenix or Schroeppel shale.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327-368). *Phoenix or Schroeppel sh.*—Olive-colored sh. and intercalated sss. underlying Donnelly ore and Lakeport ls. and overlying Kirkland iron ore or ls. Thickness 62 ft. at South Granby and Lakeport, from which place the beds are connected by numerous outcrops with the upper sandy layers at Clinton and Utica. Westward the sandy layers at this horizon drop out and thin limy ones come in, increasing until finally the division seems to merge into Irondequoit ls. Fossils listed. Type loc. at Phoenix, on Oswego River [Oswego Co.]. Since *Phoenix* has been used for ls. in Utah and for volcanic fm. in B. C., recourse may be had, if necessary, to *Schroeppel*, the Twp in which Phoenix lies.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347). Clinton fm. in Lakeport, N. Y., region divided into (descending): Sh. of Rochester age, 29 ft.; Lakeport ls. (of Rochester age), 17 ft.; Donnelly ore (of Rochester age); *Schroeppel sh.*, 62 ft.; ls. of Irondequoit age, 6 ft.; *Brewerton sh.*, 36 ft.; *Williamson sh.*, 105 ft.; Wolcott ls., 18 ft.; Sodus sh., 31 ft.; *Reynales ls.*, 7 ft.; and Maplewood sh., 7 ft. [*Schroeppel sh.* is shown as=lower part of Rochester sh. and underlying Irondequoit ls., as younger than *Williamson sh.*, and as pinching out E. of Wolcott, where Irondequoit ls. rests on *Williamson sh.* and *Williamson sh.* rests on Wolcott ls. This is position assigned to *Williamson sh.* by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10).]

†Phoenix Mine group.

Pre-Cambrian (Keweenawan): Northern Michigan (Keweenaw County).

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 175-178). Beneath the Greenstone (bed 108), and separated from it by a red clay seam, which is known locally as "The Slide" and is a thin cgl. bed farther E. and W., a few hundred ft. of rock are exposed to view in Phoenix mine, which is one of the numerous workings just beneath the Greenstone on N. and S., or crossing veins. The total thickness of these beds, which I may appropriately call *Phoenix Mine group*, is 685 ft., in beds ranging from 9 to 160 ft. Overlies Kingston cgl., from which it is separated by a covered space of 2,325 ft.

Includes upper part of Central Mine group.

Phoenix Park quartz latite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). Lava flows and tuff breccias of a fairly uniform rock. Thickness 0 to 500 ft. Is a fm. in Alboroto group of Potosi volcanic series. The main body rests on a fairly regular surface of Campbell Mtn rhyolite, and uncon. underlies Mammoth Mtn rhyolite. Another body of similar rock occurs as a lens btw. flows of Campbell Mtn rhyolite, and it is believed there was an interbedding of the two types of material. Named for development about Phoenix Park.

†Phoenixville shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1894 (Am. Phil. Soc. Proc., vol. 33, pp. 197–215). *Gwynedd and Phoenixville shales.*—In great part hard, dark or greenish gray and blackish, partly dark red, at Gwynedd and Phoenixville tunnels, with traces of coal. Thickness 3,500 ft. Underlie Lansdale shales and overlie Norristown shales.

Same as Lockatong fm., of Newark group.

Phosphoria formation.

Permian: Northeastern Utah, eastern Idaho, central western, central southern, and southwestern Montana, and western Wyoming.

R. W. Richards and G. R. Mansfield, 1912 (Jour. Geol., vol. 20, pp. 683–689). *Phosphoria fm.*—Phosphatic shales, with some thin lss., and, at top, Rex chert memb. In region of Bannock overthrust (SE. Idaho and NE. Utah) thickness of fm. is 75 to 627 ft. and thickness of Rex chert memb. 0 to 450 ft. Is=upper two members of Park City fm. of Park City dist., Utah, namely the phosphate shales and the "overlying chert." Overlies Wells fm. (Penn.) and underlies Woodside sh. (Triassic). Named for Phosphoria Gulch, which joins Georgetown Canyon 2.5 mi. N. 16° W. of Meade Park, Idaho, in which the fm. is typically exposed. [Complete detailed section at type loc. given and fossils listed.]

Piasa limestone. (In McLeansboro formation.)

Pennsylvanian: Southwestern Illinois (Jersey, Macoupin, *or* Madison Counties).

H. E. Culver, 1925 (Ill. Geol. Surv. Coop. Min. Ser. Bull. 29, p. 20). In S. part of 3d dist. are one or more lss. in McLeansboro fm. which can be traced considerable distances. The most important of these are *Piasa ls.*, named for Piasa Creek, on which it is most excellently exposed, and *Golden Eagle ls.*, well known in Calhoun Co. These beds are of considerable value in strat. work, since they constitute horizon markers which can be positively identified over relatively large areas. [Position within McLeansboro fm. not defined.]

Piasa Creek runs through SE. corner of Jersey Co., SW. corner of Macoupin Co., and NW. corner of Madison Co.

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, pp. 129–138). *Piasa ls.* overlies coal No. 7 and is 5 to 6 ft. thick in places in Jersey Co. Is older than Lonsdale ls.

†Picacho limestone.

Permian: Southeastern New Mexico (Roswell artesian basin).

A. G. Fiedler and S. S. Nye, 1933 (U. S. G. S. W. S. P. 639). *Picacho ls.*—A lithologic unit consisting dominantly of ls. and dolomitic ls. but including minor amounts of ss., sh., gyp., and anhydrite, whose upper and lower limits are variable with respect to strat. position and time. Throughout most of Roswell artesian basin the Picacho ls. is underlain, apparently conformably, by Nogal fm., but in SE. part of basin the Nogal gives place laterally to a thick ls. section, which is tentatively included in Picacho ls., and there the Picacho rests on the older Abo ss. Thickness of fm. 800 to 1,200 ft. where it underlies Pecos fm. and overlies Nogal fm., but top of fm. is locally eroded away. Named for town in vicinity of which lower part is well exposed. The beds here named *Picacho ls.* are believed by geologists working in this region to be strat. equiv. of San Andres ls. of Lee and Girty, and have been referred to by that name for years.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Picacho ls.* here abandoned for *San Andres ls. memb. of Chupadera fm.*, and *Nogal fm.* here abandoned, being replaced by Hondo ss. memb. of Chupadera fm. (above) and Yeso memb. of Chupadera fm. (below). [As originally defined and heretofore used San Andres ls. rested on the Yeso. The recognition of Hondo ss. involves slight redefinition of both Yeso and San Andres.]

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Picacho de Calera formation.

Devonian: Southeastern Arizona.

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 485, 488). *Picacho de Calera fm.*—In Picacho de Calera Hills, 25 mi. NW. of Tucson, consists of 73 ft. of beds (descending): (1) Fossiliferous calc. brown ss., 2 ft.; (2) black dol., 25 ft.; (3) yellow crystalline ls., largely of small calcified algal bodies and interbedded with thin flaggy blue ls., some fossils, 2 ft.; (4) blue ls. in beds 2 to 4 ft. thick, fossiliferous, 40 ft.; (5) yellow calc. ss., probably subeolian, 4 ft. It is there discon. underlain by Rincon ls. (Upper Camb.) and conformably overlain by Martin ls. [restricted]. Has been traced 75 mi. eastward into Rincon and Whetstone Mtns. Is Upper Dev.

Martin ls. (250 to 350 ft. thick) as originally defined and heretofore used included all Dev. of SE. Ariz., and has long been classified by U. S. Geol. Survey as *Upper and Middle Dev.* The foregoing newly described fm. appears to correspond to lower part of Martin ls. of previous repts.

Picayune volcanic group. (In Silverton volcanic series.)

Tertiary (Miocene): Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Picayune andesite.*—Augite andesite in tuff, breccia, or aggl., and massive flows; pronounced porphyritic texture. Thickness 0 to 500+ ft. Is basal div. of Silverton volcanic series. Uncon. underlies Eureka rhyolite and uncon. overlies San Juan tuff.

W. Cross, 1911 (U. S. G. S. Bull. 478, pp. 20, 24–26). *Picayune volcanic group.*—The earliest of lavas of Silverton volcanic series is a dark augite andesite occurring in relatively small exposures in Animas Valley and its minor tributary, Picayune Gulch, and named in Silverton folio the *Picayune andesite*, after latter locality. It is now known that andesite of Picayune Gulch is but one of the rock varieties erupted in first part of Silverton time, and that the complex group of early lavas is most prominent in country btw. Henson Creek and head of Lake Fork and in valleys of these streams. The name *Picayune* will be retained for the group, since it is already in use, and since relations of these rocks to overlying Eureka rhyolite are well shown in original locality. The Picayune volcanic group consists largely of andesite of type first observed, but includes also several kinds of more siliceous lava. The various elements are so irregularly associated as to make it clear the exposed rocks of the group belong to a central volcanic mass made up of surface lava streams, pyroclastic breccia and tuff, and intrusive bodies. The massive rocks have in many places been shattered and dislocated by volcanic shocks.

Picayune andesite.

See 1st entry under *Picayune volcanic group.*

Pic d' Aurore series.

Devonian: Quebec.

J. M. Clarke, 1915 (N. Y. State Mus. Bull. 177, pp. 149, 150).

Pickaway limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450–473). *Pickaway ls.*—Very dark, hard, sandy, stylolitic through most of Monroe Co. Scanty marine fossils. Thickness 175 to 400 ft. Underlies Union ls. and overlies Upper Taggard sh.; all members of Greenbrier series [ls.]. Type loc. along State road btw. Pickaway and Union, Monroe Co. Also observed in Mercer Co., and traced to NE. until it disappears in N. part of Pocahontas Co., W. Va. To SW. it increases in thickness to nearly 700 ft. in Washington Co., Va., but wholly disappears before Ky. and Tenn. lines are reached.

Pickens sandstone.

Pennsylvanian: Northern West Virginia.

J. A. Taff and A. H. Brooks, 1896 (U. S. G. S. Buckhannon folio, No. 34). *Pickens ss.*—White or gray massive ss. and cgl. at base; light-gray or white ss. at top; and a series of brown sss., shales, and coals in medial portion. Thickness 400 to 500 ft. Overlies Canaan fm. [Mauch Chunk sh.] and underlies Pugh fm. Named for town of Pickens, Randolph Co., which is located near its top.

Corresponds to New River "group" of later W. Va. repts.

Pickering gneiss.

Pre-Cambrian: Eastern Pennsylvania and New Jersey.

B. L. Miller, 1912 (Econ. Geol., vol. 7, p. 767). *Pickering gneiss.*—Graphitic gneisses. Name proposed by Miss Bascom, who intends to separate out the graphitic gneisses from the nongraphitic gneisses, both of which she included in Baltimore gneiss in Trenton folio.

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M., pp. 61–66). Observations at several places in Piedmont Plateau lead writer to believe Franklin ls. and Pickering gneiss constitute a single fm. similar to Grenville fm. of N. Y. and Canada. The Franklin ls. or marble is coarsely crystalline, white, with graphite and numerous silicate minerals. The *Pickering gneiss* is banded gneiss or schist containing lenses of highly graphitic schists.

F. Bascom, 1932 (U. S. G. S. West Chester-Coatesville folio, No. 223). Several years ago the writer, in mapping the rocks of Phoenixville quad., Pa., separated the graphitic gneisses from the nongraphitic gneisses and proposed to apply to them the geographic name "Pickering gneiss," restricting the name *Baltimore gneiss* to the nongraphitic rocks, and that name and definition were published in an article by B. L. Miller in Econ. Geol. (vol. 7, p. 767, 1912). More recent work, however, on the pre-Camb. gneisses of SE. Pa. and Del., has led writer to consider the graphitic gneiss associated with recognized Baltimore gneiss as essentially a facies of that fm. and not a distinct fm. In this folio and other repts in preparation, therefore, the graphitic gneiss is included in Baltimore gneiss and name "Pickering gneiss" is dropped.

In 1934 the U. S. Geol. Survey decided to adopt *Pickering gneiss* for the pre-Camb. sed. rocks associated with Franklin ls.—a white, coarsely crystalline ls. or marble, more or less contemp. with Pickering gneiss, with which it is found interbedded as well as apparently overlying. This gneiss is a medium-grained quartz-feldspar-mica rock, usually light-colored, owing to paucity of dark-colored constituents, and pinkish or greenish in tone, owing to abundant altered feldspar. The rock is always gneissic, but in absence of contrasting constituents this texture is not conspicuous. The feldspar is orthoclase, microperthite, microcline, and a sodic plagioclase, albite or andesine. Graphite-bearing beds are an important feature of the fm. in Phoenixville and Honeybrook quads. Uncon. underlies Lower Camb. Thickness unknown. Named for fact that Pickering Creek, Chester Co., lies almost wholly within this gneiss area. This is definition now followed by F. Bascom.

Pico formation. (Of Fernando group.)

Pliocene (upper): Southern California (Los Angeles and Ventura Counties).

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 608–609 and chart opp. p. 586). Over fairly large area in Los Angeles region there is a marked difference in dip and strike btw. the lower and middle Fernando, now referred to *Pico fm.* by U. S. Geol. Survey, and what has previously been referred to as *upper Fernando.* (Footnote: A paper by Dr. W. S. W. Kew, of U. S. Geol. Survey, is now in press in which the Fernando is considered a group composed of Pico and Saugus fms. separated by an uncon.) The beds of this upper horizon contain very large percentage of recent species. The Geol. Survey proposes to use *Saugus fm.* for the upper Fernando section, which is herein referred to as *Saugus group.*

W. S. W. Kew, 1923 (A. A. P. G. Bull., vol. 7, pp. 411–420). The author's name *Pico fm.*, for lower fm. of Fernando group, first appeared in print in 1921, in brief paper by B. L. Clark on Los Angeles region. The fm. is well exposed in Pico Canyon, Los Angeles Co., from which it is named. It is also well exposed in Santa Clara Valley and in San Fernando Valley, where it rests uncon. on Modelo fm. and lies uncon. below Saugus fm. Is entirely of marine origin and contains fauna belonging to base of the Plio.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753). *Pico fm.*, the lower fm. of Fernando group, consists of fine-grained gray ss., interbedded with coarse ss. and cgl., and is about 4,000 ft. thick. Along S. side of Fernando Valley and westward to Las

Virgenes Canyon it consists of laminated gray sandy clay and fine-grained ss. with zones or lenses of white diatomaceous soft sh.; the upper strata largely medium-grained soft ss. with some cgl.

J. E. Eaton, 1926 (Oil and Gas Jour., Nov. 11, 1926, p. 72; Oil Age, Nov. 1926, p. 16). Santa Paula fm., 10,000 ft. thick, previously unrecognized, underlies Pico fm. and uncon. overlies Modelo fm. [See under *Santa Paula fm.*]

In 1932 (16th Int. Geol. Cong. Guidebook 15) *Pico fm.* was restricted to middle and upper Plio. beds and *Repetto fm.* was adopted for lower Plio. beds. The overlying Saugus fm. was also restricted to beds of lower Pleist. age, the beds of upper Plio. age previously included in it being transferred to Pico fm. (See W. P. Woodring, pl. 2 and p. 35; R. D. Reed, p. 31; W. S. W. Kew, p. 49.)

W. P. Woodring now (March 1937) classifies Pico fm. as upper Plio., and this is present age designation of U. S. Geol. Survey.

Picton granite.

Pre-Cambrian: Northern New York (Alexandria Bay, Grindstone, and Clayton quadrangles).

J. M. Clarke, 1909 (N. Y. State Mus. Bull. 133, pp. 9–10). *Picton granite.*—Coarse red granite. Seems to be latest rock in dist. (Alexandria Bay, Grindstone, and Clayton quads.). Outcrops of considerable extent occur on Grindstone and Wellesley Islands, also in Canada, but in N. Y. it occurs chiefly as dikes cutting all other rocks. Assigned to pre-Cambric; later than Laurentian and later than Grenville schists.

H. P. Cushing et al., 1910 (N. Y. State Mus. Bull. 145, p. 11, maps). *Picton granite.*—A coarse, rather bright-red granite, with fine-grained phases. Red feldspars constitute 75 percent of mass. Named for Picton Island (called Robbins Island on all maps) [in St. Lawrence River]. Younger than Alexandria syenite, as it holds inclusions of that rock. Assigned to pre-Camb.

Picton formation.

Ordovician: Ontario.

P. E. Raymond, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 348).

Replaced by *Cobourg ls.*, q. v.

Pictou freestones.

Carboniferous: Nova Scotia.

H. M. Ami, 1899 (Brit. Assoc. Adv. Sci. Rept. 1899, p. 756).

Pictou formation.

Carboniferous: Canada.

H. M. Ami, 1900 (Canadian Rec. Sci., vol. 8, pp. 162–163).

†Picturecliff sandstones.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, p. 279).

Same as Pictured Cliffs ss.

Pictured Cliffs sandstone.

Upper Cretaceous (of Montana age): Southwestern Colorado and northwestern New Mexico.

W. H. Holmes, 1877 (U. S. Geol. and Geog. Surv. Terr. 9th Ann. Rept., for 1875, pp. 248, 250, 251, pl. 35). *Pictured Cliffs group*, also *Pictured Cliff ss.*—Overlies Sand Shale group [later named Lewis sh.] and underlies Laramie (?) group. Assigned to Fox Hills epoch. [In pl. 35 is described as consisting, in valley of Rio San Juan, of 130 ft. of massive sss.; on pp. 247–248 is described as consisting, btw. Pinon Mesa and Mesa Verde, of 30 ft. of white ss. followed [downward] by 100 ft. of brownish and yellowish sss. and shales; on p. 251 is described as consisting, as exposed on San Juan down to Great Hogback, of 40 ft. of white ss. and 60 to 80 ft. of yellowish-gray ss., underlain by 30 to 40 ft. of brownish laminated sss.]

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). Holmes evidently restricted *Pictured Cliffs ss.* to the massive ledges and excluded the interbedded sh. and sss. beneath them, which writer believes should be included, and which he does include, making total thickness of fm. 281 ft. It grades into underlying Lewis sh. and into overlying Fruitland fm., of late Montana age. The Pictured Cliffs ss. has not been recognized outside of San Juan Basin, where it is of variable thickness. It contains a littoral marine fauna of Montana age. [In pl. 4 he correlates it with uppermost part of Pierre sh.]

Named for Pictured Cliffs of San Juan River, in NW. N. Mex.

Picursian series. See *Pecursian series.*

†Piedmont group.

Cambrian and pre-Cambrian: Western North Carolina (Piedmont Plateau).

W. C. Kerr, 1869 (N. C. Geol. Surv. Rept. 2, pp. 13–35). *Piedmont group.*—A series of metamorphic gneissoid rocks, which are essentially a repetition of Buncombe group. It consists of a succession of feldspathic, hornblendic, and micaceous slates and gneiss, the most conspicuous of which is the broad belt of light-colored and gray feldspathic gneiss, sometimes fine, generally coarse-grained and porphyroidal, which extends along W. side of the fm. from upper French Broad to the Catawba in Burke Co. This fm. extends eastward to the King's Mtn slates, being limited in that direction by a line connecting that mtn with the Pilot, in Surry Co., occupying nearly the whole of the piedmont plateau. It may therefore appriately be named *Piedmont group*, although it extends across the Blue Ridge into Henderson and Transylvania Counties.

The rocks described are now divided into many fms. See North Carolina correlation chart.

Named for development in Piedmont Plateau of N. C.

†Piedmont sandstone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, pp. 519–560). *Piedmont ss.*—Upper memb. of *Pottsville (Seral) cgl.* Thickness 160 ft. Upper part consists of white and reddish-white and gray flaggy ss. and cgl.; in middle part cgl. predominates; lower part is principally thinly bedded and conglomeratic ss. [Appears to include more than Homewood ss. memb. of Pottsville fm.]

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. 180, pls. 10 and 11). *Piedmont ss.*, "the upper portion of the Pottsville cgl. (No. XII), the name Piedmont being derived from the Cumberland Basin."

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q. pp. 308–316). *Piedmont (Upper Homewood) ss.* underlies Brookville coal.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2, p. 77). *Piedmont (Tionesta) ss.* is=Homewood ss. [See quotation under †*Tionesta ss.*]

Probably named for Piedmont, Mineral Co., W. Va., where it is well exposed. See U. S. G. S. Piedmont folio, No. 28, 1896, in which Pottsville fm. is mapped as *Blackwater fm.*, and its upper ss. [Homewood=Piedmont] is said to be 110 ft. thick.

†Piedmont crystallines.

†Piedmont gneiss.

†Piedmont granite.

Terms applied by W J McGee, in early repts, to the basement rocks of Atlantic Coastal Plain. In 45th Ann. Rept. Bd. Regents Smithsonian Inst., pp. 72–74, 1891, he says *Piedmont gneiss* "is a vast complex of crystalline rocks extending from Ala. to N. J."

†Piedra formation.

Upper Cretaceous: Southwestern Colorado.

W. Cross, 1899. [See 1899 entry under *Lewis sh.*]

This name probably was intended to apply to so-called Laramie fm. of later repts on SW. Colo. and to include Pictured Cliffs ss., Fruitland fm., and Kirtland sh. of present nomenclature.

Piedra rhyolite (also **Piedra group**). (In Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 36). *Piedra fm.*—Top fm. of Potosi volcanic series. In Platoro-Summitville dist. is overlain by Fisher quartz latite and underlain by Huerto fm.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). In Platoro-Summitville dist. the *Piedra fm.* consists of 0 to 2,000+ ft. of volcanic flows with subordinate tuff, predominantly of rhyolite and quartz latite, and is uncon. on Huerto fm. In Creede dist. the Piedra becomes a *group*, divided into 8 or 9 fms., and is uncon. overlain by Creede fm. and uncon. underlain by Alboroto group, the intervening Huerto fm. being absent there. Named for exposures in Piedra Peak, San Cristobal quad.

E. S. Larsen, 1935 (U. S. G. S. Bull. 843), changed name to *Piedra rhyolite*.

Pie Knob andesite.

Pleistocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, pp. 403–404 and map). *Pie Knob andesite.*—Andesite, 180 ft. thick on Pie Knob, occurring in lower part of Campan series, about 250 ft. above it base. Forms large part of Pie Knob, N. of University Campus, Berkeley.

Pierce limestone. (In Stones River group.)

Lower Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 258–267). *Pierce ls.*—Thin-bedded, flaggy fossiliferous lss., with generally a heavy-bedded layer near base. Thickness 27 ft. Included in Trenton or Lebanon [Stones River] group. Underlies Ridley ls. and overlies Central [Murfreesboro] ls.

Named for Pierce's mill, on Stones River, in Rutherford Co.

Pierce shales.

Pennsylvanian (?): Northwestern Arizona (mouth of Grand Canyon).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 337). *Pierce shales* is name especially applied to the sandy basal red beds of Supaian section, as shown at mouth of Grand Canyon, near Pierce's ferry. Thickness 100 ft.

Pierce Canyon redbeds.

Triassic: Delaware Basin and Pecos River Valley, southeastern New Mexico and western Texas.

W. B. Lang, 1935 (A. A. P. G. Bull., vol. 19, No. 2, pp. 262–270). *Pierce Canyon redbeds.*—Series of fine sandy to earthy redbeds, polka-dotted with green reduction spots and usually irregularly veined with thin secondary selenite fillings. Thickness over most of basin 350 ft., excepting the marginal areas and the Pecos Valley of Reeves Co. No favorable exposures, but a fair outcrop is in vicinity of Pierce Canyon, SE. of Loving, N. Mex. Rests on Rustler fm. Appears to be last definite evidence of Perm. sedimentation in the Southwest.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), discriminated *Pierce Canyon redbeds* much farther N. in Pecos Valley of N. Mex., where they rest on Rustler fm. Age changed to Triassic, on basis of lithology and uncon. at base.

Piercefield gneiss.

Pre-Cambrian: Long Lake quadrangle, Adirondack Mountains, New York.

H. P. Cushing, 1907 (N. Y. State Mus. 60th Ann. Rept., pt. 2, pp. 463, 469–470). *Piercefield gneiss.*—Green syenite gneiss and red granite gneiss, with other gneisses present in minor quantity. Age relations to Long Lake gneiss and Grampus gneiss undet.

Named for exposures about Piercefield, St. Lawrence Co.

Pierpont sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 218). *Pierpont ss.*—Heavy- to current-bedded medium-grained micaceous bluish to light-gray cliff-forming ss. Thickness 40 to 60 ft. Lies 0 to 5 ft. below Pocahontas No. 7 coal, and 0 to 40 ft. above Pocahontas No. 6 coal. Forms cliffs flush with Virginia Railway grade for a short distance SE. from Pierpont, Wyoming Co.

†Pierran series.

A term applied by C. R. Keyes to Pierre sh. and its supposed equivalents.

Pierre shale. (In Montana group.)

Upper Cretaceous: South Dakota, North Dakota, eastern Wyoming, eastern Montana, eastern Colorado, Nebraska, western Minnesota.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 419, 424). *Fort Pierre group (Formation No. 4 of Cretaceous).*—Thickness 700 ft. in Nebr. [which then included Wyo., Mont., and Dakotas]. Underlies Fox Hills beds and overlies Niobrara div. Consists of (descending): (1) Dark-gray and bluish fossiliferous plastic clays exposed on Sage Creek, on Cheyenne River, and on White River above Bad Lands; (2) middle zone, nearly barren of fossils, which occurs at Fort Pierre and out on to Bad Lands—down the Missouri on high country to Great Bend; (3) lower fossiliferous zone, which occurs at Great Bend of the Missouri below Fort Pierre; and (4) dark bed of very fine unctuous clay containing much carbonaceous matter, with veins and seams of gyp., masses of sulphuret of iron, and numerous small scales of fishes, and occurring near Bijou Hill, on the Missouri.

Rocky Mtn Ass. Pet. Geol. (by its Committee, composed of T. S. Lovering, H. A. Aurand, C. S. Lavington, and J. H. Wilson), 1932 (A. A. P. G. Bull., vol. 16, No. 7, pp. 702–703). After a field conference with *J. B. Reeside, Jr.*, of U. S. Geol. Survey, *the Rocky Mtn Ass. Pet. Geol. has agreed to restrict the term Fox Hills as follows:* The base of Fox Hills fm. shall be considered as the horizon below which the section is predominantly gray marine clay shales and sandy shales of Pierre age, and above which the section changes rapidly to a buff to brown ss. containing numerous large gray to brown hard sandy concretions. This lower concretionary memb. is commonly overlain by a series of light-gray to brown sss. and sandy shales. The top of Fox Hills fm. shall be considered as the horizon above which the section is composed predominantly of fresh-and brackish-water deposits accompanied by coals and lignitic shales, and below which it is predominantly marine.

Lower fm. of Montana group.

Named for exposures at old Fort Pierre, in either Stanley or Hughes Co., S. Dak. The exact location of the old fort is not known.

Pierson limestone.

Mississippian (Osage): Southwestern Missouri.

S. Weller, 1901 (Jour. Geol., vol. 9, pp. 140, 144). *Pierson ls.*—Fine-grained buff-colored gritty ls., 3 to 30 ft. thick, forming top fm. of Kinderhook group in SW. Mo. Overlies Northview ss. and sh. Frequently nonfossiliferous, but often fossiliferous. Represents only upper part of Chouteau ls. of central Mo.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser.), correlated Pierson ls. with Fern Glen ls., which is now included in Osage group.

Named for Pierson Creek, Greene Co.

Pierson Point shale. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 80). *Pierson Point sh.*—Basal bed of McKissick Grove sh. memb. of Wabaunsee fm. Bluish argill. sh. and some sand; upper part, and at places lower part, nearly black. Thickness 8 to 10 ft. in Nebr. and Kans. Overlain by Maple Hill ls. and underlain by Tarkio ls. memb. Named for Pierson's Point, SE. of Falls City, Nebr.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), discarded McKissick Grove sh. and treated its subdivisions as *fms.* in Wabaunsee group.

Pigeon slate.

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 2). *Pigeon sl.*—Sl., of great uniformity, bluish gray when fresh, but weathers dull yellow. Mainly argill., occasionally banded by thin seams of coarser siliceous material. A few thin beds of fine white ss. occur at various parts of fm., notably toward top. Thickness 1,300 to 1,700 ft. Overlies Citico cgl. and underlies Cades cgl.

Equivalent to upper part of Hiwassee sl.

Named for exposures near West Fork of Little Pigeon River, Sevier Co., Tenn.

Pike gravel member (of Trinity formation).

Lower Cretaceous: Southwestern Arkansas.

H. D. Miser and A. H. Purdue, 1918 (U. S. G. S. Bull. 690B). *Pike gravel memb. of Trinity fm.*—Irregularly bedded pebbles and cobbles up to 10 in. diam. Thickness 100 ft. Basal memb. of Trinity fm. in Caddo Gap and De Queen quads. Rests uncon. on Atoka fm. (Penn.). Named for Pike, Pike Co.

H. D. Miser, 1927 (A. A. P. G. Bull., vol. 11, No. 5, pp. 443–453). Near Ark.-Okla. line the Pike gravel memb. and the younger Ultima Thule gravel memb. merge.

Pike sand.

A subsurface sand in Pottsville fm. of Knox, Knott, and Pike Counties, SE. Ky.

Pike Creek volcanic series.

Tertiary (late): Southeastern Oregon (Steens Mountain).

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, pp. 7–130). *Pike Creek volcanic series.*—Series of alternating acidic flows and stratified tuffs, 1,500+ ft. thick, in S. part of Steens Mtn. Includes, (descending): (1) Biotite dacite, 500+ ft.; (2) upper tuffs, 40± ft.; (3) *Little Alvord Creek rhyolite* (exposed in Little Alvord Creek); (4) upper laminated rhyolite flow, 250 to 500 ft.; (5) middle tuffs, 200 to 300 ft.; (6) lower laminated rhyolite, 200± ft.; (7) lower tuffs, 200+ ft. Overlies Alvord Creek beds (middle Mio.). Best exposed in valley of Pike Creek, on E. scarp of Steens Mtn.

Appears to be of approx. same age as his Steens Mtn andesitic series of N. part of Steens Mtn.

Pike River granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. granite in Wis. (area not stated).

Pikes Peak granite.

Pre-Cambrian: Eastern Colorado (Pikes Peak region).

W. Cross, 1894 (U. S. G. S. Pikes Peak folio, No. 7). *Pikes Peak granite.*—The mass of Pikes Peak is principally made up of a single granite type, belonging to what is apparently one great body, extending for many mi. in all directions. The main type is a very coarse-grained biotite granite or granitite, in most places red. In the Pikes Peak type proper biotite is quite subordinate, but on either side of Platte River, and in several places in SW. part of dist., a large increase in black mica greatly changes appearance of rock. The Pikes Peak type is cut by a fine, even-grained reddish or pinkish granite poor in mica.

E. B. Mathews, 1900 (Jour. Geol., vol. 8, pp. 214–240), divided the "Algonkian or early Cambrian granites" of Pikes Peak quad. into (descending order of age) fine-grained type, *Cripple Creek type*, *Summit type*, and *Pikes Peak type*. The Pikes Peak type was named for its prominence in constitution of Pikes Peak massif. Is characterized by relatively large size of its feldspar and quartz grains and its tendency to form conspicuous feldspar phenocrysts that often attain diam. of several inches. Texture presents all grades of transition. The coarse-grained granite, in which the feldspar phenocrysts are large and generally well formed, is sometimes called "*Raspberry Mtn granite*," from its conspicuous development on that mtn.

W. Lindgren and F. L. Ransome, 1906 (U. S. G. S. P. P. 54). *Pikes Peak granite* is intrusive into the gneiss and schist and probably into Spring Creek granite.

L. C. Graton, 1906 (U. S. G. S. P. P. 54). *Pikes Peak granite.*—Light pink to red, coarse-grained; consisting largely of alkali feldspar. Undoubtedly older than Cripple Creek granite.

G. B. Richardson, 1915 (U. S. G. S. Castle Rock folio, No. 198). *Pikes Peak granite* is intrusive into Algonkian qtzites and is pre-Camb.

The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

Piketon gravel.

Tertiary: Southeastern Missouri.

C. F. Marbut, 1902 (Mo. Univ. Studies, vol. 1, No. 3, pp. 18, 27, 32). *Piketon gravels.*—Stratified gravels, often showing current bedding, composed of chert, qtzite, and quartz pebbles mixed with reddish sand. Thickness not stated. The qtzite pebbles are different from any rock in Mo., and their worn condition shows they have traveled long distance, probably from northern United States. Of late Tert. (Lafayette) age [also calls them *Lafayette gravels*]. Uncon. overlain by loess, and underlain, probably uncon., by Benton or Lafayette sands.

Named for exposures at Piketon, Stoddard Co.

Pikian series.

Name employed by C. [R.] Keyes (Pan-Am. Geol., vol. 41, pp. 281, 284, 1924) to cover "the Pikes Peak granitic intrusives," the "latest Proterozoic rocks in Colo."

Same as Pikes Peak granite.

Pilarcitos sandstone. (In Franciscan group.)

Jurassic(?): Western California (San Francisco region).

R. Arnold, 1902 (Sci., n. s., vol. 15, table on p. 416). *Pilarcitos ss.*, 790 ft. thick. A fm. of the Franciscan. [Shown in table as underlying volcanics that are older than Calera ls.]

A. C. Lawson, 1903 (Geol. Soc. Am. Bull., vol. 13, pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). [Maps Franciscan rocks along Pilarcitos Creek and Pilarcitos Lake, both in San Mateo Co., as *Cahil ss.*, of which the Calera ls. is a memb.]

Pilgrim limestone.

Upper Cambrian: Central southern Montana (Little Belt Mountains), central northern Montana (Fort Benton quadrangle), and central western Montana.

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55, and Little Belt Mtns folio, No. 56). *Pilgrim ls.*—Dense gray rocks, massively bedded, containing shaly layers, often spotted with green glauconite remains; frequently carrying fossils on the surface. The layers are often cgls. formed of flat pebbles of green or buff lss. showing no definite arrangement. Thickness 140 ft. in Fort Benton quad. Overlies Park shales and ls. cgls. Underlies Dry Creek sh. Exposed in broad valley of Pilgrim Creek [SW. corner of Fort Benton quad.].

Pillar Falls mud flow.

Miocene ? (upper Miocene?): Southern Idaho (Twin Falls and Jerome Counties).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Pillar Falls mud flow.*—Well-rounded gravel and huge boulders several ft. diam. Contains andesitic pebbles and boulders intermingled with ash and soil. Fills irregularities in surface of Shoshone Falls andesite. Thickness 0 to 40± ft. Older than Neeley lake beds. Exposed at Pillar Falls, on Twin Falls-Jerome Co. line.

Pilot shale.

Mississippian: Eastern Nevada (Ely district).

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 24, 26, map, etc.). *Pilot sh.*—Exposed a short distance W. of Ely, in middle slopes on S. side of Robinson Canyon, also in open country just N. of Copper Flat, and in several places in NW. part of quad.

It breaks down at surface. From a few pits and tunnels it appears to be composed entirely of soft, highly carbonaceous sh., drab to nearly black. Thickness 100 to 400 ft. Underlies Joana ls. and overlies Nevada ls. (Dev.). No fossils found, but is believed to be of Miss. age. Named for Pilot Knob, in W. part of Ely quad.

Pilot Knob conglomerate.

Upper Cambrian: Southeastern Missouri.

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4, pp. 30, 31). *Pilot Knob cgl.*—Cgl., 0 to 40 ft. thick, more or less perfectly bedded; only known occurrence on Pilot Knob [Iron Co.]. Assigned to Algonkian. Uncon. underlies Fourth Mag. ls. and is younger than Iron Mtn porphyry.

H. F. Bain and E. O. Ulrich, 1905. [See 1905 entry under *Lamotte ss.*]

J. Bridge, 1930 (personal communication). In a few instances certain basal true cgls. at Pilot Knob have been included in *Pilot Knob cgl.* or have been referred to under this name. These were economically important and are of same age as Iron Mtn cgl.

Pilot Knob formation.

Pre-Cambrian: Southeastern Missouri.

E. R. Buckley, 1908 (Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286), and 1909 (Mo. Bur. Geol. and Mines, 2d ser., vol. 9, pt. 1, pp. 15–17). *Pilot Knob* assigned to Huronian (?). Is uncon. below Lamotte and uncon. above Laurentian diabase, granite, and rhyolite. Consists of sl. and cgl. 200 ft. thick.

C. [R.] Keyes, 1914 (Scheme of strat. succession in Mo.). *Pilot Knob* assigned to Animikian. Consists of 50 ft. of cgls. underlying Ironton sl.

J. Bridge, 1930 (personal communication). If name *Pilot Knob* is to be retained in literature it should be changed to *Pilot Knob aggl.* or *Pilot Knob tuff*, and should be classed as *Algonkian*.

Pilot Knob iron formation.

Pre-Cambrian: Southeastern Missouri.

G. W. Crane, 1912 (Mo. Bur. Geol. and Mines vol. 10, 2d ser.). *Pilot Knob iron fm.*—Breccia and tuff, 140 ft. thick.

Pilot Knob sandstone.

Pennsylvanian: Northern Tennessee coal field.

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 23, 33, 319). *Pilot Knob ss.*—Very prominent cliff-making coarse gritty ss., 20 to 40 ft. thick in Briceville region, where it lies 300 to 320 ft. above the Big Bench, and 80 ft. thick on Pilot Knob, where it lies about 250 ft. above the Big Bench. Is basal memb. of Anderson fm. Its base is 450 ft. beneath highest point on Pilot Knob. Is believed to be uncon. on Scott fm.

Pima sandstone.

Middle Cambrian: Southeastern Arizona (Whetstone Mountains).

A. A. Stoyanow, Apr. 30, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 466, 482). *Pima ss.*—Buff hard ss., 4 ft. thick, containing *Micromitra pannula*. Underlies Cochise fm. and overlies Bolsa qtzite. In places contains inclusions of Bolsa qtzite. Been traced 60+ mi., from Whetstone Mtns, Cochise Co., to Picacho de Calera Hills, Pima Co. Is Middle Camb. [Derivation of name not stated. His table on p. 482 shows it absent in Bisbee dist.]

Pimienta beds.

Jurassic (?): Mexico.

A. Heim, 1926 (Eclogae geol. Helvetiae, vol. 20, p. 86).

Pimple Hill conglomerate.

Upper Devonian or Mississippian: Northeastern Pennsylvania (Monroe, Pike, and Wayne Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 578, etc.). *Pimple Hill cgl.*—Persistent cgl., distinguished by red quartz pebbles, in upper part of Cherry Ridge red beds (Upper Dev.). Forms small ridges and hills concentric to eastern escarpment of Pocono Plateau. Named for Pimple Hill, a knob in Monroe Co. Has not been identified W. of Wayne Co. In Bradford Co. serves as key to identify presence of Catskill. [Table on p. 571 shows Pimple Hill cgl. *below* Dyberry glomerate, but text (p. 578) says Pimple Hill is in *upper* part of Cherry Ridge and Dyberry glomerate in *lower* part. For further information see 1936 entry under *Cherry Ridge group*. This name replaces *Cherry Ridge cgl.* of I. C. White.]

Pinal schist.

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Pinal schists.*—Crystalline schists of pre-Camb. age. The oldest rocks in Globe quad. Are broken by granite intrusions into very irregular masses. Are at least in part derived from quartzose sediments. Are abundantly present and well exposed in Pinal Mtns, whence their name. The largest single body of schistose rocks is that underlying greater part of W. slope of the range. Are uncon. overlain by Apache group.

F. L. Ransome, 1904 (U. S. G. S. Globe folio, No. 111). *Pinal schist* consists of quartz-sericite and quartz muscovite schists.

F. L. Ransome, 1904 (U. S. G. S. Bisbee folio, No. 112). *Pinal schist.*—Light to dark-gray or greenish schists; very fine-grained; uniform texture; imperfect cleavage; surfaces commonly have a satinlike sheen; essential constituents quartz and sericite; biotite and tourmaline rare; amphibole not observed. General character indicates the schist was at one time arkosic sands or silts. Vastly older than Camb. May = Vishnu schist of Grand Canyon. Thickness unknown.

Pinar schist.

Pre-Jurassic (?): Cuba.

J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 534). Assigned to pre-Jurassic.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 522), assigned this fm. to Jurassic.

Pina Vititos sandstone.

Name applied by C. [R.] Keyes (Conspectus of geol. fms. of N. Mex., 1915, pp. 2, 10) to "basal memb. of the Montanan coal-bearing series around the southern end of the Rocky Mtns." Thickness 250 ft. Derivation of name not stated. On p. 10 is spelled *Pino Vititos*.

Pinckneyville granite.

Post-Carboniferous: Eastern Alabama.

W. F. Prouty, 1922 (Elisha Mitchell Sci. Soc. Jour., vol. 38, p. 16; also Ala. Geol. Surv. map of Clay Co.) and 1923 (Ala. Geol. Surv. County Rept. No. 1, pp. 51–62). Biotite granite, covering large area about Pinckneyville, Clay Co. As mapped it includes the belts of biotite granite "locally designated as Bluff Springs granite." Intrudes Talladega phyllites.

On 1922 geol. map of Clay Co. the granite and town are spelled *Pinkneyville*. The map accompanying 1923 rept cited above spells the town and granite *Pinkneyville*, but throughout text the spelling *Pinckneyville* is used. The latter spelling is used on 1926 geol. map of Ala.

Pine sandstone member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 10). *Pine ss. memb.*—Quartzose, coarse, and thick-bedded ss. at base, but finer-grained and more flaggy at top. Thickness 250 ft. Is a memb. in lower part of Pottsville fm. in Cahaba and Coosa coal fields. Immediately or closely overlies Roper coal.

Named for Pine Ridge, Jefferson Co.

Pinean series.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 55, 80). *Pinean series* is essentially the White Pine sh. of Hague (1888), of Eureka dist.

Derivation of name not stated, but apparently it is an abbreviation and adaptation of the geographic name *White Pine*.

†Pine Barren beds.

A name applied in some early Ala. repts to the basal Eocene beds now known as *Clayton fm.*, which are "best seen in eastern Wilcox Co., on Pine Barren Creek and in adjoining part of Butler Co. in Little Texas region."

Pine Bluff quartz porphyry.

See under *Seneca quartz porphyry.*

Pine Canyon limestone.

Mississippian: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Pine Canyon ls.*—Beds of nearly black, dense, rather thin-bedded ls. with large black chert nodules and occasional thin beds of black chert, alternating with beds of medium- to light-gray medium- to coarse-grained, distinctly cross-bedded ls. Thickness 1,000 ft. Fossils from most of fm. are of Madison age, according to G. H. Girty, but he tentatively regards upper 300 ft. as of upper Miss. age. Underlies Humbug fm. and overlies Gardner dol. Exposed in Pine Canyon, btw. Godiva Mtn and Sioux Peak.

Pinecate formation.

Oligocene: Southern California (San Benito County).

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 470, 472 and map). *Pinecate fm.*—Chiefly massive yellowish pebbly ss. with interbedded cgl. Cross-bedding common. Thickness about 1,000 ft. Fossils rare, but when found indicate marine origin. Lies on San Juan Bautista fm. with probable discon. Underlies Vaqueros fm., probably uncon. Is upper fm. of San Lorenzo series. Typically exposed at Pinecate Peak, 4 mi. NW. of San Juan, and also near San Juan Cement Works.

Pine City moraine.

Pleistocene (Wisconsin stage): Eastern Minnesota (Pine County).

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 79–80). Oldest moraine of Rush Lake morainic system. Named for development at Pine City, Pine Co.

†Pine Creek limestone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 32). *Pine Creek (Coleman?) ls.*, 2 ft. thick. Lies 40 ft. below Bakerstown coal and overlies Buffalo ss. [In places this ls. lies 26 ft. above Buffalo ss.]

Same as Cambridge ls. memb., which has priority. The Pa. Geol. Survey, however, uses Pine Creek ls. instead of Cambridge ls.

Named for Pine Creek [Allegheny Co.?], Pa.

†Pine Creek sandstone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania (Armstrong County).

J. P. Lesley, 1880 (2d Pa. Geol. Surv. Rept. H_5, pp. xxi, 319). [See under *Kittanning ss. memb.* Lesley proposed *Pine Creek ss.*, also *Worthington ss.*, for a ss. lying in interval below Middle Kittanning coal and above Lower Kittanning coal.]

Replaced by unpreoccupied name *Worthington ss. memb.*

Pine Creek conglomerate.

Cretaceous (?): Southeastern Iowa.

J. A. Udden, 1899 (Iowa Acad. Sci. Proc., vol. 6, pp. 54–56). *Pine Creek cgl.*—Coarse, brown to yellow pebbly ss., 16 or more ft. thick, in Muscatine Co. Of post-Carbf. and preglacial age. Regarded by Calvin as identical in nature with Rockville cgl. of McGee; also resembles Cret. cgl. in Guthrie Co. Overlain by loose yellow sand.

Named for Pine Creek, Muscatine Co.

Pinecrest formation.

Lower Triassic: Central northern Utah (central Wasatch Mountains).

A. A. L. Mathews, 1929 (Chicago Univ., Walker Mus. Mem., vol. 1, No. 1, p. 1). The Lower Triassic rocks outcrop in Fort Douglas area in two localities, one on N. limb of a syncline btw. Red Butte and Dry Canyons and on S. limb of same structure near Mill Canyon. They comprise lower div. of Thaynes group and are referred to here as *Pinecrest fm.* This fm. is named after Pinecrest Ridge, which lies btw. N. and S. forks of Red Butte Creek. The fm. contains a very rich marine fauna, consisting primarily of pelecypods and cephalopods. [Fossils described, but fm. not described nor thickness given.]

A. A. L. Mathews, 1931 (Oberlin Coll. Lab. Bull., n. s., No. 1, Feb.). *Pinecrest fm.*—Chiefly dark bluish-gray dense massive brittle, resistant ls. intercalated with beds of calc. ss. and massive light blue-gray or olive-drab ls.; some thick massive beds of brittle ls. near base, and a thick resistant ss. at base. Thickness 607 ft. Conformably underlies Emigration fm. and grades into underlying Woodside sh. Is lower part of Thaynes ls. The upper part of the fm. is present in Thaynes Canyon. The overlying Emigration fm. is upper part of Thaynes ls.

Pinedale glacial stage.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310, 324–340). *Pinedale stage.*—The youngest moraines, which for convenience may be called *Pinedale drift*, are conspicuous around each of the large lakes near Pinedale on SW. side of Wind River Range.

E. Blackwelder, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865–922) correlated this drift with Wisconsin glacial stage.

Pine Hill quartzite.

Lower Cambrian: Southwestern Vermont (Rutland County).

J. E. Wolff, 1891 (Geol. Soc. Am. Bull., vol. 2, btw. pp. 331 and 338, in a description of Rutland, Vt., and vicinity), stated that the *Pine Hill qtzite* (not defined) underlies Rutland ls. Pine Hill is a short distance NW. of Rutland and a short distance SE. of Proctor, in Proctor Twp, Castleton quad.

Pine Hill quartzite.

Silurian: Southeastern New York (Orange County).

E. C. Eckel, 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1, pp. r144 to r150). *Pine Hill qtzite* is here proposed for a series of qtzite beds overlying Green Pond cgl. [restricted] and underlying Longwood shales. Transition beds btw. the qtzite and cgl. and btw. the qtzite and shales occur, but in general the lithologic distinctions btw. the fms. are evident. The fm. is well shown in Pine Hill, E. of Highland Mills, Orange Co.

These beds form upper part of Green Pond cgl. as originally defined by Darton and as still used by geologists generally, and there is no other record of Pine Hill qtzite.

Pinelog conglomerate.

Lower Cambrian: Northwestern Georgia (Cartersville district).

L. LaForge, 1919 (Ga. Geol. Surv. Bull. 35, p. 40). *Cgl. gneiss that Hayes called* [unpublished ms.] *Pinelog cgl.*—A rather heterogeneous fm. of cgl., arkose, qtzite, siliceous phyllite, and graphitic sl., all much sheared and largely altered to sericite schist and gneiss; its base is in places an arkose. Rests on Corbin granite and underlies a sl. regarded by Hayes as = Wilhite sl. of Tenn.

J. P. D. Hull, 1920 (Ga. Geol. Surv. Bull. 36, pp. 19–28). *Pinelog cgl.* borders the area of Corbin granite on all sides but the SE., and forms Pinelog, Pine, and E. part of Brushy Knob and Signal Mtns.

†Pine Mountain group. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

A. R. Crandall, 1889 (Ky. Geol. Surv. Whitley Co. Rept.). *Pine Mtn group.*—Name provisionally applied to cgls., 1,500 ft. thick, interbedded with shales and shaly sss. at intervals of 100 to 200 ft., overlying Chester group and extending to recognized top of the cgl. of the Coal Measures. Overlain by later Coal Measures. Greatly thickened equiv. in Pine Mtn region of Rockcastle group.

The rocks of Pine Mtn were, in U. S. G. S. P. P. 49, 1906, mapped as *Lee fm.*, but they probably include some beds younger than true Lee, according to geologists who have worked in the region.

Named for Pine Mtn, SE. corner of Ky.

Pine Mountain formation.

Cambrian or pre-Cambrian: Central western Georgia (Pike to Harris Counties).

S. L. Galpin, 1915 (Ga. Geol. Surv. Bull. 30, pp. 74–76). *Pine Mtn fm.*—The qtzites and associated schists which are found on Pine Mtn and the ridges nearby are here grouped under a single fm. name, which is taken from the most conspicuous physiographic feature of region. The qtzites give place to siliceous and micaceous schists about the Monroe-Pike Co. line, and the continuation of these fms. far into Monroe Co. was not noted. Mica schists may usually be found enclosing the qtzite layers, and in some instances, as on the ridges of northern Upson Co., there is a gradual transition from one rock type to the other. In most places there is no great width to these schists, but in NW. part of Upson Co. excavations along Macon & Birmingham R. R. expose them almost continuously from a point 6½ mi. NW. of Thomaston to near Flint River. Within this distance the strike changes from N. 35° E. on SE. to N. 25° W. on NW. There are also changes of dip indicating existence of one or two synclines. The qtzite layers are of medium to fine grain, usually containing considerable secondary mica. In some places disseminated crystals and groups of pyrite are found. The schists are usually of fine and rather even texture and are composed mainly of mica and quartz. Small lenses and stringers of secondary quartz are very abundant. No positive evidence as to age, but absence of intrusions of Roan gneiss, presence of one intrusion of a later dioritic rock showing some metamorphism, and nature of fm. would seem to favor its tentative classification as either pre-Camb. or early Camb.

Named for development on Pine Mtn, from W. part of Harris Co. to E. part of Pike Co.

Pine Mountain complex.

Name applied by D. Modell (Geol. Soc. Am. Bull., vol. 47, 1936, p. 1911) to a subsidiary stock (chiefly granite porphyry) in Pine Mtn-Rocky Mtn area of Belknap Mtns, N. H.

Pine Nut limestone member (of Gold Hill formation).

Cambrian? (Upper Cambrian?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Pine Nut ls. memb.*—White impure crystalline ls. carrying little knots of silicate minerals. Thickness 10 ft. Lies below middle of Gold Hill fm. and 140 ft. lower than Morning Glory ls. memb. Exposed on Pine Nut claim.

Pine Point limestone.

Devonian: Northwest Territories, Canada.

A. E. Cameron, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 26).

†Pine Ridge sandstone member (of Chemung formation).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 535), is a misprint for *Piney Ridge ss. memb.*

Pine Ridge sandstone member (of Mesaverde formation).

Upper Cretaceous: Southeastern Wyoming (Rock Creek field).

C. E. Dobbin, H. W. Hoots, C. H. Dane, and E. T. Hancock, 1929 (U. S. G. S. Bull. 806, p. 140). *Pine Ridge ss. memb.*—Light-gray slabby to massive sss., interbedded with gray sandy sh., carbonaceous sh., and four coal beds, one of which, near top, is locally 8 ft. thick. Forms top memb. of Mesaverde fm. in Rock Creek oil field. Thickness 80 ft. near Rock River and 450 ft. in Medicine Bow dome. Probably=Teapot ss. memb. of Mesaverde in other parts of Wyo. Named for exposures in Pine Ridge, about 2 mi. SE. of town of Rock River, Albany Co.

Pine River formation.

Jurassic (?): British Columbia.

E. M. Spieker, 1922 (A. A. P. G. Bull., vol. 6, pp. 112–126). [Assigned to Jurassic (?), but M. Y. Williams and J. B. Bocock, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 206), assigned this fm. to Upper or Middle Jurassic.]

Pine Run sand.

A subsurface sand, of early Miss. or Upper Dev. age, in western Pa., lying at or above horizon of Nineveh sands. Said to be older than Hundred-foot sand.

Pinetop chert.

Middle Devonian: Southeastern Oklahoma (Ouachita Mountains).

H. D. Miser, 1934 (A. A. P. G. Bull., vol. 18, No. 8, pp. 974, 975). *Pinetop chert.*—Named for Pinetop School, sec. 5, T. 2 N., R. 15 E. [in Pittsburg Co.], about 20 mi. due S. of McAlester, Okla., where 50± ft. of fossiliferous chert and ls. of Onondaga age are exposed. Replaces Brushy Creek chert of Ulrich, which is preoccupied. Underlies Woodford chert in Ti-Valley-Choctaw belt of Ouachita Mtns, Okla.

Pineville sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 211). *Pineville ss.*—Massive to current-bedded, medium-grained, buff to bluish gray, 50 to nearly 100 ft. thick. Forms cliffs nearly 100 ft. high at Pineville, Wyoming Co. Underlies Little Fire Creek coal and lies 0 to 5 ft. above Pocahontas No. 9 coal.

Piney formation.

Upper Cretaceous: Northern Wyoming (Bighorn Mountains region).

N. H. Darton, Nov. 17, 1906 (U. S. G. S. P. P. 51, pp. 13, 59–60, etc.). *Piney fm.*—Gray and brown ss. and shales, 2,000 to 3,000 ft. thick, underlying Kingsbury cgl. and overlying Parkman ss. in Bighorn Mtns. Is Upper Cret. Named for Piney Creek, NW. of Buffalo.

This name also appeared in several other repts, by Darton, published in 1906, and listed under *Parkman ss.* In U. S. G. S. Bull. 856 (1935), on Crow Ind. Res., Mont., is statement that Piney fm. as mapped by Darton in U. S. G. S. folio 141 appears to correspond to Bearpaw sh., Lennep ss., and Lance fm. as mapped in Crow Ind. Res.

Named for exposures on Piney Creek, NW. of Buffalo, Wyo.

Piney Creek conglomerate. (In Pottsville group.)

Pennsylvanian: Southern West Virginia (along New River).

D. White, 1895 (Geol. Soc. Am. Bull., vol. 6, pp. 305–320). [The massive conglomeratic ss. at top of Piney Creek section is called *upper Piney Creek cgl.* and the lower cgl. on Piney Creek, 75± ft. thick, is called *Piney Creek cgl.* and *lower Piney Creek cgl.* According to later repts of W. Va. Surv. the *upper Piney Creek cgl. of D. White* is Raleigh ss.]

Piney Ridge sandstone member (of Chemung formation).

Upper Devonian: Central Pennsylvania (Blair and Huntingdon Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 535). *Pine* [y] *Ridge ss. memb.* lies in lower part of Chemung fm., some distance below Allegrippis ss. memb.

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press). *Piney Ridge ss. memb.*—Consists of several rather thick sss. separated by soft greenish clay sh. Thickness 50 ft. Lies 30 to 200 ft. above base of Chemung fm., and 1,400 ft. below Allegrippis ss. memb. of Chemung.

Named for exposures along Piney Ridge, Huntingdon Co.

Pinguico rhyolites.

Age (?): Mexico.

C. W. Botsford, 1909 (Eng. and Min. Jour., vol. 87, p. 692).

Pinkard formation.

Upper Cretaceous: Southeastern Arizona (Clifton region).

W. Lindgren, 1905 (U. S. G. S. P. P. 43). *Pinkard fm.*—Several hundred ft. of sss. and shales. Lowest part consists of black shales, which occupy considerable areas in Silver Basin. Upper part is made up of alternating shales and yellowish-gray sss., in places calc. Rests uncon. on Modoc ls. Exposed in vicinity of Pinkard Gulch, W. of Morenci.

†Pink Cliff series.

Eocene: Southwestern and central southern Utah.

C. E. Dutton, 1880 (Geology of High Plateaus of Utah, pp. 143–159, 188–210). *Pink Cliff series*.—Consists of (descending) upper white ls. and calc. marl, 300 ft.; pink calc. ss., 800 ft.; pink cgl. 550 ft. The Pink Cliffs [N. part of Kane Co.] are exposures of the fine-grained calc. ss. forming middle memb. of the Bitter Creek. This series of beds in Markágunt and Paunságunt Plateaus is identical with Bitter Creek beds of Uinta Mtns, although actual continuity is doubtful. They rest on Cret.

These beds are now recognized as a southern development of Wasatch fm., by which name they are called. (See U. S. G. S. P. P. 164, pp. 114–116, 1931.)

Pinkerton sandstone.

Mississippian: Northeastern West Virginia.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Pinkerton ss.*—Massive white ss. and quartz cgl., in part cross-bedded, with a thin coal seam. Thickness more than 125 ft. Top fm. of Pocono group. Rests on Myers sh. Is about 125 ft. thick on Pinkerton Knob, Berkeley Co. Contains Pocono plants.

Pinkneyville granite.

See *Pinckneyville granite.*

Pinnacle.

Pliocene or Pleistocene: Southeastern Alaska (St. Elias region).

I. C. Russell, 1891 (Nat. Geog. Mag., vol. 3, pp. 167–175). *Pinnacle system*.—Thin-bedded dark-colored sh., cgl., ls., ss., best exposed in cliffs of Pinnacle Pass and along N. and W. borders of Samovar Hills. Faulted and upheaved. Thickness at Pinnacle Pass at least 1,750 ft. Plants and invertebrates indicate Plio. or Pleist. age. Relations to Yakutat system undet.

Pinnacle graywacke.

Cambrian: Southern Quebec.

See under *West Sutton sl.*, 1931.

Pinney Hollow schist.

Lower Cambrian: Southeastern Vermont (Windsor County).

E. L. Perry, 1927 (15th Rept. Vt. State Geol., p. 161). *Pinney Hollow schist*.—A uniform pale-green quartz-chlorite-sericite schist, usually intensely plicated and resembling Bethel schist in lithology and origin. Lies stratigraphically below Ottauquechee fm. and above a group of light-brown or gray qtzites. Assigned to Camb. (?). Type exposures in Pinney Hollow, in Plymouth [Windsor Co.].

E. L. Perry, 1929 (16th Rept. Vt. State Geol., pp. 1–61). *Pinney Hollow schist*, probably late Camb., is 3,500± ft. thick. Typically exposed in Pinney Hollow [Woodstock quad.] from Pinney Hollow School westward nearly to Plymouth village. Lies uncon. on series of pre-Camb. or older Camb. qtzites, cgls., dol., and schists.

C. H. Richardson and E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 288), assigned this schist to Lower Camb.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 405), assigned this fm. to Lower Camb.

Pinoche formation.

Misprint for *Panoche fm.*

Pinole tuff.

Pliocene: Western California (San Francisco region).

R. Arnold, 1902 (Sci., n. s., vol. 15, table on p. 416). *Pinole*, 1,000 ft. (pumiceous, fossiliferous tuffs). [Shown as underlying Orindan fm. and overlying San Pablo fm.]

A. C. Lawson, 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544–545). *Pinole tuffs*, 1,000 ft. (fossiliferous, pumiceous). [Shown as underlying Orindan fm. and overlying San Pablo fm.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). The *Pinole tuff* in most of its deposits is distinctly stratified. Consists almost wholly of whitish or light-yellowish pumice, partly in fragments ranging from 1 to 50 mm and partly in fine dust. Occurs only in small exposures in Concord and San Francisco quads, but is more extensively exposed in Coast Ranges farther N. Stratigraphically it lies chiefly btw. San Pablo fm. below and Orinda fm. above, but is in part interbedded with basal sediments of the Orinda, with which it is more closely associated than with the marine San Pablo. On shores of San Pablo Bay it contains fresh-water fossils and bones of terrestrial mammals. Thickness 0 to 1,000 ft. Rests, with probable uncon., on San Pablo fm. Named for exposures near town of Pinole, on San Pablo Bay.

†Pinos Altos limestones.

Ordovician: Southwestern New Mexico.

C. R. Keyes, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 360–362). *Pinos Altos fm.* consists of 400 ft. of lss. of Ord. age, underlying Dev. Chloride fm. (lss.) and overlying Camb. sss.

Probably named for town in Grant Co., and probably includes Fusselman ls. (Sil.) and Montoya and El Paso lss. (Ord.).

Pino Vititos sandstones.

See under *Pina Vititos ss.*

†Pinto limestone.

Upper Cretaceous (Gulf series): Southwestern Texas.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 222, 229, 230). *Pinto ls.*—Fossiliferous chalky lss. separated by bands of laminated limy shales, calc. clays, and purer clays. Thickness 1,500 ft. Same as Austin ls. Underlies Eagle Pass div. and overlies Val Verde flags.

Same as Austin chalk, older name.

Named for Pinto Creek, Val Verde Co.

Pinto diorite.

Age (?): Central Montana (Little Belt Mountains quadrangle).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Most noticeable rock of Neihart mining dist. At once recognized by spotted appearance. Intrudes Archean rocks; is probably Cret. [Derivation of name not stated, and no geographic feature of that name shown.]

P. A. Schafer, 1935 (Mont. Bur. Mines and Geol. Mem. 13, pp. 7, 9, map, etc.). The younger pre-Beltian rocks of Neihart dist. comprise a group of metamorphosed igneous rocks collectively called *Pinto diorite*. Although several varieties occur, they are related in origin and belong to same intrusive episode. The distinction btw. varieties is petrographic rather than genetic or structural, since all belong to one igneous mass and gradations occur btw. them. There are 2 principal rock types—one a spotted porphyritic-looking rock for which the name *Pinto diorite* was chosen; the other a dense black amphibolite, associated with the metadiorite and forming a characteristic border phase of that rock. Within these 2 facies are numerous variations. The Pinto diorite, including the amphibolite facies, is intrusive into the earlier gneisses and schists. [Derivation of name not stated.]

Pinto sandstone.

Cretaceous (probably all Upper Cretaceous): Southwestern Utah (Iron Springs region).

C. K. Leith and E. C. Harder, 1908 (U. S. G. S. Bull. 338, p. 37). *Pinto ss.*—Includes some sh., cgl., and ls. lenses. Thickness 1,500 ft. Underlies (uncon.) Claron ls. (Eocene) and overlies (uncon.) Homestake ls. (Carbf.). [Evidently named for Little Pinto Creek, which appears to cross the fm. just S. of Iron Springs quad.]

Pinto formation.

Pleistocene: Southern California (Riverside County).

D. Scharf, 1935 (Southwest Mus. Papers, No. 9, pp. 11–20). *Pinto fm.*—Lacustrine clays, sss., and gravels interstratified with basalt flows, and represented in part by very coarse fangl. Occurs in Pinto Basin, north-central part of Riverside Co. Composes Eagle Mtns; also exposed in hill btw. Eagle Mtns and the Coxcombs, and in Pinto Wash. Rests uncon. on old crystalline rocks. Horse and camel remains establish Pleist. age.

Pintoan series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 51, 53, 80), to 2,000 ft. of lss. in Calif. and Nev., said to be of basal Camb. age and much older than Prospect Mtn qtzite.

Named for Pinto Mtns, near Waucoba Springs, in White Mtn Range, Calif. Keyes has also included under this name 900 ft. of shales (which he named *Holliday*) composing basal fm. of Camb. of Utah.

Pinyon conglomerate.

Eocene: Yellowstone National Park.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Nat. Park folio, No. 30). *Pinyon cgl.*—A series of cgl. beds with local intercalations of ss., resting uncon. on upturned Laramie (Cret.). Best exposed on Pinyon Peak. Found only in S. end of Park. Assigned to Eo.

Pinyon series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53), to Eureka qtzite (Middle Ord.) and the overlying lss. of Ord. age in Nev. Also to Fishhaven dol. (Upper Ord.) and Eureka qtzite. Derivation of name not stated.

†Pinyon Mesa group.

Eocene and older (?): Southwestern Colorado and northwestern New Mexico.

W. H. Holmes, 1877 (U. S. Geol. and Geog. Surv. Terr. 9th Ann. Rept., for 1875, pp. 248, 249, 251). *Pinon Mesa group*, also *Pinon Mesa sss.*—Chiefly coarse yellowish sss., alternating with thin beds of variegated marls. Thickness 1,200 ft. Overlies Bad Land fm. ("Puerco marls"). Forms escarpment of Pinon Mesa [in NW. part of San Juan Co., N. Mex.]. [On pl. 35 he includes these beds in Wasatch and calls them *Canyon Largo of Newberry*, but Newberry never published *Canyon Largo*.]

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, p. 6), showed Holmes' 1877 use of *Canyon Largo series of Newberry* included Wasatch, Torrejon, and Puerco fms. and Ojo Alamo ss.; and his Puerco marls as = McDermott fm.

†Pinyon Peak conglomerate.

Eocene: Yellowstone National Park.

A. Hague, 1899 (U. S. G. S. Mon. 32, pt. 2, pp. 184+), applied this term to the cgl. named *Pinyon cgl.* by Weed in 1896.

Pinyon Peak limestone.

Devonian (Upper ?): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Pinyon Peak ls.*—Shaly ls., 0 to 150 ft. thick. Conformably overlies Bluebell dol. and uncon. underlies Victoria qtzite. Exposed along upper eastern slope of Pinyon Peak from its blunt eastern spur southwestward to its base. Not seen in N. spur of the peak. Only recognized Dev. rock in Tintic dist. Fossils indicate Upper Dev. (Threeforks?) age, but this correlation is not certain.

Pioche shale.

Lower Cambrian: Western Utah (House Range) and eastern Nevada (Pioche region).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9–12). *Pioche fm.*—Aren. and argill. shaly layers with some thin layers and bands of ls. more or less irregularly interbedded and limited in horizontal distribution. Is 210 ft. thick at Pioche, Nev. [1,120 ft., according to measurements of L. G. Westgate, U. S. G. S. P. P. 171, 1932]; 170 ft. thick on W. face of Highland Range, 18 mi. W. of Pioche. In Eureka dist., Nev., 135 mi. NW. of Pioche, this fm. lies btw. Prospect Mtn qtzitic ss. and the great ls. series, and is 200± ft. thick. In House Range, Utah, 105 mi. N-NE. of Pioche, it is 125 ft. thick, and overlies Prospect Mtn fm. and underlies Howell fm. Contains Lower Camb. *Olenellus* fauna. Type loc. SE. of Pioche, Nev., on road to Panaca, Utah.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1812), recognized btw. Howell fm. and Pioche sh., in House Range, 205 ft. of bluish-gray aren. ls. which he called *Langston (?) ls.*

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Engrs. Trans., No. 1647, pp. 3–8) and 1932 (U. S. G. S. P. P. 171, pp. 8+, etc). *Pioche sh.*—Comprises 1,120± ft. of shales and interbedded lss., which are doubtless the same as Pioche fm. of Walcott, although writers found thickness much greater than that given by Walcott. The sh. is yellow or brown, rarely red argill. sh., usually distinctly micaceous; in places so fine-grained that individual mineral grains do not show. In Ely Range the rock is coarser, more micaceous, and more quartzose, in some places approaching schist in appearance. Contains interbedded lss. and sss., especially in middle and upper parts. A carefully measured section on ridge N. of Lyndon Gulch gave thickness of 1,120 ft. Fossils listed. Rests conformably on Prospect Mtn qtzite and is conformably overlain by Lyndon ls. (Middle Camb.).

Pioneer shale. (Of Apache group.)

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Pioneer sh.*—Dark reddish-brown aren. shales, 200± ft. thick, overlying Scanlan cgl. and underlying Barnes cgl. in Globe dist. The basal 25 ft. are distinctly arkose, containing abundant fragments of pink feldspar. Toward top the shales become more quartzose, but are probably nowhere quite free from particles of granitic feldspar. Named for exposures at old mining settlement of Pioneer, just S. of Globe quad.

Pioneer sandstone.

Pennsylvanian: Northern Tennessee coal field.

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 18–19, 21, 22). A massive ss. that in many places outcrops in prominent cliffs and usually has a broad bench just above it. In Briceville region this ss. is very prominent and the bench immediately above it is known locally as Brayden Bench. The ss. is believed to be same as the ss. in gap at Old Pioneer, in Campbell Co., and has been called by writer *Pioneer ss.* It forms topmost memb. of Jellico fm. In some places, as near Briceville and southwestward toward Windrock, the Pioneer ss. at the base [of Scott fm.] is prominent and forms Brayden Bench, and over it there is another prominent ss. in lower part of the [Scott] fm. that forms Dougherty Bench. [On p. 32 is statement that Pioneer ss. is basal memb. of Scott fm., and on p. 51 is statement that W. of Briceville the Pioneer ss. forms the Dougherty Bench. On p. 316 is following statement: Where it [the Pioneer ss.] is in average development it forms projecting cliffs and underlies a bench that about Petros is prominently developed and known as Dougherty Bench. About Briceville, in Anderson Co., the corresponding bench is known as Brayden Bench and another bench 200 to 225 ft. higher is there locally known as Dougherty Bench. Writer evidently intended to make his Pioneer ss. the top memb. of his Jellico fm.]

Pipe Creek shale member (of Wiscoy sandstone).

Upper Devonian: Western New York.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [See 1923 entry under †*Silver Creek sh.*]

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 95, 96, 98, 193, 198, 199, 276, 278, 351, 357). *Pipe Creek black sh.* underlies Hanover sh. and overlies Portage ("Nunda") ss. Traceable from Lake Erie to Genesee River. Only 2 ft. thick on Walnut Creek, beneath type section of Hanover sh., but thickens eastward. At East Aurora it rests on Angola sh. Well exposed in Pipe Creek Glen, West Falls [Erie Co.].

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 352), included this sh. in Chemung group.

In Steuben and adjacent counties of south-central N. Y. the Pipe Creek sh. is treated by U. S. Geol. Survey as basal memb. of the Wiscoy, which in this area is a ss. and is called *Wiscoy ss.*

Pipes fanglomerate.

Upper Pliocene or lower Quaternary (mapped as Pliocene): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 379–380, and map). *Pipes fangl.*—A flat-lying sedimentary deposit. Lower 15 ft., soft gray ss. containing many rounded pebbles. This grades upward into reddish cgl., for most part of rounded granite, aplite, and quartz pebbles up to 6 inches in diam., but containing considerable angular material. Larger part of mass on hill ½ mi. SE. of The Pipes is rather well cemented and more resistant to weathering than underlying granite, so that it forms a distinct bench near top of the ridge. Total thickness on this hill is 50 ft. Total thickness at table-topped hill directly E. of The Pipes is 60 ft. on S. side, but less than 20 ft. on N. side. Overlain by basalt. Is younger than Hathaway fm.

Named for The Pipes, a watering place in San Bernardino Co., near which it occurs.

Pipestem shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 322). *Pipestem sh.*—Sandy sh., usually with streaks of ss. and with plant fossils at base; also contains marine fossils. Thickness 30 to 45 ft. Underlies Glady Fork ss. and overlies Pipestem coal. All included in Bluestone group [fm.]. Type loc. in Tallery Mtn road near foot of Davy Knob, 1$\frac{1}{10}$ mi. NE. of Pipestem, Summers Co.

†Pipestone quartzite.

Pre-Cambrian (Huronian): Southwestern Minnesota (Pipestone County).

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 2, p. xxii), shows *New Ulm and Pipestone qtzites* as older than red shales and red sandrock underlying Hinckley ss.

Later repts state that it is same as Sioux qtzite.

Pipestone formation.

Devonian: British Columbia.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, p. 51).

Pipestone beds.

Oligocene: Montana.

See *Pipestone Creek beds.*

†Pipestone Creek beds.

Oligocene (lower): Western central Montana (Jefferson County, Boulder region).

E. Douglass, 1902 (Am. Phil. Soc. Trans., vol. 20, n. s., pt. 3, pp. 237–245). *Pipestone beds*, the White River (Olig.) deposits on Pipestone Creek, just above Piedmont, Jefferson Co. Local name given for convenience till correlation is established.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 22, 60, 65). White River deposits along Pipestone Creek, Mont. (Douglass, 1902), are lower Olig.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, p. 9), called these beds *Pipestone Creek beds* and assigned them to lower Olig.

Piqua stone.

Silurian (Niagaran): Southwestern Ohio (Miami County).

John Hussey, 1878 (Ohio Geol. Surv. vol. 3, p. 478). *Piqua stone.*—Fine-grained, mostly sedimentary stone, few ft. thick, without large proportion of fossils. *Quarried* at Piqua, Miami Co. Extremely local. Belongs in Niagara. Rests on uneven surface of undoubted Clinton [not Clinton, but Brassfield ls.].

†Piqua limestone member.

Pennsylvanian: Southeastern Kansas.

G. I. Adams, 1904 (U. S. G. S. Bull. 238, p. 20). *Piqua ls.*—Heavy-bedded lss., 50 ft. thick, overlying Vilas sh. and forming top fm. exposed in Iola quad.

Same as Stanton ls., older name.

Named for Piqua, Woodson Co.

Piran series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289). *Piran series.*—Qtzites, 2,700 ft. thick, underlying [Mount] Whyte shales and overlying [Lake] Louise shales. Of early Cambric age. [Apparently same as St. Piran fm.]

Pirate Cove formation.

Upper Devonian: Quebec.

F. J. Alcock, 1935 (Canada Dept. Mines Geol. Surv. Bur. Econ. Geol. Mem. 183, p. 86).

†Piscataway sands.

Eocene: Eastern Maryland.

A. Heilprin, 1884 (Phila. Acad. Nat. Sci. Jour., 2d ser., vol. 9, pt. 1, pp. 120, 124–127). *Piscataway sands*, Eocene. Underlie Upper Marlborough or Marlborough rock. "Uncertain whether they represent Claibornian, Buhrstone, or Eo-Lignitic."

Piscataway as above used is said to probably correspond to Aquia fm. of present nomenclature, and "Upper Marlborough" to Nanjemoy fm.

Piscataway indurated marl member (of Aquia formation).

Eocene: Eastern Maryland and Virginia.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Piscataway memb. or substage.*—Basal memb. of Aquia fm. Characterized by greensands and greensand marls; lower beds often quite argill. Thickness generally exceeds 50 ft. Underlies and is faunally separable from Paspotansa or upper memb. of Aquia fm. Rests uncon. on Cret. Named for Piscataway Creek, Md.

B. L. Miller, 1912 (U. S. G. S. Choptank folio, No. 182). *Piscataway indurated marl memb.*—Basal memb. of Aquia fm. Underlies Paspotansa greensand marl memb. Rests uncon. on Cret.

Pisgah member (of Kincaid formation). (In Midway group.)

Eocene: Northeastern to southwestern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 535, 536, 540, 550). *Pisgah ls. memb. of Kincaid fm.*—Clay, glauconitic clay, and glauconitic sand containing lentils of ls. Top memb. of Kincaid fm., extending from top of Littig glauconite memb. of the Kincaid up to basal glauconite of Wills Point fm. Thickness 115 ft. In NE. Tex. it outcrops from Limestone Co. to Hopkins Co. and contains Lone Oak, Rocky Cedar Creek, and Tehuacana ls. lentils, the latter ls. at top and 40 ft. thick. In SW. Tex. it is somewhat different from typical exposures in NE. Tex.; in Medina Co. the clay is thinner, the basal glauconite bed is thicker, and the gray ls. near its top is more persistent than the lentils in NE. central Tex.

J. Gardner, 1935 (Univ. Tex. Bull. 3301), divided Kincaid fm. into (descending) Tehuacana memb. (more inclusive than Tehuacana ls. of Plummer), *Pisgah memb.* [restricted], and Littig glauconitic memb. This is adopted definition of U. S. Geol. Survey.

Named for exposures on Pisgah Ridge, Navarro Co., on road btw. Richland and Wortham, 6 mi. N. of Limestone Co. line.

Pismo formation.

Miocene (upper): Southern California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Pismo fm.*—Siliceous sh., diatomaceous earth, and thick beds of soft ss., with a memb. of ss. and cgl. at base. Thickness about 3,000 ft. Occurs in S. part of area mapped, and is considered to be contemp. with Santa Margarita fm. of N. part of area, though the two fms. are not known to have been connected. Uncon. overlain by Paso Robles fm. and uncon. underlain by Monterey sh.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 787). *Pismo fm.* is now known to be=Etchegoin fm. and therefore of Plio. age.

Named for exposures at town of Pismo, San Luis Obispo Co.

Pit shale.

Middle and Upper Triassic: Northern California (Shasta County).

H. W. Fairbanks, July 1894 (Am. Geol., vol. 14, p. 28). *Pitt shales.*—Siliceous slates, of which nearly 2,000 ft. are exposed at Silverthorne's ferry [on Pit River, approved spelling], containing fossils regarded by J. P. Smith as Middle and possibly Lower Triassic. It is intended to apply term *Pitt shales* to these rocks, which, together with some Upper Carbf. strata (McCloud shales), 20 mi. above the Fisheries, shall be embraced under designation *Pitt fm.*

J. P. Smith, October 1894 (Jour. Geol., vol. 2, pp. 592, 601–604). The *Pitt fm.* (H. W. Fairbanks ms.) overlies conformably McCloud ls., and consists of about 3,000 ft. of siliceous and calc. shales, cgls., and tuffs. The rocks in most places are highly metamorphosed, very poor in fossils, and folded to such degree that the strat. is obscure. The fm. is largely developed in region near junction of Pitt and McCloud Rivers. Contains both Carbf. and Triassic rocks, in apparently conformable series. Divided into Pitt shales, 2,000 ft. thick, of Middle and Upper Triassic age, and McCloud shales, 1,000 ft. thick, of Upper Carbf. age. Underlies Swearinger slates. The Pitt shales consist of siliceous shales and cgls. containing Triassic fossils about 1,500 ft. below their top, underlain by several hundred ft. of shales and cgls. without fossils.

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Pit sh.*—Largely dark and gray shales, thin-bedded sss., and many layers of tuffs. Thickness probably more than 2,000 ft. Conformably underlies Hosselkus ls. and rests on volcanic rocks called *Bully Hill rhyolite* and *Dekkas andesite*, the latter being in part interbedded with lower beds of Pit sh. Fossils indicate Upper and Middle Triassic age.

†Pit formation.

†Pitt formation.

Pennsylvanian to Upper Triassic: Northern California (Shasta County).

See definition under *Pit sh.* The U. S. Geol. Survey does not use the broad definition of *Pit*, which included Pit sh. and Nosoni fm. of present terminology.

†Pithole grit.

Mississippian: Northwestern Pennsylvania.

J. F. Carll, 1880 (2d Pa. Geol. Survey Rept. I_3, pp. 82, 93, 121, 130). The Third Mountain sand will receive in this report a new name, the *Pithole grit*. It was first recognized as a persistent ss. in Pithole oil wells, being well developed in all that country [in and around Pithole, Venango Co.], and making conspicuous outcrops along Allegheny River on S. and along Oil Creek on W. Is probably=Berea grit. A persistent band of red sh., sometimes 125 or more ft. thick, underlies Pithole grit all the way from S. line of Warren Co. [Pa.] to John Smith well in Butler Co. The Pithole grit lies near middle of Crawford shales.

I. C. White, 1881 (2d Pa. Geol. Survey Rept. Q_4). *Pithole grit* is Berea grit.

Pitkin limestone.

Mississippian (Chester): Northern Arkansas and eastern Oklahoma.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 27, 109). *Pitkin ls.*—Fossiliferous ls., 0 to 90 ft. thick, heretofore called "Archimedes ls." by Ark. Geol. Survey. Sometimes has associated with it ss. beds which contain same fossils as the ls. Highest Miss. fm. Late Chester fauna. Overlies Fayetteville sh. and uncon. underlies Morrow group (Penn.).

Named for Pitkin, Washington Co., Ark.

†Pitt formation. See *Pit sh.*

Pitt series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Pitt series* as a geographic name for *Middle Triassic series*.

Pittsburg. Appalachian region. See *Pittsburgh*.

†Pittsburg formation.

Eocene: Western Washington (Puget Sound region).

B. Willis, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 424–430). *Pittsburg fm.*—Sss., shales, and a few coal beds. Top fm. of Puget group. Thickness 4,770 to 7,000 ft. Overlies Wilkeson fm. Is comparatively barren of fossils. Named for town. [On p. 424 he said this fm. is exposed on South Prairie Creek. On p. 429 he called the deposits *South Prairie fm.* On pp. 426, 430, etc. *Pittsburgh fm.* and *South Prairie fm.* are used interchangeably.]

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), applied name *Burnett fm.* to top fm. of Puget group (probably because Pittsburg was preoccupied), but continued to use *South Prairie fm.* interchangeably with *Burnett fm.*

G. O. Smith, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, pp. 483–487), treated Puget as a fm., and applied *Pittsburg memb.* to upper 7,000± ft. of the Puget, and *Wilkeson memb.* to underlying 1,000 ft.

Foregoing are only recorded uses of *Pittsburg* for this Eocene fm.

Pittsburg Bluff sandstone.

Oligocene: Northwestern Oregon (Columbia County).

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, p. 254), used *Pittsburg Bluffs* for lower Olig. in Oreg. column, but did not define it. On pp. 250–254 they discussed fossils collected at that place by different geologists.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12, pp. 450, 457, 458, 459). [The "sandstone at Pittsburg Bluffs" is mentioned on p. 450. The "sandstone at Pittsburg Bluff" is mentioned on p. 457. On pp. 458 and 459 *Pittsburg Bluff ss.* is used. The ss. at Pittsburg Bluff is said to overlie Keasey sh., and it is assigned to middle Olig. All of definition.]

H. G. Schenck, 1928 (Calif. Univ. Dept. Geol. Sci. Bull., vol. 18, p. 36). *Pittsburg Bluff ss.*—Massive ss. that outcrops at Pittsburg Bluff, in SW¼ NE¼ sec. 23, T. 5 N., R. 4 W. Believed to rest on Keasey sh. Is overlain by massive sandy sh. containing admixture of tuffaceous material and a number of diatoms. Fossils (listed) correlate with Eugene, Tunnel Point, and Yaquina sss.

†Pittsburgh series.

Pennsylvanian: Central western Pennsylvania.

H. D. Rogers, 1839 (Pa. Geol. Surv. 3d Ann. Rept. pp. 88–108), applied *Pittsburg series* to the rocks overlying *formation XIII* (*Coal Measures*) in 5th dist. of Pa., "embracing the country west of Chestnut Ridge and Allegheny River." "It is believed that no part of the dist. contains rocks superior in their order of stratification to those just described, if we except the narrow belt of country a few miles in width, which forms the dividing land between the Ohio and Monongahela Rivers, and which extends from town of Washington southward, through Greene County to Dunkard's Creek, on Virginia line." [Corresponds to Perm. of present nomenclature.]

H. D. Rogers, 1840 (Pa. Geol. Surv. 4th Ann. Rept., p. 150). The Monongahela series, or Upper Coal Measures, which rest on Allegheny series, "includes the beds entitled the *Pittsburg series* in my last annual rept." [Includes Perm. and Monongahela fm. (Penn.) of present nomenclature.]

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3). *Upper Productive Coal Measures or Pittsburg group* overlies Lower Barren Measures in Somerset Co. Thickness 200 ft. Includes at top a ss. which lies 50 ft. above Great Pittsburg ls. Extends up to base of Pittsburg coal. [Corresponds to Monongahela fm.]

J. P. Lesley, 1886 (Am. Inst. Min. Engrs. Trans., vol. 14, pp. 631–652). "The Lower Barren Measures, or Barren measures proper of First Survey, which I may call the *Pittsburg series*, for all the hillsides in sight of us are made of upper half of this series and the lower half of it lies immediately beneath our feet" [at Pittsburgh]. Extends from top of Upper Freeport coal up to base of Pittsburgh coal. [Corresponds to Conemaugh fm. of present nomenclature. Has had considerable usage in this sense, being called *Pittsburgh group* in some repts.]

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed that the Pennsylvanian *system* (as he called it) be divided into two *series*, the upper one to be called *Pittsburgh series* and to include Monongahela, Conemaugh, and Allegheny *groups* (as he called them), and the lower one to be called *Pottsville series*.

†Pittsburgh limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 628–635). *Pittsburg ls.* is at top of Lower Barren Measures and immediately beneath Pittsburg coal. It consists of blue and black ls. 25 ft. thick, in 6 to 10 layers separated by sh. [As thus defined the term probably included both Upper Pittsburgh ls. memb. and Lower Pittsburgh ls. memb. of current classification. In subsequent repts, however, the name has by many geologists been restricted to Upper Pittsburgh ls. memb.]

J. J. Stevenson, 1873 (Am. Phil. Soc. Trans., vol. 15, n. s., pp. 20–21). Under term *Pittsburg ls.* I include all the ls. [of "Monongahela River series"] below the Waynesburg coal, although I am aware that it does not rightly cover so much. The total thickness [of ls.] is about 100 ft. in 350 ft. of strata. Color varies from light blue to almost black. Most of strata are quite compact. [This usage of name has not withstood the test of time.]

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. 88, 100). *Pittsburg ls. group* includes Uniontown ls. at top and Redstone ls. at base.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 87). *Lower Pittsburgh ls.* lies a short distance above Connellsville ss. It is thicker and more persistent than Upper Pittsburgh ls. The Little Pittsburgh coal lies a few ft. above L. P. ls. and is overlain by *Upper Pittsburgh ls.*, 3 to 5 ft. thick. Both of these lss. are known under general name of *Pittsburgh ls.*

In some U. S. G. S. repts the *Upper Pittsburgh ls. memb.* has been called *Pittsburgh ls. memb.*, but that usage is no longer followed.

Pittsburgh sandstone member (of Monongahela formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 503–507). *Pittsburg ss.*—Massive ss., irregularly stratified. Thickness 25 to 50 ft.; 25 ft. in Greene Co., Pa., and at Pittsburg. Is older than Redstone coal, and separated from underlying Pittsburg coal by 35 ft. of brown sh. [This definition apparently applied the name to same ss. that is now designated as *Pittsburgh ss. memb.*]

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Upper Pittsburg ss.*—Ss. or sandy sh., 40 ft. thick. Separated from overlying Redstone coal by 0 to 10 ft. of ls., and from underlying Pittsburg coal by 0 to 10 ft. of sh. [No Lower Pittsburg ss. was mentioned, and the ss. defined above has for many years been called *Pittsburgh ss.*]

F. Platt, 1876 (2d Pa. Geol. Surv. Rept. L, p. 20). The *Pittsburg ss.* (*Morgantown?*) is a great deposit of sh. above, sand in middle, and pebble rock at bottom, 70 ft. thick, extremely variable in composition in different parts of county. Lies 40 ft. below Connellsville ss. [The Pittsburgh ss. is now known to be a much younger bed than Connellsville ss., and Morgantown ss. is older than the Connellsville.]

J. J. Stevenson, 1877 (2d Pa. Geol. Surv. Rept. K_2, p. 409). Pittsburg ss. is *Upper Pittsburg ss.*, and is separated from underlying Pittsburg coal by 6 to 10 ft. of dark sh.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 63). Where Redstone ls. is absent or poorly represented there is often present a coarse massive ss. immediately above Pittsburg coal to which H. D. Rogers long ago gave name of *Pittsburg ss.* It is usually coarse, friable, and often pebbly, and 25 to 70 ft. thick.

Pittsburgh (Lower) sandstone. (In Conemaugh formation.)

In some repts of Pa. Geol. Surv. the name *Lower Pittsburgh ss.* is applied to a ss. underlying Upper Pittsburgh ls. memb. and lying not far above Lower Little Pittsburgh coal. In W. Va. Geol. Surv. Rept. Tucker Co., 1923, the name *Lower Pittsburgh ss.* is applied to 10 to 20 ft. of gray ss. lying 35 ft. below Morantown coal and overlying 4 ft. of dark sh. occupying the horizon of Upper Pittsburgh ls. In other repts the thickness of this Lower Pittsburgh ss. is given as 65 ft.

Pittsburgh red beds.
Pittsburgh red shale. (In Conemaugh formation.)
Pittsburgh Reds.

Pennsylvanian: Western Pennsylvania and Maryland, northern West Virginia and eastern Ohio.

Names commonly applied in Pa., Ohio, Md., and W. Va. repts to the red shales occurring in interval btw. Harlem coal above and Saltsburg ss. memb. below.

Named for exposures along the grade lines of many railroads at Pittsburgh, Pa.

Pittsburgh member. (In Monongahela formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include, as "prominent beds," Pittsburgh ss. and Pittsburgh coal.

Pittsford shale member (of Salina formation).

Silurian: Western to east-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Bull. 69, p. 867). Thin layer of black shales forms horizon at base of Salina shales. Exposed by excavations in Erie Canal near Pittsford [Monroe Co.] in 1897. Contains unique collection of heretofore unknown fossils. So distinctive is character of fm. and its fauna that we are distinguishing the layer at *Pittsford sh.* [According to Clarke's Hdb. 19, 1903, Pittsford sh. is basal bed of Salina, underlies Vernon sh., overlies Guelph dol., and consists of black sh. and interbedded platten dol. with profusion of eurypterids.]

In later repts thicknesses of 10 and 20 ft. are given for Pittsford sh. Is basal memb. of Salina fm.

The foregoing definition of *Pittsford sh.* continued to be followed for many years. In 1928 (N. Y. State Mus. Bull. 275, p. 21) H. L. Alling stated: "Pittsford" is only a local faunal phase of Vernon sh.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 337). *Pittsford sh.*—Black sh., 10 to 20 ft. thick. Basal part of Salina series in western and central N. Y. Underlies Vernon sh. and overlies Lockport dol. Was separated from the other shales because of fauna. [She described Vernon sh. as mainly red and green, but also as containing gray gypsiferous shales and thin flaggy dolomites.]

Piutean series.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 80). *Piutean series.*—The Plio. section of the Borate sediments in Death Valley dist. and best developed perhaps under Piute Point, in Furnace Canyon [E. of Death Valley, Inyo Co., Calif.]. [Negra clays are only fm. included in the series. On p. 61 these clays are "tentatively considered as Mio. in age." The series and the clays are both listed as present in Nev.]

Placentia.

See under *Terra Nova*.

Placerita formation.

Pre-Cretaceous (pre-Cambrian?): Southern California (San Gabriel Mountains).

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. in Math. and Phys. Sci., vol. 1, No. 1, pp. 3–12, 63–65, 83, map). *Placerita* (*metasedimentary*) *fm.*—Oldest known rocks of SW. San Gabriel Mtns; pre-Cret., probably pre-Camb. Profoundly altered from shales, sss., and lss. into various kinds of schists, qtzites, and crystalline lss. [On map a separate block is labelled *Placerita crystalline ls.*] Named for good exposures in Placerita Canyon, at W. end of San Gabriel Mtns. Thickness 800 to 2,500± ft. No fossils. Presumably is older than San Gabriel mixed fm., but the two are intimately associated and relations are not clear. The Placerita metasediments form part of San Gabriel fm. [On p. 35 he calls his Placerita a memb. of San Gabriel fm.] Noble has correlated this fm. with Pelona schist of Hershey, but writer believes it is older than Pelona schist. If the Pelona is pre-Camb. or possibly early Paleozoic, the Placerita is almost certainly pre-Camb. and probably older pre-Camb. (Archeozoic). Is intruded by Rubio diorite and Echo granite.

Placerita crystalline limestone.

See under *Placerita fm.*

†Placer Mountain group.

Upper Cretaceous: Central northern New Mexico.

F. V. Hayden, 1869 (U. S. Geol. and Geog. Surv. Terr. 3d Ann. Rept., pp. 90, 190). The next group of coal strata occurs in Placer Mtns, N. Mex., about 30 mi. S. of Santa Fe. Lithological characters of the beds are very similar to those of lignite group farther N., but evidence in regard to age or parallelism with lignite group is not so clear. While I regard the true coal beds of West as lower Tert., yet these Placer Mtn beds present appearance of greater antiquity than the coal beds farther N. Still the numerous varieties of deciduous leaves which I have obtained from rocks just overlying the coal beds indicate they are lower Tert. With this belief I have named them *Placer Mtn group*. The Gallisteo sand group overlies them in valley of Gallisteo Creek, and Cret. No. 4 underlies them.

Probably approx. same as Mesaverde fm.

Placid shale member (of Brad formation).

Pennsylvanian: Central Texas (Colorado River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 35; Univ. Tex. Bull. 2132, pp. 109–110, 115). *Placid sh.*, 30 to 50 ft. thick, is a memb. of Brad fm. in Colorado River Valley. Underlies Ranger ls. of the Brad and overlies Clear Creek ls. memb. of Brad. In places contains lentils of ss. Is "bed No. 7" of Drake [which Drake reported to be 25 to 100 ft. thick]. Named for town of Placid, McCulloch Co., which is located on its outcrop.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104 112). [See 1933 entry under *Brad fm.*]

F. M. Bullard and R. H. Cuyler, 1935. [See 1935 entry under *Brad fm.*]

Lower or ls.-bearing part of this memb. is now included in Winchell memb. of Nickell and Wallace Lee, which is top part of Graford fm. as redefined by Sellards (Univ. Tex. Bull. 3232, 1933) and by Wallace Lee and C. O. Nickell. The upper 111± ft. of Placid sh. of Plummer and Moore is still included in Brad. fm. (See Wallace Lee and C. O. Nickell, rept completed and soon to be published by Tex. Geol. Survey.)

Placita marl.

Tertiary? (probably Pliocene and Miocene): Central northern New Mexico.

E. D. Cope, 1875 (Ann. Rept. Chief Engrs U. S. A., Rept. Secy War to 44th Cong., vol. 2, pt. 2, p. 997). *Placita marls* underlie gravel mesas and overlie Cret. Nos. 4 and 3 in region from Zandia [Sandia] Mtns to and beyond village of Placita.

E. D. Cope, 1877 (U. S. Geog. Surv. W. 100th Mer., vol. 4, pt. 2, pp. 24–25). In intervals btw. the hills [Algodones to Sandia Mtns] there is a deposit of indurated clay, 40 ft. thick, of post-Plio. age, carrying shells which indicate its lacustrine character, which I have called *Placita marl*.

A. B. Reagan, 1903 (Am. Geol., vol. 31, pp. 87, 89). The patches of Pleist. deposits in inner valley of Rio Grande (20+ ft. thick and resting on cgl.) may be designated *Rio Grande marl;* btw. San Felipe and Placita they are called *Placita marl*, after Cope. Younger than Albuquerque marl.

Placitos limestone.

Pennsylvanian: Central northern New Mexico.

C. R. Keyes, 1903 (Ores and Met., vol. 12, p. 48). *Placitos ls.*—The lower black ls. in Sandia Mtns, of middle Carbf. age. Overlies Sandia qtzites. [Derivation of name not stated.]

†Plainfield schist.

Ordovician: Western Massachusetts.

R. Pumpelly, 1894 (U. S. G. S. Mon. 23, pp. 29–30), from [unpublished] rept of B. K. Emerson. *Plainfield schist*, the "upper hydromica schist." Thickness 9,000 ft. Overlies Chester amphibolite and underlies Conway schist. [According to personal communication from B. K. Emerson this name was published by Pumpelly as a quotation from unpublished work by Emerson, who, instead of using *Plainfield*, divided the rocks into *Hawley schist* and *Savoy schist*.]

Named for occurrence in Plainfield Twp.

Plainfield quartz schist.

Pre-Cambrian: Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 132, and map). *Plainfield quartz schist.*—Highly quartzose, but varies in texture from a finely divided quartz schist to an almost massive qtzite, and also to a dark-colored rock resembling sl. Crosses Plainfield Twp. Believed to be only a prominent and clearly marked variation of Putnam gneiss. It seems to be part of a series that includes Putnam gneiss and to be the oldest sed. fm. in the region. Resembles Poughquag qtzite.

G. F. Loughlin, 1910 (Am. Jour. Sci., 4th, vol. 29, pp. 448–451). *Plainfield quartz schist* may be Carbf.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the continuation into R. I. of Plainfield quartz schist of Conn. Survey as Westboro qtzite (pre-Camb.).

L. H. Martin, 1925 (Conn. Geol. and Nat. Hist. Surv. Bull. 33, with map), assigned *Plainfield quartz schist* to pre-Camb.

†Plains marl.

Pleistocene, Pliocene, and Miocene: Western Kansas.

R. Hay, 1893 (Kans. State Bd. Agric. 8th Bien. Rept., p. 101). Tert. deposits of Kans. consist of *plains marl* (Plio.), 175 ft. thick, and Loup Fork (Mio.), 50 ft. thick.

R. Hay, 1895 (U. S. G. S. 16th Ann. Rept., pt. 2, p. 570). *Plains marl* is composed of lime, sand, and clay. It is a surface deposit on the high prairie, but is sometimes found forming the bottom land of valleys, and sometimes occurs in patches on the slopes. Thickness few ft. to 200. I regard it as Plio. as to its inception, and probably its latest deposits were laid down in Quat. time. Where thickest its lower parts are often more aren. than the upper. It overlies Mio. grit.

E. Haworth, 1897 (Univ. Kans. Geol. Surv., vol. 2, pp. 257–280). *Plains marls* and *mortar beds* of Cragin have no definite strat. position, but are convenient terms to designate difference in physical properties. The *mortar beds* occur at all positions from base to summit of Tert. They contain Loup Fork fossils in some places and Pleist. fossils in other places, as do the *plains marls.*

N. H. Darton, 1905 (U. S. G. S. P. P. 32, pp. 149–155). Ogallala fm. of western Kans. comprises the Tert. grit, mortar beds, etc. It consists of calc. grit, sandy clay, and sand, underlying *Equus* beds and overlying Pierre sh.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3). Ogallala fm. [Plio. and Mio.] occupies all of High Plains of western Kans. Has been called "mortar beds." It is 0 to 300 ft. thick, overlies Pierre sh., and underlies Pleist. glacial deposits.

N. H. Darton, 1920 (U. S. G. S. Syracuse-Lakin folio, No. 212). [See 1920 entry under *Ogallala fm.*]

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, pp. 163–180). *Sanborn fm.*—Proposed for the Pleist. loess, with some gravel and sand at base, which is widely distributed on the divides in western Kans. The name is intended as a substitute for "Tertiary marl" or "Plains marl," introduced for this fm. by Robt. Hay. Major part of Sanborn fm. consists of this *Pleist. loess.* It seems to writer that only the loess that covers the divides can be considered to be Pleist., the loess of the valley slopes and bottoms being largely if not wholly redeposited from the divides, the redeposition having taken place probably for most part in late Pleist. and Recent times.

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, p. 355). "Sanborn fm." (Elias, 1931) of western Kans. is a composite of sand, gravel, and loess, ranging in age from early Pleist. (Kansan or perhaps older) to Peorian or younger (the "yellow dirt"). The separate parts of "Sanborn fm.," especially the loess, are differentiated in Nebr. and should not have been grouped together as a fm.; at least a new fm. name should not have been assigned.

†Plains series.

Pleistocene and Recent: Nebraska.

A. L. Lugn, 1935 (Nebr. Geol. Surv. Bull. 10, 2d ser., charts, pp. 128, etc.). *Plains series* is, as a whole, a unit in that the several fms. are of like origin and similar lithology, except the Sand Hills fm., and have all been more or less derived from common sources. The eolian genesis of this Plains or loess and Sand Hills series, its great areal extent of more than 62,000 sq. mi. in Nebr., and also the great thickness and large quantity of the deposits, make this grouping of eolian materials into a series a desirable and convenient expedient in classifying the Pleist.

geol. of the State. It is also separated from underlying Platte series by a great uncon., which is as widespread as are the fms. in Nebr. and adjoining States. It corresponds to (descending) Recent, Wisconsin, Peorian, Iowan, Sangamon, and Illinoian stages of Iowa classification.

Plaisance limestone.

Eocene: Haiti.

W. P. Woodring, 1922 (Prel. rept. Republic Haiti) and 1924 (Geol. Republic of Haiti, p. 99).

†Planorbis rock.

Pleistocene and Pliocene: Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 143, 157, 333). *Planorbis rock.*—Hard rock characterized by abundance of *Planorbis.* Uppermost Plio. bed of Fla.

This name is also applied to Pleist. rocks in Fla. (See Fla. Geol. Surv. 2d Ann. Rept., 1909, and U. S. G. S. W. S. P. 319, 1913.)

†Plant beds.

A name applied by J. W. Powell (Geology of eastern portion of Uinta Mtns, 1876) to upper part of Green River fm., overlying Tower ss., in Sweetwater Co., Wyo. These beds were later named *Morrow Creek memb.*

Plateau gravel phase.

Quaternary: Southwestern Arkansas.

See *Centre Point division.*

Plateau Valley beds.

Eocene (lower): Central western Colorado (Mesa County).

B. Patterson, 1936 (Geol. Soc. Am. Proc. 1935, p. 397). [Lists fossils from "*Titanoides* level in Mesa Co., Colo.," and says:] The assemblage is certainly upper Paleocene and probably either a Clark Fork or a Tiffany equiv. The name *Plateau Valley beds* is given to the upper Paleocene fm. in the area. [All of definition.]

†Platte series.

Upper Cretaceous: From Rocky Mountains eastward.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 49). *Platte series.*—Upper Cret. series of the Plains, into which shales and sss. more largely enter than in Comanche or Lower Cret. series, but which also has some important ls. fms. Includes Dakota, Benton, Niobrara, Fort Pierre, Fox Hills, and Laramie. Area of typical occurrence that segment of North American Interior Plateau which extends from Rocky Mtns eastward and constitutes the higher portion of the Plains. Named for Platte River, which in Colo. and Nebr. cuts all divisions of the series.

Platte shale.

Pennsylvanian: Southwestern Iowa and northwestern Missouri.

C. R. Keyes, 1898 (Am. Geol., vol. 21, p. 349). *Platte shales.*—Shales, 105 ft. thick, underlying Forbes ls. and overlying Plattsmouth ls.

Equivalent to Tecumseh sh. memb., Lecompton ls. memb., and Kanwaka sh. memb. of Shawnee fm.

Named for exposures at mouth of Platte River at Nebr.-Iowa bdy; also well exposed along Platte River (another stream) of NW. Mo.

†Platte series.

Pleistocene: Nebraska.

A. L. Lugn, 1935 (Nebr. Geol. Surv. Bull. 10, 2d ser., charts, pp. 88+). *Platte series.*—Is made up of Holdrege, Fullerton, Grand Island, and Upland fms. They constitute the Pleist. fluviatile deposits W. of the till border in Nebr. This series is=Grandian and Ottumwan of Iowa and eastern Nebr. The Upland fm. is=Yarmouth stage, the Grand Island is=Kansan stage, the Fullerton is=Aftonian stage, and the Holdrege is=Nebraskan stage. The several fms. are exposed in and near Platte River Valley, and they have a very significant relation to nature and history of Platte River and its valley. In addition, these 4 fms. have a generic unity in relation to the Nebraskan and Kansan glaciations in Nebr., which makes this grouping of them into a series logical. The fms. are extensively distributed over 15,000 to 20,000 or more sq. mi. of State, and occur as continuous layers under both the plains and Platte River Valley. Platte River flows on these fms. "*in situ*" for most part on Grand Island sand and gravel, from near North Platte to near Columbus. The deposits uncon. overlying the Platte series are= (ascending) Illinoian, Sangamon, Iowan, Peorian, Wisconsin, and Recent stages of Iowa and are here named *Plains series*.

Platte River formation.

A name loosely applied by H. Engelmann (Eng. Dept. U. S. Army, J. H. Simpson's Expl. of Great Basin of Terr. of Utah, 1876, pp. 247, 281–282) to exposures in bluffs along Platte River, Nebr., of so-called "Lignite fm.," which he assigned to Eo. or Upper Cret., and stated that it overlies Cret. No. 3 of Nebr. and is separated from his so-called "Scotts Bluff fm." by "a series of Tert. strata." (See also under †*Scotts Bluff fm.*)

Platteville limestone.

Middle Ordovician (Black River): Southwestern Wisconsin, southern Minnesota, Iowa, and northwestern Illinois.

H. F. Bain, 1905 (U. S. G. S. Bull. 246, pp. 18–19). *Platteville ls.*—The beds heretofore called "Trenton ls." in Miss. Valley region, but older than Trenton. Consists of (descending): (1) 10 to 20 ft. of thin beds of ls. and sh.; (2) 25 to 30 ft. of thin-bedded brittle ls. breaking with conchoidal fracture and at times called "glass rock;" (3) 20 to 25 ft. of buff to blue mag. heavy-bedded ls., frequently a dol.; and (4) 1 to 5 ft. of blue sh. and sandy sh. Overlies St. Peter ss. and underlies the massive Galena ls. The fm. is typically exposed in vicinity of Platteville, Grant Co., Wis., and entire thickness may be seen along Little Platte River W. of that town. The black shales of No. 1 are locally termed "oil rock," but the main bed of chocolate-colored sh., or the "oil rock" of the lead and zinc dist., lies just at base of overlying Galena. [E. O. Ulrich assigned these pre-Galena beds to the Black River and the Galena to the Trenton in 1879. See under *Galena dol.*]

As above defined included at top the beds later (1906) named *Decorah sh.* and now treated as a distinct fm. Some writers now exclude from base the sh. which has been named *Glenwood sh.* The U. S. Geol. Survey and the 1935 Conf. Rept. Kans. Geol. Soc. include this sh. in Platteville ls.

G. M. Kay, 1928 (Sci., n. s., vol. 67, p. 16), introduced *Spechts Ferry memb.* for lower part of his Decorah sh., and included in it the "glass rock" and some overlying beds. In 1931 (Jour. Geol., vol. 39, p. 370) he redefined his *Spechts Ferry memb. of Decorah fm.* by excluding the "glass rock," which he transferred to Platteville ls.

V. T. Allen, 1932 (Jour. Geol., vol. 40, No. 3, pp. 259–269), proposed to draw line btw. Platteville and Decorah at base of a 1- to 3-inch layer of metabentonite, which he reported as present 12 to 18 inches above base of Decorah in Minn., Iowa, and Wis.

G. M. Kay and G. I. Atwater, 1935 (Am. Jour. Sci., 5th, vol. 29, Feb., p. 101), include their Spechts Ferry memb. ("of late Black River age") in the Decorah, but later in 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 286–287) Kay included his Spechts Ferry memb. in Platteville ls., leaving his Guttenberg memb. (15 ft. thick near Platteville, Wis.) the sole representative of Decorah sh. near Platteville. On p. 288 he stated that in Minn. and northern Iowa it is "more convenient to consider the Spechts Ferry as a lowest memb. of Decorah fm." Kay stated (p. 286) his restricted Spechts Ferry memb. includes a thin bed of metabentonite 18 inches above its base. On p. 295 he showed an uncon. btw. his Guttenberg and Spechts Ferry members in Minn. and Ill.

See also 1935 entries under *Spechts Ferry memb.*

The U. S. Geol. Survey has for many years excluded the "glass rock" from Platteville ls. and included it in overlying Decorah sh., but *Decorah sh.* as recently defined by Kay et al. is applied to beds stated to have heretofore been included in Galena dol. (See under *Decorah sh.*)

†Platteville stage.

A term employed by S. Calvin (Iowa Geol. Surv. vol. 16, pp. 60, 84, 1906) to include Platteville ls. and Decorah sh.

Plattford shale. (In Scranton shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 41, 58). *Plattford sh.*—Underlies Cass ls. and overlies South Bend ls., all in Scranton sh. Thickness 16 ft. Named for outcrops along Platte River in Plattford Twp, Sarpy Co., Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). *Plattford sh.* is abandoned, another name having priority.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). *Plattford sh.* same as Weston sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 210). *†Plattford sh.* abandoned. Does not belong in Scranton sh. [Does not state where it does belong.]

Plattin limestone.

Middle Ordovician (Lowville): Eastern Missouri, central western and southwestern Illinois, and central northern Arkansas.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 111). *Plattin ls.*—Fine-grained ls. overlain by Kimmswick ls. and underlain by Joachim or "First Mag." ls. Generally called Trenton or lower Trenton. [Later repts give thickness of 150 to 350 ft.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), showed *Plattin ls.* as including beds of Lowville age at top and beds of upper Stones River age at base; as uncon. underlying Decorah sh. (of post-Lowville age) and uncon. overlying Joachim ls. in eastern Mo.; and as substantially = Platteville ls.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2), showed *Plattin ls.* all of Lowville age, as = Platteville ls., and as older than Decorah sh.

C. L. Fenton, 1928 (Am. Midland Nat., vol. 11, No. 2). Upper 32 ft. of *Plattin fm.* in Ste. Genevieve Co., Mo., consists of thinly bedded cherty lss., highly fossiliferous, underlying Decorah fm.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 104–110). The higher beds of *Plattin ls.* as originally defined consist of shales with more or less subordinate ls. layers, which contain same fauna as Decorah sh. of upper Miss. Valley and are undoubtedly exact equiv. of that fm. in Iowa. The name *Decorah sh.* is therefore applied to this sh. in SE. Mo., where it is 0 to 35 ft. thick, and it is here treated as a distinct fm. overlying Plattin ls. Locally the Plattin ls. is conspicuously cherty, nearly the entire mass of the ls. being replaced.

V. T. Allen, 1932 (Jour. Geol., vol. 40, No. 3, pp. 259–269). In Minn., Iowa, and Wis. there lies, from 12 to 18 in. above base of Decorah fm., a layer of metabentonite 1 to 3 in. thick. This bed is good horizon marker of bdy btw. Platteville ls. and Decorah fm. In Jefferson Co., Mo., a bed (7 to 10 in. thick) of metabentonite of similar petrographic and chemical characters lies at or 4 in. above base of Decorah fm., and confirms Weller's assignment of the overlying shales and lss. to Decorah sh., and their removal from Plattin ls., in which they were originally included.

See under *Decorah sh.*, last entry.

Named for exposures near mouth of Plattin Creek, Jefferson Co., Mo

Plattsburg limestone. (In Lansing group, Kansas.)

Plattsburg limestone member (of Lansing formation).

Pennsylvanian: Northwestern Missouri, southeastern Nebraska, eastern Kansas, and southwestern Iowa.

G. C. Broadhead, 1868 (St. Louis Acad. Sci. Trans., vol. 2, pp. 317, 327). *Plattsburg ls.*—Coarse gray and ashy-blue ls., 13 to 23 ft. thick, forming bed 134 of detailed section of Coal Measures from NW. corner of Mo. to Glasgow, Howard Co., Mo. Rests on brownish calc. ss. Is overlain by sandy sh. Included in Plattsburg group.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). *Plattsburg ls. memb. of Lansing fm.* underlies Vilas sh. memb. and overlies Lane sh. memb.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 70–75). *Plattsburg ls.* is basal memb. of Lansing group as restricted by R. C. Moore. The Lane sh. of Hinds and Greene is much younger than true Lane sh., and upper part of their so-called Lane sh., upon which the Plattsburg rests, has been named *Bonner Springs sh.*

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for exposures at Plattsburg, Clinton Co., Mo.

†Plattsburg group.

Pennsylvanian: Northwestern Missouri.

G. C. Broadhead, 1868 (St. Louis Acad. Sci. Trans., vol. 2, pp. 317, 327). *Plattsburg group.*—Group E of previous repts. Includes beds Nos. 134 to 146. Thickness 134 ft. Most important memb. of group is Plattsburg ls., at top.

Includes lower part of Lansing fm. and Iola ls. memb. of Kansas City fm.

Named for exposures at Plattsburg, Clinton Co.

Plattsmouth limestone.

Pennsylvanian: Northwestern Missouri, southwestern Iowa, eastern Kansas, and southeastern Nebraska.

C. R. Keyes, 1898 (Am. Geol., vol. 21, pp. 349, 350). *Plattsmouth ls.*—Ls., 30 ft. thick, underlying Platte sh. and overlying Lawrence sh. along Missouri River btw. Kansas City, Mo., and Omaha, Nebr.

For many years this ls. was believed to be same as Oread ls., but according to G. E. Condra (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 37, 1927) it represents only top 28 to 30 ft. of Oread ls. in Nebr., rests on Heebner sh. bed of the Oread, and one of its best developments is in Weeping Water Valley, at Snyderville. Condra said: "The bed has been known by this name since the days of Meek and Hayden, but has not been closely defined, there being more or less misunderstanding regarding its relation to Oread memb. as a whole." Condra gave thickness in Mo. 19 to 21 ft. and in Kans. 16 to 21 ft.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). Oread ls. divided into (descending) Kereford ls. memb., Heumader sh. memb., Plattsmouth ls. memb., Heebner sh. memb., Leavenworth ls. memb., Snyderville sh. memb., and Weeping Water ls. memb.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). Oread ls. divided into (descending) Kereford ls., Heumader sh., *Plattsmouth ls.* (17 to 18 ft. thick), Heebner sh., Leavenworth ls., Snyderville sh., and Weeping Water (Toronto) ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 167). According to my observations in July 1934, of type Plattsmouth exposures near Plattsmouth, Nebr., and of excellent section in Snyderville quarry, W. of Nehawka, Nebr., which is regarded by Condra as showing uppermost beds of Plattsmouth ls. that are eroded at Plattsmouth, it appears that Condra's definition of this unit includes equivalents not only of "upper" Oread ls. of Kans., but also of Kereford ls. memb. of Oread, Clay Creek ls. memb. of Kanwaka sh., and other lss. that appear in N. part of Kanwaka sh. If this is true the name *Plattsmouth* is not applicable to "upper" Oread ls. alone unless restricted to use in this sense. Since it was evidently Condra's intention to designate only "upper" Oread ls. memb. as Plattsmouth, and since the Kereford and other strat. units in type Plattsmouth section can be recognized, it seems best to restrict *Plattsmouth* to ls. beds btw. Kereford (Heumader sh. absent at Plattsmouth) and Heebner members of Oread. [See further remarks in 1936 entry under *Spring Branch ls.*]

See also G. E. Condra and E. C. Reed, Nebr. Geol. Surv. Bull. 11, 2d ser., p. 60, 1937.

Named for exposures near Plattsmouth, Cass Co., Nebr.

Pleasant Hill limestone.

Middle Cambrian: Central Pennsylvania (Blair County).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 528, 534, 537). *Pleasant Hill ls.*—Thick-bedded fossiliferous ls., underlain by argill. thin-bedded ls. that weathers to sh. Thickness 600 ft. Underlies Warrior ls. and overlies Waynesboro fm.

Upper part is well exposed at Pleasant Hill Church, 1 mi. NW. of Henrietta, Blair Co.

Pleasanton formation (**group** in Kansas).

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth, 1895 (Kans. Univ. Quart. vol. 3, p. 274 and pl. opp. p. 290; Am. Jour. Sci., 3d, vol. 50, p. 457 and pl. opp. p. 466). *Pleasanton shales*.—Shales (with much ls. in places and with two coal beds), 180 to 250 ft. thick, overlying Pawnee and Oswego lss. and underlying Erie or Triple ls. system. [R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 63, 77), says Hertha ls. is basal bed of †Erie ls. of Haworth and Kirk, 1894.]

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), defined *Pleasanton fm.* of Mo. as underlying Hertha ls., overlying Pawnee ls. memb. of Henrietta fm., and as top fm. of Des Moines group. This definition was followed for many years.

In 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. chart) R. C. Moore restricted Pleasanton sh. of Kans. to beds overlying Altamont ls. and separated from Hertha ls. by sh. and channel ss., with which he reported it is uncon. In 1932 he dropped Pleasanton from the Kans. classification, and in his 1936 rept (Kans. Geol. Surv. Bull. 22) he discarded the name altogether. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.) The 1933 (57th Bien.) and 1935 (58th Bien.) repts of Mo. Bur. Geol. and Mines continued to use *Pleasanton fm.* as defined by Hinds and Greene, which is definition at present followed by U. S. Geol. Survey.

Named for exposures at Pleasanton, Linn Co., Kans., where the schoolhouse hill is composed principally of these shales.

Pleasant Valley formation.

Pre-Cambrian: British Columbia (Cariboo district).

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 15). [Assigned to pre-Camb. (?), but later repts, by several geologists, assign it to pre-Camb.]

Pleasantview sandstone. (In **Carbondale formation**.)

Pennsylvanian: Northwestern Illinois (Mercer County) and central western Illinois.

H. R. Wanless, 1929 (Ill. Geol. Surv. Bull. 57, pp. 49, 90–91, 124). Olive-gray to blue-gray ss., medium-grained, very micaceous, cross-bedded. Thickness in Alexis quad. [Mercer Co.] 0–50+ ft. Is here designated *Pleasantview ss.*, a name proposed by Walter Searight (personal communication) for a ss. in similar strat. position along Mill Creek, near Pleasantview, Schuyler Co. Local distribution and marked irregularity of basal surface of this ss. suggest it is largely a group of channel deposits. Lies 17± ft. below eroded top of Carbondale fm. in Alexis quad., and 0 to 21± ft. above Colchester (No. 2) coal or 0 to 12½ ft. above Francis Creek sh. Is probably=Vergennes ss. of southern Ill.

H. R. Wanless, 1931 (Ill. Geol. Surv. Bull. 60, pp. 179–193). *Pleasantview ss.* overlies Purington sh. and in places cuts out all underlying beds down to coal No. 2.

Pleiocene.

An early spelling of Pliocene.

Pleistocene epoch (or **series**).

The early epoch of Quaternary period and the deposits formed during that epoch. Commonly called "Glacial epoch," and popularly known as the Great Ice Age, the later part of Quaternary period being known as Recent epoch (or series). For definition of *Pleistocene* see U. S. G. S. Bull. 769, pp. 45–49. Some geologists still apply Pleistocene to all of Quaternary period. It is commonly divided into (descending) Wisconsin stage of glaciation, Peorian stage of deglaciation, Iowan stage of glaciation, Sangamon stage of deglaciation, Illinoian stage of glaciation, Yarmouth stage of deglaciation, Kansan stage of glaciation, Aftonian stage of deglaciation, and Nebraskan (or pre-Kansan) stage of glaciation. G. F. Kay and M. M. Leighton, 1933 (Geol. Soc. Am. Bull., vol. 44, pp. 669–673, Aug. 31), proposed a slightly different classification (see under *Wisconsin stage*) and applied *Pleistocene* to all of the Quaternary.

†Pleito formation.

Oligocene: Southern California (Kern County).

C. M. Wagner and K. H. Schilling, 1923 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 14, pp. 235–252). *Pleito fm.*—Upper fm. of San Lorenzo group in San Emigdio region. Discon. overlies San Emigdio fm., the lower fm. of San Lorenzo group, and is uncon. overlain by Monterey group. At Caraera Pass, E. of Pleito Creek, it consists of 350 ft. of brownish and pearl-gray fine sss., the lower portion medium-grained and white; underlain by 600 ft. of massive dark-brown and buff sss, with fossiliferous layers and light bluish-gray massive cgls. toward base; the basal 50 ft. consists of dark brick-red coarse sss. and cgls. grading into gray toward W. Exposed on Pleito Creek, Kern Co. The Pleito and San Emigdio are littoral deposits but faunally distinct, the faunas being more closely related to each other than either one is to the faunas of overlying and underlying fm.

Is a faunal zone in San Lorenzo fm., according to H. W. Hoots.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 761, pl. 15). Thickness of *Pleito fm.* in San Emigdio region is 2,375 ft., and it is of upper and middle Olig. age.

Pliocene epoch (or **series**).

The last epoch of Tertiary period and the rocks formed during that epoch. For definition see U. S. G. S. Bull. 769, pp. 51–53.

Plomosas formation.

Age (?): Mexico.

R. H. Burrows, 1909 (Min. and Sci. Press, vol. 99, p. 292).

Pluma formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799 and 836–843, with maps). *Pluma fm.*—Alternating beds of finely foliated garnet schist and fine-grained gray-black carbonaceous clay slates, some of which are pyritiferous. Thickness of slates exceeds that of schists. Total thickness 4,000 ft. Uppermost pre-Camb. fm. in Lead dist. Believed to be of Keewatin age.

Named for Pluma, about 1½ mi. E. of Lead, Lawrence Co., where best exposures occur.

Plumas series.

Jurassic (Upper, Middle, and Lower): Northern California.

J. P. Smith, 1910 (Jour. Geol., vol. 18, table opp. p. 217). *Plumas series* includes Hinchman ss. of Plumas Co., Mormon ss., and Hardgrave ss., the *Arietites* beds of Inyo Co., Calif. and Nev. being considered=lower part of Hardgrave ss.

Plum Creek clay.

Silurian: East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 44, 61). *Plum Creek clay.*—Clay, 5 ft. thick, forming part of Indian Fields fm. (of Niagaran age). Overlain by Oldham ls. (top memb. of Indian Fields fm.) and underlain by ls., 1 to 2 ft. thick, which forms basal part of Indian Fields fm. and is regarded as belonging above the line of uncon. which in east-central Ky. is marked by *Whitfieldella subquadrata* and an oolitic iron-ore bed. [In 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173) Foerste assigned this clay to Medinan. In 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 33, pp. 130–133) Foerste gave further details.]

Named for Plum Creek, Powell Co.

†Plum Creek beds. (In Chester group.)

Mississippian: Southwestern Illinois (Randolph and Monroe Counties).

E. O. Ulrich, 1917 (Ky. Geol. Surv., Miss. fms. of western Ky., pt. 2, pp. 44, 56, 230, pl. D). Most of Glen Dean fossils marked as found in Randolph Co. area in Ill. occur there in the 40 ft. of shaly ls. ("Plum Creek beds") that has been included by Weller—somewhat arbitrarily, I think—in top of Okaw ls.

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41, p. 132). *Upper Okaw ls. (Plum Creek beds)* of Randolph Co. is=Glen Dean ls. of SE. Ill.

Preoccupied. Replaced by *Glen Dean ls.*

Plum Creek shale.

Middle Devonian: Northern Ohio.

A. W. Grabau, 1917 (Jour. Geol., vol. 25, pp. 337–343). *Plum Creek shales.*—If name *Prout ls.* is to be restricted to the ls. memb. of the northern series, then the sh. below it must receive another name. It certainly is not Olentangy, which name belongs to earliest Upper Dev. fm. of central O.

Plummer limestone member (of Pawhuska formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

D. E. Winchester, 1918 (U. S. G. S. Bull. 686C, pp. 11–12). *Plummer ls. memb. of Pawhuska ls.*—Black flinty angular ls., only locally fossiliferous, separated into two benches by 6 to 8 ft. of sh. The outcrop of upper bench beneath the gray ledge-making ls. of Pawhuska fm., is usually marked by long, square-edged blocks, only one edge of which is exposed. The lower bench is of much less value as a key bed. Named for exposures near house on Plummer ranch, T. 26 N., R. 9 E.

Plum Point marl member (of Calvert formation).

Miocene: Eastern Maryland.

G. B. Shattuck, 1904 (Md. Geol. Surv. Miocene vol., p. lxxiv). *Plum Point marls memb.*—A series of sandy clays and marls in which are embedded large numbers of organic remains, including diatoms. Of bluish-green to grayish-brown and buff colors. Top memb. of Calvert fm. Overlies Fairhaven diatomaceous earth memb. Named for Plum Point, Calvert Co.

Pluto shale. (In Hinton formation.)

Mississippian: Southern West Virginia and southwestern Virginia.

D. B. Reger, 1920 (W. Va. Geol. Surv. Rept. Webster Co., pp. 214, 219–220). *Pluto sh.*—Dark, carbonaceous, sometimes cherty; with plant and marine fossils. Thickness 0 to 4 ft. Lies 0 to 5 ft. below Terry ls., the intervening beds consisting of variegated sandy sh. Rests on Pluto coal. Included in Mauch Chunk.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 332–335), applied name *Pluto sh.* to 0 to 40 ft. of sh. overlying Pluto coal, and *Lower Pluto sh.* to 50 to 80 ft. of greenish-brown sandy sh., with occasional red beds and streaks of ss., carrying marine fossils and near base a plant zone. The *Lower Pluto sh.* underlies Pluto ls. and rests on Falls Mills ss. (all members of Hinton group [fm.]), and was noted in Mercer and Summers Counties, W. Va., and in Tazewell Co., Va.

Pluto limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 334). *Pluto ls.*—Shaly ls., 0 to 2 ft. thick, yellowish green, with marine fossils. Underlies Pluto coal and overlies Lower Pluto sh.; all members of Hinton group [fm.]. Named for association with Pluto coal in Summers Co.

Plymouth interlobate moraine.

Pleistocene (Wisconsin stage): Southeastern Massachusetts (Cape Cod).

N. S. Shaler, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 553). *Plymouth moraine* extends in a general southerly direction from near harbor of that name. Appears at first sight to be the largest, and is perhaps the most continuous, deposit of the kind in New England.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 138). The terminal moraine of lobe that filled Cape Cod Bay (the northern arm of Cape Cod was not then formed) now skirts S. shore of the bay, and at its SW. corner joins Falmouth moraine.

and the two extend N., a little back from present shore, as the *Plymouth interlobate moraine.*

Named for Plymouth Woods, on W. shore of Cape Cod Bay. Extends as far N. as Kingston, Mass. Same as Plymouth moraine of Shaler.

Plymouth ferruginous chert member (of Ironwood formation).

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Gogebic district).

W. O. Hotchkiss, 1919 (Eng. and Min. Jour., vol. 108, pp. 501, 502). *Plymouth ferruginous chert memb.*—Dominantly wavy-bedded granular and fine-grained ferruginous cherts; some sl.; a thin cherty qtzite sometimes present at base. Basal memb. of Ironwood fm. Underlies (uncon.) Yale memb. and uncon. overlies Palms fm. Named for Plymouth mine, Gogebic range.

Plymouth member.

Carboniferous: Nova Scotia.

W. A. Bell, 1925 (Canadian Inst. Min. and Met. Bull. 158, p. 618).

Plymouth marble.

Lower Cambrian: Southeastern Vermont (Windsor County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288). *Plymouth dol.* of central Vt. is Lower Camb. and Sherman marble of southern Vt. is Lower Camb. and=*Plymouth marble.* [*Plymouth marble* was used as a commercial term as far back as 1861 (Rept. Geol. Vt., vol. 2).]

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 405). *Plymouth marble.*—Chiefly dolomitic marble, gray or darkly mottled. In town of Plymouth ls. cgls. appear in the fm., some of which have been used for ornamental stone known commercially as "*Plymouth breccia.*" The marble is much folded and in places probably faulted, so that true thickness is unknown. Easily soluble, and underlies the deep valley which bisects Green Mtns in this region, hence exposures are few. Correlated with Rutland dol.

Plymouth granite.

Late Paleozoic: Southeastern Vermont (Windsor County).

E. L. Perry, 1929 (16th Rept. Vt. State Geol., pp. 44–46). *Plymouth granite,* intrusive, late Paleozoic. Occurs on S. slope of Morrison Hill in Plymouth [Woodstock quad.], about ½ mi. NW. of Pinney Hollow road and an equal distance due W. of Pinney Hollow schoolhouse E. of road to abandoned Morrison farm at about 1,500-foot contour level.

Plymouth conglomerate.

Lower Cambrian: Southeastern Vermont (Windham County).

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., p. 220). In Windham Twp [Windham Co.] the Lower Camb. terranes consist of following fms.: Sherburne cgl., *Plymouth cgl.,* Plymouth dol., albitic mica schist, Pinney Hollow schist, and Ottauquechee schist. [The *Plymouth cgl.* referred to may be *Plymouth breccia* mentioned by Keith in 1932 entry under *Plymouth marble.*]

†Plymouth breccia.

A trade name applied to ls. cgl. quarried from Plymouth marble in town of Plymouth, SE. Vt. See 1932 entry under *Plymouth marble.*

Pocahontas formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 3). *Pocahontas fm.*—Gray and green argill. ss. and sandy sh. with two or three coal seams in lower part and Pocahontas coal [No. 3 Pocahontas rider coal] at extreme top. Underlies Clark fm. and overlies Bluestone fm. Thickness 360 ft.

Corresponds to lower part of Pocahontas group of I. C. White.

Named for Pocahontas, Tazewell Co., Va.

†Pocahontas group. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, p. 13). *Pocahontas group* (*Lower Pottsville*).—Includes: (1) Flat Top Mtn ss. at top; (2) Pocahontas coals Nos.

8, 7, 6, 5, 4, 3, 2, and 1, together with intervening sss. and shales; and (3) at base the *Pocahontas sss.* Rests uncon. on Mauch Chunk red sh. Named for Pocahontas, Tazewell Co., Va. [This definition applies *Pocahontas* to a broader unit than Pocahontas fm. as originally defined by M. R. Campbell.]

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. on Wyoming and McDowell Counties). No. 8 Pocahontas coal is basal memb. of New River group, which rests on Flattop Mtn ss., the top memb. of *Pocahontas group.* [This definition is the one now followed by W. Va. Geol. Surv.]

Pocahontas group of I. C. White is basal fm. of Pottsville group.

Pocahontas sandstones. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, pp. 224–232). *Upper Pocahontas ss.*—Massive to heavy-bedded, medium-grained to coarse, bluish gray to buff, 50 to 75 ft. thick; lies 0 to 5 ft. below Pocahontas No. 4 coal and overlies Pocahontas No. 3 rider coal; quarried at Pocahontas, Tazewell Co., Va. *Lower Pocahontas ss.*—Massive to heavy-bedded, medium-grained, buff to bluish gray, micaceous, 0 to 50 ft. thick; lies 0 to 8 ft. above Pocahontas No. 2 coal; when shaly often carries Pocahontas No. 2A coal near middle.

Pochuck gabbro gneiss.

Pre-Cambrian: Northern New Jersey and eastern Pennsylvania.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 439). The gneissic outlier of Pochuck Mtn is represented by two bands of rock. The eastern band, which adjoins the valley and forms E. slope of Pochuck Mtn, we have called the *Pochuck gneiss.* Is about 1 mi. in width and has been traced from near Hamburg to N. edge of area mapped. The prevalent rock type is a finely foliated gneiss, rich in biotite and hornblende and often grading into mica schist. With that type there are often associated bands of amphibolite gneiss.

A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161). Name *Pochuck gneiss* is here used to include all gneisses in Highlands region that contain hornblende, pyroxene, or mica as principal mineral constituents. Some of these rocks are probably of sed. origin, and others may be altered igneous rocks, but in general they are so completely metamorphosed that their original nature cannot be ascertained. Appear to be older than intrusive Losee and Byram gneisses. Include many varieties, but all characterized by dark lines attributable to presence of hornblende, pyroxene, or mica as important mineral constituents. Usually the only light-colored mineral present is oligoclase, but some facies contain considerable scapolite. Microcline observed occasionally, andesine and labradorite feldspar rarely. Rocks range from medium- to fairly coarse-grained; texture foliated granular. In Franklin Furnace area the gneiss passes beneath Franklin ls. Although Pochuck gneiss and Franklin ls. are regarded as older than Losee and Byram gneisses, the original relations are not determinable.

W. S. Bayley, R. D. Salisbury, and H. B. Kümmel, 1914 (U. S. G. S. Raritan folio, No. 191, p. 8). It seems probable the black gneisses which have been included under term *Pochuck gneiss* should properly be divided into 2 groups of different age and possibly of different origin, the first group comprising gneisses, possibly of sed. origin, older than Byram and Losee gneisses, and the second group comprising dark gneisses of igneous origin contemp. with Byram and Losee gneisses. The latter group would probably include the dark gneisses intrusive in Franklin ls. The 2 groups have not been mapped separately because of impossibility of discriminating them in field.

The name *Pochuck gabbro gneiss* is now restricted by U. S. Geol. Survey to the black gneiss of intrusive igneous origin, and the older dark gneisses of sed. origin that formerly were included under the name *Pochuck gneiss* are now included in Pickering gneiss.

Pochuck diorite.

Pre-Cambrian: Eastern New York.

C. P. Berkey and M. Rice, 1921 (N. Y. State Mus. Bull. 225, 226, p. 51). *Pochuck diorite,* intrusive, West Point quad., pre-Camb.

Pocono formation (also **Pocono group**).

Mississippian: Pennsylvania, eastern Ohio, northern West Virginia, and western Maryland and Virginia.

J. P. Lesley, 1876 (2d Pa. Geol. Surv. Rept. L, App. E, pp. 221, 222, pl. opp. p. 224, p. 227). *Pocono ss. (Vespertine of Rogers; No. X; Upper or Gray Catskill; Mountain ss.)*, underlies Mauch Chunk (Umbral) red sh. and overlies Catskill red rocks. [Lesley did not mention type loc. The pl. opp. p. 224 is of Boyd's hill oil well, Pittsburgh, and on it "Pocono, No. X (or Upper (gray) Catskill) (or Vespertine of Rogers)" is bracketed to include all beds up to base of Mountain ls., including New River Coal Measures in upper part.]

Several county maps of 2d Pa. Geol. Surv. containing the name *Pocono ss.* bear date 1876, but the repts which they accompanied were not published until 1877 and later years. Among these are the maps of Bradford and Tioga Counties (central northern Pa.), which Lesley stated, in his rept for 1875 (A), published in 1876, would be completed that winter.

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, No. 99, Jan. to May, 1877, pp. 519–560). *Pocono (Vespertine) Gray ss.—Pocono* is new name proposed by present State Geologist [J. P. Lesley]. Underlies Mauch Chunk Red sh. and overlies Catskill fm. Thickness 2,133 ft. Is No. X of repts. Constitutes mass of Pocono Mtns, Pa. The middle memb. (*New River Coal Series*), 313 ft. thick, is original New River series of Lesley. [The latter statement is erroneous, according to D. B. Reger, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 403). Ashburner's paper was read Feb. 16, 1877, and was reviewed in Am. Jour. Sci., 3d, vol. 13, pp. 384–385, May 1877.]

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxiii–xxx). *Pocono (Upper Catskill) ss.*—New name proposed by State Geologist of Pa. [J. P. Lesley] for Rogers' "Vespertine, No. X." Is basal fm. of New River system (No. X, in Greene Co., SW. Pa.), the upper fm. of that system being designated New River Coal Measures. Rests on Catskill Old Red ss. (IX). Forms the mass of the great mtn plateau btw. Delaware and Lehigh Rivers, and attains greatest development in Pocono Mtns [of NE. Pa. (Monroe Co.)].

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, p. 235), applied *Elk Mtn transition group* (also *Transition (Sub-Pocono) measures*) to 375 ft. of beds underlying Pocono ss. and overlying Catskill fm., in Susquehanna and Wayne Counties, NE. Pa., and treated Mount Pleasant cgl. as basal memb. of this transition group.

J. P. Lesley, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. ix to xv), explained how he came to map incorrectly as *Pocono* rocks that are not Pocono. He stated: "To find any Pocono on Pocono Plateau one must go a number of mi. to N. of front edge of the plateau, where ridges of the lowest Pocono rock, the Mount Pleasant cgl., remain uneroded."

J. P. Lesley, 1882 (2d Pa. Geol. Surv. Rept. G_6, p. 78, footnote). The Cherry Ridge cgls. were considered by First Survey as base of No. X. Hence I named whole of No. X the *Pocono fm.*, because entire crest of the escarpment, and face of plateau behind it, are made by these rocks. White prefers to carry top of Catskill fm. 500 ft. higher up the column.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 89–95). Mount Pleasant cgl. is basal memb. of *Pocono fm.* in Pike and Monroe Counties, Pa., and Mount Pleasant red sh. is topmost memb. of Catskill series.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7), applied *Pocono-Catskill group (transition group)* to 300 to 500 ft. of beds underlying Pocono ss. and overlying Catskill series proper in the six counties of NE. Pa., and treated Mount Pleasant cgl. as basal memb. of this transition group.

In some subsequent repts of 2d Pa. Geol. Survey these transition beds of NE. Pa. were treated as distinct from Pocono, and in other repts, covering the same areas, the Pocono was described as resting on the Catskill.

C. S. Prosser, 1894 (U. S. G. S. Bull. 120, p. 78), treated Mount Pleasant cgl. as basal memb. of Pocono.

J. J. Stevenson, 1903 (Geol. Soc. Am. Bull., vol. 14), included in Pocono all beds to base of Mount Pleasant cgl. of NE. Pa. and to top of Riceville sh. of NW. Pa.

J. Barrell, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 429–472). *Pocono ss.* has two phases—marine in western Pa. and Ohio and fluviatile in eastern Pa. Grades into underlying Catskill through beds of passage, the bdy line being arbitrary, and Pa. geologists differing among themselves to extent of several hundred ft.

W. A. VerWiebe, 1917 (Am. Jour. Sci., 4th, vol. 43, pp. 301–307), applied *Pocono* to beds of NW. Pa. extending down to base of Berea ss.

D. B. Reger, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 397–410), doubtfully correlated Berea ss. (which he made basal memb. of Pocono) with Mount Pleasant cgl.

In many repts on NW. Pa. all beds down to top of Catskill and top of Riceville sh. have been included in the Pocono.

The present Pa. Geol. Survey classifies the Pocono as a *series*.

The 1884 geol. map of Monroe Co., Pa. (2d Pa. Geol. Surv.), mapped Pocono ss. at and around Pocono Mtn (Jackson Twp), also in W. part of Pocono Twp. and near Pocono Station. But this is not Pocono, according to G. H. Chadwick (see Feb. 1935, entry), who also quoted I. C. White's Rept G_6, to same effect.

G. H. Chadwick, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 177). The eastern or *type Pocono* has nothing to do with the Miss. strata and faunas called by that name in other parts of the State, but is midway in Upper Dev., as may also be typical Mauch Chunk.

D. White, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 265–272). The Pocono is a moderately distinct strat. and sedimentary unit, of continental gray cgls., coals, and shales, btw. red Mauch Chunk (above) and red Catskill (below), extending from East Mauch Chunk, on slope of Pocono Mtns, southward along E. side of Appalachian Trough as far as Tenn., and called *Pocono* since that name was proposed to supersede Rogers' Vespertine. On Lehigh River below Mauch Chunk, where it is now well exposed, due to modern road building, it embraces about 1,250 ft. of beds, as measured by Winslow, consisting mainly of gray sss., many of which are coarse sand or very fine gravel, coarse cgls., numerous coal beds, and shales with some greenish flaggy layers. The lower portion presents here and there relatively thin red sh. deposits. The Pocono retains these general characters throughout greater part of its outcrop along E. border of Appalachian Carbf. from East Mauch Chunk to Big Moccasin Gap, 2 to 3 mi. E. of Gate City, Scott Co., Va., and about 2½ mi. N. of Tenn. line. The Pocono forms a continuous well-marked topog. feature throughout eastern zone of Appalachian embayment. Viewed from both diastrophic and paleobotanical standpoints the Pocono of eastern belt is Miss.

G. H. Chadwick, Feb. 1935 (Am. Jour. Sci., 5th, vol. 29, No. 170, pp. 133–143). "What is Pocono?" According to I. C. White's Rept. G_6, 2d Pa. Geol. Surv., 1882, pp. 89–90, there is no Pocono in Pocono Mtn (Pocono Knob) or Pocono Twp, or in fact on whole Pocono Plateau except topping a few isolated peaks far back from the scarp. [Long discussion. See also *Moosic*.]

G. H. Ashley and B. Willard, 1935 (Sci., n. s., vol. 81, No. 2112, June 21, pp. 615–617). Lesley, perhaps at a staff conference, certainly not later than 1876, proposed *Pocono* to replace Vespertine or No. X of Rogers, whose [1858] definition [quoted] is essentially the definition of Pocono as now in use (D. White, Am. Jour. Sci., 5th, vol. 27, pp. 265–272, 1934), and is equiv. to that officially recognized by present Pa. Survey. *Pocono* was intended to be applied throughout the State wherever *Vespertine* had been used, whatever his type loc. may have been. This is sense in which *Pocono* is now accepted and used stratigraphically in Pa. and to S. Its application to plateau btw. Delaware and Lehigh Rivers, whatever Lesley's original intent, may be wrong, and, if so, has been wrongly followed. But it seems reasonable that Lesley's original thought, even though he incorrectly dated the beds of the plateau, was to apply the name to the ss. btw. the "Catskill" and Mauch Chunk. There seems no necessity for discontinuing use of *Pocono fm.* for the gray sss. and cgls., probably of early Miss. age, which overlie highest recognized Dev. beds and help support Allegheny Front, border much of the anthracite fields, produce prominent ridges in central Pa., and appear as more or less flat-lying beds in W. part of State. But in so doing, we must bear in mind the anomalous situation that first published application of term was not to a type loc. of that name. Evidently we are forced either to propose a new term, or, and this is by far the more reasonable and least confusing course, accept a name, which, however dubious its origin, is made acceptable by long usage.

B. Willard 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 597–599). There is no reasonable doubt that Lesley's type loc. for his redefined Pocono is essentially included in Moosic Mtns. Although his definition is clear, and he promised to publish the map of Pike and Monroe Counties to conform thereto, he did nothing of the sort. Instead, the map of those counties was drawn nearly as that part of Rogers' 1858 State map. This error was continued on 1893 and 1931 State maps. Writer's only disagreement with Lesley's redefinition of Pocono [1882] would be that the base should be drawn a little higher (300 to 400 ft.), at Griswolds Gap cgl., not at Mount Pleasant cgl. This very change was adopted by I. C. White in vol. G_7, 1883. No fossils have been described from type region of Pocono, but D. White recognized Lower Miss. age of Pocono flora at Lehigh River near Mauch Chunk. This has been corroborated by W. Darrah from Pocono plants he has studied from that section. That the beds exposed at this locality and in Moosic Mtns are=Pocono cannot now be denied. Lesley realized this. Because Lower Miss. continental strata, known as Pocono fm. as redefined by Lesley, are found on Pocono Plateau along its W. border, writer holds the name should be retained, at least until better reasons for change than can now be marshaled are available. The name should still be applied from type loc. to W. and S. all through central Pa. To substitute *Moosic*, as Chadwick has hinted, would produce confusion concerning a wide area where *Pocono* has had long standing. Possibly such a change may eventually be found advisable, but at present it is writer's conviction that neither he, nor Chadwick, nor anyone else, has given sufficient study to problem to offer such a change. For present *Pocono* should be continued to be interpreted essentially as Lesley finally defined it and as observations dictate. [On p. 603 Willard stated:] There is Pocono of Miss. age on Pocono Plateau. Correlations, based on sections by Winslow and I. C. White and determination of nearby floras by D. White and W. Darrah, establish, with reasonable certainty, the Miss. age of the Pocono in Moosic Mtns.]

Poestenkill fault breccia.

Ordovician: Eastern New York (Albany, Cohoes, Troy, and Schenectady quadrangles).

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, pp. 113–115). *Poestenkill fault breccia.*—Largely composed of black Normanskill chert, Normanskill grit, and Bald Mtn ls. Composition very different from that of Rysedorph cgl. Named for outcrop in bed of the Poestenkill.

Pogonip limestone.

Lower Ordovician: Eastern and southern Nevada and southeastern California.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map IV), and 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 187–195, 248). *Pogonip ls.*—Dark ls.; lower ls. beds highly siliceous and steely black, with blue shades, varying a good deal in physical characteristics, passing downward into rather argill. shales; higher in series the rock is dark blue and much banded by zones of aren. ls. and occasional seams of pure chert several inches thick. Thickness 4,000 ft. Conformably underlies Ogden qtzite (Dev.) and conformably overlies Camb. qtzite. Type loc. Pogonip Ridge at White Pine [Hamilton], Nev. [This definition includes all beds btw. Prospect Mtn qtzite (Lower Camb.) and Eureka qtzite (Middle Ord.).]

In 1883 (U. S. G. S. 3d Ann. Rept., pp. 253-263 and map) Arnold Hague, in his rept. on Eureka dist., defined *Pogonip ls.* as comprising 2,700 ft. of highly fossiliferous lss., the upper part consisting of purer fine-grained ls. of bluish-gray color and distinctly bedded, and the lower part consisting of interstratified lss., argillites, and, at base, aren. beds; the fm. being overlain by Eureka qtzite and underlain by Hamburg sh. (later named *Dunderberg sh*). This is commonly accepted definition of Pogonip ls. As thus defined the main mass of fm. has been classified as of Beekmantown age, but at top it carries a Chazy fauna. In 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, pp. 466–467, 475), however, C. D. Walcott proposed restricting Pogonip to upper part of Pogonip ls. of previous usage, and applied *Goodwin fm.* to lower 1,500 ft., which he stated contain a "Lower Ozarkian" fauna. The fm. has been mapped by S. H. Ball (U. S. G. S. Bull. 308, 1907) in Inyo Co., Calif. The U. S. Geol. Survey uses *Pogonip ls.* in broad sense.

†Pogonipan series.

A term introduced by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 53, 80), for a part of Pogonip ls. of Nev., and applied by him to supposedly contemp. deposits in other States, for example, to Bighorn dol. of Wyo.

Pohenagamuk formation.

Ordovician: Quebec.

J. A. Dresser, 1912 (Canada Geol. Surv. Mem. 35, p. 25).

Pohono granodiorite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 123). Grayish-white mixture of quartz and feldspar in which are embedded elongated grains of hornblende and biotite about 1 mm in diam.

Named from occurrence near Pohono Trail.

Poinsettan series.

A name introduced by C. [R.] Keyes to cover the late Tert. gravels of Mo., and later applied by him in Ill. (See Iowa Acad. Sci. Proc., vol. 22, p. 252, 1915.) Derivation of name not stated.

Point a Pierre grits.

Cretaceous: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in Geol., No. 7, p. 39).

Point aux Barques sandstone.

Mississippian: Michigan (Saginaw Bay region).

A. Winchell, 1871 (Am. Phil. Soc. Proc., vol. 11, btw. pp. 60 and 66). *Point aux Barques sss.* belong to Marshall group. [And are so mapped on 1916 geol. map of Mich. Geol. Surv.]

A. C. Lane, 1900 (Mich. Geol. Surv. vol. 7, pt. 2), gave thickness of *Point aux Barques ss.* as 18 ft., and stated that it belongs to lower part of Marshall fm.

Point aux Barques lighthouse.

Mississippian: Michigan (Huron County).

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30, p. 85). *Point aux Barques lighthouse.* [In columnar section of Huron Co. this name is applied to a thin ss. in upper part of Coldwater sh. lying a considerable distance below Point aux Barques ss.]

Point aux Gres limestone.

Mississippian: Eastern Michigan (Arenac County).

C. C. Douglass, 1839? (Mich. Leg. House Doc. 27, btw. pp. 97 and 111). *Point aux Gres ls.*—Light cream-colored aren. ls. containing Septarea. Overlies black bituminous sh., and uncon. underlies Tert.

C. C. Douglass, 1841 (Mich. Leg. Doc., vol. 1, No. 2, 4th Ann. Rept. State Geol., for 1840, btw. pp. 545 and 551). *Point aux Gres ls.*—Light-colored aren. ls. containing Septarea. Overlies black bituminous sh. and underlies Tert.

Only known uses of name. The 1916 geol. map of Mich Geol. Surv. mapped the ls. of Point aux Gres as *Bayport ls.*, a name that has been in use in Mich. since 1899.

Point Edward formation.

Pennsylvanian: Nova Scotia.

J. E. Hyde, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 252).

Pointe Levis group.

Cambrian: Canada.

J. Marcou, 1897 (Am. Geol., vol. 19, pp. 43–45). "Exact syn. Phillipsburg group."

Point Grey formation.

Pleistocene: British Columbia.

E. W. Berry and W. A. Johnston, 1922 (Roy. Soc. Canada Proc. and Trans., 3d ser., vol. 16, sec. 4, p. 134), and W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 43).

Point Hey sandstone member (of Redwood formation).

Oligocene: Southeastern Alaska (Katalla district, Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 773+). *Point Hey ss. memb.*—Basal memb. of Redwood fm. Consists of 1,100 ft. of sss. and cgls. with thin sh. beds, and with heavy cgls. at top. Lower part is pebbly ss. and fine-grained thin-bedded shaly ss. with intercalations of dark sandy sh. This passes up into flaggy sss. and sandy shales with thin beds of sandy ls. and with abundant plant fragments. Lenses of cgl. are numerous, and upper part consists of a fairly heavy cgl. with pebbles and cobbles up to 6 or 8 in. diam. Conformably underlies Puffy sh. memb. and conformably overlies Burls Creek sh. memb. of Katalla fm. [restricted]. Assigned to upper Olig. on basis of lithologic correlation with fossiliferous rocks in Yakataga dist. that are assigned to upper Olig. by B. L. Clark.

The U. S. Geol. Survey classifies typical Katalla fm. as Mio. (?).

Point Lookout sandstone. (In Mesaverde group.)

Upper Cretaceous: Southwestern Colorado and northwestern New Mexico.

A. J. Collier, 1919 (U. S. G. S. Bull. 691K). *Point Lookout ss.*—The lower massive ss. of Mesaverde group of SW. Colo. Is 250 to 300 ft. thick. Forms the cliffs which border Menefee and Weber Mtns and make them inaccessible at many places. Seen to best advantage in imposing cliffs at Point Lookout, about 7½ mi. SW. of Mancos, Colo. Is "Lower Escarpment" of W. H. Holmes' subdivisions of the Mesaverde. Underlies Menefee fm.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). [See under *Mesaverde group*, 1924 entry.]

Point Lookout granite.

Pre-Cambrian (?): Southwestern Virginia (Grayson County).

A. I. Jonas, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 49). A biotite granite here named *Point Lookout granite*, from its occurrence in Point Lookout Mtn, Grayson Co., SW. Va. [Not described.]

†Point of Rocks group.

Upper Cretaceous (Montana): Southwestern Wyoming, northwestern Colorado, and northeastern Utah (Uinta County).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 47, 155). *Point of Rocks group.*—Uncon. underlies Bitter Creek group and overlies Salt Wells group. Thickness 1,800 ft. A good section can be obtained at Point of Rocks Station [Sweetwater Co., Wyo.]. Consists of (descending): (1) Massive gray ss. (Upper Hogback ss.); (2) irregularly bedded shales and sss.; (3) massive gray ss. (Middle Hogback ss.); (4) massive and thinly bedded yellowish-buff sss. alternating with massive beds of light-gray or white ss.; and (5) *Golden Wall ss. or group*, consisting of thinly laminated gray and buff ss.

Includes Adaville and Blair fms. (=all of Mesaverde group) of SW. Wyo. The †Goldenwall ss. is present in SW. Wyo. only.

Point Pleasant limestone.

Middle Ordovician: Southwestern Ohio and northern Kentucky.

J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, table opp. p. 89, pp. 119–121). *Mount [Point] Pleasant beds.*—Alternating lss. and shales, 350± ft. thick, underlying Eden sh. and overlying Trenton ls. in Ohio.

E. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 370, 373, 378, and table opp. p. 399). *Point Pleasant beds.*—Massive blue lss., 50 ft. thick, of lighter color than upper part of Cincinnati group, interbedded with concretionary-bearing sh., beginning at low-water mark at Cincinnati and descending until they include lowest rocks exposed in the State. It is not easy to determine with exactness the upper bdy above mentioned at Point Pleasant, as no facts can be found in either lithological or fossil characters that serve to identify any particular layer as the bottom layer at Cincinnati; but judging from such indications as both lithology and fossils furnish, it is safe to say that Point Pleasant beds have at least the thickness already assigned to them, viz. 50 ft. Overlain by River Quarry beds and underlain, in well borings, by Calciferous sandrock. Lowest fm. of Cincinnati group.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, pp. 53+). *Point Pleasant beds* are same as River Quarry beds. Unquestionably of Trenton age. Thickness 50 ft.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, pp. 8–10), applied name *Point Pleasant ls.* to 25+ ft. of ls. underlying Fulton sh. and overlying Bromley sh. in vicinity of Cincinnati.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 13, 14, 211–212), stated that *Point Pleasant bed* underlies Utica sh. and overlies Greendale bed.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull., vol. 14, pp. 209–228), applied *Nicholas ls.* to 35 ft. of ls. beneath Fulton sh. and above Point Pleasant, and stated: "The term *Point Pleasant* should be restricted to the lower part of the exposures at Point Pleasant, as intended by Prof. Orton. That part of the river quarry beds at Cincinnati which contains *Trinucleus concentricus* does not belong to the Point Pleasant part of Cynthiana fm."

See also under *Cynthiana fm.*

Named for exposures at Point Pleasant, Clermont Co., Ohio.

Point Woodbury formation.

Carboniferous or pre-Carboniferous: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60).

Poison Canyon formation.

Eocene: Southeastern Colorado (Huerfano County).

R. C. Hills, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, pp. 148–164). *Huerfano beds proper.*—Uncon. overlie the Laramie and Colorado along the shore line and in part rest on Archean, although elsewhere graduating conformably into upper part of Laramie. Are uncon. overlain by coarse cgls. and sss. tentatively assigned to Plio. The most typical exposures of these Eocene beds occur on drainage of Muddy Branch of Huerfano River, while best section is probably to be found in the nearly uninterrupted exposure of inclined beds extending down Poison Canon [W. of Gardner] and across Muddy Creek to Promontory Bluffs. Total thickness here developed can hardly be less than 7,000 to 8,000 ft., distributed as follows (descending): (1) Red and yellow sandy clays and marls, sometimes shaly, alternating with yellowish, white, gray, and greenish sands, 2,000 ft.; (2) light-red, white, brownish, or variegated soft sss, alternating with red and yellow sandy clays and marls, 1,500 ft.; (3) yellowish or light-colored soft sss. and cgls. with occasional beds of yellow clay or marl, 3,500 to 4,500 ft. [Throughout this paper the author refers to these beds in Poison Canyon area as *Poison Canyon series.* He also mentions eruptive pebbles and finer eruptive debris contained in the *Poison Canyon cgls.* As thus originally defined "*Huerfano beds proper*" and "*Poison Canyon series*" applied to all of Eocene in Huerfano Basin.]

R. C. Hills, 1889 (Colo. Sci. Soc. Proc., vol. 3, pt. 2, pp. 218, 222). Recent measurements give total thickness of *Huerfano beds* near mouth of Poison Canyon of 7,100 ft. It appears that the beds will be more clearly defined by *restricting* the designation "middle division" to about 300 ft. of massive pink and white ss. which forms a well-marked horizon btw. upper and lower beds and is recognizable wherever it occurs throughout the basin. With this modification the thickness of the 3 divisions is (descending): (1) marls, clays, soft shales, and sands, of red, gray, yellow, green, and purple colors, red predominating, 3,300 ft.; (2) pink and white massive sss., 300 ft.; (3) soft sss. and fine cgls. of yellowish tint, with occasional bands of yellow clay or marl, 3,500 ft. The total thickness in Poison Canyon is no doubt greater than is now exposed in any other part of field. Evidence thus far accumulated points strongly to Bridger age of upper div. of *Huerfano series*, although it is doubtful if lower div., in which vertebrate remains have not yet been found, can be included in same category.

R. C. Hills, 1890 (Colo. Sci. Soc. Proc., vol. 3, pt. 3, pp. 391, 395). In Huerfano Basin there are certain deposits (*Poison Canyon beds*) referred by myself to Lower Eocene, which consist of massive soft sss., often conglomeratic, alternating with relatively thin beds of yellow clay and some clay sh. Away from old shore border they are apparently conformable with underlying Laramie, with which they might be confounded, but along W. margin of the exposures they show great angular uncon. with all Cret. beds. The existence of eruptive pebbles in Huerfano Eocene, as stated by me in pt. 1 of this vol., is true only of the *upper div. to which the term "Huerfano beds" is now restricted*, the statement that they occurred in *the lower div. of "Poison Canyon beds"* being due to an error in original notes.

R. C. Hills, 1893? (Colo. Sci. Soc. Proc., vol. 4, pp. 7–9; paper read Feb. 2, 1891). Term "Poison Canyon series" was first employed as a convenient designation for the lithological sequence of Eocene beds at locality where they were first studied and where the two lower members especially are characteristically developed. A complete section of the upper one, however, is not shown at Poison Canyon, the inclined strata extending some distance into Muddy Creek Valley beyond. Subsequently "Huerfano series" was used with reference to Huerfano Eocene beds collectively; and since this term necessarily includes all beds exposed in Poison Canyon, it seems appropriate to retain it in sense it was originally employed, as a designation for entire Eocene series of Huerfano lake basin, in preference to former term "Poison Canyon series." The general designation "Huerfano beds" was originally applied to the subdivision of Eocene recognized in Huerfano and Cuchara Basins. As it is now apparent that these several subdivisions cannot all be referred to same stage of sedimentation, it is proposed (1) to restrict *Huerfano beds* to *upper* of the 3 subdivisions described in vol. 3, pt. 2, p. 218, which contains mammalian remains indicating Bridger age; (2) to name the *middle memb. Cuchara beds*, after Cuchara River, where they form the surface exposures N. and S. of La Veta; and (3) to apply the name *Poison Canyon beds* to the *lower memb.*, after the locality on Poison Creek where they are characteristically developed. The relations of the fms. can be expressed as follows:

Huerfano series (Eocene)	Huerfano beds=Bridger group.	
	[Uncon.]	
	Cuchara beds	Lower Eocene.
	[Marked uncon.]	
	Poison Canyon beds	

H. F. Osborn, 1929 (U. S. G. S. Mon. 55). Huerfano fm. correlates with lower part of Bridger fm., upper part of Wasatch fm., and upper part of Fort Union fm. The Cuchara fm. is of middle Wasatch age and the *Poison Canyon fm.* is of lower Wasatch age.

W. T. Lee, 1917 (U. S. G. S. P. P. 101, p. 61). *Poison Canyon fm.* is younger than Raton fm. and has generally been regarded as uncon. with it. It seems possible Poison Canyon and Raton fms. may differ but little in age, and that their physical differences may be due to local variations in conditions of sedimentation.

The U. S. Geol. Survey does not employ the same name in two senses. It therefore has abandoned "Huerfano series" as a local name for the Eocene deposits of Huerfano Basin, but uses *Huerfano fm.* as restricted by Hills.

†Poison Canyon series.

See explanation under *Poison Canyon fm.*

Poison Creek formation.

Pliocene (?): Southwestern Idaho (Snake River valley).

J. P. Buwalda, 1923 (Idaho Bur. Mines and Geol. Pam. 5, p. 3). *Poison Creek fm.* consists of ash, clays, shales, and sss. very similar to Payette fm. (middle or upper Mio.) but containing mammalian fossils indicating lower Plio. or later age. It immediately overlies the 1,000 ft. of rhyolite flows which rest on Payette fm., in Snake River Valley of SW. Idaho. The Idaho fm., which lies in middle and flatter part of the valley, is generally made up of cream-tinted silt and volcanic ash, contains mammalian fossils indicating Pleist. age, and rests uncon. on underlying fms. [On p. 8 he mentions sed. beds extending SE. from E. flanks of Silver City Range at Murphy to Grandview and Bruneau River dist. which "are quite similar to those exposed at N. end of Silver City Range at *Poison Creek grade*." This appears to be type loc. The Payette fm. as first defined and as used in previous repts was said to be of Mio. age and immediately overlain by Idaho fm. (Plio.), from which it was said to be separated with difficulty. The introduction of this new name appears to mean a restriction of Idaho fm.]

Pokegama quartzite.

Pre-Cambrian (middle Huronian): Northeastern Minnesota (Mesabi district).

H. V. Winchell, 1893 (Minn. Geol. Surv. 20th Ann. Rept., p. 123). There seems to be no question that the qtzite of Mesabi iron range which rests uncon. on the schists and granite is same as Pewabic qtzite at Gunflint Lake and *Pokegama qtzite* of Mississippi River.

G. E. Culver, 1894 (Minn. Geol. Nat. Hist. Surv. 22d Ann. Rept., p. 102). *Pokegama qtzite (Pewabic).*—The qtzite at Pokegama Falls, on the Miss., appears at intervals along an irregular line extending from N. end of Pokegama Lake NE. to rapids of Prairie River. At all exposures it appears pinkish, is rather fine grained and very hard. At Pokegama Falls, where it has been quarried, it is seen to have been originally greenish in color. Iron ore is found in it at many places, always apparently in upper portion. The qtzite was not seen in contact with any other rock.

U. S. Grant, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4, p. 181). *Pokegama qtzite.*—Coarse-grained vitreous qtzite, white, gray, reddish, and greenish. Thickness 335 ft. Mapped. Also called at times *Pewabic qtzite.*

C. R. Van Hise and C. K. Leith, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 353, 357–358). *Pokegama fm.*—Fine cgl., qtzite, and quartz sl., 0 to 450 ft. thick. Conformably underlies Biwabik fm. and uncon. overlies Lower Huronian. Basal fm. of Upper Huronian of Mesabi dist.

C. K. Leith, 1903 (U. S. G. S. Mon. 43, p. 90). *Pokegama qtzite.*—Chiefly vitreous qtzites of various colors; some micaceous quartz sl.; at base cgl. Thickness 0 to 500 ft. Underlies Biwabik fm., with slight erosion interval between, and uncon. overlies Lower Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 164), gave thickness as ranging up to 200 ft., and assigned fm. to upper Huronian.

C. K. Leith, 1933 (16th Int. Geol. Cong. Guidebook 27, p. 9), assigned this fm. to middle Huronian, as did C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184).

Polaris Harbour formation.

Silurian: North Greenland.

C. Poulsen, 1934 (Mus. minér et géol. comm. pal. No. 50, pp. 6, 43).

Poleo sandstone.

Triassic (Upper?): Central northern New Mexico.

F. v. Huene, 1911 (Neues Jahrb., Beilage-Bd. 32, pp. 730–739, pl. 32). The soft massive grayish-yellow ss., 12 to 15 m. thick, forming crest of Mesa Poleo, we always called "*Poleo top ss.*"

N. H. Darton, 1922 (U. S. G. S. Bull. 726, p. 183). Shinarump cgl. appears to be represented in Nacimiento-Chama-Cobre region by a massive ss. which Huene has called *Poleo ss.*, from Poleo Mesa, of which it forms the surface. This ss. contains Triassic plants. Above this *Poleo ss.*, as I shall term it in this paper, are red shales supposed to belong to Chinle fm., extending up to base of unmistakable Wingate ss. Underlying the Poleo ss. are red shales and sss. 1,000± ft. thick, which doubtless include representatives of Moenkopi, Chupadera, and Abo fms.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, p. 1428). Upper Triassic vertebrates occur at some places below Poleo ss. (according to E. C. Case, Contr. from Mus. Pal. Univ. Mich., vol. 3, No. 1, 1928), indicating that Poleo ss. and some part of underlying beds are younger than Permian and that Poleo ss. is younger than Shinarump cgl.

†Polk Bayou limestone.

Upper and Middle Ordovician: Northern Arkansas.

H. S. Williams, 1899 (Am. Jour. Sci., 4th, vol. 8, pp. 139–152). *Polk Bayou ls.*—Coarse-grained pinkish or red marble containing Ord. (Trenton) fossils. [Relations to underlying and overlying fms. not clearly defined, but name *St. Clair ls.* seems to be applied to the Sil. ls. and *Izard ls.* to an older (Ord.) ls., the name *Polk Bayou ls.* being applied to all beds containing Trenton fossils.]

H. S. Williams, 1900 (Ark. Geol. Surv. Ann. Rept. 1892, vol. 5, pp. 278–284). *Polk Bayou ls.*, name suggested by J. C. Branner in letter, adopted for Cincinnati memb. of Dr. Penrose's St. Clair ls., or for the ls. underlying the manganese-bearing shales named Cason sh., instead of restricting St. Clair ls. to this memb., as writer did in 1894, since this ls. does not outcrop in region of St. Clair Springs. Uncon. underlies Cason sh. and overlies Izard ls.

At type loc. contains Richmond fossils in upper part and Black River fossils in lower part, with uncon. btw. them representing Lorraine and Trenton time. Is now divided into Fernvale ls. (of Richmond age) and Kimmswick ls. (of Black River age). Underlies Cason sh. uncon. and uncon. overlies Plattin ls. (See H. D. Miser, U. S. G. S. Bull. 715G, 1920.)

Named for Polk Bayou, near Batesville, Independence Co.

†Polk County ash bed. (In Stanley shale.)

Pennsylvanian: Southwestern Arkansas.

J. F. Williams, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 375–376). *Polk County ash bed.*—In SW. Ark. btw. Ind. Ter. [Okla.] border and upper waters of Little Missouri River, a series of outcrops of rock containing much detrital igneous material interbedded with sss. and shales following them in all their folds. Owing to active weathering the rock in most places appears only in form of boulders, from which little or nothing could be learned concerning its mode of occurrence. Writer has not examined the rocks in field, but they were observed and noted by J. P. Smith and afterward by R. A. F. Penrose, Jr. Penrose thinks in some places the beds are 20 or more ft. thick.

Replaced by *Hatton tuff lentil* of Stanley sh., a county name being considered inappropriate for so minor a unit.

Named for exposures in Polk Co.

Polk Creek shale.

Upper Ordovician (Richmond): Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557; also Slates of Ark., Ark. Geol. Surv., pp. 30, 36). *Polk Creek sh.*—Sh. resembling Ouachita sh. in color, hardness, and texture, in presence of large number of quartz veins, and in locally having well-developed slaty cleavage. Differs from Ouachita sh. in containing no sandy or calc. layers and in being only about 100 ft. thick; in places appears to be absent. Overlies Bigfork chert and underlies [uncon.?] Blaylock ss.

Named for Polk Creek, Montgomery Co., Ark.

Pomeroy sandstone. (In Monongahela formation.)

Pennsylvanian: Southeastern Ohio.

E. Lovejoy, 1888 (Ohio Geol. Surv. vol. 6, pp. 630, 631, 635). *Pomeroy ss.*, 10 to 75 ft. thick, overlies Pomeroy coal. Upper part of ss. is in some areas replaced by red clay. In places the ss. replaces the ls. 45 ft. above Pomeroy coal. Included in Upper Coal Measures.

Named for Pomeroy, Meigs Co.

Pomeroy quartz monzonite.

Post-Carboniferous: Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 79). Pinkish gray to bluish gray. Carries great numbers of small bluish-gray plagioclase crystals. Named for Pomeroy Mtn., Monarch dist.

Pomfret phyllite.

Carboniferous: Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, p. 129). *Pomfret phyllite.*—Skirting E. border of Woodstock quartz schist, and extending S. into Hampton, is a narrow belt of mica sl. or phyllite. A detached area occurs in Bozrah and Franklin. Where typically developed, in NE. part of Pomfret, the phyllite is well foliated, the foliation planes being made of minute flakes of mica, which give the rock a purplish tone and silky luster. This type continued northward seems=Worcester phyllite. In addition to the typical phyllite, this fm.

also exhibits distinctly schistose varieties, containing much muscovite in fairly large plates. This type is traversed in places by calc. seams with which hornblende crystals are associated.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the continuation of this fm. in Mass. as Worcester phyllite, which name has priority.

Pomfret granite.

Devonian: Southeastern Vermont (Windsor County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of eastern Vt., but without definition. Probably named for Pomfret Twp, Windsor Co., or some of villages of that name within that Twp, in Woodstock quad.

Pompey member. (In Skaneateles shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 219, 220, etc.). *Pompey memb. of Skaneateles fm.*—Black sh. that grades gradually upward into aren. mudstone, and, in some localities, into cross-bedded ss. *Leiorhynchus* fossils at base; Hamilton fossils abundant at top. Underlies Berwyn memb. of Skaneateles fm. and overlies Delphi memb. Lies 150 ft. below Centerfield ls. Extends from Skaneateles Lake to Chenango Valley. Type section is at top of Pratt Falls, being the upper 60 ft. of that section, the upper hard beds (*Eunella-Nyassa* zone) forming the supporting ledge of the cascade. Easternmost locality of Pompey is at the cascades above the lower falls in Honts Creek, Sangerfield Valley, to E. of which it cannot be separated from Berwyn memb. Is 60± ft. thick in Chenango Valley, 45 to 50 in Onondaga Valley. [Derivation of name Pompey probably is village in Tully quad.]

Ponca sand.

A subsurface sand, of Penn. age and 40 to 150± ft. thick, in central northern Okla., reported to correlate with Upper Hoover sand and with a part of Elgin ss.

Ponca sandstone.

Upper Cretaceous: Northwestern Iowa and northeastern Nebraska.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 148, 150). *Ponca ss.*—Sss., 25 ft. thick, underlying Woodbury [restricted] shales and overlying Sergeant shales. Composes top fm. of Dakotan series.

Named for Ponca, Dixon Co., Nebr.

Ponce chalky limestones.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 10, 17).

Poncho Rico formation.

Pliocene and Miocene (?): Southern California (Salinas Valley).

R. D. Reed, 1925 (Jour. Geol., vol. 33, pp. 591, 592, 605–607). *Poncho Rico fm.*—Marine strata variously classed as latest Mio. or earliest Plio. Overlies Santa Margarita fm.; where latter is absent rests on Monterey sh. Underlies nonmarine Paso Robles fm. A striking feature of lower part of sandy strata resting on Monterey sh. (Santa Margarita, in strict sense) is large amount of cleanly washed white granitic sand that it contains. One sample proved to contain almost nothing but quartz grains, an extremely unusual condition for a Tert. ss. In higher parts of series diatomite occurs on great scale; also clastic sh., yellowish ss., and cgl. beds in which Monterey sh. pebbles play an increasingly prominent role toward top of series. These are strata here grouped together as Poncho Rico fm.

These beds were identified as Jacalitos and Etchegoin fms. by W. A. English in U. S. G. S. Bull. 691, p. 231, 1919.

Probably named for exposures along or near Poncho Rico Creek, Monterey Co.

Pond limestone.

Mississippian (Chester): Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). [See under *Southward Pond fm.*]

†Ponderosa marl.

Paleontologic name applied in early repts on eastern Tex. to Taylor marl.

Pond Hill granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map, p. 28). *Pond Hill granite.*—Medium- to fine-grained granite of quartz, potash feldspar, oligoclase, and biotite. Late Dev. or late Carbf. Assigned to New Hampshire magma series. [Mapped on Pond Hill.]

Pondville conglomerate.

Carboniferous: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134–141). *Pondville group.*—Consists of "basal arkose beds" (grayish arkoses and quartz pebble and qtzite cgls.) to N., in Norfolk County Basin, and of "suprabasal cgls." to S., in Narragansett Basin, where they usually overlie beds of arkose. The "suprabasal cgls." include *Millers River cgl.*, 300 to 400 ft. thick. The Pondville group underlies Wamsutta group and uncon. overlies pre-Carbf. granitite. The basal arkose beds are well exposed near Pondville Station, on Walpole & Wrentham R. R. [Norfolk Co., Mass.].

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 54). *Pondville cgl.*—Coarse cgl. or arkose made up of material derived from adjacent granite. Underlies Wamsutta fm.

†Ponent series.

Upper Devonian and Carboniferous (?): Appalachian region.

H. D. Rogers, 1844 (Am. Jour. Sci., 1st, vol. 47, pp. 153–158). *Ponent series* "includes all rocks between base of Catskill red ss. and top of overlying cgl. (formation X of Pa. and Va. ann. repts). Usually embraces but 2 formations, the *Ponent red ss.* and the *Ponent cgl.* or Catskill red ss." [As thus defined includes Catskill fm. and probably Cattaraugus, Oswayo, and Knapp fms. of northern Pa.]

†Ponent conglomerate.

See under †*Ponent series.*

†Ponent red sandstone.

See under †*Ponent series.*

Pontchartrain clay.

Pleistocene: Southeastern Louisiana and southwestern Mississippi.

L. C. Johnson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 24–25). There was, indeed, an era during which the Mississippi embouched through Manachac, and during which the action was so much grander and so different in character [from Biloxi sand] as to require different consideration. During this era there was formed what may provisionally and for convenience be called *Pontchartrain clays.* The method of action was essentially similar to that concerned in the building of the coast sand fm. during Biloxi period, and similar to that displayed by the comparative insignificant agency of the Nita crevasse. Hence all the Pontchartrain clays extend farther inland than the Biloxi sands, or to the edge of the rolling lands of St. Tammany and even to foot of the gravelly hills of Miss. and Ala., as well as up the large estuaries of Pearl and Pascagoula Rivers; the bluffs, excavations, and artesian borings reveal a like sequence of sands and brownish or yellowish-blue clays under a thick coat of clay which forms the water-holding pan of the "pine meadows." No fossils found. Assigned to glacial period. Considered older than Biloxi sand.

G. D. Harris and A. C. Veatch, 1899 (La. Geol. Surv., pt. 5, Rept. for 1899). Investigations by L. C. Johnson in 1890, in southern Miss. and in region N. of Lake Pontchartrain, in coastal phase of the Port Hudson, led him to propose for it the name *Pontchartrain clays.* At same time he proposed the name *Biloxi sands* for the more recent coastal fms. The difficulty of distinguishing btw. the two beds, which were formed under very similar conditions, led to extension of meaning of Biloxi sands to include Pontchartrain clays.

G. D. Harris, 1905 (La. Geol. Surv. Bull. 1, pp. 10–20). If anything is to be gained by applying a name to clays that were evidently deposited in brackish-water bays, estuaries, and lakes along the Gulf border, some such term as "Pontchartrain clays" may be used, with understanding the name denotes a particular kind of deposit or phase of deposition having no special time value. So, too, the deposits, mainly alluvial, containing a large amount of vegetable matter, especially stumps and trunks of trees, may, if necessary, be classed as Port Hudson clays, and marine sands, which may be found at various depths, may be referred to as *Biloxi sands*; but in all cases *the terms must be understood as denoting mere phases of deposition, not stratigraphic units.*

L. C. Johnson, 1905 (U. S. G. S. W. S. P. 114, pp. 171–178). Port Hudson group includes *Pontchartrain clay* and Biloxi sand. The former is a greenish clay occurring in a narrow belt in extreme S. part of Miss., and separated from the coast by a very narrow strip of sandy beds known as Biloxi sands. The buckshot sands of the delta have sometimes been referred to Port Hudson group.

See also under *Port Hudson fm.*

Pontiac schist.

Pontiac group.

Pre-Cambrian: Quebec.

M. E. Wilson, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 175). *Pontiac schist.*

M. E. Wilson, 1912 (Canada Geol. Surv. Summ. Rept. 1911, pp. 274, 275). *Pontiac group.*

Pontiac limestone. (In McLeansboro formation.)

Pennsylvanian: Central eastern Illinois (Livingston County).

J. E. Lamar, 1929 (Ill. Geol. Surv. Rept. Invest. No. 17, passim). *Pontiac ls.*—Nodular fine-grained brown, light-gray, or bluish-gray ls., containing numerous cavities lined with crystals of calcite. Irregular masses of hydrated iron oxide are also common in cavities and along joint planes. Where unweathered is in beds 1 to 3 ft. thick, but weathers to slabs 1 to 2 in. thick. General character quite constant, so that bed is recognizable at its various outcrops. Quarried near Pontiac, where it consists of (descending): (1) Gray porous ls., locally spotted brown by iron hydroxide, 11 ft.; (2) ls. similar to above but less porous and bluish gray, 3 ft.; (3) bluish gray ls., clayey, fossiliferous, 1 ft. 2 in. This 3-fold division is common to most outcrops of the stone. Outcrops SE., NE., and NW. of Pontiac, Livingston Co. Although it is probably the Lonsdale or La Salle ls. it is here called *Pontiac ls.* because of uncertainty of its identity. Lies 0 to 36± ft. below top of Penn. Unconsolidated materials overlie the ls. at all outcrops visited. In some places it is overlain by a tough greenish-brown clay; in others by a pebbly gray or brown glacial clay which is usually thin but may be 15 or 20 ft. thick.

Pontotoc group.

Pennsylvanian and Permian (?): Central southern Oklahoma.

G. D. Morgan, 1922 (Okla. Geol. Surv. Circ. No. 11). *Pontotoc series.*—An arkosic series, 1,000 to 1,500 ft. thick, consisting of coarse sss., shales, and impure argill. or aren. lss. In a general way divided into three parts: (1) In upper div. shales predominate, lss. are almost absent, and although there are a few local occurrences of grits and cgls. the sss. become thinner and more fine-grained, with a consequent decrease in size of feldspar particles; (2) middle part carries sss., but shales are thicker and more numerous than in lower part, and a total thickness of about 100 ft. of impure lss. is present; (3) lower part consists of alternating strata of sss., cgls., and shales. Base is drawn where magascopic feldspar is first encountered, and top is drawn where megascopic feldspar disappears. Assigned to late Penn.

G. D. Morgan, 1923 (Okla. Geol. Surv. Circ. No. 12). *Pontotoc series* (arkosic, conglomeratic) is separated from underlying *Seminole fm.* by 4 new fms. to be described in a forthcoming paper, named (descending) Ada, Vamoosa, Belle City, and Francis.

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2). *Pontotoc terrane* is divided into (descending) Konawa fm. and Stratford fm. (both Perm.) and Vanoss fm. (Penn.). Overlies Ada fm. and underlies Asher fm. Is characterized by arkosic materials.

H. D. Miser, 1926 (Okla. geol. map). *Pontotoc group* includes beds below Asher fm. and above Ada fm. Is of Penn. and possibly Perm. age.

Named for development in western part of Pontotoc Co.

Pony series.

Pre-Cambrian (pre-Belt): Southwestern Montana (Madison County).

W. Tansley, P. A. Schafer, and L. H. Hart, 1933 (Mont. Bur. Mines and Geol. Mem. 9, p. 8, map). *Pony series.*—Dark and light-colored gneisses and schists, of sed. and igneous origin and pre-Beltian age, folded and faulted in complex manner, and uncon. underlying Cherry Creek series (pre-Beltian) in Tobacco Root Mtns, Madison Co. More metamorphosed than Belt series. [Thickness not given.] Named for exposures at and in vicinity of town of Pony.

Pony Creek shale. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 74, 81). *Pony Creek sh.*—Top bed of McKissick Grove sh. memb. of Wabaunsee fm. Bluish to reddish argill. sh., brownish sandy sh., some ss. Varies much in color and texture. Thickness 23 ft. Thickens southward. Overlies Dover ls. and underlies Brownville ls. Named for exposures E. of Pony Creek, btw. Kans.-Nebr. line and 2 mi. S. of Falls City, Nebr.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 96). *Pony Creek sh.*, top bed of McKissick Grove sh., underlies Brownville ls. and overlies Jim Creek ls., which is separated from Dover ls. by Table Creek sh.

R. C. Moore and G. E. Condra (Oct. 1932 revised correlation chart). *McKissick Grove sh.* divided into (descending) Pony Creek sh., Nebraska City ls., French sh., Dover ls., Table Creek sh., Maple Hill ls., and Pierson Point sh.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 9–10). *Pony Creek sh. fm.* underlies Brownville ls. fm. and overlies Dover ls. fm., which rests on McKissick sh. fm. [restricted].

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 243–244). *Pony Creek sh.* is here restricted to beds overlying Caneyville ls. and underlying Brownville ls. Thickness 5 to 20 ft. Consists of bluish and bluish gray sh. and locally some red clayey or sandy sh.; locally some ss. in middle; a thin coal bed in upper part. The Pony Creek sh. extends entirely across Kans. and is well developed in Nebr. and northern Okla.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Pony Express beds. (In Morrison formation.)

Upper Jurassic: Southwestern Colorado (Ouray district).

J. D. Irving, 1905 (U. S. G. S. Bull. 260, p. 56). [*Black Girl and Pony Express ls.* is shown as basal bed of McElmo fm. in section of Gold Hill, Ouray dist.]

W. S. Burbank, 1930 (Colo. Sci. Soc., vol. 12, pp. 151–232). *"Pony Express beds."*—An important ore-bearing horizon forming basal part of Wanakah sh. memb. of Morrison fm. in Ouray dist. Consists of sh., ls., and breccia, 1 to 70 ft. thick. Separates "Upper La Plata" of Cross from "Lower La Plata." Commonly known to miners as "Pony Express ls." and "Pony Express contact," from its occurrence in Pony Express mine.

Pony Spring siltstone member (of Maroon formation).

Permian: Central Colorado (Park and Chaffee Counties).

D. B. Gould, 1935 (A. A. P. G. Bull., vol. 19, No. 7, pp. 971–1009). *Pony Spring siltstone memb. of Maroon fm.*—Gray to light-red siltstone with interbedded gray-green ss. and gray sh. Thickness 5,931 ft. Named for Pony Spring, at W. side of Pony Park, near NW. corner sec. 28, T. 12 S., R. 77 W. Lies 644 ft. below top of Maroon fm. in Salt Creek area, Park and Chaffee Counties. Includes at base Bath ss. submemb., 810 ft. thick. Rests conformably on Chubb siltstone memb. Assigned to Perm.

Pools Brook limestone.

Silurian (?): Central New York (Onondaga County).

B. Smith, 1929 (N. Y. State Mus. Bull. 281, pp. 27, 31). *Pools Brook ls.*—Laminated dark-blue ls. that weathers bluish white. Occurs in E. part of Onondaga Co. At Manlius may be 30 ft. thick. Is usually capped by basal quartz ss. of Onondaga, but for short distance E. of Manlius it is uncon. overlain by Bishop Brook ls. Conformably overlies Jamesville ls., which has been included in Helderbergian by some authors, but is here included in Manlius. Named for Pools Brook Valley, along whose southern rim it is exposed. Is next to top fm. of Manlius group.

Poonah sands.

Miocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in Geol., No. 7, p. 68).

Poorman formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793-799, 836-843, with maps). *Poorman fm.*—Most abundant rocks are carbonaceous banded mica schists and slates, of light-gray to dark-gray color, and fine-grained. A few beds of garnetiferous schist are interbedded. All rocks are schistose, tightly folded, and considerably cross-jointed. The fm. is calc., graphitic, and pyritiferous. Thickness 2,500 ft. Basal fm. in Lead dist. Overlain by De Smet fm., into which it grades. Believed to be of Keewatin age.

Named for exposed section at junction of Poorman and Deadwood Gulches, along railroad track, Lead dist.

Poor Mountain limestone series.

Poor Mountain series.

Poor Mountain zone.

Cambrian (?): Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 10). *Poor Mtn zone (Cambr. ?).*—This fm. is exposed along Rich Mtn, Poor Mtn, and Potato Top Mtn, which establishes SE. limit of prominently elevated region of Oconee Co. The soluble character of the ls. has largely caused its disappearance from depressed areas intermediate to successive knobs of ridges; where it has been rapidly drained it has persisted. The exposure of this series from a high point on Poor Mtn to a low point on a dale of Rich Mtn, indicates a moderate dip to SE. Narrow belt of Carolina gneiss series underlies Poor Mtn series, which comprises dark calc. slates, marble, thin hornblende schists, ottrelite (?) schists, sss., itacolumite. The white dolomitic marble of this zone grades to a dark-green pyroxenic mass, in places altered by dynamometamorphic action to hornblende. This series probably pertains to Keith's "Brevard schists," assigned to Camb.

Named for exposures along Poor Mtn, Oconee Co.

Pope Chapel sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503-520). *Pope Chapel ss. memb. of Atoka fm.*—Massive to irregularly bedded ss., coarse- to medium-grained, saccharoidal, highly colored, usually red, brown, yellow, or white; contains clay blebs. Thickness 50 ft. Separated from Coata ss. (basal memb. of Atoka fm.) by 150 to 220 ft. of sh. and from overlying Georges Fork ss. memb. by 80 to 120 ft. of sh. Named for exposure at Pope Chapel, sec. 24, T. 12 N., R. 19 E.

Pope Creek cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179-193) to a portion of lower part of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated. Probably named for Pope Creek, Mercer Co., NW. Ill. (See also Geol. Soc. Am. Bull., vol. 42, 1931, pp. 801-812.)

†Pope Hollow conglomerate.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

J. F. Carll, 1883 (2d Pa. Geol. Surv. Rept. I_4, pp. 180-181). Wrightsville cgl. of Warren Co., Pa., is probably the SW. continuation of *Pope's Hollow cgl.* of N. Y. [See Wrightsville cgl.]

G. D. Harris, 1891 (Am. Geol., vol. 7, pp. 168, 172-178). *Pope Hollow cgl.*—At Pope Hollow, S. part of Chautauqua Co., N. Y., it is 50 ft. thick, and lies below 100 ft. of Barren series forming top beds of Chemung group and above the Lamellibranch series, also a part of the Chemung. Is probably=Wrightsville cgl.

F. A. Randall, 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 713–719). *Pope Hollow cgl.*—Ss. with flat pebbles, but fewer pebbles than the older Panama cgl. Is 23 ft. thick at Warren, Pa.; 20 ft. at Corydon, Pa.; 20 ft. at Pope Hollow, N. Y. Probably=Salamanca cgl.

L. C. Glenn, 1904 (Geol. Soc. Am. Bull., vol. 14, pp. 522–531). Salamanca, Panama, Pope's Hollow, and Tuna are all same cgl.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 88). Salamanca cgl. has been called "Pope Hollow."

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 87–89). *Pope Hollow cgl. memb.*—Upper memb. of Salamanca formational suite. Is same as Wrightsville cgl. of Warren Co., Pa., Millers ss. of Chadwick, Salamanca cgl. of Butts (Warren folio) and Glenn (N. Y. State Mus. Bull. 69, 1903), and Venango second oil sand (upper stratum) of Carll (1875 and 1883) and of I. C. White (Rept. Q_4).

†Popo Agie beds. (Pronounced pōpō'-zhah.)

Upper Triassic: Western Wyoming (Wind River Mountains).

W. C. Knight, 1901 (Eng. and Min. Jour., vol. 72, p. 359), used *Popo Agie* in a table, for Triassic beds above what he called *Shoshone* and below what he called *Oil Springs*, and also for Perm. beds; but judging from pp. 628–629 of this Jour. he did not intend the names as geologic terms.

S. W. Williston, 1904 (Jour. Geol., vol. 12, p. 688). *Popo Agie beds.*—Univ. Chicago paleontological expedition to Wyo. the past summer secured valuable collection of stegocephalian and reptilian remains from Trias, from 40 to 80 ft. of beds lying about 200 ft. below top of the red-beds and 600± ft. above their base. Their description will be given later in paper by N. H. Brown, their discoverer, and writer. Meanwhile the horizon may be distinguished by name *Popo Agie*, suggested by Brown, from the river along whose branches they are most characteristically shown. Assigned to Upper Triassic.

S. W. Williston, 1905 (Jour. Geol., vol. 13, pp. 338–350). *Popo Agie beds* believed to be of early Keuper age [Upper Triassic].

E. B. Branson, 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 220–229), assigned these beds to Upper Triassic, but later (1929) he assigned them to Middle Triassic and stated he believed them to be older than Jelm fm.

C. L. Camp, 1930 (Calif. Univ. Mem. No. 10, p. 5, quarto), assigned these beds to Middle Triassic.

The U. S. Geol. Survey has adopted *Jelm* for these rocks, as explained under *Jelm fm.*, but Branson and Camp have thrown doubt upon equiv. of the two.

†Poquag quartzite.

Same as †Poughquag qtzite.

Porcupine beds.

Tertiary: Southwestern Alaska (Yukon gold district).

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 197, 253). *Porcupine beds.*—Mio. or Plio. Exposed on Porcupine River, btw. mouth of Driftwood River and head of the Ramparts. Yellowish and whitish sands and sss. interbedded with grayish rather hard cgl. of quartz pebbles, fragments of sh., and scales of silvery micaceous schist. Probably=Twelvemile beds.

Porcupine series.

Cretaceous: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 216).

Porcupine group.

Ordovician and Silurian: Yukon-Alaska boundary between Porcupine and Yukon Rivers.

D. D. Cairnes, 1912 (Canada Geol. Surv. Summ. Rept. 1911, pp. 26–33, in rept. on Yukon-Alaska bdy btw. Porcupine and Yukon Rivers). *Porcupine group.*—Lss., dolomitic lss., and dolomites, white, various shades of gray to almost black, and

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sionally reddish or pink; massive, crystalline. Fossils are Ord. and early, middle, and late Sil. Named because the rocks correspond to the Ord.-Sil. rocks on Porcupine River described [but not named] by E. M. Kindle, Geol. Soc. Am. Bull., vol. 19, pp. 322–327, 1908. Thickness at least 6,000 ft. Underlies Raquet series (Carbf.) and forms bedrock of northern 20 mi. of dist. mapped.

Porcupine Hill series.

Upper Cretaceous or Eocene: Canada.

G. M. Dawson, 1883 (Canada Geol. Surv. Repts 1880–81–82, p. 4B) and 1885 (Canada Geol. Surv. Repts 1882–83–84, pp. 82C, 96C, 112C–113C). Included in Laramie.

Recent repts of Canada Geol. Survey assign *Porcupine Hills fm.* to Tert.

Porphyrian.

Pre-Cambrian: General.

See under *Pelodian.*

Porphyry Peak rhyolite.

Tertiary: Central southern Colorado (Bonanza district, Saguache County).

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Porphyry Peak rhyolite.*—Rhyolite flows and interbedded tuffs and aggls.; some intrusive rhyolite included. Thickness 0 to 1,000± ft. Overlies Squirrel Gulch latite and underlies Brewer Creek latite. Exposed on slopes of Porphyry Peak.

Porphyry Peaks rhyolite.

Tertiary: Central northern Colorado.

L. E. Spock, Jr., 1928 (N. Y. Acad. Sci. Annals, vol. 30). *Porphyry Peaks rhyolite.*—A rhyolite porphyry, brownish gray, remarkable for its large glassy feldspar phenocrysts and rapid mechanical disintegration. Caps Porphyry Peaks and occurs on mtn tops on either side of Stillwater Creek farther S. [in NE. part of Grand Co.].

Portage group (also **formation** and **shale**).

Upper Devonian: New York, Pennsylvania, Maryland, West Virginia, and western Virginia.

J. Hall, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 391–392, 452–455). *Portage or Upper Fucoidal group.*—Underlies Chemung group and overlies Gardeau or Lower Fucoidal group. Consists of (descending): (1) Slightly argill., compact, and finer-grained ss. than No. 2, 150 to 200 ft.; in places contains some pyrites; (2) shales and sss.; (3) coarse-grained ss. forming platform or table rock of lower falls of Genesee River. The sss. do not have the glazing of sh., as do those of underlying Gardeau or Lower Fucoidal group.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 171, 172). *Portage or Nunda group.*—Includes Cashaqua sh., Gardeau and Portage groups, and Sherburne flagstone and sh. of the repts. Underlies Ithaca group and overlies Genesee sl.

J. Hall 1843 (Geol. N. Y., 4th dist., pp. 224–249). *Portage or Nunda group.*—Includes Sherburne flagstones and sh., Cashaqua sh., Gardeau and Portage groups of ann. repts. Named for superior development along banks of Genesee River in dist. formerly included in town of Nunda, now Portage. Overlies Genesee sl. and underlies Chemung group (in which Ithaca sh. is included, because of its fossils). Thickness not less than 1,000 ft. Divided into (descending) Portage sss. (the thick-bedded sss. at Portage), Gardeau sh. and flagstones, and Cashaqua sh.

In subsequent repts *Portage* continued for many years to be applied to the sss. and shales below the Chemung and above Genesee sh.

In 1885 (N. Y. State Geol. Rept. for 1884, pp. 9–22, and U. S. G. S. Bull. 16) J. M. Clarke included "Portage sss." in Chemung group, because of their contained fauna. He also described Portage or Nunda group of Hall as containing, in Ontario Co., in lower part, an "Upper Black Band" 5 to 10 ft. thick and a "Lower Black Band" 40 ft. thick, the two separated by 150 ft. of greenish and drab soft shales, the "Lower Black Band" being underlain by 10 to 15 ft. of soft olive-green and grayish shales resting on Genesee beds. The "Lower Black Band" was later named *Middlesex sh.* According to D. D. Luther, 1899 (N. Y. State Geol. 16th Ann. Rept., for 1896), the black sh., 30 to 40 ft. thick, that "has sometimes been called the Lower Black Band of the Portage Group" belongs in Genesee sh. (In 1904, however, Luther and Clarke included this bed in the Portage.) In 1888 C. S. Prosser and H. S. Williams classified the Portage rocks as consisting of Upper Portage sss. and shales, 600 ft.; Middle Portage or Ithaca, 450 ft.; and Lower Portage sss. and shales, 250 ft. In 1893 Prosser (Geol. Soc. Am. Bull., vol. 4, pp. 116–117) applied *Portage* to rocks btw. the Chemung and Genesee, and assigned to them thicknesses of 900 to 1,000 ft. in western N. Y., 1,300 to 1,780 ft. in western-central N. Y., and 1,315 ft. in eastern N. Y. In 1894 James Hall applied *Portage* to the rocks btw. Genesee and Chemung. The same year J. M. Clarke described Upper Portage as=the [so-called] Portage sss., the Middle Portage as=the Ithaca, and the Lower Portage as resting on the Genesee. In 1897 James Hall continued to include in top of Portage group the "mass of heavy bedded sss. which were originally termed 'Portage sss.'" The same year (also in 1899) J. M. Clarke included in top of the Portage not only the †Portage ss. but the overlying Wiscoy shales and flags, and defined the Portage base as top of Genesee sh. In 1898 and 1899 F. J. H. Merrill divided Portage group into Portage ss., Naples beds, Gardeau sh. and ss., and Cashaqua sh.; and D. D. Luther also used Portage in two senses, i. e., for the group and for top fm. of the group. In 1901 and 1902 Luther called the group *Portage or Nunda*, included in it the Wiscoy shales at top, and applied *Portage sss.* to the sss. underlying the Wiscoy. J. M. Clarke's 1903 Hdb. included in Portage group the Wiscoy sh., "Portage sss.," and underlying beds to base of Middlesex sh. In 1903 H. F. Cleland (U. S. G. S. Bull. 206), also J. M. Clarke and D. D. Luther (N. Y. State Mus. Bulls. 63 and 82), applied *Portage* to the beds btw. the Ithaca and the Genesee. In 1906 and 1907 (Jour. Geol., vols. 14 and 15) H. S. Williams used *Nunda fm.* to include the beds btw. Chemung and Genesee, the name Portage "having been dropped because it was already specifically applied to the upper ss. memb. of Nunda fm. of Genesee Valley." In 1908 (N. Y. State Mus. Bull. 118) J. M. Clarke and D. D. Luther introduced *Nunda ss.* for the sss. that had previously been called *Portage sss.*, and stated that paleontologically the Wiscoy shales and sands belong to Portage group, although they were not included in original (1840) definition of Portage group. In 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169) H. S. Williams defined *Portage fm.* of typical Chemung area as underlying Cayuta memb. of the Chemung, overlying Genesee sh., and as divided into (descending) Enfield memb., Ithaca memb., and Sherburne memb. In 1912 C. A. Hartnagel (N. Y. State Mus. Hdb. 19, p. 74) defined Portage fm. of western N. Y. as consisting of beds carrying the Naples fauna; in central N. Y. of the Sherburne and Ithaca beds partially intercalated with the Naples fauna; in eastern N. Y. of the Sherburne and Ithaca beds (marine) overlain by the Oneonta beds (brackish). And he included in the Portage all beds btw. top of Wiscoy sh. and base of Middlesex sh. In 1913 H. S. Williams (U. S. G. S. P. P. 79) defined *Portage fm.* of central N. Y. as underlying Cayuta sh. memb. of Chemung fm., as resting on Genesee sh., and as divided into Enfield sh. memb. (top), Ithaca sh. memb., and Sherburne flagstone memb. (base); and described Oneonta ss. of eastern N. Y. as=upper part of Ithaca sh. memb. He also stated that to E. the Chemung type of sediments began earlier and occupy the time interval of Enfield sh. and upper part of Ithaca sh. In 1920 (Geol. Soc. Am. Bull., vol. 31, p. 118) G. H. Chadwick included in the Portage all beds btw. base of Middlesex sh. and top of Nunda ss. In 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69) and 1924 (N. Y. State Mus. Bull. 251, pp. 149–157) he transferred to the Chemung of western N. Y. certain beds (Dunkirk sh., Gowanda sh., Laona ss., Westfield sh., Shumla ss., and Northeast sh.) that had previously been included in the Portage, and drew base of Chemung at top of Hanover sh. of western N. Y. and at top of Wiscoy sh. of west-central N. Y. (See his correlations under *Chemung fm.*, 1924 entry.)

E. W. Hard, 1931 (A. A. P. G. Bull., vol. 15, pp. 165–180) and I. W. Fox, 1932 (A. A. P. G. Bull., vol. 16, No. 7, pp. 676–690), expanded Portage group by including in it, at base, West River fm. and Genundewa ls., both formerly included in the Genesee, which they restricted to the basal part of the Genesee of common usage, or to the beds named *Geneseo sh.* by Chadwick in 1920.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), divided *Portage group* of western N. Y. into (descending) Wiscoy sh., *Nunda ss.*, Gardeau sh., Grimes ss., Hatch sh., Rhinestreet sh., Cashaqua sh., Middlesex sh., Standish sh., West River sh., and Genundewa ls., and restricted the *Genesee* to the basal memb. (the Geneseo sh. of Chadwick).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96–100), adopted *Portage* for the bluestone and *Nunda* for the group.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 319). All the upper and major part of what has long passed as "Portage group" (correctly *Nunda*) is=type Chemung, although wholly different in facies. [On p. 345 he stated:] Along Genesee River, at and below Portageville, is type section of what has currently passed as *Portage*, i. e., all beds from Genesee group up to include Portage sss. (bluestone), to which it seems historically necessary to limit the name, and above these the Wiscoy shales. A century of painstaking collecting has failed to disclose throughout this entire "Portage" sequence (along Genesee River) a single fossil of Chemung aspect. In topmost beds (Wiscoy memb.) one is startled, however, to find a large cup coral, "out of its depth." [On p. 346:] No one in those days [Hall's time] would have been countenanced in supposition Chemung at E. and Portage at W. are identical. [On p. 352:] The former "Portage" (correctly the *Nunda*) group, because it bestrides both Naples and Chemung, lacks application beyond its type section along Genesee River. Historically, Portage either applied to the bluestones or is replaced by the uncontroversial synonym *High Point*, for *Nunda*, having been used first in group sense, has no rights of restricted applications to these bluestones in way Clarke employed it over protests of H. S. Williams. [On this p. 352 Chadwick correlated Wellsburg ss. memb. of type Chemung with (descending) Hanover sh., Pipe Creek black sh., and *Portage bluestones*, and correlated the underlying Cayuta memb. of type Chemung with (descending) Letchworth sh. (new), Gardeau sh., and Grimes ss.]

The U. S. Geol. Survey in 1908 (after correspondence with interested American geologists) discarded *Portage ss.* and adopted *Portage group*, to include the rocks below Cayuta sh. memb. of Chemung and above Genesee sh., or the same definition then employed by N. Y. State Survey. In central Pa. the Portage group has been divided into Brallier sh. above and Harrell sh. below and includes at top beds equiv. to Wiscoy sh. of N. Y. The Middlesex sh. is recognized as basal bed of the Portage of N. Y. B. Willard, 1935 (Pa. Acad. Sci. Proc., vol. 9, p. 40), divided *Portage group* of Pa. into (descending) Trimmers Rock ("Ithaca") ss., Braillier greenish sh., Harrell dark gray sh., Burket ("Genesee") black sh., and Tully ls.

†Portage sandstone.

Upper Devonian: New York.

J. Hall, 1843 (Geol. N. Y., div. 4, 4th dist., pp. 226, 228–229, 248). *Portage sss.*—The thick-bedded sss. at Portage, which form terminal rocks of Portage group. Well exposed in deep gorge below Portageville. Upper part consists of thick-bedded ss. with little sh.; while below the sandy layers become thinner, with more frequent alternations of sh. The thick-bedded character of the sss. and presence of fucoids passing vertically through the strata induced separation from the rocks below, where the characteristic species of same genus lies horizontally upon surface of the strata. Rests on Gardeau sh. and flagstones and is overlain by Chemung group.

In some repts this ss. has been included in Chemung group. See further explanation under *Portage group*.

In 1908 J. M. Clarke and D. D. Luther replaced this name with *Nunda ss.*, which they included in Portage fm. C. A. Hartnagel (1912 Hdb.) and G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69) also included this ss. in the Portage. Chadwick later (see 1935 entry under *Portage group*) recommended abandonment of Portage group and limitation of *Portage* to this ss.

Portage moraine.

Name that has been applied to a Pleist. moraine deposited at Portage, N. Y. (See H. L. Fairchild, N. Y. State Mus. Bull. 118, 1908, pp. 76, 79.)

Port au Port shale and gritstone.

Age (?) : Newfoundland.

J. B. Jukes, 1839 (Rept. on geol. of Newfoundland, p. 4).

Port Austin sandstone.

Mississippian: Michigan (Huron County).

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30, p. 85). *Port Austin ss.*—Younger than Point aux Barques ss., both of which belong to Lower Marshall.

A. C. Lane, 1910 (Jour. Geol., vol. 18, p. 422). *Point* [Port] *Austin ss.*, 23 ft. thick, is separated from underlying Point aux Barques ss. by 68 ft. of sandy sh.

Named for exposures at Port Austin, Huron Co.

Port Byron limestone.

Silurian (Niagaran) : Northwestern Illinois.

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 525-526, 531-533). *Port Byron ls.*—In new limekiln quarry at town of Port Byron [Rock Island Co.] a thickness of 35 to 40 ft. of yellowish dol. is exposed. It occurs in thin irregular layers, which, in occasional pockets and along thin bands, are crowded with fossils [listed], which also occur in upper ls. of Thornton quarry, near Chicago, and which are thought to indicate Guelph age. The strata, which dip SE. at angle of nearly 35°, are considered = to those in upper part of quarry at Thornton, Ill. [which are 54 ft. thick], and the name *Port Byron* is given to this ls. It overlies Racine ls. (restricted to beds of pre-Guelph age) without distinct break.

Is uppermost fm. of Niagaran age in Ill., according to later repts. See under *LeClaire dol.*, 1935 entry, for additional information.

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 270-274). *Port Byron ls.* occurs in NW. Ill. only. Savage has decided these beds are same as Leclaire of Iowa (type loc. of which is just across Miss. River from Port Byron, Ill.) and has suggested that Port Byron be abandoned. But, since the Port Byron of Ill. includes all Sil. beds above Racine ls., it is more nearly identical with the Gower than with the LeClaire. It seems best to retain LeClaire, and to restrict it to the "reef" phase of the Greer of Iowa. Rocks of this age are restricted to NW. Ill. and Iowa. Although Savage originally believed the Port Byron occurs in NE. Ill., he is now of opinion (personal communication) the NE. Ill. section does not contain any strata of Port Byron age.

Port Clarence limestone.

Lower and Upper Ordovician, Silurian, and Devonian: Northwestern Alaska (Seward Peninsula).

A. J. Collier, 1902 (U. S. G. S. P. P. 2, p. 18, map). *Port Clarence ls.*—Blue or gray ls., almost unaltered; basal beds flaggy and slightly schistose. Thickness 2,000± ft. Fossils identified by Schuchert as belonging to Lower Sil. system [Ord.]. Is basal part of Nome series. Conformably underlies Kugruk group (Upper Sil.). Rests, probably uncon., on Kuzitrin series.

Later work proved that the lss. included in overlying †Kugruk (Kougarok) group are Port Clarence ls., and Kugruk (Kougarok) was discarded. (See Collier, U. S. G. S. Bull. 328, 1908, pp. 61–65.) Further work also yielded fossils from Port Clarence ls. that were identified by E. Kirk as including Lower Ord., Upper Ord., and middle and late Sil. faunas. P. S. Smith (U. S. G. S. P. P. 192, in process of publication) also shows that Port Clarence ls. includes Dev. But sufficient work has not been done to differentiate the rocks of these different ages, so that the blanket term *Port Clarence ls.* is still continued. The type loc. is in York Mtns, N. of Port Clarence.

Port Deposit gneiss.

Pre-Cambrian: Northeastern Maryland (Cecil, Harford, and Baltimore Counties) and southeastern Pennsylvania.

G. P. Grimsley, 1894 (Cincinnati Soc. Nat. Hist. Jour., vol. 17, p. 112). *Port Deposit granite gneiss.*—Has been called *syenite, granite,* and *gneiss.* Probably of igneous eruptive origin. Occurs at Port Deposit, Cecil Co.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799). *Port Deposit gneiss* assigned to Algonkian, but later than Glenarm series.

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 104, 127). *Port Deposit granite (granodiorite).*—There are several outcrops in Baltimore Co. of rock that has been correlated with Port Deposit gneiss of Cecil and Harford Counties, on account of general geol. relations and lithologic similarity. NE. of Baltimore the rock is gray porphyritic gneiss; the rock of Melvale area and Rognel Heights quarry is a porphyritic biotite gneiss; the granite at Oakland is a potassic muscovite granite. Assigned to late pre-Camb. Intrudes Glenarm series (late pre-Camb.).

This fm. was formerly classified by U. S. Geol. Survey as of Algonkian age, but that term having now been discarded as a time term it is classified as pre-Camb.

Porter shale.

Oligocene: Southwestern Washington (Thurston County) and Puget Sound region.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). [See 1912 entry under *Lincoln fm.*]

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). *Porter horizon* is characterized by *Turritella porterensis* zone, Olig. Fossils listed. Outcrops at Porter and along Porter Creek. Older than Blakeley horizon and younger than Lincoln horizon.

K. E. H. Van Winkle, 1918 (Geol. Soc. Am. Bull., vol. 29, p. 166). *Porter fm.*—Strat. and faunal studies of this fm. at type loc. on Porter Creek show that it consists of 1,200 ft. of predominantly shaly sss. and sandy shales, resting uncon. on Tejon basalts. Fauna at Porter has closer similarity to that at Lincoln Creek than it has to Blakeley fauna at Restoration Point, and it is possible the beds can be correlated with those exposed at Lincoln Creek [Lincoln fm. of Weaver].

Porter sand.

A subsurface sand, of Upper Dev. (Portage?) age, in western Pa., southern N. Y., and W. Va. Considered same as Elk sand.

†Porter terrane.

An abbreviated form of *Porters Creek clay*, employed by C. [R.] Keyes.

Porters Creek clay. (In Midway group.)

Eocene (lower): Western Tennessee and Kentucky, southwestern Illinois, southeastern Missouri, eastern Mississippi, and southwestern Alabama.

J. M. Safford, 1864 (Am. Jour. Sci., 2d, vol. 37, pp. 361, 368). *Porter's Creek group.*—No marked distinction btw. this and adjacent groups (Ripley and La-Grange), except that it contains proportionally much more laminated or slaty clay, several beds of which are from 5 to 60 ft. thick. In Hardeman Co., on Porter's Creek—the first creek on map W. of Middleton—is a heavy bed said to be 100 ft. thick. The clay has the usual characters, contains mica scales, is dark when wet and whitish gray when dry. Thickness 200 to 300 ft. Underlies Orange sand or La Grange group and overlies Ripley group (Cret.). Heretofore included in Orange sand.

J. M. Safford, 1892 (Geol. Soc. Am. Bull. vol. 3, pp. 511–512; Am. Geol. vol. 9, pp. 63–64), separated from Ripley fm. of Tenn. certain beds which he named "Middleton fm." and assigned to basal Eo. These beds are now known as *Clayton fm.*

G. D. Harris, 1896 (Am. Pal. Bull., vol. 1, pp. 18–22), established the Midway age of Porters Creek clay and †Middleton fm. (Clayton fm.), and *Midway group* is now used to include Porters Creek clay above and Clayton fm. below.

Named for exposures on Porters Creek, Hardeman Co., Tenn. This clay in Ala. is usually known as *Sucarnoochee clay.*

Portersville fossilferous horizon (or limestone). (In Conemaugh formation.)

Pennsylvanian: Southeastern Ohio.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, pp. 20, 41). *Portersville ls.*—Dark-colored fossiliferous calc. or pyritous sh., 0 to 3 ft. thick; overlies Anderson coal, underlies Cowrun ss., and carries marine fossils. Included in Conemaugh fm.

Named for village near E. edge of Perry Co.

Port Ewen limestone. (In Oriskany group.)

Lower Devonian: Eastern New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 21). *Port Ewen ls.*—The somewhat shaly lss. which are typically exposed and attain thickness of 100 to 200 ft. in vicinity of Port Ewen. Included in Helderbergian group. In Orange Co. sections the fauna seems to graduate into that of the overlying Oriskany. Underlies Oriskany beds and overlies Becraft ls.

Replaces *Kingston beds,* found to be preoccupied. In 1903 (Am. Geol.) C. Schuchert transferred these beds to base of Oriskany group.

In 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 468–470) A. W. Grabau separated from base of Port Ewen ls. 20 to 50 ft. of cherty lss. "containing a modified Becraft fauna," to which he applied the name *Alsen cherty ls.,* and stated that they are separated from rest of the Port Ewen by a big hiatus and discon.

In early repts called "Upper Shaly ls."

The N. Y. State Geol. Survey now includes this ls. in Helderberg group. (See W. Goldring, 1931, N. Y. State Mus. Hdb. 10). But U. S. Geol. Survey at present assigns it to Oriskany group, in which it has been included for many years.

Port Hood coal measures.

Pennsylvanian: Nova Scotia.

P. D. Trask and K. F. Mather, 1927 (Wash. Acad. Sci. Jour., vol. 17, p. 323).

Port Hudson formation.

Pleistocene: Louisiana, southern Mississippi, and eastern Texas.

E. W. Hilgard, 1869 (Am. Jour. Sci., 2d, vol. 47, pp. 77–88; vol. 48, p. 332; also Prel. rept. geol. reconn. La., 1869). *Port Hudson group,* a swamp, lagoon, and estuary fm.=most if not all of my Coast Pliocene. Blue, yellow, and greenish clay, with some orange and yellow sand strata. Thickness 160–630 ft. Older than Loess or Bluff fm. [which is absent at Port Hudson] and younger than Orange sand group [Citronelle fm.]. Assigned to Quat.

L. C. Johnson, 1905 (U. S. G. S. W. S. P. 114, pp. 171–178). *Port Hudson group* includes Pontchartrain clay and Biloxi sand. The former is a greenish clay occurring in a narrow belt in extreme S. part of Miss., and separated from the coast by a very narrow strip of sandy beds known as Biloxi sands. The buckshot sands of the delta have sometimes been referred to Port Hudson group.

A. F. Crider and L. C. Johnson, 1906 (U. S. G. S. W. S. P. 159, pp. 6–13). *Port Hudson fm.*—Clays, silts, and unconsolidated sands, containing old cypress stumps representing different generations superimposed one on another. Possibly the so-called Port Hudson of Yazoo Delta belongs to much younger age than Port Hudson farther south, but for present it is all mapped as one fm. Thickness 100 to 125 ft.

E. N. Lowe, 1925 (Miss. Geol. Surv. Bull. 20). *Port Hudson fm.* is oldest memb. of Pleist. Overlies the Plio. sands and gravels and underlies the loess of river bluffs. At type loc. consists of massive greenish, bluish, or gray clays containing driftwood, pebbles, and mastodon bones. In places interstratified with this clay is white indurate silt or hardpan, and often near the top of the clays are porous calc. concretions, and ferruginous concretions at a lower level. The deposits are river and swamp accumulations. Near Port Hudson below these deposits were found 3 to 4 ft. of brown peaty matter with cypress stumps, showing that the accumulations had been made upon site of an old cypress pond. At that time all lands bordering Lake Pontchartrain and adjacent parts of southern La. were either shallow margins of the Gulf or salt marshes. The mouths of the Miss. opening N. of Lake Pontchartrain spread Port Hudson clays across that part of La. and along the region of "Pine Meadows" on Miss. coast. In this region the river clays were deposited in shallow salt water and contain marine fossils. This marine phase of these deposits, which consist of alternate beds of blue clay and sand to a thickness of at least 200 ft., has been called *Biloxi beds*, because definitely established at Biloxi in boring the city well. Mastodon remains have been found both in the Port Hudson and the loess bordering the Miss.

L. W. Stephenson, W. N. Logan, and G. A. Waring, 1928 (U. S. G. S. W. S. P. 576, p. 63). As described by E. W. Shaw in an unpublished ms. the *Port Hudson fm.* consists chiefly of clay and sand of late Pleist. age and is apparently largely a brackish-water deposit, though a part was laid down by fresh waters at lower end, near mouths of rivers, and a part is a marine deposit offshore. Its areal distribution indicates that a large part was laid down in estuaries, the principal one of which extended up Miss. River to southern Miss. and perhaps farther north. Where best developed the Port Hudson bears only a scant deposit of loess, and this loess is probably of later age than main body of loess, which is regarded as of Iowan or early Peorian age.

Named for prominent development at Port Hudson, East Baton Rouge Co., La.

Port Huron morainic system.

Pleistocene (Wisconsin stage): Eastern and northern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53; also on moraine map in P. P. 106. Named for Port Huron, Mich. In some earlier repts called *Port Huron moraine*. Includes Main moraine, Bay City, Tawas, Whitehall, Manistee, and Cheboygan moraines.

Port Jervis limestone. (In Oriskany group.)

Lower Devonian: Southeastern New York.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). Southwestward, as at Cottekill [Ulster Co.], Connelly cgl. appears to give way to shaly lss. exactly resembling those of underlying Port Ewen, but having a strongly Oriskany fauna, and it is suspected these are = Barrett's *Dalmanites dentatus* zone, herein designated provisionally by the name *Port Jervis*.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 62 and chart). *Port Jervis ls.*—For Ulster Co. the term *Connelly* (1908 Chadwick) has been used to indicate the basal cgl. [of Oriskany ss.] and *Glenerie* (1908 Chadwick) the overlying ls. For Orange Co. *Port Jervis ls.* (1908 Chadwick) has been suggested for the lower div., with *Dalmanites dentatus*, while the upper div., specially characterized by *Spirifer murchisoni*, is as yet without name.

Named for occurrence at Port Jervis, Orange Co.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 381). *Port Jervis ls.* (*Dalmanites dentatus* zone) contains a mingled Helderbergian and Oriskanian fauna. [But she includes it in Oriskany, where it has been included for many years.]

Port Lambton beds.

Devonian: Ontario.

C. R. Stauffer, 1915 (Canada Geol. Surv. Mem. 34, p. 13), and W. Malcolm, 1915 (Canada Geol. Surv. Mem. 81, p. 44).

Portland clays.

C. H. Hitchcock, 1861 (Rept. geol. Maine, pp. 275–282), referred to clays at and around Portland, Maine, as *Portland clays.*

Portland series.

Pre-Carboniferous: New Brunswick.

G. F. Matthew, 1863 (Canadian Nat., vol. 8, pp. 244, 246).

†Portland quartzite.

Pre-Cambrian (middle? Huronian): Central southern Wisconsin (Dodge County).

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, pp. 252–256). *Portland qtzite.*—Outcrops in several places in town of Portland, Dodge Co.

Same as Waterloo qtzite.

Portland group.

Pre-Cambrian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 189).

†Portland shale.

Upper Devonian: Western New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 24 and chart). The Dunkirk sh. of the Portage of Lake Erie section is underlain by Angola sh. and overlain by *Portland sh.*

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1019–1029). Lake Erie section of Portage group is divided into (descending): Laona ss.; *Portland gray shales* with concretions and few flags and frequent layers of black sh.; Dunkirk black sh.; Silver Creek light soft shales; Angola soft shales with concretions.

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, pp. 199–214). Portage of Erie and Chautauqua Counties divided into (descending): Laona ss.; Portland light-colored shales and thin flags, 282 ft.; Dunkirk black band, 58 ft.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 78). The Gardeau fm. is recognized as far W. as Lake Erie, where it includes at base the Dunkirk sh. The term "Portland" has been used locally to designate certain sh. and flags lying above the Dunkirk sh. As this term is preoccupied and it is now evident that these beds are embraced in the upper Gardeau, the name *Gardeau* will be used to include these beds. [Hartnagel's 1912 chart, however, shows *Gardeau flags* of western N. Y. as overlying Dunkirk sh.] Assigned to Portage group.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157). In Lake Erie section *Gowanda beds* replaces Portland beds, which is "preoccupied and withdrawn." Overlie Dunkirk black sh. and uncon. underlie Laona ss. Assigned to Chemung. [See under *Gowanda sh.*]

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, pp. 149–157). [See 1924 quotation under *Dunkirk sh.*]

Probably named for exposures at Portland, Chautauqua Co.

†Portland division (of Selma chalk).

Upper Cretaceous: Alabama.

E. A. Smith, 1903 (58th Cong., 1st sess., S. Ex. Doc. 19, pp. 12–20 and map). *Upper or Portland div. (of Selma chalk).*—Highly argill., from 25 percent upward of clayey matter, some strata being calc. clays or marls containing many fossils, mainly oysters. Along Tombigbee River from Pace's Landing nearly to Moscow, and along Alabama River from Elm Bluff to Old Lexington Landing. It consists of dark-colored fossiliferous clays alternating with lighter-colored and somewhat more indurated ledges of purer, less argill. rock. Top part of Selma chalk. Overlies Demopolis div. of Selma and underlies Ripley fm.

Later workers did not find it feasible to make the 3 subdivisions of the Selma indicated in above rept, and the names have been discarded. (See Ala. Geol. Surv. Rept. No. 14, 1926, p. 239.)

Named for exposures at Portland, Dallas Co.

Portland stone.

Carboniferous: Indiana.

T. C. Hopkins, 1895 (Ind. Dept. Geol. 20th Ann. Rept., p. 306). The Carbf. ss. quarried at Worthy, Vermilion Co., Ind., is known on market as *Portland stone*. Is quarried by Portland Stone Co. Belongs to Coal Measures at a horizon above that of Mansfield stone.

Portland moraine.

Pleistocene (Wisconsin stage): Central Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Portland, Ionia Co.

Portland delta gravels.

Name applied to the Pleist. gravels filling lower Willamette Valley around Portland, Oreg. (See J. P. Buwalda and B. N. Moore, Carnegie Inst. Wash. Pub. 404, 1930, pp. 21–22.)

See also under *Satsop fm.*

Portland Point member. (In Moscow shale.)

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 218, 229, etc.). *Portland Point ls. memb. of Moscow fm.*—Basal beds of Moscow fm. in Cayuga Lake region. Is Second Terebratula zone of Cleland (1903), who published an extensive fauna from it. It has a 1-ft. bed of crinoidal ls. at base, which is followed by alternations of calc. sh. and ls. for about 8½ ft. Traced to E. the basal crinoidal ls. bed becomes a shell breccia, which is seen last at Lebanon, Morrisville quad., where it is only a few in. thick. Upper beds become sandier and homogeneous to E. and can be traced with certainty as far as Sherburne and less certainly into Unadilla Valley. West of Cayuga Lake on Kashong Creek at Seneca Lake the Portland Point consists of a hard light-gray basal ls. followed by 8 ft. of sh., capped by 1 ft. of shaly ls. containing *Centronella impressa* and *Rhipidomella vanuxemi* in some abundance. At Menteth Point, on Canandaigua Lake, the basal ls. is separated from thin ls. beds containing *Centronella impressa* by 15 ft. of sh. West of Canandaigua Lake this association could not be continued because the *Centronella* beds disappear in this direction. The basal ls., however, is *Menteth ls.* of Clarke and Luther (1904), which can be followed W. to Darien and Bullis Bridge. The Menteth and associated beds are correlated with Portland Point memb., although there may be some doubt as to whether the Menteth or the upper *Centronella* beds correlate with basal crinoidal ls. in Cayuga Lake region. The Menteth ls. can be traced W. into Genesee Valley and beyond, where it forms base of the Moscow. In its extent westward this ls. approximates stratigraphically the Tichenor ls. horizon. At Canandaigua Lake it is 55 ft. above Tichenor ls., at Jacox Run (in Genesee Valley) it is only 9 ft. above, and at Hill's Gulch, 5 mi. S. of LeRoy, it is 3 ft. above the Tichenor; at Darien and Bullis Bridge it is uppermost thin noncrinoidal ls. capping the Tichenor. The Menteth was not identified definitely at Spring Brook and Windom. In Livonia salt shaft it appears 416 ft. below surface. Named for excellent exposures at Portland Point (formerly Shurger Point), Cayuga Lake. The name *Deep Run memb.* is proposed for the brittle bluish sh. that lies btw. the underlying Tichenor ls. and the Menteth ls. of Portland Point memb. in Deep Run Ravine, near Cottage City, Canandaigua Lake.

Port Nelson limestone.

Silurian: Manitoba (Hudson Bay).

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 342, 345, 355, 367).

Portneuf limestone. (Of Thaynes group.)

Lower Triassic: Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492). *Portneuf ls.*—Top fm. of Thaynes group in Fort Hall Ind. Res. Thickness 1,500± ft. Overlies Fort Hall fm.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 38). *Portneuf ls.*—Siliceous cherty gray to yellowish ls. in massive beds; rounded elongated nodules and streaks of chert; fossiliferous. Thickness 1,500± ft. Top fm. of Thaynes group in Fort Hall Ind. Res. Underlies Ankareh [now called Timothy] ss. and overlies Fort Hall fm. Named for Portneuf River, at head of which it is well exposed.

Port Renfrew series.

Age (?): Vancouver Island.

C. W. Hall, 1906 (Postelsia, p. 324).

Portsmouth conglomerate.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 328–329). *Portsmouth cgls.*—Coarse cgls. exposed near Portsmouth Grove Station, also in Portsmouth camp-meeting grounds and elsewhere in that region.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped Purgatory cgl. over area described.

Portsmouth member. (In Black Hand formation.)

Mississippian: Southern Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 758). *Portsmouth memb.*—Upper sh. memb. of Cuyahoga fm. in central Ross, Pike, and Scioto Counties. Thickness 253 ft. Equivalent to Churn Creek, Vanceburg, and Barden members of SW. part of Scioto Co. Overlies Buena Vista ss. memb. ("City Ledge") and underlies Logan fm. Upper 50 ft. or more of Portsmouth shales at Portsmouth are stratigraphically=lower part of Byer memb. of Logan fm.

J. E. Hyde, 1921 (Ohio Geol. Surv., 4th ser., Bull. 23). *Portsmouth memb. of Logan ss.*, 170 ft. of soft gray clay sh. Is=Byer, Allensville, and probably part of Vinton ss. to E.

Named for Portsmouth, Scioto Co.

Portuguese tuff bed. (In Monterey shale.)

Miocene (middle): Southern California (Palos Verdes Hills).

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 131). The thick bentonitic tuff at top of lower div. of Altamira sh. memb. (basal div. of Monterey sh.) is here named *Portuguese tuff bed*, from Portuguese Bend, on S. coast. Type region is along Portuguese Canyon, where the tuff is 55 ft. thick.

†Portville conglomerate.

Devonian or Carboniferous: Southwestern New York.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 83). The *Portville cgl.* on the hills about Portville, N. Y., was mentioned and named by James Hall (Surv. of 4th geol. dist., Nat. hist. of N. Y., vol. 4, 1843 [page not cited]) and later described by Williams 4 pages after he described Wolf Creek cgl. The *Portville cgl.* is a synonyn of the Wolf Creek because of inadequacy of Hall's definition, page priority of name Wolf Creek in H. S. Williams' paper (U. S. G. S. Bull. 41, 1887, p. 86 vs. p. 90).

The compiler has been unable to find the page in vol. 4, 1843, where Hall used the name "Portville cgl.," but finds that Williams did not use the name. He simply described, under the heading "Portville, Cattaraugus Co., N. Y., 486," the cgl. at that place, which he stated was without doubt the Wolf Creek cgl., described on p. 86. The first use of the name *Portville cgl.* therefore appears to be that of Caster, 1934. On p. 79 of book cited above, Caster stated Wolf Creek cgl. is well shown in vicinity of Portville village and on Wolf Run, near Portville, in Olean quad.

K. E. Caster, 1936 (letter dated Oct. 29). I cannot now find that Hall used *Portville cgl.*, and on rereading Williams' 1887 paper I do not think I would now credit him with applying the name in a strat. manner, although the name is implied throughout his discussion of Portville, Cattaraugus, Co., N. Y. It appears that item "K" on p. 83 of my 1934 paper is incorrect.

Port Washington stage.

Pleistocene: Southeastern New York (Long Island).

J. B. Woodworth, 1901 (N. Y. State Mus. Bull. 48, pp. 621–663 and map, pl. 1). The first definite trace of a halt in ice front after retreat from the main moraine [in Nassau Co. and Borough of Queens, Long Island] is found on northern and western extremity of Manhasset Neck, near Port Washington; hence the ice-laid and the water-laid drift of this episode are here assembled under the name *Port Washington stage of ice retreat*. Some of deposits lying S. of this line and yet N. of the moraine, as in plain N. of Greenvale Station, may constitute an intermediate series of deposits. Included in Wisconsin epoch.

Porus formation.

Pleistocene or Pliocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 85).

Posideon shale member. (In Graford formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 48–50, map). *Posideon sh.*, basal memb. of Graford fm. in Palo Pinto Co. Consists of 50± ft. of dark-gray soft sandy to calc. fossiliferous sh. containing thin layers of ls. Underlies Wiles ls. memb. and overlies Palo Pinto ls. Typically exposed above the Palo Pinto ls. in vicinity of Posideon, Palo Pinto Co.

Poso Creek sand.

Miocene: Southern California (Kern County).

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, p. 14 and pl. 2). The upper bed of so-called Santa Margarita fm. in Mount Poso oil field, NE. of Bakersfield, Kern Co., consists of fine, silty, fairly well sorted to well-sorted gray sand of marine origin, which has been locally called *Poso Creek sand*. It rests on a bed of brownish-gray and brown micaceous sandy siltstone containing fish remains, etc.

Possum sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

M. I. Goldman, 1920 (U. S. G. S. Bull. 686W, pp. 330, 332). *Possum ss.*—The first ss. of prominence below Cheshewalla ss. in T. 29 N., R. 11 E., being separated from the Cheshewalla by 75 to 100 ft. of sh. containing several lenticular sss. which together occupy 50± ft. of the interval. The Possum ss. is therefore=part of Revard ss., probably lying at or near top of that ss. In W. part of its area it is a soft massive bed, the freshly broken surface of which shows some discontinuous bedding lines, and is generally covered with rusty or blackish specks as much as ⅛ in. diam. To E., in sec. 32, T. 29 N., R. 12 E., the bed thins abruptly, changes to a hard, platy greenish limy or sideritic ss. a few inches thick, and within a few ft. disappears entirely. Named for occurrence as a prominent ledge along sides of Opossum Creek, in SE. cor. of T. 29 N., R. 11 E.

Possumtrot shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 414). *Possumtrot sh.*—Dark sandy deposit, with streaks of ss. and with plant fossils. Thickness 4 to 25 ft. Underlies Raines Corner coal and overlies Droop ss.; all members of Bluefield group [fm.]. Type loc. on W. side of Indian Creek 1.6 mi. NE. of Raines Corner and slightly N. of Possumtrot Branch, in Monroe Co. Observed in Mercer and Summers Counties, W. Va., and in Giles Co., Va.

†Posterior trap.

†Posterior sandstones and shales.

Descriptive terms applied in early repts to an upper part of Newark group in Conn.

†Postmedidial series.

Nongeographic name applied by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to include Chemung group to Marcellus sh., both inclusive.

of Appalachian region. Abandoned by Rogers in his 1858 classification (Geol. Pa., vol. 1, pp. 59, 104–109; vol. 2, pt. 2, pp. 751–775).

Named to indicate "sunset period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

†Post-Meridian series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 107, 273+, and vol. 2, p. 755). Divided into *Post-Meridian ls.* (Upper Helderberg or Corniferous ls. of N. Y.), 80 ft. thick in NE. Pa.; and *Post-Meridian grits* (*Cauda-Galli and Schoharie grits of N. Y.*), 300 ft. thick NE. of Delaware Water Gap.

Potapaco clay member (of Nanjemoy formation).

Eocene: Eastern Maryland and Virginia.

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Potapaco memb. or substage.*—Greensand, often very argill. and at times gypseous, forming basal memb. of Nanjemoy fm. Underlies Woodstock memb. or substage of Nanjemoy fm. and overlies Aquia fm. Thickness 60 to 65 ft. Potapaco is early name of Port Tobacco Creek, a corruption of word Potapaco, found on Smith and other early maps.

W. B. Clark and B. L. Miller, 1912 (Va. Geol. Surv. Bull. 4, p. 104). *Potapaco clay memb.*—Basal memb. of Nanjemoy fm. Underlies Woodstock greensand marl memb. and overlies Aquia fm.

Potato sandstone.

Miocene probably: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 374–375, and map). *Potato ss.*—Very hard ss., entirely different from any other rock in dist. For most part is a well-bedded coarse angular arkose with angular boulders of schist and granite. A yellowish variety predominates, but there are also finer greenish and some red varieties. A few thin beds of sh. are found btw. the ss. strata. Bedding varies in thickness from a few in. to more than 30 ft. Age not definitely determined. The intense shearing and induration indicate it is older than Hathaway fm. and Santa Ana ss. Believed to be younger than Saragossa qtzite, but relations are obscure. Tentatively considered Mio. Resembles Puente ss., of Mio. age.

Named for Potato Canyon, San Bernardino Co. Forms the part of the ridge btw. Potato Canyon and Mill Creek E. of Wilson Creek.

†Poteau stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51), and H. M. Chance (idem, p. 52). *Poteau stage* as defined by Winslow is top div. of Coal Measures of Ark. and consists chiefly of sh., 3,300 to 3,900 ft. thick, containing several coal beds, that mined at Huntington and neighboring localities in NW. Ark. being most important and near the base. Overlies Sebastian stage, top memb. of which is Greenwood ss. As described by Stevenson the Poteau stage is top div. of Coal Measures along Choctaw, Oklahoma & Gulf Ry in Ind. Ter.; consists of sss., shales, and coals, over 5,000 ft. thick; overlies Tomlinson stage (top memb. of which is a ss. 50 ft. thick [Greenwood ss. of Winslow]); and it includes Secor coal bed 30 ft. above base.

Probably named for Poteau Mtns, Le Flore Co., Okla., and Sebastian Co., Ark.

Potem formation.

Middle and Lower Jurassic: Northern California (Redding quadrangle).

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Potem fm.*—Sss., shales, and tuffs. Thin-bedded sss. and gray, sometimes slaty shales predominate in lower part and make up greater portion of fm. They are more or less calc. and contain a few small lentils of ls. Tuffaceous cgls. occur sparingly in lower half of fm., but in upper part are most abundant—in fact, nearly all sediments of this part are of igneous material, some of which may have been furnished by contemp. volcanic activity, but most of it was derived by ordinary processes of erosion from a wide expanse of volcanic rocks. Must be at least several thousand ft. thick [2,000± in columnar section]. Regarded as=Hardgrave ss. and most likely the Mormon ss. also. Underlies Chico fm. and overlies in places Bagley andesite and in other places rests, probably conformably, on Modin fm. [See also under *Bagley andesite*.] Named for development on Potem Creek, Shasta Co.

Potlatch anhydrite formation.

Devonian (Upper or Middle): Central northern Montana (Sweetgrass arch, north of Great Falls region).

E. S. Perry, 1928 (Mont. State Bur. Mines and Geol. Mem. 1, pp. 4–6). *Potlatch anhydrite fm.*—Alternating and interbedded sh., anhydrite, gyp., dol., ls., with 20 ft. of rich oil sh. at top; is mainly anhydrite. Thickness 940 ft. The anhydrite and gyp. are compact massive pearl-gray, sometimes cleavable, also irregularly associated with dol. giving mottled appearance. Assigned to Dev. Is probably about=Jefferson fm. Underlies Madison ls. Overlies 300 ft. of light-gray ls. of undet. age. Lies at about 2,500 ft. depth on top of Sunburst dome. Name derived from fact complete section of the fm. is shown by cuttings of Potlatch-Adams No. 1 deep well on sec. 21, T. 34 N., R. 1 W.

P. D. Moore, 1931 (A. A. P. G. Bull., vol. 15, No. 10, pp. 1151–1152). Perry suggests it seems best to classify this as about=Jefferson fm., but Romine and Lebkicher place it definitely in the Threeforks. Writer favors latter opinion.

Potomac group.

Lower Cretaceous: Maryland, Delaware, and Virginia.

W J McGee, 1886 (Rept. Health Office D. C., 1885, pp. 19–21; also Am. Jour. Sci., 3d, vol. 31, pp. 473–474). *Potomac fm.*—Fine homogeneous plastic clay, sand, coarse and fine gravel, with occasional boulder beds. Forms surface E. of a line crossing Potomac River near Chain Bridge and passing a little E. of Brightwood, except where cut through by gneiss. Is known to extend from Baltimore to Washington, thence southward through Fredericksburg and Richmond to Petersburg, Va. Underlies Columbia fm. and uncon. overlies the gneiss.

W J McGee, 1888 (Am. Jour. Sci., 3d, vol. 35, pp. 120–143). *Potomac fm.* is of Mid-Cret. to earliest dawn of Cret. or closing episodes of Jurassic. The upper memb. is 350 ft. thick, and probably corresponds to Raritan clays of N. J. It rests uncon. on lower memb., which is 250 ft. thick. The Potomac is uncon. overlain by upper Cret. N. of the Patapsco, and in other areas is overlain by different fms. to and including Columbia fm. Usually rests on crystalline rocks.

Subsequently the Potomac (nonmarine) was raised to rank of a group, separated into 4 fms., named (descending) Raritan, Patapsco, Arundel, and Patuxent. Further study by W. B. Clark proved Raritan fm. to be Upper Cret. and the other 3 fms. to be Lower Cret., and Raritan fm. was excluded from Potomac group. This is present commonly accepted definition of Potomac group.

†Potomac marble.

A ls.-cgl. lentil in Newark group (Upper Triassic) has for many years been quarried for ornamental stone, especially near Point of Rocks, Md., under trade name of "Potomac marble." W. B. Rogers referred to it in 1840 (Rept. Prog. Geol. Surv. Va. for 1839, p. 72) as "the well-known *Potomac marble*." In southern Pa. it grades laterally into Arendtsville fangl. lentil of Gettysburg sh.

Potosi dolomite.

Upper Cambrian: Eastern and central Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 351, 355). *Potosi ls.*—Ls. containing chert and drusy quartz, constituting country rock about Potosi, Mo. Underlies Crystal City [St. Peter] ss. and overlies St. Joseph ls. Is upper part of St. Francois ls. [This definition was followed by Winslow, 1895 (Am. Geol., vol. 15, pp. 81–89). In 1896 (U. S. G. S. Bull. 132) he gave thickness of his *Potosi ls.* as 270 ft. This is a broad use of Potosi, corresponding to Potosi group of Bain and Ulrich, 1905.]

F. L. Nason, 1901 (Am. Jour. Sci., 4th, vol. 12, p. 358), divided the rocks uncon. above Bonneterre ls. in St. Francois Co., Mo., as follows (descending): (1) Potosi Residuary, 100 ft.; (2) *Potosi lss.*, 350 ft., consisting of cherty ls. at top, drusy quartz in middle, and shaly ls. at base; (3) Potosi slates and cgls., 106 ft.

H. A. Buehler, 1907 (Mo. Bur. Geol. and Mines vol. 6, 2d ser.). *Potosi* underlies Proctor and overlies Doe Run.

E. R. Buckley, 1908 (Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286). *Potosi* underlies Eminence and uncon. overlies Doe Run (top div. of Elvins).

E. R. Buckley, 1909 (Mo. Bur. Geol. and Mines vol. 9, pt. 1). *Potosi fm.* restricted to the siliceous cherty and drusy dol., 300 ft. thick, underlying Eminence fm. and uncon. (?) overlying Doerun fm. (upper part of Elvins fm. of Ulrich). Consists of massive dol. and thick chert alternating. [This is accepted definition of *Potosi ls.* in subsequent repts of Mo. geologists, and is the one followed by U. S. Geol. Survey, which now classifies the fm. as Upper Camb.]

Named for Potosi, Washington Co.

†Potosi group.

Upper Cambrian and Lower Ordovician: Southeastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 351, 355), used *Potosi ls.* [See 1894 entry under *Potosi dol.*]

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bulls. 260, 267). *Potosi or Yellville group.*—Includes all rocks btw. base of St. Peter ss. above and top of Elvins fm. below. Is characterized by large quantities of chert and drusy quartz.

Discarded in favor of more restricted and useful name *Potosi dol.* Includes fms. of Upper Camb. and Lower Ord. age.

Potosi volcanic series.

Miocene: Southwestern Colorado.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). *Potosi rhyolitic series*—Alternation of rhyolite flows and tuffs, former predominating near base; some of thin upper flows are glassy; a thin augite andesite sheet occurs btw. rhyolite flows in lower part; at base few to 100+ ft. of coarse-grained tuff or flow breccia, gray or light red. Thickness 1,300+ ft. Overlies Intermediate series [later named Silverton volcanic series].

W. Cross and E. Howe in 1905 (U. S. G. S. Silverton folio, No. 120) changed name to *Potosi volcanic series*. In Creede dist. the series is now divided into Piedra group above and Alboroto group below.

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153), introduced *Henson tuff* for uppermost fm. of Silverton volcanic series, and stated that in Silverton folio the upper part of Henson tuff was included in overlying Potosi volcanic series and lower part in underlying pyroxene andesite, which was then called uppermost fm. of Silverton volcanic series.

Named for Potosi Peak, Silverton quad., where upper several hundred ft. is present.

†Potosi Residuary.

Upper Cambrian: Eastern Missouri.

F. L. Nason, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 358–361). *Potosi Residuary.*—Residuary Potosi clay with drusy quartz, 100 ft. thick, overlying Potosi ls. (cherty ls. at top, drusy quartz in middle, and shaly ls. at base) in St. Francois Co.

J. Bridge, 1930 (personal communication). Corresponds to part of Eminence and part of Potosi of present nomenclature.

†Potosi slates and conglomerates.

Upper Cambrian: Eastern Missouri.

F. L. Nason, 1901 (Am. Jour. Sci., 4th, vol. 12, pp. 358–361). *Potosi slates and cgls.*—Fossiliferous slates, interbedded with cgls., 100 ft. thick, with basal ls. cgl., 6½ to 10 ft. thick, the disks of ls. in which lie edgewise. Typically exposed near Elvins. Uncon. overlies Bonne Terre or St. Joseph ls. and underlies Potosi lss. (cherty ls. at top, drusy quartz in middle, and shaly ls. at base) in St. Francois Co.

Same as Elvins fm. of present nomenclature.

Potsdam sandstone.

Upper Cambrian: Central and eastern New York.

E. Emmons, 1838 (N. Y. Geol. Surv. 2d Rept., pp. 214–217, 230), described the rocks of St. Lawrence Co., NW. N. Y., as consisting of (descending) calciferous sand rock, transition ls., *ss. of Potsdam* [heading], and primary strata. The *ss. of Potsdam* (in St. Lawrence Co.) he described as a true ss., of red, yellowish-red, gray, and grayish-white colors, made up of grains of sand and held together without a cement; "intermixed with the siliceous grains are finer particles of yellowish feldspar." In one place on p. 217 he called it *Potsdam ss.* On p. 230, under heading "sandstone of Essex," he said: This I consider the same fm. I have described under the name of *Potsdam ss.*

In 1842 (Geol. N. Y., pt. 2) Emmons stated: "In consequence of Potsdam ss. presenting two quite distinct varieties, one well developed at Potsdam and the other at Keeseville [St. Lawrence Co., NW. N. Y.], I have sometimes given it a compound name—the *Potsdam and Keeseville ss.*; for reason that at former place a beautiful granular variety exists, and at latter place a harder and more crystalline mass predominates which resembles the granular quartz of the Taconic system." He also called attention to granitic cgl. forming basal bed of Potsdam ss., and stated that at Potsdam the fm. is 60 to 70 ft. thick. In 1846 Emmons stated thickness of Potsdam ss. as 0 to 300 ft.

For many years the name *Potsdam ss.* continued to be applied to the rocks btw. †Calciferous ss. [Beekmantown] and †Primary strata, and the use of this N. Y. name was extended over a large part of the country. In 1859 (Pal. N. Y., vol. 3, pt. 1) James Hall stated that "it presents a uniform, even monotonous, physical character over the wide areas in which it has been investigated in N. Y., Canada, Pa., Va., Iowa, Wis., and Minn." In 1863 he stated: In final nomenclature of N. Y. geologists *Potsdam ss.* was adopted for lowest stratified rock of the series known to contain fossils. In 1883 (Am. Ass. Adv. Sci. Proc., vol. 31, pp. 40–63) he called attention to wide distribution of Potsdam ss. and said that it is everywhere marked by ripple marks. In 1890 (Geol. Soc. Am. Bull., vol. 1) Brainerd and Seely stated that Potsdam ss. of Champlain Valley consists of mag. ls. and ss., 170 to 200 ft. thick, carrying a peculiar fauna. In 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 669–683) H. P. Cushing stated that 400 ft. of Upper Camb. Potsdam ss. is exposed in Champlain and Beekmantown Twps, N. Y. In 1895 (Geol. Soc. Am. Bull., vol. 6, pp. 285–296) Cushing stated that Potsdam ss. of Chazy Twp, Clinton Co., N. Y., consists of more than 350 ft. of massive beds of ss., of red, white, or yellow-brown color and varying degree of induration, with cgl. and arkose at base, and at top *passage beds* lithologically distinct from †Calciferous above and from Potsdam beds below. In 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, pp. 503–574) Cushing gave thickness of Potsdam ss. as 350 to 2,000+ ft., and stated that while upper part is Upper Camb. it is far from certain the whole of it is Upper Camb.; that main mass of fm. is quite pure quartz sand, with large feldspathic content in basal layers, with basal cgl., and toward summit interbedded with dolomitic layers or beds of pure sandy dol., forming passage beds to †Calciferous. In N. Y. State Mus. 51st Rept., pt. 1, pp. 137–180, 1899, F. J. H. Merrill stated that the *Potsdam* is 70–333 ft. thick, consists of ss. around the Adirondacks and of correlated lss. in Dutchess, Washington, and Saratoga Counties, with a coarse cgl. at base at a few places. The same year (Sci., n. s., vol. 10, pp. 874–878) J. M. Clarke and C. Schuchert stated that the Potsdam consists of ss. and ls.

In 1901 (N. Y. State Mus. 53d Ann. Rept., pt. 1, pp. r39 to r69) H. P. Cushing removed from top of Potsdam ss. of Clinton Co., N. Y., the "passage beds" (consisting of btw. 500 and 600 ft. of alternating layers of dol. and ss.), and restricted *Potsdam ss.* to 800 or 900 ft. of beds of very uniform character, mostly coarse grit, white or buff, in massive beds, much of it cross-bedded and ripple-marked, with very coarse cgls. at base.

In 1902 (N. Y. State Mus. Bull. 52) G. Van Ingen stated thickness of *Potsdam ss.* in Lake Champlain Basin (SE. Clinton Co. and NE. Essex Co., N. Y.) to be 455 to 1,150 ft., the "transition beds" at top not being present. Upper Camb. fauna in upper part.

In 1903 (N. Y. State Mus. Hdb. 19, p. 12) J. M. Clarke stated: On E. slope of Adirondacks the sand deposits of the Potsdam pass upward without break into the dolomites of Beekmantown fm., and Schaghticoke shales with *Dictyonema flabelliforme* are conformable with shales of both earlier and later date, but mark the top of the Cambric in the sh. facies. In Saratoga Co. the shore deposits of Potsdam ss. are overlain by heavy beds of ls. (*Greenfield ls.*). The Cambric or Neelytown lss. [shown on chart as underlying Schaghticoke sh.] of Orange Co., which constitute a part of Kittatinny ls. series of N. J., are deeper-water deposits of similar character.

According to H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95), the upper 350 ft. of Potsdam ss. (beneath the passage beds) has been shown by Walcott and Van Ingen to carry a sparse Upper Camb. marine fauna, while lower part contains no fossils and may possibly be older than Upper Camb.

In 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 155+) H. P. Cushing introduced *Theresa fm.* for the "passage beds" at top of Potsdam ss., which he defined as consisting of 20 to 70 ft. of somewhat calc. sandy dolomites, with interbedded weak sss., especially near base, and drew line btw. Potsdam ss. as thus restricted and Theresa fm. at base of first dol. layer. The *Theresa fm.* (named for Theresa Twp. Jefferson Co., N. Y., "in which it is exposed in its entirety") he stated is uncon. overlain by Pamelia ls., of Chazy age. (See also J. M. Clarke, N. Y. State Mus. Bull. 121, pp. 11–13, 1908.) In 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 780–781) E. O. Ulrich and H. P. Cushing excluded the passage beds from Potsdam ss. but did not apply any name to them in Mohawk Valley, N. Y., where they are overlain by Little Falls dol. The same year J. M. Clarke (N. Y. State Mus. Bull. 140, pp. 11–12) mapped (in Broadalbin quad., Fulton and Saratoga Counties, N. Y.), under the name *Galway fm.*, a series of distinctly transitional beds btw. Potsdam ss. and Little Falls dol. On p. 99 of same bulletin E. O. Ulrich and H. P. Cushing replaced *Greenfield ls.* (preoccupied) with *Hoyt ls.*, which they treated as a local basal memb. of Little Falls dol. and as overlying *Theresa fm.* or "passage beds" in Mohawk Valley, the name *Theresa fm.* being applied to apparently the same beds that Clarke named *Galway fm.* In N. Y. State Mus. Bull. 145, 1910, Cushing described Potsdam ss. of Thousand Islands region as 100 ft. thick, consisting of red, white, and buff quartz ss., with 0 to 20 ft. of coarse cgl. at base, and overlain by Theresa dol. (consisting of 35 ft. of blue-gray sandy mag. ls. with beds of weak ss., "constituting division A of Brainerd and Seely's Beekmantown, but not Beekmantown").

In 1911 (Geol. Soc. Am. Bull., vol. 22) E. O. Ulrich assigned Little Falls, Hoyt, Theresa, and Potsdam fms. to Saratogan epoch of his Ozarkian system. But all N. Y. State Geol. Surv. and Canada Geol. Surv. publications up to 1926, inclusive, continued to classify Potsdam ss. as Camb. In 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, p. 469) C. D. Walcott recognized Ulrich's Ozarkian as a distinct system, and assigned to it the same N. Y. fms. that Ulrich assigned to it, but he stated (p. 469) that fauna of Hoyt ls. and upper part of Potsdam ss. is comparable with that of lower Mons of Alberta, and (p. 470) that fauna of lower Mons is "predominantly Upper Cambrian."

In 1915 (Geol. Soc. Am. Bull., vol. 26, pp. 289-291) G. H. Chadwick described "*Upper Potsdam*" (*Keeseville?*) as white ss., and the underlying *typical Potsdam sss.* as mostly red, the former being overlain by *Theresa mixed beds or fm.* In 1916 (N. Y. State Mus. Bull. 191) H. P. Cushing included the white ss. in Potsdam ss. of Ogdensburg and adjacent quads. In 1919 (N. Y. State Mus. Bull. 213, 214) W. J. Miller stated that Potsdam ss. (underlying Theresa fm.) is well represented in St. Lawrence, Champlain, and Mohawk Valleys; that in SE. Adirondacks it extends, as outliers, as far as Wells (Hamilton Co.), North River (Warren Co.), and Schroon Lake (Essex Co.), and that it is oldest Camb. fm. in northern N. Y., where Middle and Lower Camb. are unknown. The same year H. I. Alling stated (N. Y. State Mus. Bull. 207, 208) that "white Potsdam" ss. is *Keeseville ss.* of many geologists. In 1920 G. H. Chadwick doubtfully identified "white Potsdam" ss. as *Keeseville ss.*, and stated that possibly there is an uncon. btw. it and the underlying *typical red Potsdam ss. and cgls.*

In 1925 (N. Y. State Mus. Bull. 259, pp. 49-50) H. P. Cushing and D. H. Newland stated: From Potsdam W. to Clayton the Potsdam ss. is rather thin, and in places where the Precambrian floor was highest on the granites and garnet gneisses, for example, it may entirely fail, and Theresa fm. lie on Precambrian. East of Potsdam the fm. rapidly thickens by the successive addition of beds at base. In other words, the thin fm. present from Potsdam to Clayton represents only summit of the fm. as it occurs more to eastward. This upper part consists largely of somewhat calc., not extra-resistant ss., of brown or white color, carries marine fossils sparingly, and seems an unquestionably marine fm. The ss. found in these residual patches in Gouverneur quad. differs from above in color and in being very vitreous and hard and noncalc. except locally when in immediate contact with ls. Angular blocks of hard red ss. are also found as pebbles in the basal cgls. The phenomena are quite as they are in Thousand Islands region and, as shown in rept on that dist., suggest that this lower, hard ss. is materially older than the ordinary Potsdam of the region, although it is not thought to be older than basal part of Potsdam ss. of Clinton Co. It also seems to be a nonmarine fm. The evidence is not yet clear, however, as to precise significance to be attached to observed phenomena. It is quite certain that the deposit of the sand in these hollows of the old surface was not immediately followed by the sands which form the general Potsdam of the region, but that a time interval lay between. Whether this was a long interval, or a comparatively short one, is at present not known. Writer is of opinion the older sand here is approx.=basal part of fm. as it appears in Clinton Co., and that the other, in like manner, is=the summit, and that there is nothing here equiv. to middle div. of fm. in Clinton Co. It is quite possible, however, that there is a break btw. the lower and middle divisions of fm. there, and the whole fm. is very thick, at least 1,290 to 1,500 ft. There is at hand today very little direct evidence in substantiation of the above opinion. The general Potsdam of this NW. area is very thin and is unquestionable equiv. of extreme summit of the fm. in Clinton Co. The precise age of the basal sands of these hollows is an entirely open question.

The early practice of applying the name *Potsdam ss.* to any ss. or sss. occupying a somewhat similar strat. position in the Middle States has in recent years been questioned, and present tendency of geologists is to treat Potsdam ss. as a local (N. Y. and southern Canada) fm. The U. S. Geol. Survey now classifies the Potsdam ss. as *Upper Camb.*

†Potsdam period.

A term applied in some early repts to †Calciferous sandrock (Beekmantown) and underlying Potsdam ss.; also to Upper Cambrian epoch of America.

†Potsdam group.

A term applied in some early repts to Potsdam ss., and also to Upper Cambrian series.

†Potsdam limestone.

A term applied in some early repts to dolomitic beds formerly included in top of Potsdam ss. but later separated and named *Theresa fm.* (See under *Potsdam ss.*) In 1886 (Am. Jour. Sci., 3d, vol. 31, pp. 125–133) W. B. Dwight applied *Potsdam ls.* to 300 ft. of aren. ls. and dol. in Dutchess Co., N. Y., later (1927) identified by E. B. Knopf (from contained fossils) as Hoyt dol. and described as overlain by Rochdale ls. (of Beekmantown age) and underlain by Stissing ls. (of Middle? and Lower Camb. age).

†Potsdamian.

†Potsdamic.

Names applied in some early geologic repts to Upper Cambrian series. See U. S. G. S. Bull. 769, pp. 94–97.

†Pottawatomie formation.

Pennsylvanian: Eastern Kansas.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 92–94). *Pottawatomie fm.*—Group of strata well limited stratigraphically by [top of] Pleasanton shales below and [base of] Lawrence shales above.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), divided *Pottawatomie fm.* into Kansas City, Lansing, and lower part of Douglas fms., and the name has now been abandoned by Kans. Geol. Surv. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 76), stated that Pottawatomie fm. of Haworth, 1898, extended from base of his (Moore's) 1936 Bronson group to top of his 1936 Lansing group.

Named for Pottawatomie River, SE. Kans., "which rises near the Stanton ls., the uppermost one of the complex, and flows over the gently upturned edges of a number of the fms. here included."

†Pottawatomie series.

Pennsylvanian: Kansas, Missouri, Iowa, Nebraska, and Oklahoma.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Pottawatomie series* extends from uncon. at top of sh. overlying Iatan ls. down to top of Pleasanton sh. Underlies Virgil series and overlies Des Moines series.

R. C. Moore, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, pp. 279–280). [See this reference under *Virgil series.*]

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 88, 96), discarded *Pottawatomie series* and revived *Missouri series,* for the rocks btw. his Virgil series and Des Moines series.

Potter formation.

Tertiary (Pliocene): Panhandle of Texas.

L. T. Patton, 1923 (Univ. Tex. Bull. 2330, pp.78–80). *Potter fm.*—Coarsely stratified sand and gravel somewhat firmly cemented by calcium carbonate. Color slightly darker than overlying Coetas fm., being of reddish cast. Is strongly cross-bedded at many localities. These beds have been called "mortar beds," but it is not proposed to class all "mortar beds" as Potter fm., but only those beds that have a definite relation to overlying Pliocene Coetas fm. Thickness 78 to 100 ft. Characterized by large numbers of water-worn fossils, mainly *Gryphaea,* which have been weathered out of earlier fms. These fossils are not found in Coetas fm. Rests uncon. on Triassic and on Perm. rocks. Is either Plio. or pre-Plio. Tert.

It seems to be present opinion of most if not all workers that there is no Mio. in this part of Tex., and that the deposits of Llano Estacado are all Plio. They are mapped as *Ogallala fm.* (*Plio.*) on 1937 map of Tex.

Potter parvafacies.

Devonian or Carboniferous: Northern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 31). The red parvafacies of Catskill magnafacies may well be called *Potter parvafacies,* from red development of Venango stage in Potter Co., Pa. The next eastern facies development of Venango stage, which is within Tioga magnafacies, might appropriately be called *Elkland parvafacies,* from area about Elkland, Pa. This parvafacies was originally mistaken for eastern extension of Oswayo sh.

Potter Farm formation.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Potter Farm fm.*—Blue to gray sh. alternating with crinoidal sublithographic or argill. lss. of small lateral extent, containing fauna characterized by *Cylindrophyllum.* Greatest measured thickness, 36 ft. Is middle fm. of Thunder Bay stage. Separated from overlying Partridge Point fm. by covered interval of 70 ft. Lies on Norway Point fm. Type loc., Fred Potter farm, E. half of secs. 18 and 19, and sec. 20, T. 31 N., R. 8 E., Alpena Co.

†Pottsboro subgroup.

Lower Cretaceous (Comanche series): Northeastern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 121, 247, 270, 280–288). *Pottsboro subgroup.*—Uppermost subgroup of Denison beds. Includes Grayson marls above (15 ft. thick) and Main Street ls. below (10 ft. thick). Overlies Pawpaw fm. and underlies Woodbine sand.

Named for Pottsboro, Grayson Co.

Pottstown shale. (In Newark group.)

Upper Triassic: Southeastern Pennsylvania (Bucks and Montgomery Counties).

B. S. Lyman, 1893 (Pa. Geol. Surv. geol. and topog. map of Bucks and Montgomery Counties) and 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, pp. 2589–2638). *Pottstown shales.*—Red shales with a few scattered green layers; 10,700 ft. thick. Overlie Perkasie shales and uncon. underlie Potomac sands. Exposed at Pottstown.

Corresponds to upper part of Brunswick sh. of Newark group.

Pottsville formation (also **Pottsville group**).

Pennsylvanian: Pennsylvania; southern Ohio, Indiana, and Illinois; Kentucky, Tennessee, northeastern Mississippi, Alabama, West Virginia, Virginia, and Maryland.

J. P. Lesley, 1876 (2d Pa. Geol. Surv. Rept. L, App. E, pp. 221–227). *Pottsville Seral cgl.* (*Millstone Grit, No. XII*), 59 ft. thick in Boyd's Hill gas well at Pittsburgh, Pa. Overlies Mauch Chunk Umbral Red sh. and underlies Lower Productive Coal Measures. [Type loc. not stated.]

C. A. Ashburner, 1877 (Am. Phil. Soc. Proc., vol. 16, pp. 520, 535). *Pottsville* (*Seral*) *cgl.* (*Millstone Grit, No. XII*).—*Pottsville* is new name proposed by present [Pa.] State Geologist [J. P. Lesley]. Underlies Allegheny River Coal

Measures and overlies Mauch Chunk red sh. Divided into Piedmont ss. (160 ft. thick) at top, Kanawha River Coal Series, and, at base, the Conglomerate proper (80 ft. thick).

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. xxiii). *Pottsville cgl. (Seral).*— Extends from base of Lower Productive Coal Measures to top of Mauch Chunk sh. Is No. XII of Rogers.

The U. S. Geol. Survey classifies the Pottsville in most areas as a *fm.* Where divided into two or more named and mapped major units, it classifies it as a *group* and the named subdivisions as *fms.* The present Pa. Geol. Survey classifies the Pottsville as a *series*. In anthracite coal field of NE. Pa. (the typical Pottsville region) the Pottsville fm. is 1,200 ft. thick, and three paleobotanic subdivisions of it have been recognized by David White and other geologists. For convenience these are called *upper Pottsville*, *middle Pottsville*, and *lower Pottsville*. The upper Pottsville extends from base of Buck Mtn. (or Twin) coal down to base of sss. considered to=Sharon cgl. memb. of western Pa., and includes, toward middle, Lykens No. 1 coal. The middle Pottsville extends downward from base of the sss. which are correlated with Sharon cgl., and includes Lykens Nos. 2 and 3 coals and underlying rocks. The lower Pottsville includes in upper part Lykens Nos. 4, 5, and 6 coals and toward middle the Lykens Valley coal bed. The fm. thins to NE., and is only about 200 ft. thick in Wilkes-Barre region.

†Poughquag quartzite.

Lower Cambrian: Southeastern New York and western Connecticut.

J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 3, pp. 179–186, 250–256). [Describes "the quartzite" of Green Mtn region of Conn., Mass., Vt., and adjacent parts of N. Y. Casually alludes to it on p. 181 as *Green Mtn qtzite*. On pp. 250–256 the qtzite in SE. N. Y. is described under heading "Quartzite of Poughquag, Dutchess Co., N. Y." In one place on p. 250 it is casually alluded to as *Poughquag qtzite*. Throughout rest of articles cited the fm. is simply called "the qtzite." The qtzite at Poughquag "is in general evenly bedded. While there are hard compact layers, many are very thin and friable, looking sometimes as if argill., though really consisting of fine quartz sand. This finer kind is often a little silvery, with micaceous or talcoid scales, and sometimes contains traces of chlorite." Stratification varies little from horizontality. Rests uncon. on Archean. The "overlying" Stockbridge ls. ("the great metamorphic ls. of Green Mtn range") is frequently mentioned in articles cited above, and it is also referred to as "Pawling ls.," "Poughquag ls.," and "Stissing and Barnegat ls." The qtzite is regarded as older than the ls. and uncon. with it.]

F. J. H. Merrill, 1902 (U. S. G. S. New York City folio, No. 83, distributed in August 1902). *Poughquag qtzite* is so named from its probable strat. equivalence to the qtzite of Dutchess Co., which bears same relation to the dol. above and the gneiss below as the qtzite within Harlem quad. The Dutchess Co. qtzite contains Lower Camb. fossils at Stissing. The qtzite varies from almost white to brown in color, is characteristically thin-bedded, occasionally massive, often with muscovite or tourmaline developed along bedding and cleavage planes. Thickness in Harlem quad. 1 to 30 ft., but at type loc. (railroad cut at Poughquag, N. Y.) over 100 ft. is exposed. Rests, with sharp contact, on pre-Camb., and is overlain by Stockbridge ls., the basal beds of which integrate with top beds of the qtzite. [The qtzite of Harlem quad. has since been proved to be of pre-Camb. age, and is now called *Lowerre qtzite*.]

E. C. Eckel, 1902 (N. Y. State Mus. 54th Ann. Rept., pt. 1, pp. r145–r146, r167; received in library of U. S. Geol. Survey about January 2, 1903). In Dutchess, Orange, Putnam, and Westchester Counties a relatively thin qtzite usually underlies the Cambro-Sil. lss. [Described under heading "Stockbridge and Barnegat lss.," the blue ls. of Orange and SW. Dutchess Co. being called *Barnegat*, and the ls. of "the other southeastern counties and western New England" being called *Stockbridge*.] In Stissing Mtn and at other points this qtzite has been found to contain Lower Camb. (Georgian) fossils. It is essentially continuous, stratigraphically, throughout the counties above named, few contacts of Stockbridge ls. with pre-Camb. gneisses failing to show this intervening qtzite. In its lithologic character it is very uniform. Dr. [F. J. H.] Merrill described it in 1896 as *Lowerre qtzite*, while the names *Vermont* and *Cheshire* have been given it by New England geologists. The name recently adopted for it is *Poughquag qtzite* (Dana 1872) in recognition of fact that its thickness, lithologic character, and strat. position are well shown at Poughquag, Dutchess Co., N. Y.

The U. S. Geol. Survey has since 1914 used the older name *Cheshire qtzite* for the Lower Camb. qtzite of SE. N. Y. to which local name "Poughquag" has been applied. The N. Y. State Survey, however, continues to use the local name. (See also †*Stissing qtzite*.)

†Poughquag limestone.

Ordovician and Cambrian: Southeastern New York (Dutchess County).

J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 3, pp. 179–186, 250–256), frequently mentioned *Stockbridge ls.*, "the great metamorphic ls. of Green Mountain range," and also called it "Pawling ls.," "Poughquag ls.," "Stissing and Barnegat ls.," because exposed at or near those localities in Dutchess Co., N. Y. "The qtzite of region is considered to be older than the ls. and uncon. with it." In places he used *Pawling (Stockbridge) ls.* He also stated that the Stockbridge ls. extends from Canaan, W. of S., through Dover to Pawling; that it continues beyond latter place southward along the valley for 7 or 8 mi., where both valley and ls. narrow out; and that the Poughquag and Pawling lss. appear to be identical.

The U. S. Geol. Survey uses *Stockbridge* for this ls. The N. Y. State Survey repts use local names *Wappinger ls.* and *Barnegat ls.*

Poul Creek formation.

Oligocene: Southeastern Alaska (Yakataga district, Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 753+). *Poul Creek fm.*—Dark hard platy blue-gray shales (in part calc. and in part sandy), thin-bedded sss., cgls. (of stream, beach, and glacial origin), occasional thin argill., blue-gray lss., and a few beds of glauconitic ss. The shales greatly predominate, especially in lower part, and make up fully 75 percent of fm. Glauconitic sss. are also present, but not so numerous as in the conformably overlying Yakataga fm.; they are usually thin, but one with thickness of 25 ft. was noted. Thickness 3,000+ ft. Named for exposures along Poul Creek, Yakataga dist. A fairly large fauna was obtained from various parts of both Yakataga and Poul Creek fms. According to B. L. Clark both are of upper Olig. age, and=Blakely horizon of Wash. and San Ramon horizon of Calif.

B. L. Clark, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 797–846). [Described the fossils collected by Taliaferro, and said (p. 799):] All determinable species from Yakataga fm. occur also in Poul Creek fm.; the change in lithology is not accompanied by a change in fauna—it belongs to one zone, the Blakely horizon as recognized in Wash., which is considered by writer to be upper Olig.; it is correlated with that of San Ramon fm. of Calif.

Poultney slate.

Lower Ordovician (Beekmantown): Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 403). *Poultney sl.*—Mainly gray sl., which becomes lighter, or even white, on exposure. Most prominent feature is white or light-gray chert which appears in very thin seams or in massive beds 1 ft. or more thick. Resists erosion and outcrops abundantly. Named for good exposures in town of Poultney at bdy of N. Y., 7 mi. SW. of Castleton [in Castleton quad.]. Underlies Indian River sl. (red) and rests uncon. on Hooker sl. (Lower Camb.).

Poundridge granite.

Age (?): Southeastern New York (Westchester County).

G. K. Bell, Jr., 1936 (Geol. Soc. Am. Proc. 1935, p. 65). *Poundridge granite* occupies most of Poundridge (New York State Park) Reservation in NE. Westchester Co. N. Y. Massive pink gneissoid biotite granite, rich in soda, and with abundant pegmatite facies. Writer is inclined to correlate it with Yonkers granite.

Poverty Run limestone. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio (Muskingum County).

W. Stout, 1918 (Ohio Geol. Surv., 4th ser., Bull. 21, p. 65). *Poverty Run memb.*—Consists of (descending): Ore, 4 in.; calc. sh., 1 ft.; gray fossiliferous ls. of marine origin, 5 in. Lies 26 ft. 4 in. below Lower Mercer or No. 3 coal, and 5 ft. above Vandusen coal. Fully exposed on Poverty Run, Muskingum Co.

H. Morningstar, 1922 (Ohio Geol. Surv., 4th ser., Bull. 25, p. 28). *Poverty Run ls.* of Stout (1918) is same as Lowellville ls. of Lamb. (1910).

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 97). *Lowellville or Poverty Run ls.* is oldest known marine ls. of Pottsville fm. of Ohio. Lies in interval btw. Vandusen coal and Lower Mercer clay.

Poway conglomerate.

Tertiary (Eocene): Southern California (San Diego County).

A. J. Ellis, 1919 (U. S. G. S. W. S. P. 446). *Poway cgl.*—Chiefly cgls., but lenses of cross-bedded sand and thin layers of marly clay are exposed in some canyon walls. Forms Poway Mesa and occurs in narrow belt extending from that mesa E. to Witch Creek. Also well exposed near town of Poway, and forms S. wall of Poway Valley. Max. thickness W. of Foster about 1,000 ft. No fossils found and relations to marine San Diego fm. not determined, but probably is somewhat older than upper part of the San Diego. Rests on pre-Tert. crystalline rocks.

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7), said fauna is Eo., and tentatively correlated the fm. with Tejon fm.

W. J. Miller, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 10, p. 1555). Writer is unable to answer the following pertinent questions regarding *Poway cgl.*: Did it ever extend across central and southern parts of Ei Cajon Valley? If so, how was it removed? Is it stream-cut? If so, by what stream? Is it wave-cut, as suggested by Ellis? Are the so-called marine terraces of Ellis in reality stream terraces?

See also under *Ballena gravel.*

Powderhorn granite.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). *Powderhorn granite group.*—Comprises a large number of genetically related and locally metamorphosed intrusive masses, forming an intricate complex of granite types, whose composition is believed to be nearly uniform but whose texture is strikingly diversified. The rocks range from granite porphyry (near a rhyolite porphyry) to coarsely porphyritic granite. Three types—granite porphyry, porphyritic biotite granite, and gray biotite granite—have been distinguished on map. The granites of Powderhorn group everywhere cut and are younger than Dubois greenstone. To N. of Powderhorn most of divide btw. Cebolla and Goose Creeks consists of these granites.

For 1935 geol. map of Colo. this name was changed to *Powderhorn granite* and the fm. was included in Front Range granite group.

Powell limestone (also **Powell dolomite**).

Lower Ordovician (Beekmantown): Northern Arkansas and southeastern Missouri.

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Powell ls.*—Light-gray to greenish-gray mag. ls. with some sh. and locally a bed of ls. cgl. at base. Thickness 0 to 200 ft. Uncon. underlies Everton ls. and uncon. overlies Cotter dol. The fm. was named by E. O. Ulrich [unpublished] from exposures at Powell Station, on White River branch of St. Louis, Iron Mtn & Southern Ry.

E. T. McKnight, 1935 (U. S. G. S. Bull. 853). Believed by E. O. Ulrich to underlie, uncon., Smithville fm. [See under *Smithville fm.*]

Powell sand.

A subsurface unit, forming lower 100 ft. of Nacatoch sand, of Powell oil field, eastern Tex.

Powell moraine.

Pleistocene (Wisconsin stage): Central Ohio. Shown on moraine map (fig. 8) in U. S. G. S. Columbus folio (No. 197), p. 12. Named for Powell, Delaware Co.

Powelton shale. (In Allegheny formation.)

Pennsylvanian: Central southern Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, pp. 61–62). *Powelton shales.*—Chiefly shales, but in places gray ss. replaces the sh. to considerable extent. Thickness 50 ft. Underlie Barnett coal and overlie Cook (Fulton) coal. Named for village in Huntingdon Co.

Powers Bluff quartzite.

Pre-Cambrian (middle Huronian): Central northern Wisconsin (Wood County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 82). *Powers Bluff qtzite.*—Medium- to very fine-grained, mainly pinkish qtzite. Thickness surmised to be perhaps 1,000 ft. Forms main portion of Powers Bluff, near Arpin, Wood Co. In isolated exposures S. of Powers Bluff the qtzite is generally coarser and whiter than that of the bluff. On SE. side of Powers Bluff it is overlain by cgl. containing detritus of Powers Bluff fm. and grading upward into medium- to coarse-grained qtzite. May be Rib Hill qtzite. Assigned to lower Huronian (?).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this qtzite to *middle Huronian.*

Powwow conglomerate member (of Hueco limestone restricted).

Permian (?): Western Texas (Hueco Mountains).

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 909, 911). Above the beds of Strawn age are lss. containing Canyon and Cisco fossils. *Chaetetes* is absent, and a zone of *Fusulinella mecki* occurs at base. Uppermost beds contain Cisco fusulinids (identifications of C. O. Dunbar). Near top is a memb. of cgl. and red beds, which is folded with the rest of the Carbf. The red beds are well exposed from 2 to 5 mi. S. of Hueco Canyon along main escarpment of Hueco Mtns, and for them the name *Powwow* is proposed, from Powwow Canyon 3½ mi. S. of Hueco Canyon, which is followed by the new El Paso-Carlsbad highway.

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 743). *Powwow cgl. memb. of Hueco ls.*, unnamed then, was correctly placed above the uncon. by J. W. Beede (Univ. Tex. Bull. 1852, p. 14, 1920), but was erroneously grouped with the strata below the uncon. by P. B. and R. E. King in publication cited above.

Poxino Island limestone. (In Wills Creek shale.)

Silurian: Northeastern Pennsylvania (Monroe County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 146–147, 223–224). *Poxino Island ls.*—Very hard bluish-gray fossiliferous crystalline ls., in thin layers. Thickness 5 ft. Underlies Poxino Island shales and rests on 5 ft. of greenish shales which lie on Clinton red sh. Exposed only in steep bluff on Delaware River opposite Poxino Island. Lowest memb. of Lower Helderberg series.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, p. 94). The Poxino Island sh. and underlying *Poxino Island ls.* are not Lower Helderberg, but belong to Salina group.

Is a ls. in basal part of Wills Creek sh.

†Poxino Island shale.

Silurian (Cayugan): Northeastern Pennsylvania (Monroe and Carbon Counties).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 77, 145–146). *Poxino Island sh.*—A series of buff, greenish, and variegated, limy shales, unfossiliferous, underlying Bossardville ls. and overlying Poxino Island ls. Thickness 200 ft. Exposed in bluff of Delaware River in Middle Smithfield Twp, opposite Poxino Island. Included in Lower Helderberg fm. [Helderberg].

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, p. 94). *Poxino Island sh.* and underlying Poxino Island ls. belong to Salina group, and not to Lower Helderberg.

Essentially same as Wills Creek sh., better-established name.

Pozo formation.

Tertiary (Pliocene?): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 70, etc.). *Pozo fm.*—Roughly bedded, imperfectly assorted cgls. associated with some soft ss. Mainly of volcanic derivation, andesitic, basaltic, and pumiceous fragments being abundant. Fluviatile. Thickness 0 to 100 (?) ft. Conformably underlies Spearhead rhyolite and uncon. overlies Siebert [Esmeralda] fm. Named for exposures in Pozo Canyon.

†Prairie diluvium.

Descriptive term used in early La. repts to include the Quat. alluvium, yellow loam, and loess.

†Prairie formation.

A term applied in early Ill. and other repts to the Pleist. loess.

Prairie Bluff chalk.

Upper Cretaceous: Southwestern Alabama.

A. Winchell, 1857 (Am. Ass. Adv. Sci. Proc., vol. 2, pp. 83, 84, 90). *Prairie Bluff ls.*—White ls., 6 ft. thick, exposed at top of section at Prairie Bluff. Embraces in upper part a bed of dark-colored disintegrated ls. 4 ft. thick, containing obscure casts of fossils; lower portion abounds in them, and base is almost entirely made up of *Exogyra costata* and *Gryphaea mutabilis*, in very fine state of preservation. I have not seen Tert. beds in immediate superposition above this, but I presume the Prairie Bluff ls. is=Black's Bluff ls. and is uppermost memb. of Cret. series of Ala.

L. W. Stephenson, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 250). *Prairie Bluff tongue of Selma chalk* is revival of Winchell's name *Prairie Bluff ls.*, for the chalk or "ls." exposed in Prairie Bluff, Wilcox Co. Is contemp. with Oktibbeha tongue of Miss., and extends E. from main body of Selma chalk in Marengo Co. nearly through Wilcox Co. It appears to be [is now known to be] separated from underlying Ripley sand by an uncon.

L. W. Stephenson and W. H. Monroe in April 1937 proposed that the Prairie Bluff deposits be raised to rank of a fm., designated *Prairie Bluff chalk*, uncon. overlying the Selma chalk restricted in a limited area in Miss. and Ala., and elsewhere uncon. overlying the Ripley; and that the definition of Prairie Bluff be expanded so as to include the deposits heretofore designated "Oktibbeha tongue of Selma chalk," which was discarded. This is present approved name and definition of U. S. Geol. Survey. (See A. A. P. G. Bull., 1937.)

Prairie Bluff limestone.

See 1st entry under *Prairie Bluff chalk*.

Prairie d'Ane clay.

Pleistocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 32–33, 46–47, 188). *Prairie d'Ane clay.*—Unstratified white or yellow clays, of not very great thickness, sometimes mixed with siliceous gravel, sparsely embedded in places and in other places constituting well-defined hummocks, some 15 ft. in diam. Forms Prairie d'Ane at Prescott, Prairie de Roan at Hope, and Bois d'Arc Prairie 10 mi. S. of Washington. Overlies Arkadelphia shales, or high bluff sands, or chalky Cret. marls. [On p. 29 of book cited these clays and gravel are called *Prairie de Roan div.* On p. 32 author used (in heading) "Prairie d'Ane or White clay till;" on p. 33 he used (in heading) "White Prairie d'Ane clay."]

Named for exposures in Prairie d'Ane at Prescott, Nevada Co.

Prairie de Roan division.

Pleistocene: Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 29, 33). [White clay and gravel till, called *Prairie de Roan div.* on p. 29, but on p. 33 described under heading *Prairie d'Ane or White clay till*, q. v.]

Named for Prairie de Roan at Hope, Hempstead Co.

Prairie du Chien group.

Lower Ordovician (Beekmantown): Southwestern Wisconsin, southern Minnesota, Iowa, and western Illinois.

H. F. Bain, 1906 (U. S. G. S. Bull. 294, p. 18). *Prairie du Chien fm.*—Geographic name to replace "Lower Magnesian" of early repts. Includes (descending): Shakopee or Willow River dol. (approx. 40 ft. thick); New Richmond ss. (15 to 130 ft. thick); and Oneota dol. (200 to 225 ft. thick). Rests on Camb. and is uncon. overlain by St. Peter ss.

For many years the Prairie du Chien has been treated as a *group* and the Shakopee, New Richmond, and Oneota as fms. The Shakopee and New Richmond were for a time classified by U. S. Geol. Survey as Lower Ord. (Beekmantown) and Oneota dol. (formerly classified as Lower Ord.) was classified as Camb. or Ord., it being assigned by E. O. Ulrich to his Ozarkian system. A. C. Trowbridge and G. I. Atwater (Geol. Soc. Am. Bull., vol. 45, pp. 78–79, 1934) would include all of Prairie du Chien group in Lower Ord., and it is so classified in Rept. 9th Ann. Field Conf. Kans. Geol. Soc. (1935) and by U. S. Geol. Survey.

See also under *Oneota dol.*, *New Richmond ss.*, and *Shakopee dol.*

Named for exposures in vicinity of Prairie du Chien, Wis.

Prairie River granite.

Pre-Cambrian: Northeastern Minnesota (Itasca County).

G. E. Culver, 1894 (Minn. Geol. Nat. Hist. Surv. 22d Ann. Rept., btw. pp. 102 and 114). *Prairie River granite* exposed in SE¼ SE¼ sec. 32, also sec. 33, and abundantly in sec. 34, T. 56, R. 25, in Itasca Co. Is a fine-grained gray rock with some gneissic phases and contains some bodies of schist, which were taken to indicate the granite is eruptive.

Prairie Rock limestone.

Upper Cretaceous: Mississippi.

E. C. Eckel, 1905 (U. S. G. S. Bull. 243, pp. 206–219), and A. F. Crider, 1905 (U. S. G. S. Bull. 260, pp. 510–521). [Both of these repts refer to ls. in Selma chalk at *Prairie Rock* as *Prairie Rock ls.* Crider states (p. 515) that the ls. is quarried on SW. side of Bogue Chitto Creek, ½ mi. E. of Prairie Rock. Bogue Chitto Creek is in Neshoba and Kemper Counties, NE. Miss.]

Pratt coal group.

Pennsylvanian: Central Alabama.

A group of coal beds in Pottsville fm. of Warrior coal field, the top coal lying 210 to 260 ft. below Camp Branch ss. memb., and the coals occurring within a vertical section of 150± ft. Includes Pratt coal (at top), Nickel Plate (Cardiff), American (Double), Curry, and Gillespie coals.

Prattsburg sandstone and shale.

Upper Devonian: West-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 25 and chart). *Prattsburg ss.* carries an early Chemung fauna, but is stratigraphically continuous with Wiscoy sh., which carries a Portage fauna.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). *Prattsburg ss. and sh.*—Top div. of Chemung beds in Canandaigua and Naples quads. Overlies High Point ss. Thickness 500 to 625 ft. Upper 300 to 400 ft. consists of light bluish-gray sss., usually in lentils and compact or uneven layers, with interstratified shales (mostly blue and hard, but black and slaty layers occur frequently). Lower 200 to 225 ft. consists of sss. (mostly olive gray, rather soft and schistose or in thin even layers) and shales (in part soft and blocky, but blue, olive, and black layers also occur), which lie in horizon of Wiscoy shales, but the Wiscoy carries a Portage fauna. [For Clarke and Luther 1905 see 1905 item under *Wiscoy sh.*]

D. D. Luther, 1906 (N. Y. State Mus. Bull. 101). *Wiscoy (Prattsburg) shales.*—In Penn Yan-Hammondsport quads. the *Prattsburg shales and flags* are mostly shales or thin blocky or shaly sss. 250 ft. thick, and contain many Chemung and few Portage fossils; but in Genesee River section at Wiscoy the beds are soft, shaly, and somewhat calc. and contain only Portage fossils.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [Table shows upper part of *Prattsburg sss.* as=basal Chemung and lower part as=Wiscoy sh. (pre-Chemung). Underlying fm. is called *Highpoint ss.* and overlying fm. is called *Gowanda*.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Prattsburg ss.* is included in Portage group.

Named for occurrence at Prattsburg, Steuben Co.

Praysville porphyry.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 81, 176, 177). *Suffolk or Praysville porphyry.* Occurs on Old Suffolk mining location, Praysville, Keweenaw Point.

Belongs to Bohemian Range group.

pre-Kansan drift (Pleistocene).

A name that has sometimes been applied to the oldest or Nebraskan glacial drift, because it is older than the Kansan drift.

†Premedidial series.

Nongeographic name applied by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to the rocks of Appalachian region including Oriskany ss. at top and "Pentamerus and Catskill shaly lss." of N. Y. at base. Rogers abandoned the name in his 1858 classification (Geol. Pa., vol. 1, pp. 59, 104–109; vol. 2, pt. 2, pp. 751–775).

Named to indicate "forenoon period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

†Pre-Meridian series.

†Pre-Meridian limestone.

Nongeographic names introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 107, 136–137, 272+, and vol. 2, p. 754) for beds stated to be same as Lower Helderberg ls. of N. Y. [Helderberg group of present nomenclature].

Prescott diorite.

Late Carboniferous or post-Carboniferous: Western central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, pl. 34). *Prescott diorite.*—A great stock of coarse plagioclase-hornblende rock.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 215 and map). *Prescott diorite* comprises Packard Mtn in Prescott, Mass.

Presidio formation. (Of Trinity group.)

Lower Cretaceous (Comanche series): Western Texas (Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10, 11, 25–30). *Presidio beds.*—Fossiliferous beds of cgl., clay, ls., and ss., 400 ft. thick, constituting lithologic unit in sense they have one character in common in which they differ from other Lower Cret. divisions, i. e., they are all mixtures of mechanical sediments, such as gravel, sand, and clay, with precipitated carbonate of lime as an original ingredient, the lss. being never free from sand and the sss. rarely free from calc. material. Basal fm. of Lower Cret. Uncon. overlies Carbf. and underlies Shafter beds. Lithologically and stratigraphically resemble Travis Peak beds, but differ faunally.

C. P. Ross and W. E. Cartwright, 1935 (Univ. Tex. Bull. 3401, pt. 3, pp. 585–586). *Presidio fm.*—Uncon. underlies Shafter ls. Appears to be identical with Travis Peak fm. and may eventually be abandoned.

Named for exposures W. of new shaft of Presidio Mining Co., Presidio Co.

Presque Isle granite.

Pre-Cambrian (post-Keweenawan): Northwestern Michigan (Gogebic range).

R. C. Allen and L. P. Barrett, 1915 (Jour. Geol., vol. 23, p. 697). *Presque Isle granite.*—Acid type. Varies through gradational phases into syenite and diorite. Mainly massive, but marked gneissosity is not uncommon. Uncon. underlies Copps group in E. part of Gogebic range.

R. C. Allen, 1915 (Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, pp. 23, 30, 50). *Presque Isle granite* intrudes Palms and Ironwood fms. Named for Presque Isle River. [In table is placed above Tyler sl.] As mapped may include some Laurentian rocks, but greater part is of late Animikie age.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Presque Isle granite* to Killarney revolution (post-Keweenawan pre-Cambrian).

Presque Isle series.

Middle Devonian: Northeastern Michigan (Presque Isle and Alpena Counties).

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14, pp. 4, 25+). *Presque Isle series.*—Name newly proposed by A. W. Grabau, on pp. 290–308 of unpublished ms. dated in 1915. The fourfold subdivision previously adopted for Traverse group in Presque Isle and Alpena Counties has more recently been restricted by Grabau, the Bell shales now forming lowest memb. of Presque Isle series. Grabau's downward succession as now understood is [as listed under 1930 entry under *Traverse fm.*]. Fossils listed. Derivation of name not stated.

Presqu' île dolomite.

Devonian: Northwest Territories, Canada.

A. E. Cameron, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 26).

†Preston formation. (In Washita group.)

Lower Cretaceous (Comanche series): Northeastern Texas.

R. T. Hill, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 302, 303, 326). The Kiamitia and Duck Creek beds collectively can appropriately be called *Preston beds*, in honor of Professor Marcou's type loc., where the beds are best exposed. Underlie Fort Worth beds and overlie Fredericksburg div. Are paleontologically a single fauna.

Considered an unnecessary name, as Kiamichi clay and Duck Creek fm. are easily separable.

Named for Preston, Grayson Co.

Preston gabbro.

Carboniferous or post-Carboniferous: Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 74, 115, 153, and map). *Preston gabbro diorite.*—Dark-colored rock which shows a number of variations and follows a definite gradation from center of mass towards the periphery. Includes coarse porphyritic gabbro, diorite, and quartz diorite. Intruded before the metamorphism that reconstructed the rocks of the entire State. Covers part of Preston Twp.

G. F. Loughlin, 1912 (U. S. G. S. Bull. 492), mapped and described two facies of Preston gabbro—a coarse porphyritic gabbro with large poikilitic phenocrysts of diallage, and a quartz-hornblende gabbro. The Preston gabbro is older than Sterling granite gneiss. It intrudes sed. rocks of Camb. and Carbf. age.

Preston limestone. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 16, 26, 28). In Missouri River section btw. La Platte, Nebr., and Charleston Creek, Kans., *Preston ls.* is hard, massive, bluish, breaks into boxlike blocks, and is 2½ to 3 ft. thick. In Big Nemaha Valley section, Nebr., it consists of several lss. separated by sh.; is light-colored, also bluish, brownish; includes hard and massive beds; thickness 4 to 11 ft. Separated from overlying Tarkio ls. by 40 to 50 ft. of sh. with thin lss., and from underlying Fargo ls. [Wakarusa ls.] by 14 to 34 ft. of sh. Type loc. near level of railroad at bridge W. of Preston, Richardson Co., Nebr.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 60, 63). "Preston" ls. is now known to be Emporia ls.; latter name has priority.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 96) used *Emporia ls.*, as did Condra and Moore in their Oct. 1932 revised chart of Perm. and Penn. rocks of Kans. and Nebr. But Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), discarded *Emporia* for *Preston*.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 224–226), discarded both Emporia and Preston and treated their named subdivisions (Reading ls., Harveyville sh., and Elmont ls.) as fms.

Preston hornblende diorite.

Paleozoic (?): Northwestern California (Siskiyou and Del Norte Counties).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, p. 128 and map). *Preston hornblende diorite.*—Commonly a fine-grained gray rock closely cut by quartz veinlets. Green hornblende is more characteristic than brown, though both occur. Intrudes Grayback fm. (Dev.) and is intruded by serpentine and by Siskiyou granodiorite. May come anywhere in great interval btw. Dev. and late Jurassic; is likely to prove to be late Paleozoic. Named for occurrence in Preston Peak, Siskiyou Co.

Preston sand.

A subsurface sand or sands, of early Penn. (Cherokee) age, in central eastern Okla., said to correspond to Dutcher sand series. In its type area (Preston pool, Okmulgee Co.) the sand beneath the Booch sand is called Dutcher sand.

Preuss sandstone.

Upper Jurassic: Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 81). *Preuss ss.*—Very fine, even-grained sss., pale reddish gray to deep dull red, usually calc. and more or less argill., becoming very shaly in places; the beds generally less than 6 in. thick. Weathers to dull-red soil. Thickness 1,300 ft. Underlies Stump ss. and overlies, with minor uncon., Twin Creek ls. Named for Preuss Creek, in NE. part of Montpelier quad., about 12 mi. NE. of Montpelier.

Price sandstone.

Mississippian (Osage): Southwestern Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 177, pl. 4). *Price (Pocono) ss.*—Alternating coarse yellow or green sss., beds of sh., and coal. Overlies Kimberling sh. and underlies Pulaski sh. [Maccrady fm.]. [In later repts thickness is given as 200 to 420 ft. or more.]

Named for Price Mtn, Montgomery Co.

Price River formation. (Of Mesaverde group.)

Upper Cretaceous: Central eastern Utah (Wasatch Plateau and Book Cliffs).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 445+). *Price River fm.*—A succession of sss., grits, and cgls. with a minor amount of sh. Thickness 900 to 1,000 ft. Includes Castlegate ss. memb. (150 to 400 ft. thick) at base. Is top fm. of Mesaverde group in Wasatch Plateau. Uncon. underlies Wasatch fm. and overlies (uncon.?) Blackhawk fm., of Mesaverde group.

Named for exposures in Price River Canyon, NW. of town of Castlegate.

Prichard slate (also **Prichard formation**).

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and northwestern Montana.

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277–285). *Prichard sl.*—Mostly blue-black, blue-gray to light-gray sl., generally distinctly banded; considerable interbedded gray ss.; upper part characterized by rapid alternations of argill. and aren. layers and by shallow-water features. Thickness 8,000+ ft. Base not exposed. Underlies Burke fm. Occupies almost entire drainage basin of Prichard Creek, Coeur d'Alene dist., Idaho. Description of general geology of region is based almost wholly on work of F. C. Calkins.

Priddy sand.

A subsurface sand, of Penn. age and 20 to 30 ft. thick, in Cotton Co., Okla. Lies higher than Keys sand.

Pride shale. (In Bluestone formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 294, 325). *Pride sh.*—Greenish-brown fissile sandy sh., often weathering into pencil-like forms. Thickness 70 to 150 ft. Underlies Pipestem coal and overlies Princeton cgl. or ss. Is basal memb. of Bluestone group [fm.]. Type loc., at base of Bent Mtn, just S. of Pride, Mercer Co., W. Va.

Priest Hill granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Franconia quadrangle).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 9, etc.). *Priest Hill granite* is proposed for a somewhat gneissic granite exposed only on Priest Hill. Light-gray granular rock, chiefly quartz, feldspar, and some biotite, with very small amount of muscovite. Is late Dev. or late Carbf. Assigned to New Hampshire magma series.

Priest River terrane.

Pre-Cambrian: Southern British Columbia and northwestern Idaho.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 6, 7, 116° 30' to 117° 30'). *Priest River terrane*, pre-Beltian. [Maps the following subdivisions, descending order:] Mica schists, qtzites, and dolomites; dolomites, qtzite, phyllite; phyllites and sericite-quartz schist; sheared massive qtzite, with sericite and chlorite schist; sericite schist spangled with large biotite crystals; schistose qtzite and mica schist.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 178, 194, 258). *Priest River terrane* uncon. underlies Irene cgl. Correlates with Cherry Creek beds of Mont. Outcrops at and to E. of headwaters of Priest River.

In 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 61) Drysdale assigned these rocks to Belt series, or "Beltian," as he called it.

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, pp. 47–49). *Priest River terrane* believed to be at least 18,000 ft. thick.

†Prieta sandstone.

Upper Cretaceous: Central northern New Mexico.

C. L. Herrick and D. W. Johnson, 1900 (N. Mex. Univ. Bull., vol. 2, pt. 1, pp. 3–63). *Prieta sss.* (also *Prieta series*).—Loose yellow ss., with shaly phases. Thickness 1,000 ft. Overlies massive Punta de la Mesa ss. in Albuquerque quad., and is overlain by lignitic div. of Cret., consisting of sand, ss., and lignite beds. [Derivation of name not stated.]

†Prieta series.

See †*Prieta ss.*

†Primal series.

Nongeographic name introduced by H. D. Rogers (Am. Jour. Sci., 1st, vol. 47, pp. 153–158, 1844) to embrace the rocks btw. base of "Calciferous ss." of N. Y. [Beekmantown] at top and base of Paleozoic. In 1858 (Geol. Pa., vol. 1, pp. 104, 122–123, 150–207+, and vol. 2, p. 751) Rogers divided his "Primal series" into (descending): "Primal upper slate," 700 ft.; "Primal white ss. (Potsdam ss. of N. Y.)," 300± ft.; "Primal older slate," 1,200 ft. in Va., but too folded to measure in Pa.; and "Primal cgl.," absent in Pa., but 150 ft. thick in Va. and Tenn.

Named to indicate "dawn period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

†Primal crystalline schists.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 59, 104–109) for the rocks now classified as pre-Camb. and known as *Glenarm series*. Rogers defined the unit as underlain by "Gneissic or Hypozoic rocks" and overlain by †Primal cgl.

†Primary system.

A term applied in early N. Y. repts to all pre-Potsdam rocks; also to pre-†Taconic rocks, the †Taconic being defined as intermediate btw. Potsdam ss. and †Primary system.

†Primitive.

Paleozoic and Proterozoic.

Giovanni Arduino, an eminent Italian scientist, in 1760 published (Nuova raccolta di Opuscoli Filologici ec del P. Abb. Calogera, T. VI, Venice, p. 159) the first geologic time classification. His subdivisions consisted of Primitive (the oldest), Secondary, and Tertiary (the youngest). In this classification the more recent surficial deposits of the earth, to which the name Quaternary is now applied, were ignored. His "Primitive" included the Paleozoic and pre-Paleozoic rocks; his "Secondary" included the Mesozoic rocks; and his Tertiary included the post-Mesozoic and pre-Quaternary deposits, or those to which the name Tertiary is still applied. The book cited above is very rare. A copy of it is in the Royal Library Vittorio Emanuele, at Rome, Italy, shelf number 79, A 15. The only copy known in this country is in the Library of the Army Medical Mus., Washington, D. C.

Primm sand.

See 1925 entry under *Meakin sand*.

†Primordial.

A term applied in early geologic repts, especially those of Europe, to the rocks now called *Cambrian system*.

Primrose sandstone member (of Springer formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

R. Roth, 1928 (Econ. Geol., vol. 23, p. 45). [See under *Overbrook ss. memb.*]

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 13). *Primrose memb. of Springer fm.* is a zone of shaly to thin-bedded semi-crystalline calc. ss. 150 to 250 ft. thick, locally carrying 1 or 2 ft. of impure fossiliferous ls. Lies 100 to 300 ft. above Lake Ardmore memb. of Springer fm.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 19). *Primrose memb.* lies 250 to 500 ft. above Lake Ardmore memb. Named for Primrose Ridge, in sec. 7, T. 4 S., R. 2 E., on which stand the buildings of Primrose dairy farm.

Prince Rupert formation.

Carboniferous or Triassic: British Columbia.

R. G. McConnell, 1913 (12th Int. Geol. Cong. Guidebook 10, p. 17). Upper Paleozoic (?).

V. Dolmage, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, p. 12), and G. Hanson, 1925 (Summ. Rept. 1924, pt. A, p. 40), assigned this fm. to Carbf. or Triassic.

Princess formation.

Carboniferous or pre-Carboniferous: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60).

Princess Anne formation. (In Columbia group.)

Pleistocene: Coastal Plain of Maryland and Virginia.

C. K. Wentworth, 1930 (Va. Geol. Surv. Bull. 32, pp. 81+). L. W. Stephenson (N. C. Geol. Surv. Bull. 3, 1912) included in Pamlico terrace the whole area of Coastal Plain in N. C. east of Chowan-Dismal Swamp scarp and below 25 ft. elev. From recent topog. maps of Coastal Plain of Va. it is clear there is a distinct terrace about 12 ft. above sea level, which is separated from the 25-ft. terrace by a well-marked scarp, which is prominent in Cape Henry quad. E. of Norfolk. It appears from maps to be well developed on seaward side of Eastern Shore. This low terrace and fm. are here designated *Princess Anne terrace and fm.* because of their typical occurrence at village of Princess Anne, in Princess Anne Co., Va. Here the terrace forms a rounded reentrant extending into type area of Dismal Swamp terrace. The scarp that separates Princess Anne and Dismal Swamp terraces is well developed E. and SE. of Barney's Corner, Princess Anne Co. Thickness 15 to 20 ft. Is of marine origin. [On p. 105 he says largely marine.]

C. W. Cooke, 1931 (Wash. Acad. Sci. Proc., vol. 21, p. 513). Wentworth separated "Princess Anne" terrace from "Dismal Swamp" terrace because of presence of a low scarp above 12 ft. in neighborhood of Norfolk and elsewhere in Va. Although no one can dispute the existence of this scarp (which is plainly shown on Cape Henry quad.) opinions may differ as to whether it is really a sea cliff formed at a stage of sea about 12 ft. above present sea level. Evidence at present appears inconclusive.

L. W. Stephenson, C. W. Cooke, and W. C. Mansfield, 1932 (16th Int. Geol. Cong., Guidebooks 5 and 12). Shore line of Pamlico terrace (which is regarded by Cooke as identical with "Dismal Swamp" terrace) lies about 25 ft. above sea level, that of Princess Anne terrace about 12 ft.

The terrace fms. of Columbia group now recognized by Cooke from Del. to southern Ga. and probably into Fla., are enumerated herein under *Columbia group*.

Princes Town marl.

Miocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in Geol., No. 7, p. 54).

†Princeton limestone.

Mississippian: Western Kentucky.

The original use of this name is said to be by Ulrich in Crittenden Press, Dec. 1890. This publication is not in U. S. Geol. Survey Library nor in Library of Congress.

E. O. Ulrich, 1903 (U. S. G. S. Bull. 213, pp. 207–208). *Princeton ls.*—Upper third, light-gray compact ls. with more or less sh.; in middle, calc. ss. 1 to 12 ft. thick; lower two-thirds, massive, oolitic, light-gray or nearly white ls. Thickness of fm. 200 to 250 ft. Underlies Chester group and overlies St. Louis ls. in Crittenden, Livingston, Caldwell, and adjacent counties of western Ky.

E. O. Ulrich and W. S. T. Smith, 1905 (U. S. G. S. P. P. 36, pp. 39, 52). *Princeton ls.* is same as Ste. Genevieve ls. [Also see U. S. G. S. Bull. 225, p. 507, 1904, in which Ulrich discarded *Princeton ls.* for *Ste. Genevieve ls.*]

Probably named for Princeton, Caldwell Co. In repts on Ky. prior to 1903 these beds were included in St. Louis ls. or "group."

Princeton sandstone.

Mississippian: Southern West Virginia and southwestern Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 489). *Princeton cgl.*—One of most variable beds of a variable series. First appears in section 1,100 ft. above railroad grade at Hinton, where it consists of 15 to 20 ft. of loosely cemented sand containing many well-rounded quartz pebbles. On crest of hill below Sandstone, 1,050 ft. above railroad, is represented by 30 ft. of ss., very hard when unweathered but yielding quickly to disintegrating agencies, and so far as seen contains no pebbles. At Meadow Creek this ss. is 60 ft. thick, is conglomeratic, and is 820 ft. above railroad track. Two and one-half mi. below it is 600 ft. above grade and is 80 ft. thick.

which is max. thickness in New River. Opposite mouth of Mill Creek it is 180 ft. above grade; at Quinnimont it is 200 ft. above grade and is a cgl., 20 ft. thick, lying uncon. upon shales. Is absent in section up Laurel Creek, but comes in again and is present along road from Quinnimont to Prince. Overlies Hinton fm. and underlies Royal fm.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26, p. 3), named the fm. overlying the Princeton the *Bluestone fm.*

Named for Princeton, Mercer Co., W. Va.

Princeton quartz monzonite.

Post-Carboniferous: Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 78). Named for Mount Princeton, N. of Monarch-Tomichi dist.

Princeton series.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Marquette County).

R. C. Allen, 1914 (Jour. Geol., vol. 22, p. 571). *Princeton series.*—Interbedded slates, ferruginous slates, cherts, qtzites, ferruginous qtzites, and graywacke, with, at base, cgl. 30 to 100 ft. thick. Thickness 400 to 500 ft. Uncon. overlies Gwinn series.

Named for Princeton mine, Gwinn dist.

Princeton moraine.

Pleistocene (Wisconsin stage): Northwestern Illinois (Bureau County). See C. O. Sauer, 1916 (Ill. Geol. Surv. Bull. 27, p. 75, fig. 23).

Principe formation.

Eocene: Cuba.

R. H. Palmer, 1934 (Jour. Geol., vol. 42, No. 2, p. 132).

Pringle andesite.

Tertiary: Central southern Colorado (Silver Cliff-Rosita region).

W. Cross, 1890 (Colo. Sci. Soc. Proc., vol. 3, pt. 3, p. 276). *Pringle andesite,* a mica-argite andesite, forms upper part of Pringle Hill, W. of Rosita.

Procamelus beds.

A paleontologic name applied by E. D. Cope to upper Mio. strata of the West containing fossil remains of *Procamelus.*

Proctor sandstone. (In Greene formation.)

Permian: Northern West Virginia.

I. C. White, 1883 (The Virginias, vol. 4, p. 124). Along Ohio River below mouth of Proctor Creek, just S. of Marshall-Wetzel Co. line, occur 3 sss., called *Upper Proctor ss., Middle Proctor ss.,* and *Lower Proctor ss.* The Upper Proctor is very massive yellowish gray, rather micaceous, and 30 ft. thick; the Lower Proctor is massive and 10 ft. thick; the Middle Proctor is massive and lies about midway btw. Upper and Lower Proctor sss., which are separated by 183 ft. of sh. with some ss. and 2 coal beds.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties). *Proctor sss.*—Great massive sss., which form 2 or 3 ledges, separated by red and sandy sh. Thickness 70 ft. Younger than Windy Gap ls. Named for Proctor magisterial dist., Wetzel Co.

R. V. Hennen, 1912 (W. Va. Geol. Surv. Rept. Doddridge and Harrison Counties). *Proctor sss.*—Topmost beds of Dunkard series so far as known. Confined to summits of high knobs. [In general section for W. Va. the thickness of Proctor sss. is given as 150 ft.]

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties). *Upper Proctor ss.* is flaggy, 40 ft. thick, and lies 15 ft. above *Middle Proctor ss.,* which is 25 ft. thick and lies 10 ft. above *Lower Proctor ss.,* which is massive, green, micaceous, 25 ft. thick, and lies 35 ft. above Windy Gap ls.

Proctor dolomite.

Cambrian (Upper): Central and eastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 366). *Proctor ls.*—Mag. lss., in massive layers 5 to 10 ft. thick, not specially distinguishable from overlying Osage ls., though perhaps less cherty. Overlain by Cole Camp ss. [Oldest fm. listed in central Mo.]

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser.). *Proctor ls.*—Bluish usually, but also grayish, pinkish, greenish or yellowish dol., uncon. underlying Gunter ss. in Miller Co. Thickness 57+ ft. Is Fourth Mag. ls. of Swallow. [Oldest fm. listed in Miller Co.]

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, p. 42). Decaturville ls.=Proctor ls. and is younger than Lesueur ls.

E. R. Buckley, 1905 (Mo. Bur. Geol. and Mines vol. 3, 2d ser., pp. 3–9). *Proctor ls.* (dol.) uncon. underlies Gunter ss.; is younger than LaMotte ss. and=Bonne Terre ls.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bulls. 260 and 267). *Proctor ls.*= Fourth Mag. ls. Is younger than Elvins fm.

H. A. Buehler, 1907 (Mo. Bur. Geol. and Mines vol. 6, 2d ser., pp. 217–232). *Proctor* lies btw. Potosi below and Gunter above.

C. F. Marbut, 1908 (Mo. Bur. Geol. and Mines vol. 7, 2d ser.). *Proctor ls.* in Morgan Co. consists of 150+ ft. of massive mag. gray ls. with no chert, uncon. underlying Gunter ss. memb. of Gasconade fm.

E. R. Buckley, 1908 (Am. Min. Cong. Rept. Proc. 10th Ann. Sess., p. 286), gave following downward succession: Roubidoux; Gasconade; uncon.; Proctor; Eminence; Potosi; uncon.; Elvins (with Doe Run at top). [This definition of Proctor was followed by R. S. Bassler, 1911 (U. S. Nat. Mus. Bull. 77, p. 39).]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27, pp. 629–633). *Proctor dol.*—Nonsiliceous massive dol., with no chert; uncon. underlying Gunter ss. and resting on Eminence chert. Best developed in Morgan and Miller Counties, where it attains thickness of about 60 ft. Much thinner in Shannon and Carter Counties, and seems to be locally absent.

Wallace Lee, 1914 (Mo. Bur. Geol. and Mines vol. 12, 2d ser.). *Proctor fm.* of Miller Co. and to W. underlies Gunter ss. memb. of Gasconade fm. and probably is included in upper Eminence. The exposures of Proctor fm. in basin of Osage River occur chiefly in bluffs. They are noncherty, entirely without fossils, and resemble the bluff exposures near top of Eminence fm. at type loc., which also underlies, probably uncon., 4 or 5 ft. of ss. forming basal bed of Gasconade fm.

H. A. Buehler, 1917 (Am. Inst. Min. Engrs. Bull. 130, pp. 1699–1718). *Proctor*, 100 ft. thick, underlies Gasconade and overlies Eminence. [Same definition was given by C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser.).]

E. B. Branson, 1918 (Univ. Mo. Bull., vol. 19, No. 15). *Proctor fm.*, 0 to 60 ft. thick, occurs on W. flank of Ozarks. Consists of thick beds of medium- to coarse-grained crystalline to granular gray dol., deeply pitted on weathered surface; chert entirely absent in many regions but occurs here and there in some outcrops. Further investigation may show that Eminence and Proctor are same fm. The Eminence of E. flanks of Ozarks uncon. underlies Gasconade fm.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.). *Proctor fm.* is about 60 ft. thick at type loc., in Miller, Morgan, and Camden Counties, and thinner in Carter, Shannon, and Washington Counties. Does not appear to have been recognized elsewhere. Uncon. underlies Gunter ss. and uncon. overlies Eminence fm., which is typically exposed in Shannon, Carter, Washington, and other Counties, and is doubtfully present in Camden and Morgan Counties.

Named for exposures on Proctor Creek, Morgan Co.

Proctor's Lake limestone.

A name applied by W. E. Logan, 1863 (Canada Geol. Surv. 15th Rept. Prog., pp. 43–45), to a 20-ft. bed of ls. in middle part of Grenville series of Grenville region, Ontario.

†Productive Measures.

See under †*Barren Measures*.

†Progonic (also †Progonozoic).

Names proposed by J. J. Sederholm in 1914 to cover all pre-Camb. time and rocks. Correspond to Proterozoic era of U. S. Geol. Survey. For definition see U. S. G. S. Bull. 769, pp. 30-31.

Proserpine quartz porphyry.

Age (?): British Columbia.

W. L. Uglow, 1922 (Canadian Inst. Min. and Met. Mon. Bull. No. 127).

Proserpine intrusives.

Pre-Mississippian: Canada.

W. A. Johnston and W. L. Uglow, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. A1, No. 2331, p. 5A).

Prospect porphyritic gneiss.

Ordovician (?): Western and western central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 59, 102-104, and map). *Prospect porphyritic gneiss.*—Light-gray porphyritic gneiss, including small areas of porphyritic granite with inconspicuous gneissoid development and narrow bands of mica schist distributed unevenly. At its extreme N. limit it is prevailingly less porphyritic and more quartzose and contains areas of intrusive basic rocks. Is believed to have been originally a mass of porphyritic granite intruded into Hartland (Hoosac) schist. Covers E. part of Prospect Twp.

†Prospectan series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 51, 53, 80), to Prospect Mtn qtzite and overlying Pioche sh. of Nev.

Prospect Hill sandstone member (of Hannibal shale). (In Kinderhook group.)

Mississippian: Southeastern Iowa (Des Moines County).

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 22, 23-24). *Prospect Hill ss. memb. of Hannibal fm.*—Soft fine-grained drab-weathering buff ss., shaly in upper part; some seams filled with casts of fossil shells; occasional plant remains. Thickness at Prospect Hill, Burlington, Iowa, 6 ft. Top memb. of Hannibal fm. Underlies Chouteau ls. and overlies McKerney ls. memb. of Hannibal. Is of slightly lighter color and denser texture than English River ss. memb., and fossils are different. Contains a large Chouteau element in its fauna, but it is lithologically and faunally more closely allied to Hannibal fm. at Burlington.

Prospect Mountain quartzite.

Lower Cambrian: Eastern Nevada and western Utah (House Range and Gold Hill district).

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 254). *Prospect Mtn qtzite.*—Bedded brownish-white qtzites weathering dark brown; ferruginous near base; intercalated with thin layers of aren. sh.; beds whiter near summit. Thickness 1,500 ft. Oldest sed. rock exposed in Eureka dist. Directly overlain by Prospect Mtn ls. [now replaced by Eldorado ls.]. Named for occurrence in Prospect Peak, Eureka dist., Nev.

This fm. has been mapped by S. H. Ball (U. S. G. S. Bull. 308, 1907) in Inyo Co., Calif., and has been identified by C. D. Walcott in House Range, western Utah (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 12, 1908), with a thickness of 1,200+ ft.

†Prospect Mountain limestone.

Middle Cambrian: Eastern Nevada.

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept. pp. 253, 254-259). *Prospect Mtn ls.*—Gray compact ls., crystalline and granular, lighter in color than Hamburg ls., traversed with thin seams of calcite; bedding planes very imperfect. Interstratified are lenticular or wedge-shaped bodies of sh. varying greatly in width. Thickness 3,050 ft. Rests on Prospect Mtn qtzite and grades into overlying Secret Canyon sh. Named for exposures on Prospect Mtn, Eureka dist.

Replaced by Eldorado ls., the name *Prospect Mtn* being retained for the qtzite.

Prospect Peak basalts.

See under *West Prospect basalt.*

Prospect Point eruptives.

Post-Eocene: British Columbia.

W. A. Johnston, 1923 (Canada Geol. Surv. Mem. 135, p. 33).

Prosperity limestone member (of Greene formation).

Permian: Southwestern Pennsylvania (Washington County) and southeastern Ohio.

F. G. Clapp, 1907 (U. S. G. S. Bull. 300, pp. 13, 128; and U. S. G. S. Amity folio, No. 144; name suggested by M. J. Munn; see also U. S. G. S. Bull. 318, p. 77). *Prosperity ls. memb. of Greene fm.*—Hard dark blue-gray to nearly black compact ls.; in appearance almost exactly like Upper Washington ls. Supposed to reach max. thickness of 20 ft. Lies 100 to 180 ft. above Upper Washington ls. Named for village of Prosperity, Washington Co., Pa.

Prosperity sand.

Name applied to a subsurface sand of Perm. age in Cement oil field, Caddo Co., Okla., lying at 2,400 ft. depth, and about 100 ft. lower than Fortuna sand.

Prosser limestone.

Middle Ordovician: Southeastern Minnesota, northeastern Iowa, and northwestern Illinois.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27, pp. 368, 369, 524, 525). *Prosser ls.*—Name proposed for a fm. comprising the *Clitambonites, Nematopora,* and *Fusispira* beds of Minn. repts. Upper part corresponds to lower part of Galena dol., and lower part is older than Galena, but of basal Trenton age. Uncon. underlies Stewartville dol. and uncon. overlies Decorah sh.

R. S. Bassler, 1911 (U. S. Nat. Mus. Bull. 77, pp. 25–27). *Prosser ls.*—Cherty nonmag. light-blue fine-grained ls. 10 to 20 ft. thick; underlain by 20 to 35 ft. of thin-bedded, occasionally shaly fine-grained bluish ls. containing *Fusispira* bed fauna and locally the *Nematopora* fauna in basal strata; underlain by 20 to 45 ft. of thin-bedded shaly ls. containing large examples of *Receptaculites oweni* at top and *Clitambonites* fauna at base. Underlies Stewartville dol. and overlies Decorah sh. Is basal fm. of Trenton group.

C. R. Stauffer, 1933 (Minn. Geol. Surv. Bull. 23, p. 21). *Prosser ls.* is typically developed in Fillmore Co., where it attains thickness of about 60 ft. and is uniformly a high-grade ls. It receives its name from a small gulch [Prosser Ravine] near [west of] Wykoff [Fillmore Co., Minn.], where it is fully developed. Outcrops along all larger streams in Olmsted and Fillmore Counties, often with very little overburden. Underlies Stewartville dol. and grades into underlying Decorah sh. Basal part is often shaly. Necessary to depend on fauna to distinguish it from Decorah, and even that is not a sure guide.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 27). *Prosser div.* of Galena dol. can be seen in Jo Daviess Co., Ill. [Fig. 1 of this rept. shows it as overlying Decorah and underlying Stewartville.]

G. M. Kay, 1935 (pp. 290–292 of Conf. Rept. cited above). In SE. area the Prosser is discon. on Decorah fm. and underlying Platteville. In southern Minn. it is 135 ft. thick, and reaches max. of 170 to 180 ft. in eastern Iowa. Outcrops in Miss. River bluffs from NW. Ill. to opposite mouth of Wisconsin River. There is possibly a discon. btw. the Prosser and overlying Stewartville.

†Protean group.

A term applied by L. Vanuxem in early N. Y. repts (1838, 1839, etc.) to the rocks now designated as *Niagara group.* The term as used by James Hall in early N. Y. repts (1842 et seq.), however, applied to Clinton fm. only, because of its diverse lithology, the meaning of *protean* being "changeable in form."

Protection formation.

Upper Cretaceous: British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 99).

Proterozoic era.

As used for many years by U. S. Geol. Survey and other geologists this term includes all pre-Cambrian time represented by rocks visible for study. It has, however, been restricted by some geologists to what for many years was known as "Algonkian period," and by other geologists to "late Algonkian" time. As originally defined it applied to †Algonkian period only. (For definition see U. S. G. S. Bull. 769, 1925, pp. 14, 31–42.) The U. S. Geol. Survey has discarded "Algonkian system" and "Archean system," and classifies all pre-Paleozoic rocks as *pre-Camb.*, the time covered by these rocks being called *Proterozoic era.*

Protoceras beds (also Protoceras sandstones).

A paleontologic name that has been applied to part of Brule clay (Olig.) of western Nebr., Wyo., and S. Dak.

†Protozoic era.

A name suggested by Rev. A. Sedgwick in 1838 (Geol. Soc. London Proc., vol. 2, No. 58, p. 684) for the pre-Cambrian rocks in case they should be found to contain organic remains. See U. S. G. S. Bull. 769, 1925, pp. 42–43.

Prout limestone.

Middle Devonian: Northern Ohio.

C. R. Stauffer, 1907 (Jour. Geol., vol. 15, p. 592). *Prout ls.*—A thin fossiliferous layer immediately below Huron sh. in northern Ohio. Certainly of Hamilton age. Generally supposed to be northern equiv. of Olentangy sh.

C. R. Stauffer, 1909 (Ohio Geol. Surv. Bull. 10, pp. 27, 90, 115, 117, 119, 120). *Prout ls. memb.*—Top memb. of Olentangy sh. Thickness 10 ft. in Sandusky region. Fauna not abundant nor well preserved, but it carries among its more plentiful species forms common to Delaware ls.

C. R. Stauffer, G. D. Hubbard, J. A. Bownocker, 1911 (Ohio Geol. Surv., 4th ser., Bull. 14). That *Prout ls.* is northern equiv. of Olentangy sh. is reasonably certain.

C. S. Prosser, 1913 (Jour. Geol., vol. 21, p. 326). *Prout ls.*, 10 ft. thick, known only in northern Ohio, and it is probably well to consider it as a lentil or memb. of Olentangy fm., as Stauffer has done. Type loc. is deep cut on B. & O. R. R. 6 mi. S. of Sandusky and 1 mi. N. of Prout [Erie Co.], in which 5 ft. of ls. is now shown.

A. W. Grabau, 1917 (Jour. Geol., vol. 25, pp. 337–343), assigned Olentangy sh. to Upper Dev. (and=in part Huron sh.), applied name *Plum Creek shales* to shales (of Hamilton age) beneath *Prout ls.* and above Delaware ls., and included both Prout ls. and Plum Creek shales in *Prout fm.*

Prout series.

Middle Devonian: Northern Ohio.

A. W. Grabau, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 112). *Prout series* proposed for northern Ohio lss. and shales of early Hamilton age, which are considerably older than Olentangy sh., which is Upper Dev.

A. W. Grabau, 1917 (Jour. Geol., vol. 25, pp. 337–343). *Prout fm.* includes Prout ls. above and Plum Creek shales below.

Providence sand member (of Ripley formation).

Upper Cretaceous: Western Georgia and southeastern Alabama.

Otto Veatch, 1909 (Ga. Geol. Surv. Bull. 18, p. 86). *Providence sand.*—Unconsolidated yellow, white, red, and purplish cross-bedded sand, 150 ft. thick, forming top subdivision of Ripley fm. in Chattahoochee, Stewart, Marion, and Quitman Counties. Overlies Renfroes marl, through gradual transition. Underlies bright-red sand, in which, at a few localities, boulders of fossiliferous siliceous ls. are found, and which are probably Eocene.

Is top memb. of Ripley fm.

Named for exposures in the deep gullies at Providence, 8 mi. W. of Lumpkin, Stewart Co., Ga.

Providence limestone. (In McLeansboro formation.)

Pennsylvanian: Western Kentucky (Webster and McLean Counties).

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 98). *Providence ls.*—Blue argill. ls., usually quite impure and variable in composition and irregular in bedding. In places split into 2 members by a few inches or ft. of gray argill. sh. Thickness 0 to 12 ft. Lies 0 to 4 ft. above coal No. 11 and lower than coal No. 12. Marine fossils. Well exposed in and about Providence.

L. C. Robinson, 1931 (Ky. Geol. Surv., ser. 6, vol. 37, p. 314). *Providence ls.* (the *Jolly ls. of F. M. Hutchinson*) is an important memb. of Carbondale fm. It is only well-marked ls. horizon in the Carbondale, and is rather persistent wherever the Carbondale is exposed. It occurs a few ft. higher than No. 11 coal, and ranges in thickness from 1 to 4 ft. Is a shaly ls. of bluish color and weathers light brown. [Derivation of name not stated and reason for discarding Jolly ls. of Hutchinson not given. Coal No. 11 of Ky. is coal No. 6 of Ill., which is top bed of Carbondale fm. This ls. therefore belongs in McLeansboro fm.]

Providence Cove beds.

Age (?): Vancouver Island.

C. W. Hall, 1906 (Postelsia, p. 324).

Provo epoch.

Provo stage.

Provo epoch is name applied to the time during which Lake Bonneville of Utah stood at the *Provo stage*.

†Prozoic era.

A name proposed by J. Phillips in 1855 for pre-Paleozoic time, and thus synonymous with Proterozoic era of U. S. Geol. Survey. For definition see U. S. G. S. Bull. 769, p. 43.

Prue sand.

A subsurface sand, of Penn. age and 0 to 110 ft. thick, in northern Okla. Is older than Bixler sand and younger than Markham sand. Lies not far below Oswego lime in Prue pool, Osage Co.

Pryor conglomerate member (of Cloverly formation).

Lower Cretaceous: Central southern Montana (Carbon County) and central northern Wyoming (Bighorn Basin).

C. J. Hares, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 429). Gastroliths were found in summer of 1916 in Cloverly fm. in NE. part of Bighorn Basin, Wyo., at about base of Pryor Mtns in [Carbon Co.,] Mont. These gastroliths occur in sh. portion of the Cloverly, btw. *Pryor cgl. memb.* at base and Greybull ss. memb.

C. F. Bowen, 1918 (U. S. G. S. Bull. 691F, section A of pl. 25), published the Elk Basin section from C. J. Hares' unpublished rept., and showed *Pryor cgl. memb.* as basal 40± ft. of Cloverly fm.

Pryor Creek shale. (In Cherokee shale.)

Pennsylvanian: Northeastern Oklahoma (Nowata and Vinita region).

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. No. 4, p. 13). Basal part of Vinita fm. [Cherokee sh.] in NE. Okla. consists of 550 ft. of bluish sh. that weathers light yellow and a few sss. This unit is well exposed in vicinity of town of Pryor Creek, and may be called *Pryor Creek sh.* It is probably=Drake's Lower Coal Measures.

†Psychozoic era.

Name proposed by J. Le Conte (Am. Jour. Sci., 3d, vol. 14, p. 114, 1877) for the epoch beginning "with the completed supremacy of man, i. e., the Present epoch." (See U. S. G. S. Bull. 769, p. 9.)

Ptarmigan limestone.

Middle Cambrian: Alberta and British Columbia.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444, pp. 1-5). *Ptarmigan fm.* is proposed for series of aren. gray lss. interbedded with bands of thinner-bedded dark bluish-black lss. and some sh. bands, that occur above Mount Whyte (Lower Camb.) and beneath Cathedral fm. (Middle Camb.) in Alberta and B. C. Thickness 516 ft. at Ptarmigan Peak and 664 ft. at Ross Lake, 8½ mi. W.-SW. of Ptarmigan Lake. Contains Middle Camb. fossils, including the *Albertella* fauna of Alberta and B. C. Type loc. is SE. slope of Ptarmigan Peak, above Ptarmigan Lake, 4¾ mi. NE. of Lake Louise Station on Canadian Pacific R. R., Alberta. [Detailed section given and fossils listed.] The *Albertella* zone, 7 to 11 ft. thick, is here named *Ross Lake sh. memb. of Ptarmigan fm.* It lies about 100 ft. below top of Ptarmigan fm. It may be an error to include the Ross Lake sh., with its *Albertella* fauna, in Ptarmigan fm. That is one of problems for future worker in field to determine.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 2, Pub. 2445). At Mount Bosworth the Cathedral lss. are 1,086 ft. thick, exclusive of a lower div. of 509 ft., which I have now included in a recently recognized fm. named *Ptarmigan*.

†Pteranodon beds.

Paleontologic name formerly applied to Smoky Hill chalk (Upper Cret.) of Kans.

Puckett sandstone member (of Mingo formation, in Pottsville group).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 40). *Puckett ss. memb.*—Cliff-making ss., 0 to 100 ft. thick, in Mingo fm., lying 160 ft. below top of Mingo.

Named for Puckett Creek, Bell Co., Ky.

Puckmummie schist.

Post-Ordovician(?): Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 50, 62+, maps). *Puckmummie schist.*—Dark slates and schists, little metamorphosed, noncalcareous, of sed. origin. Best exposed on lower part of Puckmummie Creek and on rocky knob to E., in low hill NW. of Post Creek, and in a few scattered outcrops. Is probably = Hurrah sl. (post-Ord.?), from which it differs only in being somewhat more schistose. Is younger than Solomon schist and probably younger than Sowik ls. Assigned to post-Ord.

Puckwunge conglomerate.

Pre-Cambrian (lower Keweenawan): Northeastern Minnesota (Cook County).

N. H. Winchell, 1897 (Am. Geol., vol. 20, pp. 50–51). *Puckwunge cgl.*—Basal cgl. of Keweenawan. Chiefly qtzite pebbles, white to pink and red. Named for stream that enters Pigeon River from W. to N. of Grand Portage village, Cook Co. What it lies upon we could not find out, but in a lower level in same hills is a singular-looking and somewhat slaty soft greenish rock of late Animikie age which we named *Puckwunge sl.* This sl. extends across Puckwunge Valley and to the E. and is probably an upper memb. of the Animikie.

N. H. Winchell, 1900 (Geol. Minn. Final Rept., vol. 5, pt. 1). *Puckwunge cgl.*, the fragmental base of the Keweenawan; 144 ft. exposed; unexposed part probably as much more. Contains much debris from Animikie slates.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 370, 371, 394). *Puckwunge cgl.* lies at base of Keweenawan series. It grades up into ss. and rests uncon. on Animikie.

†Puckwunge slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Cook County). See under *Puckwunge cgl.*

Pueblo formation. (In Cisco group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Pueblo fm.*—Is bounded at top by *Pueblo ls.* [Camp Colorado ls.], which is yellow, fossiliferous, and impure. Near Red Bed line in Stephens Co. it changes to sand and loses its identity, but just below its horizon is a thin ls. abundant in *Myalina* fossils, which characterize this bed. The members of this fm. are so variable that no one section is typical. Underlies Moran fm. and overlies Waldrip fm. [now replaced by Harpersville fm.].

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 40). *Pueblo fm.*—Largely gray, buff, or reddish sh., with Camp Colorado ls. (3 to 6 ft. thick) at top and Camp Creek sh. memb. at base. Thickness of fm. 150 to 200 ft. Underlies Watts Creek sh. memb. of Moran fm. and overlies Harpersville fm., top memb. of which is Saddle Creek ls. [This is present definition of U. S. Geol. Survey.]

Named for exposures along valley of Battle Creek at Pueblo, Callahan Co.

†Pueblo limestone member (of Pueblo formation).

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). [See under *Pueblo fm.*]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 40), replaced this name with *Camp Colorado ls. memb.*

†Pueblo quartzite.

Pre-Cambrian: Central northern New Mexico (Taos County).

J. W. Gruner, 1920 (Jour. Geol., vol. 28, pp. 731–742). *Pueblo qtzite.*—As a whole is yellow, but southern end becomes reddish and purplish gray. Exposed at head of Pueblo Creek [Twps 26 and 27 N., Rs. 14 and 15 E.], Taos Co.

Pueblo formation.

Mesozoic or older: Southeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Pueblo fm.*—Crystalline rocks, porphyries, schists, etc., massive and irregular, of undet. thickness. Type loc. Pueblo Mtns, S. part of Harney Co.

Pueblo Mountain series.

Tertiary (late): Southeastern Oregon and northwestern Nevada.

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, pp. 14, etc.). The acidic flow capping the *Pueblo Mtn series* (the great volcanic series of Pueblo Mtn) is definitely older than Thousand Creek beds, which are late Plio.

Evidently refers to *Pueblo Range series* of Merriam.

Pueblo Range series.

Miocene (early): Northwestern Nevada.

J. C. Merriam, 1910 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 6, No. 2, pp. 26–52, pl. 2). *Pueblo Range series.*—More than 1,000 ft. of eruptives, consisting of basalt, tuff, and rhyolite, the rhyolite following the basalt. Older than Virgin Valley beds, an epoch of erosion intervening. Whether the sed. beds in upper part of Pueblo Range section actually belong with the underlying lavas and tuffs is uncertain, but they appear to represent one general period of deposition. For practical purposes it is desirable to refer to the rhyolites and basalts on W. side of Pueblo Range, with whatever eruptives or other beds may be shown to belong in the same series, as the *Pueblo Range series*, a geographic designation indicating the section first described by J. Blake (Proc. Calif. Acad. Sci., vol. 5, pp. 210–214, 1875), who assigned the beds to early Mio.

Puente formation.

Miocene (upper and middle): Southern California (Puente Hills and Los Angeles district).

G. H. Eldridge and R. Arnold, 1907 (U. S. G. S. Bull. 309). *Puente fm.*—Miocene deposits uncon. underlying Fernando fm. in Puente Hills [S. part of Los Angeles Co.] and Los Angeles dist. Consists of (descending):

Upper Puente sh., 300–2,000 ft. (Earthy chalk-like sh. with a few beds of fine yellow ferruginous ss. and quartzose calc. concretions.) Resembles Monterey sh.

Puente ss., 300–2,000 ft. (Moderately coarse gray and yellow heavy-bedded ss. separated by minor bands of organic siliceous sh.)

Lower Puente sh., 2,000 ft. (Chiefly earthy sh., but with minor members of siliceous nature, the whole gray or brown, from presence of iron and bitumen. Thin fine-grained sss. interbedded from top to base, and lentils of gray ls. This is lowest rock exposed in Puente Hills.)

Is uncon. overlain by Fernando fm., and overlies, uncon., pre-Cret. granite and schist.

According to W. S. W. Kew (U. S. G. S. Bull. 753, pl. 3, 1924) the Puente fm. of Puente Hills corresponds to Modelo fm. of Bull. 753, and Puente fm. of Los Angeles dist. corresponds to Modelo and underlying Topanga fm. of Bull. 753.

†Puente sandstone.

See under *Puente fm.*

†Puente shale.

See under *Puente fm.*

Puercan series.

A name introduced by C. [R.] Keyes to include Torrejon and Puerco fms. of current terminology, but he substitutes *Jemez* for *Puerco* in his classification. (See Pan-Am. Geol., vol. 58, No. 4, p. 289, 1932.)

Puerco formation. (In Nacimiento group.)

Eocene: Northwestern New Mexico.

E. D. Cope, 1875 (Ann. Rept. Chief Engrs U. S. A., Rept. Secy War to 44th Cong., vol. 2, pt. 2, pp. 1008–1017). *Puerco marls.*—Soft soapy marls, black and green; no lignite nor coal. Lowest beds of Eocene in Rio Puerco region. Important near Nacimiento. Outcrop over 40 mi. Valley of Upper Puerco excavated in them. No fossils except petrified wood, which gives weight to probability they are lacustrine. In places rest on Eocene sss.; in other places on Cret. No. 4. Are conformably overlain by light-reddish or yellowish sss. of Green River group (Eo.) [now known to belong to Wasatch fm. instead]. [On p. 1016 he calls the beds *Puerco group* and gives thickness of 500 ft.]

E. D. Cope, 1877 (U. S. Geog. Surv. W. 100th Mer., vol. 4, pt. 2, pp. 14–18). *Puerco group.*—Green and black marls, believed to be lacustrine. Thickness 500 ft. Overlies Cret. No. 4.

E. D. Cope, 1884 (U. S. Geog. and Geol. Surv. Terr., vol. 3, pp. 4–20). Most southern locality at which I have observed *Puerco fm.* is the one for which I named it, and where its characters are distinctly displayed, as W. of Jemez and Nacimiento Mtns, N. Mex., at sources of Puerco River, where its outcrop is about 500 ft. thick. On E. side of Animas River thickness is 1,000 to 1,200 ft.

E. D. Cope, 1888 (Am. Geol., vol. 2, pp. 266–267). *Puerco fm.* of NW. N. Mex. and SW. Colo. is 850 ft. thick and consists of sss. and soapy marls. It overlies Laramie fm. and underlies Wasatch. Contains rich vertebrate fauna (listed).

E. D. Cope, 1888 (Am. Phil. Soc. Trans., n. s., vol. 16, pt. 2, pp. 298+), divided his *Puerco series* into *Upper Puerco* and *Lower Puerco* and described the fossils, but did not define the subdivisions.

J. L. Wortman, 1897 (Sci., n. s., vol. 6, p. 852), proposed restricting Puerco to the lower Puerco and adopting name Torregon [Torrejon] fm. for the upper Puerco. (See under *Torrejon fm.*)

W. D. Matthew, 1900 (Am. Mus. Nat. Hist. Bull., vol. 12, p. 20). *Puerco fm.* is 500 ft. thick and overlying Torrejon fm. 300 ft. thick.

J. H. Gardner, 1910 (Jour. Geol., vol. 18, No. 8, p. 713). *Puerco fm.*, lower fm. of Nacimiento group, consists of variegated clay, sh., and soft coarse-grained ss. of white, gray, and tan colors. Thickness 560 ft. Underlies Torrejon fm., but the two cannot everywhere be readily separated without fossils.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, pp. 35+). The name *Puerco* was applied by Cope in 1875 to entire series of beds on Puerco River, now supposed to include both Puerco and Torrejon fms. No fossils have been found in the beds on Puerco River, but later numerous fossils were found W. of Puerco River, which were believed by Cope to have come from the equiv. of his Puerco beds, and were described by him as "Puerco fauna." These fossils were later separated by Wortman (1897) into two quite distinct faunas. For the beds yielding the younger fauna he proposed the name *Torrejon*, from exposures on Arroyo Torrejon, Sandoval Co., retaining Cope's name Puerco for the beds yielding the older fauna. In these senses the names have been generally accepted since that time. The Torrejon fauna is interpreted by most students of vertebrate paleontology to be a direct descendent of Puerco fauna, but is sufficiently different to demand the lapse of a long interval of time. As, in addition, the two faunal zones appear to be relatively close together stratigraphically at some localities and widely separated at others, and as the area yielding Torrejon fauna is much greater in extent than that yielding Puerco fauna, it would seem necessary to assume a hiatus. But owing to great similarity in lithology and restriction of fossils to relatively narrow zones with a barren interval between, no break has been recognized in the field in the series of beds, even at localities where both fms. are known to be present. *Nacimiento group* is a convenient term where the two fms. are not distinguished on maps and in discussions. The Puerco fm. as defined by its fauna is now known only in a small area extending from Escavada Wash to head of W. fork of Gallego Arroyo, SE. part of San Juan Co., N. Mex. The distance along the outcrop is 35± mi. No fossils are known from section on Puerco River near Cuba, whence the name was derived, and only Torrejon fossils from beds on Arroyo Torrejon. In fact, as Puerco fm. is characterized only by its fossils, it is very doubtful whether the fm. is present at either of these localities. It is purely an assumption to apply either *Puerco* or *Torrejon* to the barren interval btw. the fossiliferous zones of the Puerco and Torrejon or to the lateral extension of the beds in this interval into localities where Puerco fossils are not known. The barren interval is rather thin on both Arroyo Torrejon and Puerco River, and may be later than fossiliferous Puerco. It is possible Torrejon fm. overlaps and conceals Puerco fm. over most of San Juan Basin, and writer prefers this hypothesis. The Puerco uncon. overlies Ojo Alamo ss. [Fossils listed.]

C. H. Dane, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 14, pp. 406–411, 1932), presented evidence to show that "the *Puerco fm.* may be present along Rio Puerco, although the distinctive vertebrate fauna by which alone it is recognized has not yet been found there."

Puertecito formation.

Lower Cretaceous (?) to base of Triassic: Northwestern New Mexico (Socorro and Valencia Counties).

E. H. Wells, 1919 [1920] (N. Mex. State School Mines Bull. 3). *Puertecito fm.*—The sed. beds btw. Perm. and Cret. rocks. Consist of purplish-red shales, purplish-red and purplish-gray sss., and a few thin cgl. beds. Colors maroon, purplish red, purplish gray, subordinate white, grayish drab, and purplish blue. Thickness 1,150 to 1,250 ft. in Puertecito dist., Socorro and Valencia Counties. Possibly upper part includes Jurassic and Lower Cret. Darton considers the fm. largely Triassic.

Puertecitos limestone.

Upper Cambrian (?): Mexico (Sonora).

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 320). [Named for town. No age assigned.]

M. L. Lee, 1912 (Econ. Geol., vol. 7, p. 327). Puertecitos ls. of Mexico is of same age as Abrigo ls. of Ariz. [which is Upper Camb.].

Puerto Colorado sandstone member (of Indio formation).

Eocene (lower): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1368, 1371, 1380). *Puerto Colorado ss.*, basal memb. of Indio fm. Crops out in Puerto Colorado scarp at kilometer 1188 on Laredo-Monterrey highway. Can be traced from Rio Grande to Rio San Juan, Tamaulipas.

Puerto Ferro limestone.

Miocene: Puerto Rico.

H. A. Meyerhoff, 1933 (Geol. of Puerto Rico, p. 74).

Puffy shale member (of Redwood formation).

Oligocene: Southeastern Alaska (Katalla district, Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 773+). *Puffy sh. memb.*—Upper memb. of Redwood fm. Predominantly dark clay sh., with many thin layers of fine flaggy sss. and many sh.-matrix cgls., in part of glacial origin. Thickness 4,000+ ft.; top not seen. Conformably overlies Point Hey ss. memb. Lower 200 to 300 ft. consists of massive calc. sh. with thin beds of hard fine-grained ss., which stands out as cliffs in upper part of Puffy Creek Basin. Assigned to upper Olig. on basis of correlation with fossiliferous rocks in Yakataga dist. that are assigned to upper Olig. by B. L. Clark.

The U. S. Geol. Survey classifies typical Katalla fm. as Mio. (?). Taliaferro correlated his Redwood fm. with Katalla.

Puget group.

Eocene: Western Washington (Puget Sound Basin).

C. A. White, 1888 (Am. Jour. Sci., 3d, vol. 36, pp. 443–450). *Puget group.*—Deposited in estuary. Brackish-water fauna. Occupies large part of Puget Sound Basin and extends upon W. flank of Cascade Range. Similar deposits on E. side of Cascade Range are believed to belong to same fm. Overlies Upper Cret. marine strata.

B. Willis, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 400–436). *Puget group,* 5,480 to 9,000± ft. thick, divided into (descending) Pittsburg fm., Wilkeson fm., and Carbonado fm. [He later replaced *Pittsburg fm.* with *Burnett fm.*]

For many years the age of these beds was in doubt. They were originally assigned to Cret., and later were assigned in part to Mio., also to Olig. Knowlton considered the plants indicate Puget group is all upper Eocene. E. W. Berry, 1929 (Flora of Green River age in Wind River Basin), stated he considered Puget group is late Eocene or Olig. The U. S. Geol. Survey at present classifies the Puget as Eocene, which seems to be the generally accepted classification.

Pugh formation. (In Pottsville group.)

Pennsylvanian: Northeastern West Virginia.

J. A. Taff and A. H. Brooks, 1896 (U. S. G. S. Buckhannon folio, No. 34). *Pugh fm.*—Blue and black clay sh., thin brown ss., false-bedded gray ss., in places white ss. and cgl., and a few thin coal beds. Thickness 300 to 450 ft. Overlies Pickens ss. and underlies Upshur ss. Named for exposures at Pugh P. O., Webster Co.

Is a local name for rocks approx. equiv. to Kanawha fm.

Pugh sand.

A subsurface sand in Robberson field, central southern Okla., lying lower than Simpson sand and higher than Dunlap sand. The Simpson sand is assigned to Ord. in Okla. Geol. Surv. Bull. 40Q, 1928, p. 179.

Pulaski shale.

Upper Ordovician: New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 373–374). *Pulaski shales.*—In last rept called *shales of Salmon River.* Shales predominate at lower part of village of Pulaski, with some lime carbonate, while above the village the ss. begins to predominate. Occur at Pulaski [Oswego Co.] unaccompanied by any other mass, hence the name. Underlie Salmon River [Oswego] ss. and overlie Frankfort sl.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, Geol. of 2d dist., pp. 119–123, 401, 429). *Lorraine shales.*—Thin beds of gray ss. alternating with fine argill. slates of greenish color, even-bedded; upper part highly fossiliferous. Overlain by the Grey ss. [Oswego] that underlies Medina ss., and underlain by Utica sl. In ann. repts this mass has been designated *Pulaski shales,* a name which it would have been well to have retained, if it had embraced the whole series; but at Pulaski only upper part is visible; while at Lorraine the entire mass is exposed and cut through by Sandy Creek, from the grey ss. to Trenton ls. Lorraine is therefore a locality far more important than Pulaski; and hence, according to modern practice of giving names, the former is to be preferred to the latter. [As thus defined *Lorraine* included Pulaski shales and Frankfort sl. of Vanuxem, and it did not supplant *Pulaski sh.*, but in some repts it was itself replaced by †Hudson River group, and in other repts it was dropped from classification, *Pulaski* and *Frankfort* being used alone.]

Pulaski sh. is in good standing as originally defined by Vanuxem. In 1925 (N. Y. State Mus. Bull. 258) R. Ruedemann classified it as top fm. of Lorraine group, the lower fm. being called *Whetstone Gulf fm.* in Black River region and *Frankfort sh.* in Utica Basin. The present N. Y. State Survey divides Lorraine into Pulaski sh. (above) and Frankfort sh. (below). Thickness of Pulaski has been given as 400 ft.

†Pulaski shale.

Mississippian: Southwestern Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 178, pl. 4). *Pulaski sh.*—Bright-red shales overlying Price (Pocono) ss. and underlying the Carbf. Umbral ls. in Pulaski, Wythe, and Montgomery Counties. [In later repts thickness is given as 20 to 750 ft. or more.]

Preoccupied. *Maccrady fm.* was introduced to replace this preoccupied name, but according to C. Butts the *typical* †Pulaski sh. did not include at top any beds of Warsaw age, while *typical* Maccrady fm. did include beds of Warsaw age. He, however, later restricted Maccrady sh. to the pre-Warsaw beds, and that is present approved definition of Maccrady.

Named for Pulaski, Pulaski Co.

†Pulaski formation. (In Arago group.)

Eocene: Southwestern Oregon.

J. S. Diller, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 319–320). *Pulaski fm.*—Main body of Arago fm. Distinguished from Coaledo fm. (the coal-bearing part of Arago fm.) by fact that it contains mere traces of coal and that strata containing brackish-water fossils are rare. Forms the hills about head of Pulaski Creek and Pulaski arch, which separates Beaver Slough and Coquille coal basins.

J. S. Diller, 1901 (U. S. G. S. Coos Bay folio, No. 73). *Pulaski fm.*—Chiefly rather soft yellowish ss., contrasting strongly with the ss. of underlying Myrtle fm. in color and freedom from cracks; some sss.; and locally shales and traces of ls.; also mere traces of coal. Embraces all Eo. strata of Coos Bay quad. not included in the coal field. Uncon. overlies Myrtle fm. and underlies Coaledó fm.

This name is preoccupied and was discarded by U. S. Geol. Survey many years ago. The beds are essentially equiv. to Tyee ss. and Umpqua fm.

Pulaski sand.

A subsurface sand bed, about 40 ft. thick, in Vaqueros ss. in Coalinga dist., Calif., lying about 40 ft. below the Sauer Dough.

†Pulliam formation.

Upper Cretaceous (Gulf series): Southern Texas.

T. W. Vaughan, 1900 (U. S. G. S. Uvalde folio, No. 64, p. 2). *Pulliam fm.*—Brown ferruginous sss., occurring in ledges or slabs; some beds of clay; near top a bed of soft unconsolidated sand impregnated with asphalt, overlain by several very fossiliferous layers; at top an aggl. of oyster *Ostrea cortex*. Thickness probably 100 to 200 ft. Overlies Anacacho fm. and underlies Eocene Myrick fm.

Same as Escondido fm., older name.

Named for Pulliam ranch, on Nueces River, Zavalla Co.

Pumpkin Creek limestone member (of Dornick Hills formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 14). *Pumpkin Creek ls.*, top memb. of Dornick Hills fm., has max. exposed thickness of 70 ft., including 20 ft. of shaly beds.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 33–34). Uppermost memb. of Dornick Hills fm. is designated *Pumpkin Creek ls.*, from excellent outcrops on Pumpkin Creek in SE¼ sec. 19, T. 6 S., R. 3 E. The upper lss. of Dornick Hills fm. are also well exposed in secs. 10 and 15, T. 6 S., R. 2 E., where main part of Pumpkin Creek memb. forms a strong topog. ridge and reaches thickness of 70 ft., including 20 ft. of shaly beds. Its ls. strata here vary from medium- to coarse-grained, pure to sandy, nearly barren to quite fossiliferous. Most distinctive type, which is found also on other side of Overbrook anticline in N½ sec. 7, T. 6 S., R. 2 E., and in nearly all outcrops of this memb. btw. there and Dornick Hills (N. of Ardmore), is a very coarsely granular cross-bedded, rather sandy gray ls. which weathers to a sort of coarse gray calcitic sand. About 150 ft. below the main Pumpkin Creek ls. on S. line of sec. 10, T. 6 S., R. 2 E., occurs another bed of fossiliferous ls. only 2 ft. thick. Between the two are some very fossiliferous shales in which the cavities in some of the shells, especially crinoid stems and high-turreted gastropods, are filled with bluish chert. Disk-shaped masses of siliceous (sponge?) spicules, the disks up to 2½ in. in diam., constitute a unique element in this fauna. Four or five hundred ft. lower in section, at same locality, occurs a 15-ft. stratum of lumpy, chalky ls. closely interbedded with chalky shales, all highly fossiliferous. This type of rock occurs in much closer association with main Pumpkin Creek ledge N. of Ardmore, where it has been mapped as part of that memb., and is probably the bed mentioned by Goldston as carrying *Campophyllum torquium*, near top of his Cup Coral memb. It weathers in many places to white chalky soil, full of a great abundance and variety of easily collected fossils, including large cup corals. On S. line of sec. 10, T. 6 S., R. 2 E., the main ledge of Pumpkin Creek memb. occurs about 2,000 ft. above Bostwick memb. This interval diminishes rapidly northwestward, with especially pronounced convergence in secs. 4 and 5, T. 6 S., R. 2 E.; N. and W. of Ardmore it is only 900 to 1,000 ft.

Punchbowl volcanics.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 55–60). Punchbowl tuff crater consists of 3 rock fms. younger than Koolau basalt, which underlies the flanks. The oldest is the tuff, which makes up main mass of the crater. The second and third are the closely associated black ash and basalt of much more recent date. The *Punchbowl tuff* is of typical palagonitic variety, somewhat coarser than Diamond Head tuff. Its thickness is 2 to 50 ft. No partly altered ash was seen in the Punchbowl mass.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Punchbowl volcanics.*—Tuff and basalt composing Punchbowl cone, near center of Honolulu. Included in Honolulu volcanic series [q. v.]. Assigned to late Pleist. Younger than Koolau volcanic series. [Evidently includes the Punchbowl tuff of Wentworth and the overlying basalt of Wentworth.]

Puncheon Creek sandstone. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky (Magoffin County).

I. B. Browning and P. G. Russell, 1919 (Ky. Geol. Surv., 4th ser., vol. 5, pt. 2, p. 13). *Puncheon Creek ss.*—Massive coarse-grained white to brownish-white cliff-forming ss. 60 ft. thick, underlain by 30 to 50 ft. of fine-grained massive, sometimes shaly ss. which usually does not form cliffs. Total thickness 70 to 120 ft. Overlies Fugate coal and underlies Hindman coal. Named for Puncheon Creek of Licking River, Magoffin Co., where it is well developed.

†Punta de la Mesa sandstone member. (In Mesaverde formation.)

Upper Cretaceous: Central northern New Mexico.

C. L. Herrick, 1900 (Am. Geol., vol. 25, pp. 331–346; N. Mex. Univ. Bull., vol. 2, pt. 1, pp. 3–63, pt. 2, pp. 1–17). *Punta de la Mesa ss.*—Massive ss., 50 to 75 ft. thick in Albuquerque quad., 25 to 50 ft. thick in western Socorro and Valencia Counties. Underlies Prieta sss. Lies 225+ ft. above Tres Hermanos ss., and 80 to 100 ft. above the cephalopod zone, 25 ft. thick.

W. T. Lee, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 592–598). *Punta de la Mesa ss.* at its type loc. in Rio Puerco field is here placed at base of Mesaverde fm., inasmuch as it is lowest ss. of the coal-bearing fm. But it seems to be age equiv. of part of Mancos sh. as developed farther N.

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 172–174, 179). Later investigations show that *Punta de la Mesa ss. memb.* (50 ft. thick) occurs 850 ft. below top of Mancos sh. as developed farther N., and it is here treated as a memb. of Mancos sh. It was previously included in Mesaverde fm. on assumption that that fm. extended downward to include all of the massive sss. At Casa Salazar it lies 1,147± ft. above Tres Hermanos ss. memb. of Mancos.

Named for Punta de la Mesa, N. of San Ignacio, Guadalupe Co.

According to later work by C. B. Hunt the Punta de la Mesa ss. is E. extension of middle and major part of Gallup ss. memb. of Mesaverde fm., and the name has been discarded by U. S. Geol. Survey.

Punta Maisi limestone.

Miocene: Cuba.

S. Taber, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 588).

Purcell series.

A term applied by Canadian geologists to rocks of Purcell Mtns, British Columbia and adjacent part of NW. Mont., which they correlate with the typical pre-Camb. Belt series of Mont. and Idaho. (See S. J. Schofield, The geology of East Kootenay, B. C., abstr. of thesis, Mass. Inst. Tech., p. 3, 1912, and Canada Geol. Surv. Summ. Rept. 1911, p. 159, 1912.) Includes Mooyie fm. at top and Creston qtzite at base. These rocks are included in Belt series by U. S. Geol. Survey.

Purcell basalt.

A term applied by Canadian geologists to altered basalt, of pre-Camb. age, underlying Mooyie fm. and overlying Kitchner fm. in SW. Alberta, SE. British Columbia, and NW. Mont. (Glacier Nat. Park). "Since it has its max. known thickness in McGillivray div. of Purcell Mtn system, the fm. has been called *Purcell lava*." (R. A. Daly, 1913, Can. Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 207.) Daly mapped the fm. in 1912 (Can. Geol. Surv. Dept. Mines Mem. 38, several sheets). C. H. Clapp, 1932 (Mont. Bur. Mines and Geol. Mem. 4, pp. 21–22), says "Purcell lava consists of basalt flows in Siyeh and Missoula groups of Belt series."

Purcell sandstone lenses. (In Hennessey shale.)

Permian: Northern central Oklahoma (Kingfisher County).

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, p. 1465). *Purcell ss. lenses.*—In vicinity of Purcell the upper 250 ft. of Hennessey sh. is filled with ss. lenses, the most prominent of which may be seen in river bluff just N. of the town. In this zone the sss. are highly lenticular and are cross-bedded. Lower part of zone forms a topog. ridge that can be followed from Purcell to Table Mtn area in Garvin Co. At Table Mtns, T. 3 N., R. 3 W., the top of zone is capped by a well-stratified bench-forming bed that can be followed many mi. W. and SW. At Purcell the zone of lenses is 230 ft. thick and the base is 150 ft. above Garber ss. On S. side of Washita River, in area SW. of Maysville, a good sh. section, 160 ft. thick, lies btw. base of Purcell lenses and the Antioch ss.

Purefoy's Mill series.

Age (?): Northern central North Carolina (Chapel Hill area).

W. H. Fry, 1911 (Elisha Mitchell Sci. Soc. Jour., vol. 27, p. 124). Chapel Hill area is in northern central N. C., in "Carolina metamorphic slate and volcanic belt." Bounded on S. by igneous slates of unknown age, generally spoken of as *Purefoy's Mill series*; on SE., E., and NE. by Triassic sss.; on N. and W. by very basic crystalline plutonics and acid volcanics of comparatively recent age, probably Triassic. The rocks composing the area are mainly granites.

Purgatoire formation.

Lower Cretaceous (Washita): Eastern Colorado, central northern and northeastern New Mexico, and Oklahoma Panhandle.

G. W. Stose, 1912 (U. S. G. S. Apishapa folio, No. 186). *Purgatoire fm.*—Upper third largely sh. with minor thin platy sss.; lower two thirds is almost wholly ss., of lighter color than overlying Dakota ss. Thickness 220 ft. Conformably overlies Morrison fm. and conformably underlies Dakota ss. as here recognized. Was formerly regarded as part of Dakota ss., but contains marine fossils which T. W. Stanton says are of Washita (Comanche) age, and therefore older than Dakota ss. Named for Purgatoire Canyon, in Mesa de Maya quad., Colo.

Purgatory conglomerate.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 364–374). *Purgatory cgl.*—Coarse cgl., overlying Aquidneck shales, also overlying Sakonnet ss. [of R. I.]. Is latest Carbf. fm. in S. part of Narragansett Basin. Typically developed at Purgatory. Thickness 380 to 600 ft.

Purington shale.

Name applied by H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804, and Ill. Geol. Surv. Bull. 60, pp. 179–193), to an undescribed sh. in lower part of Carbondale fm. (Penn.) of central western Ill., shown as 0–50± ft. thick; as lying lower in section than No. 4 coal and higher than No. 2 coal (from both of which it is separated by other rocks, the overlying rocks being called *Pleasantview ss.* and the underlying rocks *Oak Grove memb.*); and as in places cut out by Pleasantview ss. Derivation of name not stated.

Purisima formation.

Pliocene: Western California (Santa Cruz Mountains).

H. L. Haehl and R. Arnold, 1904 (Am. Phil. Soc. Proc., vol. 43, pp. 16–53). *Purisima fm.*—Fine-grained sss. and sh., 700 ft. thick, resting on basal cgl. 20 ft. thick. At top grades into beds having fauna somewhat similar to that of Merced fm. Its upper limit may be defined as base of Merced. Rests uncon. on Monterey sh.

Named for exposures near Purisima and along Purisima Creek, San Mateo Co.

Purslane sandstone. (In Pocono group.)

Mississippian: Northeastern West Virginia and western Maryland.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Purslane ss.*—Massive hard coarse white ss. and milky-white quartz cgl. alternating with softer cross-bedded ss. with a little sh. and thin coal seams. Thickness 180 to 310 ft. Underlies Hedges sh. and overlies Rockwell fm.; all included in Pocono group. Purslane Mtn, Morgan Co., W. Va., is formed of this ss.

Put-in-Bay dolomite member (of Bass Islands dolomite).

Silurian (Cayugan): Southeastern Michigan and northern Ohio.

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 546). *Put-in-Bay dolomites.*—Middle memb. of Lower Monroe fm. [Bass Islands dol.]. Underlies Raisin River beds and overlies Greenfield dol. [On a later page (553–556) thickness is given as 100+ ft. Later repts give thickness 0 to 220± ft.]

See under *Tymochtee sl.*

Named for exposures on Put-in-Bay Island, Lake Erie.

Putnam gneiss.

Late Carboniferous or post-Carboniferous: Eastern Connecticut and southern Massachusetts.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 129, 133, 134, 136, 140, and map). *Putnam gneiss.*—Consists of bands of schist, gneiss, qtzite, and igneous intrusions in great variety. In texture varies from compact bluish-black sl. and qtzite through fine black schist to coarse gray quartzose schist and feldspathic gneiss. Includes beds of ls., intrusive sheets of Sterling granite gneiss and pegmatite, amphibolite, and layers of black granite porphyry. In composition shows gradations from hornblende-biotite schist (or sedimentary amphibolite?) with little or no feldspar, through quartz-biotite schist and gneiss (or crystalline arkose?) to qtzite. Of sed. origin. In town of Preston there are 2 main varieties—a gray schist, often feldspathic, and a fine biotite-hornblende schist, both thoroughly injected with intrusive sheets and stringers of granite and pegmatite. The fine black schist evidently underlies the gray feldspathic variety. Evidence indicates Putnam gneiss underlies Scotland schist. The two fms. are conformable and pass into each other without noticeable change.

G. F. Loughlin, 1912 (U. S. G. S. Bull. 492, p. 16). The northward continuation of *Putnam gneiss* into Mass. is represented in Bolton gneiss, which Emerson and Perry assign to Carbf.

Putnam formation. (In Wichita group.)

Permian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 40). *Putnam fm.*—Composed of Santa Anna Branch sh. memb. (below) and Coleman Junction ls. memb. (above). Thickness 125 to 150 ft. in Colorado Valley; about 175 ft. in

Brazos Valley. Top fm. of Cisco group. Conformably overlies Sedwick ls. memb. of Moran fm. Named for town in Callahan Co.

This fm. was transferred to Perm. Wichita group by E. H. Sellards in 1933 (Univ. Tex. Bull. 3232), and Perm. is present age designation of U. S. Geol. Survey.

Putnam limestone. (In Putnam formation.)

Permian: Central northern Texas (Shackelford County).

O. F. Hedrick, E. Owens, P. A. Meyers, 1929 (Tex. Bur. Econ. Geol. geol. map of Shackelford Co.). *Putnam ls.*, 5± ft. thick, lies 55± ft. below top of Cisco, and overlies Putnam ss.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 170). *Putnam ls.*, in Putnam fm., preoccupied by Putnam fm. and discarded. Putnam fm. transferred to Perm. Wichita group.

Putnam sandstone. (In Putnam formation.)

Permian: Central northern Texas (Shackelford County).

O. F. Hedrick, E. Owens, and P. A. Meyers, 1929 (Tex. Bur. Econ. Geol. geol. map of Shackelford Co.). *Putnam ss.*, 5± ft. thick, underlies Putnam ls. and lies 110± ft. above Sedwick ls., all in Cisco group.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 170). *Putnam ss.*, in Putnam fm., preoccupied by Putnam fm. and discarded. Putnam fm. transferred to Perm. Wichita group.

Putnam erosion cycle.

Name applied by G. R. Mansfield (U. S. G. S. Bull. 713, 1920, p. 15) to a Pleist. erosion cycle in SE. Idaho, well developed in vicinity of Mount Putnam.

Putnam Hill limestone member (of Allegheny formation).

Pennsylvanian: Eastern Ohio.

E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 84, 85). *Putnam Hill ls.*—Blue ls., 4 ft. thick, in midst of coal measures. Underlain by 6 ft. of black bituminous sh. with thin layers of coal and overlain by 25 ft. of sh. and fissile ss. Is 78 ft. above Maxville ls.

Later repts state it overlies Brookville or No. 4 coal, and belongs near base of Allegheny fm.

Named for Putnam Hill, Muskingum Co.

Putnamville stone.

Trade name for a ls., of pre-Chester Miss. age, quarried at Putnamville, Ind. (See Collett, Ind. Dept. Statistics and Geol. 2d Ann. Rept., 1880, p. 409.)

Puyallup sand.

Pleistocene (pre-Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Puyallup sands.*—Stratified sand, 40± ft. thick. Included in Puyallup interglacial epoch. Underlie Douty gravels. Overlie Orting gravels. Occur at a number of sections in Puyallup Valley; the occurrence on W. side of valley may be considered typical. [Some geologists consider this deposit to be of glacial origin.]

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), gave thickness of *Puyallup sands* as 40 to 200 ft.

Puyallup interglacial epoch.

Pleistocene (pre-Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Puyallup interglacial epoch.*—Preceded Vashon glacial epoch and followed Admiralty glacial epoch. Includes Puyallup sands, Orting gravels, and Tacoma delta, which occur in Puyallup Valley.

Some geologists consider the deposits covered by this term to be of glacial origin.

Puyer formation.

Eocene: Central Washington (Pierce County).

J. Daniels, 1915 (Geol. Soc. Am. Bull., vol. 26, No. 1, p. 132). *Puyer fm.*, of Eo. age, Pierce County coal field, Wash., 12,000 to 14,000 ft. thick. [Not defined.]

Pyburn limestone member (of Olive Hill formation).

Lower Devonian (Helderbergian): Western Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, p. 685). *Pyburn ls.*—It appears possible to divide Linden bed into two subdivisions, *a lower, Camarocrinus or Ross ls.*, and *an upper, or Pyburn ls.* The upper half appears to contain a greater quantity of softer, clayey material, which weathers readily. It appears to give rise to greater number of exposures at which Linden bed fossils may be collected free from the rock. The exposures at Perryville, Linden, and Cumberland City appear to belong to upper or Pyburn horizon, which appears to have a greater eastward extension than the lower, overlapping latter.

W. F. Pate and R. S. Bassler, 1908 (U. S. Nat. Mus. Proc., vol. 34, pp. 427–429). *Pyburn beds* of Foerste consist of blue shales and thin lss. overlying Ross bed.

C. O. Dunbar, 1919 (Tenn. Geol. Surv. Bull. 21, p. 47). *Pyburn ls. memb. of Olive Hill fm.*—Thin-bedded impure, dirty and cherty ls. with occasional bands of chert 2 to 10 inches thick; lower part somewhat softer, but upper 14 ft. or more is heavy-bedded and lithologically closely resembles underlying Ross ls. Occupies more or less the strat. position of Bear Branch memb. of Olive Hill fm., but lithology is distinctly different and they occur in different regions, so that both names will be useful. [Detailed section at Pyburn Bluff given. Thickness 43½ ft. at Pyburn Bluff, where it is discon. overlain by Hardin ss. This is present approved definition of Pyburn ls.]

Named for exposures in Pyburn Bluff, Hardin Co.

Pyramid shale.

Cretaceous (?): Eastern New Mexico.

C. R. Keyes, 1905 (Am. Jour. Sci., 4th, vol. 20, p. 424). In E. part of N. Mex. the Comanche sss. are uncon. underlain by *Pyramid shales*, 100 ft. thick, which overlie Amarillo sss. and are correlated with Zuni shales of western N. Mex. [Derivation of name not given.]

Pyramid conglomerate.

Upper Cretaceous: Southwestern (?) New Mexico.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, p. 338). *Pyramid cgls.* is proposed for basal beds of Dakotan section as outcropping in Pyramid Butte, N. Mex.

Pyrites granite.

Pre-Cambrian: Northwestern New York (Canton quadrangle).

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 66, 71–73, 96). *Pyrites granite mass* is located just NE. of Pyrites, in SW. corner of Canton quad. Forms Pyrites phacolith. The granite and its border zone have been mapped by J. C. Martin (N. Y. State Mus. Bull. 185, 1916), who, however, refers to it as a boss. Intrudes Grenville series. [According to p. 52 this granite is of his Alexandria type.]

Quabin quartzite.

Carboniferous: Western central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60, 72–75, and map). The Paxton quartz schist persists with its usual features for a long distance beyond border of the Brimfield, but at length it changes to a sugary white friable qtzite, once in demand for furnace hearthstones, which becomes more or less sericitic or chloritic, and at Amherst is full of large irregular masses of garnet. This rock is called *Quabin qtzite.* It also grades into Oakdale qtzite. Composes a great portion of Quabin and Felton Mtns.

Quaco conglomerate.

Triassic: Nova Scotia and New Brunswick.

S. Powers, 1916 (Jour. Geol., vol. 24, p. 6).

Quadrant quartzite.

Quadrant formation.

Pennsylvanian (early) and upper Mississippian: Montana (rather widespread, except in Stillwater to Rosebud Counties region of central southern Montana) and northwestern Wyoming.

A. C. Peale, 1893 (U. S. G. S. Bull. 110, on Three Forks, Mont., region). *Quadrant fm.*—Thin-bedded cherty lss. and qtzite layers (150 ft. thick) underlain by 200 ft. of red aren. lss. At one place (N. of Gallatin) the basal bed of fm. is a cgl. ls. Bdy btw. the red lss. and the cherty lss. is a shifting one. The fm. rests conformably on Madison ls. and is overlain by Ellis fm. [Upper Jurassic] in vicinity of Three Forks, Mont. Fossils [Miss. and Penn.] listed. The names for Paleozoic fms. in this area were selected after consultation with Mr. Arnold Hague's division [to which Mr. Weed belonged].

W. H. Weed, 1896 (U. S. G. S. Yellowstone Park folio, No. 30). *Quadrant qtzite.*—White, yellowish, and occasionally pink beds of qtzite, with intercalated beds of drab saccharoidal lss. The qtzite is generally compact and in beds 4 to 25 ft. thick. Thickness of fm. averages 400 ft. in Gallatin Range. Named for Quadrant Mtn, in Gallatin Range [NW. corner of Yellowstone Park, Wyo.], where it forms a picturesque bluff encircling the mtn, rests on Madison ls., and is separated from overlying Ellis fm. by 200 ft. of sss., gray lss., and calc. shales named *Teton fm.* [Perm. and Triassic]. [In this original definition of Quadrant fm. at its type loc. the Perm. strata were included in Weed's overlying Teton fm. In subsequent repts on areas in Mont. to NW. of Yellowstone Park *Quadrant fm.* was applied to rocks that included the Perm. strata later identified as northward extension of Phosphoria fm. In 1919 (U. S. G. S. P. P. 120 F) D. D. Condit restricted Quadrant fm. to Weed's original definition, called the overlying Perm. strata *Phosphoria fm.* and the underlying rocks *Madison ls.*, and stated that typical Quadrant had yielded Miss. and Penn. fossils. In many subsequent repts the name was applied to strata of Penn. and Miss. age resting on Madison ls. over large areas in Mont., but in Stillwater and Rosebud Counties region of central southern Mont. the corresponding rocks have been divided into Tensleep ss. and Amsden fm.]

H. W. Scott, 1935 (Jour. Geol., vol. 43, No. 8, pp. 1011–1032). Basal 109 ft. of type section of Quadrant fm., consisting of ls. and sh., were originally called "talus," and cannot be considered part of the fm. *This lower zone is Amsden fm.*, which rests on Madison ls. [Scott's graphic section at Quadrant Mtn (p. 1016) shows his Amsden fm. as consisting in upper half of massive ls. and in lower half of shaly ss. and sh., from which it looks as if Weed included these beds in his Madison ls.] The Quadrant is westward extension of Tensleep ss.; it is marine; strat. and paleontologic evidence indicates it is basal Penn. The strat. and paleontologic evidence shows Amsden is Miss., probably Chester. [Lower part of Amsden fm. has long been correlated by U. S. Geol. Survey with Brazer ls., of upper (Chester) and middle Miss. age.] As determined by tracing, true Quadrant wedges out 5 mi. NE. of Lombard, Mont. It is unknown in central Mont., where the rocks that have been called *Quadrant fm.* consist of the older Amsden fm. underlain by Big Snowy group, divided into 3 fms. [See under *Big Snowy group.*] The Quadrant is present NW. of Lombard, also in vicinity of Helena, and in extreme SW. and west-central Mont.—Philipsburg, Melrose, and Dillon areas. In most areas the Quadrant and the Tensleep are uncon. on Amsden fm., but the uncon. is not angular, and in vicinity of Three Forks there is evidence that would support theory of continuous deposition. A few sections show upper part of Amsden ls. interbedded with qtzite, which becomes more and more dominant until massive qtzites of the Quadrant are reached.

Quail porphyry.

Eocene: Western central Colorado (Tenmile district).

S. F. Emmons, 1898 (U. S. G. S. Tenmile Special folio, No. 48). *Quail porphyry.*—Hornblende rock. Largest sheet occurs under White Quail group of mines, Tenmile quad.

†Quakertown group. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, between pp. xxi–xxxvi and 319–333). *Quakertown group.*—Underlies Middle Mercer shales and overlies Connoquenessing Lower ss. Includes (descending) Quakertown coal, Quakertown fire clay, and

Quakertown iron shales. Included in Connoquenessing ss. [In some repts these beds have been called *Quakertown coal group.*]

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3), gave following strat. succession in Mercer Co., Pa. (descending): Connoquenessing Upper ss., 40 ft.; *Quakertown over shales and ore*, 10 ft.; Quakertown coal, 0 to 2 ft.; *Quakertown under shales and ore*, 20 to 50 ft.; Connoquenessing Lower ss., 0 to 90 ft.

I. C. White, 1880 (2d Pa. Geol. Surv. geol. map of Crawford and Erie Counties). *Quakertown shales*, 50 [ft.]. Underlie Connoquenessing Upper ss. and overlie Connoquenessing Lower ss.

Quakertown shale. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2, p. 66). *Quakertown iron shales* contain iron ore in nodules. Are 40 ft. thick. Underlie Quakertown coal and overlie Lower Connoquenessing ss. The Quakertown coal occurs at the "Falls" on Quakertown Run, near Quakertown Station, Lawrence Co., Pa.

See also under †*Quakertown group*, I. C. White, 1880.

Quakertown fire clay. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2, p. 332). *Quakertown fire clay*, with iron ore balls, underlies Quakertown coal and overlies Quakertown iron shales.

Quakertown coal group.

See under †*Quakertown group*, 1879.

Quakertown slate. (In Kanawha formation.)

Pennsylvanian: Northern West Virginia and western Maryland.

D. B. Reger, 1918 (W. Va. Geol. Surv. Rept. Barbour and Upshur Counties, p. 273). *Quakertown black sl.*—Hard, fissile, carbonaceous, fossiliferous; 0 to 4 ft. thick. Lies 0 to 7 ft. below Quakertown rider coal and overlies Quakertown (Coalburg?) coal. Not previously noted or described. Named for relation to Quakertown coal.

D. B. Reger, 1921 (W. Va. Geol. Surv. Rept. Nicholas Co.). *Quakertown black sl.*—Named for occurrence along Tygart Valley River in northern Randolph Co., where it lies just above Quakertown (Winifrede?) coal. Its supposed position is below Coalburg coal (Quakertown Rider?) and above Little Coalburg coal.

Quall limestone.

Lower Devonian (Oriskany): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 746). *Quall ls.*—Heavy-bedded fine-grained cherty gray ls. in layers 18 to 20 in. thick. Weathers to very porous, rotten white and buff chert with yellow clay. Thickness 0 to 10± ft. Fauna clearly upper Oriskany. Lies uncon. above Decaturville chert and uncon. below Harriman chert. Confined to S. part of State.

Named for development on farm of Jim Quall, in valley of Dry Creek, a small stream entering Tenn. River near Walnut Grove, Hardin Co.

Quanah gypsum.

Permian: Southwestern Oklahoma and central northern Texas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 356 (footnote), 357). *Quanah gyp.*—Gyp. underlying Groesbeck dolomites in Hardeman Co., Tex., and Greer Co., Okla. Is a lower gyp. than Collingsworth gyp. May belong to Cave Creek fm.

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, pl. 1). *Quanah gyp.* lies lower than Guthrie dol. and overlies San Angelo fm.; all included in Double Mtn group.

Named for Quanah, Hardeman Co., Tex.

Quanah granite.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 137–138). *Quana granite.*—Granite eruptive into Camb. and Ord. fms. in Wichita Mtns, Okla. Named for a prominent chief near whose lodge it is well exposed.

J. A. Taff, 1904 (U. S. G. S. P. P. 31), mapped the granite of Wichita Mtns as pre-Camb.

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C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). *Quanah granite (pre-Camb).*—Medium-grained flesh-red hornblende granite. Intrusive. The latest granite mass of Wichita Mtns dist. Named for Quanah Mtn.

Quanah granophyre.

A name applied by M. G. Hoffman (Okla. Geol. Surv. Bull. 52, 1930, geol. map of Wichita Mtns, Okla.) to the Quanah granite of previous repts.

Quantico slate.

Upper Ordovician: Northeastern Virginia.

N. H. Darton, 1894 (U. S. G. S. Fredericksburg folio, No. 13). *Quantico sl.*—A narrow belt of black slates [mapped] overlying the crystalline rocks and underlying Potomac fm. Named for Quantico Creek. Resembles the roofing slates on James River which carry lower Sil. fossils.

T. L. Watson and S. L. Powell, 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 36–43). *Quantico slates.*—Gray to dark-gray and black slates with beds of green and maroon slates; also dense, homogeneous black graphitic slates of fine texture. Laid down at about same time as Martinsburg sh. W. of the Blue Ridge. Named for Quantico Creek, Prince William Co.

T. L. Watson, 1916 (Va. Geol. Surv. geol. map of Va.). [Map explanation of Ord. (Cincinnatian) block reads "Includes the Arvonia and Quantico slates of the Piedmont Plateau province."]

J. T. Lonsdale, 1926 (Jour. Geol., vol. 34, pp. 159–166). *Quantico sl.* occurs in narrow discontinuous belt, rarely more than 1 mi. wide, extending for more than 40 mi. in a NE-SW direction along E. border of NE. Piedmont dist. Is known to be of Cincinnatian age through work of Watson and Powell, who reported a Cincinnatian fauna from it in Powell's Creek section near Dumfries, Prince William Co. The sl. varies from black graphitic to a gray type closely related to phyllite.

W. A. Nelson, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Quantico sl.* is in part graphitic and includes rhyolite flows in northern areas. Mapped near Quantico, Prince William Co. Assigned to Ord.

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 6, 25), assigned this fm. to Upper Ord. (See under *Arvonia sl.*)

Quapaw chert.

See under *Lincolnville chert.*

Quarry Creek limestone.

Pennsylvanian: Southeastern Illinois (Clark County).

A. H. Worthen, 1875 (Ill. Geol. Surv., vol. 6, pp. 10–17). *Quarry Creek ls.* (also *Quarry Creek and Martinsville ls.*).—Ls., 20 to 30 ft. thick, near top of Coal Measures of Clark Co. Upper part heavy bedded; lower part thinner-bedded, becoming shaly at base and locally passing into fossiliferous green clay sh. with thin plates and nodules of ls. Overlain by heavy ss., 30 to 40 ft. thick, forming top part of Coal Measures in this county; underlain by sh., the lower part of which is bituminous.

According to J. E. Lamar and H. B. Willman (Ill. Geol. Surv. Bull. 61, 1934, pp. 129–138) this ls. is same as LaSalle ls. memb. of McLeansboro fm.

Named for Quarry Creek, 1½ mi. E. of Martinsville, Clark Co.

Quartermaster formation.

Permian: Southwestern and northwestern Oklahoma and eastern part of Panhandle of Texas.

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 57). *Quartermaster div.*—Soft red sss. and aren. clays and shales, 300 or more ft. thick. Overlies Greer div., which consists of red clays, sh., and sss., and includes several gyp. beds, named, in descending order, Delphi, Collingsworth, Cedartop, Haystack, Kiser, and Chaney. Underlies Tert. or later deposits.

L. C. Snider, 1913 (Okla. Geol. Surv. Bull. 11). *Quartermaster fm.*, 300 ft. thick, contains no important gyp. deposits in Okla. The underlying Greer fm. is 150 to 300 ft. thick, and overlies Day Creek dol. memb. of Woodward fm.

In 1924 C. N. Gould introduced *Cloud Chief gyp.* for the rocks underlying Quartermaster fm. that were formerly known as "eastern area of Greer fm." (See under *Cloud Chief gyp.*)

R. W. Sawyer, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 312–320). *Quartermaster fm.* overlies Cyril gyp., which Gould referred to as "eastern area of Greer." The Cyril overlies Day Creek dol. [These fms. were mapped in order here stated.]

The downward strat. succession of Quartermaster fm., Cloud Chief gyp., Day Creek dol., and Whitehorse ss. was given in repts by C. N. Gould, 1924; C. N. Gould and F. E. Lewis, 1926; C. N. Gould, 1926; R. L. Clifton, 1926; F. Gouin, 1927; C. N. Gould, 1927; N. Evans, 1927; N. Evans, 1928; A. M. Lloyd and W. C. Thompson, 1929; G. G. Suffel, 1930; A. F. Freie, 1930; R. L. Clifton, 1930; and R. L. Six, 1930. The 1926 rept of Gould and Lewis suggested that "it might be well to consider the Day Creek dol. the basal part of Cloud Chief gypsum." In 1930 (Okla. Geol. Surv. Bull. 40,I) C. M. Becker stated that "Day Creek dol. and Cloud Chief gypsum are thought by some to occupy the same stratigraphic position." The 1928 rept of N. Evans (A. A. P. G. Bull., vol. 12, p. 708) identified in Weatherford area, Okla., 5± ft. of dol. lying btw. Quartermaster fm. above and Cloud Chief gyp. below as *Quartermaster dol.*, and showed Cloud Chief gyp. ("massive pinkish-white gypsum") as separated from underlying Day Creek dol. by 20 to 60 ft. of red to buff ss. with gyp. lentils, which he stated "is apparently Whitehorse." The 1930 rept of G. G. Suffel (Okla. Geol. Surv. Bull. 49) stated that in some places Day Creek dol. appeared to be below top of Whitehorse ss.

R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40HH). The term "Day Creek dol." of Cragin has been applied to Weatherford dol., Greenfield dol., and Quartermaster dol. It is believed its continued use will only serve to confuse. Writer does not know what bed, if any, in SW. Okla., corresponds to Day Creek dol. of Kans.

R. L. Clifton, 1930 (A. A. P. G. Bull., vol. 14, pp. 161–172). *Cloud Chief* as originally defined by Gould includes beds from top of Day Creek up to base of Quartermaster fm. Evidences in field suggest Cloud Chief is not a geol. unit, but that it represents a group of more or less continuous strat. units. Writer believes Cloud Chief as a fm. name should be dropped and that another fm. name should be adopted to include the beds from base of Day Creek dol. up to base of Quartermaster, and there is some evidence to suggest that even the Quartermaster might well be included in this suggested revision. At any rate a new fm. to include Day Creek dol., Hackberry sh., Big Basin ss. and the Perm. beds overlying the Big Basin, up to base of Quartermaster, seems necessary if geologic designation is to be more strictly applicable to NW. Okla. and adjacent areas.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 408–432). Day Creek dol. overlies Cloud Chief gyp., instead of underlying it, as previously believed, and all Perm. beds above Day Creek dol. in Okla. and Kans. belong to Quartermaster fm. The Kans. terms "Hackberry" and "Big Basin" should be dropped. Writer has not anywhere seen beds of gyp. in Quartermaster fm. The Quartermaster rests conformably on Day Creek dol. The Cloud Chief is here made a memb. of Whitehorse fm.

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437), does not regard Evans' interpretation of strat. relations of various fms. as proved.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454, 1458, 1473), divided Quartermaster fm. of central and west-central Okla. into (descending) (1) *Elk City ss. memb.*, (2) *Doxey sh. memb.*, and (3) *Cloud Chief memb.* (consisting of ss., gyp., and dol. facies); and defined it as uncon. overlying Rush Spring fm.

Named for exposure along banks of Quartermaster Creek, Roger Mills Co., Okla.

Quartermaster dolomite. (In Quartermaster formation.)

Permian: Western Oklahoma (Custer County).

Name applied by some geologists to a dol. memb., 0 to 15 ft. thick, lying short distance above base of Quartermaster fm. in Weatherford dist., Custer Co. See Noel Evans, 1928 (A. A. P. G. Bull., vol. 12, No. 7, pp. 706, 708), and G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 49, pp. 107, 114, 124, 128).

Quartzite Range formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1934 (Canada Dept. Mines Geol. Surv. Mem. 172, No. 2345, p. 8).

Quaternary period (or system).

Includes all post-Tertiary time and the rocks formed therein. Divided into Pleistocene epoch (or series) and Recent epoch (or series). See U. S. G. S. Bull. 769, pp. 43–49.

Quaternic.

A variant of *Quaternary* employed by some geologists.

Quatsino limestone.

Triassic: British Columbia (Vancouver Island).

H. C. Gunning, 1933 (Canada Geol. Surv. Summ. Rept., pt. A2, p. 33).

Quealy sand.

A subsurface sand occurring in transition zone at base of Mesaverde fm., lying at depth of 1,050 to 1,100 ft. in Saddleback Hills anticline, Carbon Co., Wyo.

Quebec group.

Ordovician, Cambrian, and pre-Cambrian: Quebec.

W. E. Logan, 1860 (Canadian Nat., vol. 5, pp. 472–477), 1861 (Can. Jour., n. s., vol. 6, pp. 40–46), and 1863 (Can. Geol. Surv. Rept. 1843–63, pp. 225–297, 844–880). *Quebec group;* Cambro-Sil.

A. R. C. Selwyn, 1883 (Can. Roy. Soc. Proc. and Trans., 1882–83, vol. 1, sec. 4, pp. 1–13). Quebec group includes pre-Camb., Camb., and Cambro-Sil.

Subsequent Canada Geol. Survey repts divided these rocks into (descending) Sillery, Lauzon, and Levis fms. Many repts assigned them to Ord., some assigned them to Camb., others assigned them to "Cambro-Ord." More recent repts seem to restrict name to Ord.

†Quebecan substage (of Wisconsin stage).

Pleistocene: Great Lakes region.

M. M. Leighton, 1931 (Jour. Geol., vol. 39, pp. 51–53). *Quebecan substage (early and middle Wisconsin).*—Includes Shelbyville moraines back to but not including Port Huron and its correlatives. Named for Quebec, a very large area in eastern Canada, over which general area the center was most potent and from which it extended farthest S. and SW. during this substage. During latter part of Quebecan substage the ice field grew westward into the Patrician area and gave rise to a considerable lobe moving S. across Lake Superior and to SW., depositing the extensive sheet of red drift or Patrician drift of that region. It also gave rise to the notable Green Bay deployment, and retained its power in the East.

M. M. Leighton, 1933 (Sci., vol. 77, p. 168), withdrew *Quebecan substage* and replaced it by *Cary substage* (middle Wisconsin) and *Tazewell substage* (early Wisconsin).

Quebec City formation.

Ordovician: Quebec.

P. E. Raymond, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 356). *Quebec City fm.*, Ord., Quebec.

Quebradillas limestone.

Miocene: Puerto Rico.

T. W. Vaughan, 1924 (Geol. Soc. Am. Bull., vol. 35, No. 4, table 3).

Queen sandstone member (of Chalk Bluff formation).

Permian: Southeastern New Mexico (Eddy County).

F. S. Prout, 1929 (A. A. P. G. Bull., vol. 13, p. 656). *Queen sand zone* to N. toward Carlsbad is in top of San Andres ls. [?] and Seven Rivers gyp. is above it.

K. H. Crandall, 1929 (A. A. P. G. Bull., vol. 13, pp. 929, 940). *Queen sand.*—Brown and buff ss., 100 ft. thick, underlying Seven Rivers gyp. Named for extensive outcrops in vicinity of Queen P. O., sec. 30, T. 24 S., R. 22 E., Eddy Co., N. Mex.

W. G. Blanchard, Jr., and M. J. Davis, 1929 (A. A. P. G. Bull., vol. 13, pp. 972, 983, 987). A sandy ls. and sand zone, 0 to 500 ft. thick, notable near old post office at Queen, Eddy Co., N. Mex., is often referred to by N. Mex. geologists as "*Queen ss.*" The "Queen ss." consists primarily of reddish-brown and gray sss. interbedded with hard gray lss. that are locally sandy. These ss. lenses lie in uppermost part of San Andres ls. [?], and *Queen sand zone* is considered the top of that fm. Because there are several of these lenses within 200 ft. or more of section the term *zone* is applicable. These sss. have been traced from their type loc. SW. to El Paso Gap, through Dog Canyon to Bush Mtn (a high mass in the Guadalupes) and S. to approx. 5 mi. S. of N. Mex. line and 1 mi. NE. of El Capitan. The upper lenses of *Queen zone* are stratigraphically within 300 ft. of top beds of El Capitan. Several mi. E. of Queen P. O. the Queen outcrop dips steeply N. and NE. and is at base of gyp. beds in Carlsbad memb. [In pl. 11 they show Queen ss. underlying Carlsbad fm., and in one place they say it is very close to strat. position of Frijole ls. *Queen sand zone* and *Queen ss.* as here used include much more than the Queen sand of Crandall, which outcrops in vicinity of Queen, Eddy Co., N. Mex., is 100 ft. thick, and, according to W. B. Lang, can be traced 20 or more mi. in outcrop.]

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *Queen ss. memb. of Chalk Bluff fm.* is a brown and buff ss., 100 ft. thick, exposed on Queen Mesa, in upper Dark Canyon and along N. slope of Hess Hills in Gaudalupe Mtns. It underlies Seven Rivers gypsiferous memb. of Chalk Bluff fm. and overlies Dog Canyon ls. [According to Lang (personal communication) his Queen ss. memb. corresponds to Queen sand of Crandall, and is the upper ss. of the thick series of sss. and lss. which has been called *Queen sand*, *Queen ss.*, and *Queen sand zone* by the oil geologists, and which includes Dog Canyon ls. of Lang. This is approved definition of U. S. Geol. Survey.]

†Queen sand.

†Queen sand zone.

Permian: Southeastern New Mexico.

See under *Queen ss. memb. of Chalk Bluff fm.*

Queen sand.

A subsurface sand, 23 ft. thick, of probable Chemung age, occupying interval btw. 1,406 and 1,429 ft. in Ulf well No. 1, near Tidioute, Warren Co., Pa. Lies 181 ft. above Speechley sand. (See C. R. Fettke, Geol. Soc. Am. Bull., vol. 44, No. 3, p. 604, 1933.)

Queen Charlotte Island formation.

Lower Cretaceous: British Columbia.

J. F. Whiteaves, 1883 (Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 85); and J. W. Dawson, 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 120–127).

Has also been called *Queen Charlotte Islands group*, *Queen Charlottes Island fm.*, *Queen Charlotte series*, and *Queen Charlotte group*.

Queen City sand member (of Mount Selman formation). (In Claiborne group.)

Eocene (middle): Eastern Texas.

W. Kennedy, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 50–52). *Queen City beds.*—Uppermost memb. of Lignitic beds. Appears to be a series of laminated or thinly stratified white and red sands and sandy clays, frequently merging into one another and forming a mottled sandy clay or clayey sand. *Best developed in neighborhood of Queen City, Cass Co.*, where it has known thickness of 65 ft. In Marion Co., near Jefferson, and in Harrison Co. the beds appear at various places immediately underlying a yellowish-brown ss. or altered glauconite containing occasional casts of fossils and belonging to Mount Selman or lower memb. of the

Marine beds. They occur also near Tyler, Smith Co., and as far S. as within 2 mi. of Troupe. To N. they occur at Gladewater, Gregg Co., and from Wilkins' mill, Upshur Co., westward to within short distance of Big Sandy. They rest on a series of black, blue, and gray micaceous sands, blue, brown, and gray clays with thin strata of sss. and ls., and also contain many small seams and several heavy deposits of lignites.

See additional entries under *Mount Selman fm.*

A. Deussen, 1914 (U. S. G. S. W. S. P. 335). *Queen City sand memb. of Wilcox fm.*—Littoral deposits comprising top memb. of Wilcox fm. Consists of 50 to 200 ft. of white porous, loose water-bearing sands, with some interstratified clays.

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 83–84). *Queen City-Carrizo.*—Oldest fm. of Claiborne group. In E. Tex. is known as *Queen City*, and consists of 50 to 200 ft. of laminated or thinly stratified white or red sands and sandy clays. In western [southern] Tex. is known as *Carrizo*, and consists of at least 150 ft. of sss. of varying color, texture, and thickness, prevailingly grayish yellow, weathering light brown, some beds white when freshly broken; the beds ranging from fairly hard ss. 2 to 4 or more ft. thick, to beds thin, slabby, fairly soft, and almost shaly. Regarded by Vaughan as lower Wilcox, but in Rio Grande country the Carrizo overlaps the Wilcox and Midway.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1342, 1345, pl. 14). *Queen City memb. of Claiborne fm.*—First described by Wm. Kennedy (Geol. Surv. Tex. 3d Ann. Rept.). Strat. position is below Weches memb. of Claiborne and above Reklaw memb. of Claiborne. According to present knowledge is limited to Tex. side of Sabine uplift. As a well-defined massive sand extends from Queen City, Cass Co., S. through Smith and Cherokee Counties, attaining thickness of 400 ft. In Houston Co. it thins to 110 ft. and in western Angelina Co. to 90 ft. From San Augustine E. it is only a few ft. thick, finally disappearing.

According to recent work of Tex. geologists and Julia Gardner the Queen City sand contains Claiborne fossils, underlies Weches greensand memb. of Mount Selman fm. and overlies Reklaw memb. of Mount Selman. (See U. S. G. S. 1932 geol. map of Tex.)

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 630). *Queen City fm.* of eastern Tex. divided into (descending): (1) Upper memb., 200 to 230 ft. of thin-bedded, cross-bedded sand, containing 2 layers of bentonite in upper 100 ft. and 2 layers of brown lignite in lower 100 ft.; (2) *Omen greensand memb.*, dark-green and black, partly cross-bedded, friable, sandy, unfossiliferous glauconite, 10 to 15 ft. thick; (3) lower memb., 140 to 150 ft. of gray and brown sand and gray sandy sh. with irregularly shaped lentils of sand.

Queen Hill shale. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northwestern Missouri, and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 46, 47). *Queen Hill sh.*—Bluish and argill. in upper part, and black, fissile, and somewhat carbonaceous in lower part. Thickness 5 to 5½ ft. in Nebr., 6 ft. at Folsom, Iowa, 5 ft. N. of Amazonia, Mo., and 5 to 6 ft. S. of Atchison, Kans. Underlies Cullom ls. [later named *Beil ls.* and still later abandoned] and overlies Big Springs ls., all in Lecompton ls. Named for Queen Hill, NE. of Rock Bluff, Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). The so-called Queen Hill sh. of Bull. 1 Nebr. Geol. Surv. is Cherryvale sh. memb.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). *Queen Hill sh.* underlies Beil ls. and overlies Big Springs ls., all included in Lecompton fm.

Queens River moraine.

Pleistocene (Wisconsin stage): Rhode Island (Narragansett Bay) and Massachusetts.

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, table opp. p. 988).

Extends from highland SW. of Providence northeastward into Mass.

Queenston shale.

Upper Ordovician (Richmond): Western New York and Ontario.

A. W. Grabau, 1908 (Sci., n. s., vol. 27, pp. 622–623). *Queenston shales*—red Medina shales. Of Richmond (Ordovicic) age. Thickness 1,100 ft. Named for town on Niagara River opposite Lewiston, N. Y., "where these beds are partly exposed." [The same year (in vol. 28 of Sci., pp. 346–348) G. H. Chadwick proposed *Lewiston sh.* for these beds, which he stated underlie the "upper or true Medina" with suggested discon. Because of priority of publication *Queenston sh.* is the generally recognized name.]

In 1909 (Jour. Geol., vol. 17, p. 238) Grabau introduced *Whirlpool ss.* for basal bed of the Sil. and of his restricted Medina ss. (which rests on Queenston sh.), and correlated the Queenston with the Juniata and the Richmond.

In 1911 (Geol. Soc. Am. Bull., vol. 22) E. O. Ulrich used Chadwick's name *Lewiston* (with *Queenston* in parens), correlated the fm. with Juniata, and assigned all to Ord.; but he considered the Richmond younger, and assigned it to Sil. He also showed a great hiatus btw. the Queenston and the overlying Medina ss., to which he restricted the name *Medina*.

In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel included Queenston sh. in the Medina and assigned all to Sil.

In 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 107–108) E. O. Ulrich recommended that well-established Pa. name *Juniata* be used in N. Y., to replace *Lower Medina* and also the recently introduced name *Queenston sh.*, he being satisfied of equivalency of the two. He also transferred the *Juniata* (*Queenston*) to Sil., and stated that Lower Medina is=greater part if not all of the Richmond. The same year (12th Int. Geol. Cong., Canada, p. 28) Ulrich stated that "the Richmond passes laterally into the lower Medina (or Queenston) of N. Y.," and that the Queenston is uncon. with overlying Albion ["Upper Medina" of early literature]. In Niagara folio of U. S. Geol. Survey (No. 190, 1913) the Queenston sh. was described as consisting of 1,200 ft. (only 300 ft. exposed) of cherry-red and green sh. and green or gray ss., and it was retained in Medina group, but, because of lack of fossils and disagreement among geologists as to its exact age, it was classified as *Ord. or Sil.* In Canada Geol. Surv. Guidebook 4, 1913, W. A. Parks assigned Queenston sh. to Ord., stating that at Collingwood, Ont., a distinct Richmond fauna had been collected from it, although in Niagara and Hamilton, Ont., sections it is unfossiliferous. He described it as consisting of red shales with an occasional green band and an occasional bed of ls., and stated that it overlies the marine type of Richmond.

In 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 277–320) C. Schuchert assigned Queenston sh. to Ord. and to "Richmondian," but favored excluding it from Medina, and stated that, although originally included in Medina, "at the Medina type locality, along Orchard Creek, Medina, N. Y., these beds are practically not seen." He also stated that Whirlpool ss. is everywhere discon. on Queenston. The same year (Canada Geol. Surv. Summ. Rept. 1913, pp. 179–188), also in 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser.), M. Y. Williams stated that Whirlpool ss. overlaps Queenston sh.

In 1916 (Canada Dept. Mines, Geol. Surv. Mem. 83, pp. 175–176) A. F. Foerste stated: "The Queenston shales appear to be merely the estuarine representatives of a part of those marine strata which elsewhere are known under the term Richmond fm.," and he correlated them with upper fms. of Richmond group of Mississippi Valley.

In 1923 (Md. Geol. Surv. Sil. vol., p. 347) E. O. Ulrich showed Albion uncon. on Queenston.

In 1924 (Canada Dept. Mines Geol. Surv. Mem. 138) A. F. Foerste correlated Queenston sh. of N. Y. with upper part (chiefly Whitewater) of the

Richmond of SW. Ohio and Ind., and stated that Queenston sh. of different parts of Canada ranges in age from upper Waynesville to Whitewater, both inclusive, and that "strictly speaking, the Queenston is merely a lithological designation, not an accurate time unit."

The U. S. Geol. Survey now classifies Queenston sh. as Upper Ord., and regards its Richmond age as established. (See also under *Richmond group.*)

Queniult formation.

Pliocene: Northwestern Washington.

See *Quinault fm.*, the spelling approved by U. S. Geographic Board.

Quercan sandstone.

Miocene: Central western California (San Pablo Bay region).

C. E. Weaver, 1909 (Calif. Univ. Pub., Bull. Dept. Geol., vol. 5, p. 251). *Quercan ss.*, top div. of Monterey fm. in San Pablo region, closely resembles San Pablo ss. Overlies Herculean sh. memb. [Derivation of name not stated.]

Approx. same as Briones ss.

Quesnal Lake crystalline series.

Pre-Cambrian: British Columbia.

A. Bowman, 1889 (Canada Geol. Surv., n. s., vol. 3, pt. 1, p. 25C).

Quesnal River beds.

Cretaceous: British Columbia.

A. Bowman, 1889 (Canada Geol. Surv., n. s., vol. 3, pt. 1, pp. 17C to 19C). Is= upper part of Shasta group of Calif.

Quesnal River series.

Cretaceous (?): British Columbia.

C. H. Crickmay, 1927 (Stanford Univ. Abstracts of dissertations 1924–26, vol. 1, p. 132). Assigned to Cret. [G. Hanson (Canada Geol. Surv. Summ. Rept. 1933, pt. A, p. 35, 1934) assigned these beds to Jurassic and Cret. (?).]

Quiet Lake intrusives.

Late Jurassic or Cretaceous: Yukon Territory, Canada.

E. J. Lees, 1934 (Royal Canadian Inst. Trans., vol. 20, pt. 1, p. 26).

Quillayute formation.

Miocene (?): Northwestern Washington.

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22, p. 203). *Quillayute fm.*—In interior region, where exposed along Bogachiel River, it is composed of ss. and bluish-gray sh., but base not seen there. The coast exposures are all cgls. or coarse gravelly rock resting uncon. upon older rocks. Occupies valley of Quillayute River and country drained by its eastern tributaries eastward at least to their respective middle courses, thence W. to Waatch Strait, and in places to the coast. Thickness not ascertained. Fossils are Plio.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 604). Reagan's description of Quillayute fm. is based on glacial filling of valley of Quillayute River. If Reagan had visited the locality from which the fossils he describes from the Quillayute were brought by the Indians, he would have found it to be about 2 mi. from Devils Club Swamp, where he says they occur, and the fm. very different lithologically from what he describes. It is typical Empire ss.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 268–276). Quillayute fauna appears to be a mixture much the same as the Quinaielt, but the Quillayute suggests that the fauna is slightly lower and more like upper Mio. in faunal aspect, and therefore it is probably somewhat lower than Quinaielt fauna and may be in part of upper Mio. age.

R. H. Palmer, 1927 (A. A. P. G. Bull., vol. 11, No. 12, pp. 1321–1328). *Quillayute fm.* consists of soft slate-gray ss., probably not more than 50 ft. thick, locally carrying a plentiful upper Mio. fauna.

Quinaielt formation.

Pliocene: Northwestern Washington.

See *Quinault fm.*, the spelling approved by U. S. Geographic Board.

Quinault formation. (Approved spelling.)

Pliocene: Northwestern Washington.

R. Arnold, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 451–468, map). *Quinaielt fm.*—Coarse cgl. and fine shales, with minor ss. and clay. Thickness 2,260 ft. Most important area is in great syncline btw. Capes Elizabeth and Greenville through which trough of Quinaielt River empties into sea. Fossils are lower Plio. Uncon. overlies Clallam fm.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, table opp. p. 604), assigned *Quinaielt fm.* to upper Mio. and lower Plio.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 268–276). Fauna of *Quinaielt fm.* is possibly a mixture, although it appears to be lower Plio., as Arnold suggested.

Quincy syenite.

C. H. Hitchcock, 1872 (Am. Jour. Sci., 3d, vol. 3, p. 47). *Quincy syenite* lies contiguous to porphyritic granite in Abington, Mass.

Quincy granite.

Carboniferous (probably Mississippian): Eastern Massachusetts and Rhode Island.

W. O. Crosby, 1876 (Rept. on geol. map of Mass., pp. 1–42), referred, in several places, to *Quincy granite*, and said that the hornblendic granite is quarried at Quincy and Rockport, Mass.

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, p. 51). *Quincy granitic group* occupies whole area btw. the green schist and the Carbf. rocks along NE. border of the green schist from Diamond Hill southward to Berkeley, forming a southern lobe of the broad Quincy band in Boston Basin.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 167, 188–196, and map). The normal *Quincy granite* is a moderately coarse-grained rock composed of dominant quartz, feldspar, and hornblende with accessory aegirite, zircon, titanite, and ores. Type area is in Quincy and Milton, Mass., but largest area is in eastern Essex Co., Mass.

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Quincy granite* in Mass. intrudes Lynn volcanic complex, which is probably contemp. with Mattapan volcanic complex, of Dev. or Carbf. age.

Quincy amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Same as Pewabic amygdaloid. The mineralized part is the Quincy lode. Named for occurrence in Quincy mine, Houghton Co. Is in Ashbed group.

Quincy flow.

Same as Pewabic flow. Includes Quincy amygdaloid and underlying trap.

Quincy Pewabic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pl. 18).

Belongs in Ashbed group. Same as Pewabic amygdaloid. The mineralized part is the Quincy Pewabic lode.

Named for occurrence in Quincy and Pewabic mines, Houghton Co.

Quincy Pewabic flow.

Includes Quincy (Pewabic) amygdaloid and underlying trap.

Quindaro shale.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 92, 97). [See under *Wyandotte ls.* Derivation of name not stated.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 59). *Quindaro sh. memb. of Wyandotte ls.*—Gray argill. or limy sh., 3± ft. thick, underlying Argentine ls. memb. and overlying Frisbie ls. memb. Named for a political twp in Wyandotte Co., Kans. Typically exposed in floor of Boyn's quarry, near NW. cor. sec. 30, T. 10 S., R. 25 E.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Quiniault formation.

See *Quinault*, the approved spelling.

Quinn sand.

A subsurface sand, of Penn. age, in Lyons-Quinn oil pool of south-central Okla. Is the middle zone in Wapanucka fm. Lies higher than Ingram sand of Lyons-Quinn pool, which is=Sykes sand of Wewoka pool.

Quinnesec ore-formation.

Huronian: Northern Peninsula of Michigan (Menominee iron region).

C. L. Rominger, 1881. [See under *Lake Hanbury sl. group*.]

J. Fulton, 1888. [See under *Lake Hanbury sl. group*.]

Quinnesec greenstone.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Quinnesec schists.*—Greenstone schists, gabbros, diabases, and diorites, cut by dikes of gabbro, diabase, diorite, and granite. Quinnesec Falls is on some of harder ledges of these rocks. Assigned to Archean, and treated as oldest fm. of region. [In 1911 (U. S. G. S. Mon. 52) C. R. Van Hise and C. K. Leith assigned these schists to late upper Huronian (post-Michigamme sl.).]

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), changed name of fm. to *Quinnesec greenstone* and classified it as older than Michigamme sl.

†Quinnimont beds.

†Quinnimont coal group.

Pennsylvanian: Western Pennsylvania, West Virginia, and southwestern Virginia.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_2, pp. xxii–xxiv). Recent correspondence with Prof. Fontaine has convinced me that use of term "*Kanawha River system*" will lead to future embarrassment, because Kanawha River does not receive that name until it has passed to W. of the great outcrops of that system, retaining its name of New River as low down as mouth of Gauley River, where the "Kanawha River system" has mainly or entirely gone under water level. The term New River system cannot be employed, because it is required for the coal measures of Montgomery and Wythe Counties, Va., and I have therefore substituted the name *Quinnemont beds*, with which I understand Prof. Fontaine to acquiesce, at least for the present and until a better name can be suggested. [The *Sharon and Quinnimont coal group* is shown as = "Pottsville cgl. (Seral), No. XII."]

W. G. Platt, 1878 (2d Pa. Geol. Surv. Rept. H_4), excluded *Sharon and Quinnimont coal group* from Pottsville fm.

J. J. Stevenson, 1880 (Am. Phil. Soc. Proc., vol. 19, pp. 219–262). *Quinnimont group or Seral (Pottsville) cgl.*—Mapped in parts of Lee, Wise, Scott, and Washington Counties, Va. Thickness 1,000± ft. Includes, at top, ss., 135 ft. thick, known as "Bee Rock," succeeded below by a series of shales, sss., and 6 or 7 coals, and at base cgl. 45 ft. thick. Overlies Mountain ls.

J. J. Stevenson, 1880 (Am. Phil. Soc. Proc., vol. 19, pp. 498–505). *Quinnimont coal group.*—Includes Purdue coal (100 ft. below top in Mercer Co., W. Va., and Tazewell Co., Va.), St. Clair coal, Reed coal, Tabor coal, Coal Branch coal, Nelson coal, and older unnamed coals.

J. J. Stevenson, 1885 (The Virginias, vol. 6, p. 71). *Quinnimont group* of Va. and W. Va. is=Rogers No. XII or Lower Coal Measures.

Quinnimont shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26). *Quinnimont sh.*—Sh. with thin beds of ss. and a few coal seams called the Horsepen group. Quinnimont coal is basal bed. Underlies Raleigh ss. and overlies Clark fm. Thickness 300 ft. Named for exposures at Quinnimont, Fayette Co., W. Va.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Quinnimont sh.*—Sandy sh., 180 to 225 ft. thick. Includes Beckley coal at top and Quinnimont coal at base. Underlies Raleigh ss. and overlies Thurmond fm. (=Clark and Pocahontas fms. of Pocahontas folio).

Quinnimont shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 206). *Quinnimont sh.*—Dark gray, laminated, with both argill. and aren. layers. Thickness 0 to 75± ft. Underlies Quinnimont ss. and overlies Fire Creek (Quinnimont) coal. Named for exposures at Quinnimont, Fayette Co.

This is a part only of Quinnimont sh. of Campbell, 1896. (See W. Va. chart I.)

Quinnimont sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 206). *Quinnimont ss.*—Current- to heavy-bedded medium-grained light-gray to buff ss., 0 to 100 ft. thick. Underlies Beckley ("War Creek") coal and overlies Quinnimont sh., and in places cuts out Quinnimont sh. and rests on underlying Fire Creek (Quinnimont) coal. Included in Middle Pottsville or New River group. Named for exposures at Quinnimont, Fayette Co.

Quitman bed. (In Trinity group.)

Lower Cretaceous (Comanche series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 728, 736). *Quitman bed.*—Across Quitman Mtn at Quitman Gap consists of (descending): (1) Massive *Caprotina* ls., 60 ft.; (2) thickly bedded siliceous shell ls., 20 ft.; (3) calc. flaggy and yellow friable ss. containing large *Exogyra* and oyster resembling *O. owenana*, 250 to 300 ft. Is younger than Mountain bed and overlies Bluff bed; all included in Washita div.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745, p. 21). Quitman bed and Bluff bed of Taff belong to Finlay ls.; his Mountain bed belongs to underlying Cox ss.

Named for Quitman Mtn and Quitman Gap, El Paso Co.

†Quitman limestone.

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., pp. 54-55). *Quitman cap rock.*—Massive argill ls. capping Quitman or No. 9 coal.

Same as Howard ls. memb. of Shawnee fm., according to H. Hinds and F. C. Greene (1915) and R. C. Moore (1936).

Named for exposures at Quitman, Nodaway Co.

Quivira shale. (In Kansas City formation.)

Pennsylvanian: Northeastern Kansas and northwestern Missouri.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Quivira sh.*, new name; overlies Dekalb ls. (which rests on Cherryvale sh.) and underlies Drum ls.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 91, 97). *Quivira sh.*—Sh. forming top memb. of Cherryvale sh. in southern Kans. Underlies Drum ls. and overlies Dekalb ls. [On p. 45 it is described as consisting of (descending): (1) Greenish-gray clay sh., 1 ft.; (2) carbonaceous sh., ½ ft.; (3) greenish-gray clay sh., 6 ft.; and (4) black fissile sh., 1 ft.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 43). *Quivira sh.*—Thin argill. and bituminous sh. underlying Cement City memb. of Drum ls. and overlying Westerville ls. (not DeKalb, but younger). Is=top part of Cherryvale sh. of SE. Kans. Named for Quivira Lake on Kansas River E. of Holliday, where the fm. is exposed below the dam. Also typically shown at E. edge of Holliday, Kans. Was erroneously considered lower part of Chanute sh. by Mo. geologists.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Quoddy shale.

Silurian (Niagaran): Southeastern Maine (Eastport quadrangle, Washington County).

E. S. Bastin and H. S. Williams, 1913 (Maine Water Storage Comm. 3d Ann. Rept., p. 168; Geol. Soc. Am. Bull., vol. 24, pp. 378, 379). [Name mentioned but not defined. Refers to Eastport folio.]

E. S. Bastin and H. S. Williams, 1914 (U. S. G. S. Eastport folio, No. 192, pp. 3, 10). *Quoddy sh.*—Chiefly hard sh., some portions of which are slaty or even schistose. Contains minor amounts of volcanic rocks, both flows and tuffs, chiefly rhyolite but some diabase. Greatly disturbed and altered by intrusives. The few fossils indicate very early Niagaran. Oldest fm. in Eastport quad. Named for exposures at West Quoddy Head (easternmost point of land in United States), Washington Co.

On 1933 geol. map of Maine, by A. Keith, the sedimentary rocks of West Quoddy Head are mapped as Miss. and the igneous rocks as Dev.

Quoggy Joe quartz trachyte.

Age (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 109, 111, 164–168). *Quoggy Joe quartz trachyte* forms entire mass of Quoggy Joe group of hills, Aroostook Co.

Rabbitskin sandstone.

Cretaceous: Canada (Mackenzie).

E. J. Whittaker, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 99).

Rabbit Spring formation.

Tertiary (Pliocene?): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 71, etc.). *Rabbit Spring fm.*—Ss., apparently derived from underlying Spearhead rhyolite, with lenses of cgl. composed of pebbles of volcanic rock. Thickness 10 to 15 ft., possibly 25 ft. Upper part merges with overlying Malpais basalt. Probably fluviatile. Exposed in bluffs above Rabbit Spring and in other places along edge of Malpais Mesa, Goldfield dist. If Siebert [Esmeralda] fm. ever covered this part of Goldfield dist. it was eroded away before Rabbit Spring fm. was deposited.

Rabble Run red sandstone member (of McKenzie formation).

Silurian: Western Maryland.

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol., p. 36). *Rabble Run red ss. memb.*—These red strata lie about 100 ft. below top of McKenzie fm. in Washington Co. In passing E. they make their first appearance in Cacapon Mtn, W. of Hancock, as thin tongues of red strata a few ft. thick, separated by gray bands. Farther E. increase in thickness until they finally merge to form one nearly continuous mass of red beds that attain a thickness of nearly 100 ft. on Rabble Run in North Mtn. Closely resemble the younger Bloomsburg red ss.

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 660), show *Rabble Run red bed*=basal part of *Bloomsburg red beds.*

Raccoon shale.

Mississippian: Central Ohio.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, pp. 216, 219). *Raccoon shales.*—Blue and gray shales full of concretionary masses of iron ore, which are mere shells filled with marl or sand; 300 ft. thick; near bottom some layers are massive enough for quarrying. Overlain by Black Hand cgl. or Granville beds; underlain by Sunbury black sl. All included in Waverly group.

Same as Cuyahoga fm. of C. S. Prosser, C. R. Stauffer, J. A. Bownocker, G. D. Hubbard, and others, but lower part only of Cuyahoga fm. of J. E. Hyde (Jour. Geol., vol. 23, 1915, pp. 655–682, 757–779).

Named for exposures on Raccoon Creek, Licking Co.

†Raccoon River beds.

Pennsylvanian: Central southern Iowa and northwestern Missouri.

H. F. Bain and A. G. Leonard, 1898 (Geol. Soc. Am. Bull., vol. 10, pp. 11–12). *Raccoon River beds.*—Sandy shales, 30 to 70 ft. thick, forming top memb. of Des Moines beds in central Iowa. Overlie Appanoose beds. Probably same as Haworth's Pleasanton fm., but local name preferable.

Same as Pleasanton fm., older name.

Named for Raccoon River, Dallas Co., Iowa.

Racine dolomite.

Silurian (Niagaran): Southeastern Wisconsin and northeastern Illinois (?).

J. Hall, 1861 (Wis. Geol. Surv. Rept. 1860, pp. 1–7). I have arrived at certain results fortified by occurrence of numerous fossils which lead me to conclude that *Racine ls.*, mentioned in a former rept [where?], is upper memb. of Niagara group, while the heavy-bedded mass below is but the expansion of the lss. of Clinton group.

J. Hall, 1862 (Wis. Geol. Surv. Rept. 1, p. 67). *Racine ls.*—Friable yellow or ocherous ls.; gray, rarely bluish-gray, or buff-colored mag. ls. of crystalline texture, very tough and compact in some portions but extremely porous. Thickness 250 to 500 ft. Absent in SW. Wis. Best developed at Racine. Rests on Waukesha ls. at Waukesha. Extends from Kewaunee to S. line of State. Contains Niagara fossils. May represent upper memb. of Niagara group of western N. Y.

T. C. Chamberlin, 1877 (Wis. Geol. Surv. vol. 2, pp. 360–377). *Racine beds redefined.*—Equiv. to what has been known as *Racine ls.* (Geol. Wis., 1862, p. 67) except that upper portion (consisting of rough, thick-bedded irregular dol., usually free from impurities and of buff, gray, or blue color) is now separated as Guelph beds, and the reefs and associated rocks W. of Milwaukee, which have been referred to a lower horizon, are now included in it. Rests on Waukesha beds. Where separation btw. Racine and Waukesha is not distinct it is best to regard the chertless beds as Racine and the cherty beds as Waukesha. The Racine beds consist of mag. ls. of very irregular texture, forming reef-like masses of conglomeratic rock, which on denuded surface appear as mounds or ridges, and which graduate into various kinds of porous, granular, irregularly bedded rock, or into fine-grained, compact, even-bedded strata. In its N. portion, where it rests on Upper Coral beds, it has a much more uniform character. At Racine (whence the fm. takes its name), as exposed at rapids of Root River, it is a blue, gray, or buff brittle dol. with somewhat glassy fracture, subcrystalline structure in part and earthy in part, and contains many geodic cavities filled with calcite and pyrite and sometimes mammillary deposits; texture uneven, sometimes granular, sometimes brecciated, usually coarse and porous, but sometimes fine and compact; bedding irregular, but usually rather heavy, from 5 ft. downward. Fossils abundant. To N. (Sheboygan region) Racine ls. rests on Upper Coral beds, which appear = upper part of Waukesha beds.

In subsequent repts the Racine was treated by some writers as excluding Guelph and by other writers as including Guelph.

G. M. Ehlers, 1920 (Mich. Acad. Sci. 21st Rept., pp. 87–90). The division of the Racine of Wis. into Guelph and Racine by Professors Chamberlin and Whitfield is apparently unwarranted, in opinion of writer and of E. O. Ulrich. Ulrich states there is no strat. nor paleontologic break btw. beds of Racine fm.

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93), treated Racine and Guelph as two distinct units in SE. Wis., and stated that both are of Lockport age.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 27). Although there is some doubt that the Racine of eastern Wis. can be definitely recognized in NW. Ill. and NE. Iowa, in all probability equiv. beds occur in sections to be seen today, and the term *Racine* appears in these sections [overlain by Port Byron ls. and underlain by Waukesha dol.].

Radcliff formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Derivation of name not stated.]

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct., 1932, pp. 329–356). *Radcliff fm.*—Chiefly flaggy, corrugated, impure, aren. ls., gray when fresh, reddish brown when weathered, intercalated with a dark-gray thinly banded lime-silicate rock, containing muscovite, biotite, diopside, epidote, zoisite, vesuvianite, and abundant pyrrhotite; also gray and white sss., gray and white mottled crystalline lss., and finely striped gray and green sl. and phyllite. Thickness 600± ft. Conformably overlies Sentinel dol. and conformably underlies Redlands dolomitic ls., all included in Telescope group (lower Paleozoic?), of S. part of Panamint Range. [Derivation of name not stated and not apparent from his maps.]

†Raddatz porphyry.

Miners' local name for the porphyry of Tert. (Eocene?) age in Stockton dist., central northern Utah, first cut by mine workings near Stockton under supervision of Mr. Raddatz. (See U. S. G. S. P. P. 173, pp. 52, 53, 1932.)

Raft lake beds.

Pliocene (middle ?): Southern Idaho (Cassia County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Raft lake beds.*—Buff-colored clay, silt, sand, often in lenticular form and in places filled with concretions; partly consolidated; weathers to brown sandy loam, forming rounded hills except along Snake River, where it forms a terrace. Thickness 200± ft. Exposed along S. shore of Lake Walcott as far as mouth of Raft River. Form bluff along Lake Walcott Reservoir. Basal cgl. is exposed at head of Fall Creek. Older than Banbury volcanics and younger than Rockland Valley basalt. In places rest uncon. on Paleozoic ls.

Raft River formation.

Pliocene (?): Northwestern Washington.

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22, p. 202). *Raft River fm.*—An outcrop on N. side of mouth of Raft River, which contains concretionary ss. and gray sh., which Dr. Arnold considers=part of Quinaielt fm.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 604). The Raft River Plio. of Reagan contains a small but characteristic Empire fauna.

Ragan sand.

A subsurface sand of late Penn. age in central northern Okla. In Perry pool, Noble Co., it is 100 ft. thick and lies at 1,805 ft. depth, the Vann sand lying at 1,587 ft. and the Tonkawa at 2,714 ft.

Ragged Point series.

Tertiary: West Indies.

J. W. W. Spencer, 1902 (London Geol. Soc. Quart. Jour., vol. 58, p. 360).

Raggedy Mountain gabbro.

Pre-Cambrian: Southwestern Oklahoma.

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 136). *Raggedy Mtn gabbro.*—Gabbro, including a considerable variety of basic rocks regarded as facies of one magma. Possibly eruptive through Carrollton Mtn porphyry. Assigned to Archean (?). Named for Raggedy Mtns, Kiowa Co.

Ragland sandstone.

Middle Devonian (Hamilton): Eastern Alabama (St. Clair County).

C. Butts, 1927 (Wash. Acad. Sci. Jour., vol. 17, pp. 128–129; Am. Jour. Sci., 5th, vol. 14, pp. 365–380; U. S. G. S. Bessemer-Vandiver folio, No. 221, p. 9, footnote). *Ragland ss.*—Sss. of Hamilton age in Ala. Heretofore included in Frog Mtn ss. At type loc. the fm. is uncon. overlain by Fort Payne chert and uncon. underlain by Little Oak ls., and it consists of (descending): (1) Thick-bedded ss., some layers coarse-grained, others fine-grained with nodular chertlike bands, some dark sh., scattered fossils, 48 ft.; (2) ss. and sh., ferruginous, brown, rotten, highly fossiliferous, 2½ ft.; (3) hard fine-grained calc. ss., fossiliferous, 1½ ft.; (4) dark argill. sh., fossiliferous, ½ ft.; (5) ls., rather coarsely crystalline, dark, sandy, fossiliferous, 1 ft. Named for exposures in abandoned quarry 1½ mi. S.-SW. of Ragland, St. Clair Co.

Ragland sand.

A subsurface sand, lying at top of or above Ohio sh., in eastern Ky. The name has also been applied to an older sand, of Middle Dev. (Onondaga) age, in eastern Ky., but the true Ragland is the younger sand.

Rail Canyon sandstone member (of Vermejo formation).

Upper Cretaceous: Northeastern New Mexico (Raton coal field).

W. T. Lee, 1924 (U. S. G. S. Bull. 752). *Rail Canyon ss. memb.*—Massive cross-bedded ss., 0 to 50 ft. thick, lying near middle of Vermejo fm. in Raton coal field. Is readily recognized by its numerous inclusions of clay balls. Forms roof of mines in many places in Dawson dist. and extends to southern extremity of that dist., but its relation to beds S. of this dist. is not known. Named because of economic importance in making a firm roof in Dawson mines, in Rail Canyon. Rests uncon. on 0 to 65± ft. of sh. and sss. forming lower part of Vermejo fm., and lies 100± ft. below top of Vermejo fm.

Railroad Ridge basalt.

Pliocene: Northwestern Nevada.

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, p. 14). South of Pueblo Mtn. and immediately W. of tilted spur formed by southern extension of the volcanic series as it plunges southward, lies Thousand Creek Basin. This basin, which is but superficially eroded, contains stratified tuffs of unknown thickness, which directly overlie Pueblo Mtn series, which writer correlates with upper flows exposed on Steens Mtn. From vertebrate fauna Merriam considered these beds lower Plio., but later studies by C. Stock (personal communication) indicate they are "definitely Pliocene and fairly late in that period." These light-colored tuffs are locally capped by a thin flow known as *Railroad Ridge basalt.* This lava was thought to have originally filled a river bed.

†Rainbow beds.

Pliocene or Miocene: Southern California (Fresno and Kings Counties).

F. M. Anderson, 1905. (See 1905 entry under *†Coalinga beds.*)

Rainbow series.

Post-Franciscan: Northern California (Humboldt County).

W. Stalder, 1915 (Calif. State Min. Bur. Bull. 69, pp. 447–449). *Rainbow series.*—Post-Franciscan and pre-upper Mio. rocks of Rainbow Ridge, divided into Walker Ridge sss. above, 50 to 750 ft. thick, and Walker Ridge shales below, 500 to 1,500 ft. thick. Underlies Bear River series (upper Mio.) and overlies post-Franciscan rocks called basal ss. series.

Rainbow member (of Richfield formation).

Pre-Cambrian: British Columbia (Cariboo district).

G. Hanson, 1935 (Canada Dept. Mines Geol. Surv., Bur. Econ. Geol. Mem. 181, No. 2396, p. 4).

Rainbow Bend sand.

A subsurface sand in lower part of Cherokee sh. in Rainbow Bend field, Cowley Co., Kans. Is correlated by D. R. Snow and D. Dean with Burbank sand of Okla. and assigned to Bartlesville sand zone.

Raines Corner limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 404). *Raines Corner ls.*—Dark and hard; weathers gray; 5 to 10 ft. thick; marine fossils. Underlies Indian Mills sh. and overlies Raines Corner sh.; all members of Bluefield group [fm.]. Type loc. in bed of Indian Creek, ½ mi. NW. of Raines Corner, Monroe Co. Also observed in Mercer and Summers Counties, W. Va., and has been traced as far S. as Big Stone Gap, Va.

Raines Corner shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 409). *Raines Corner sh.*—Green or grayish sandy deposit, 5 to 20 ft. thick, with marine and plant fossils. Underlies Raines Corner ls. and overlies Raines Corner coal; all members of Bluefield group [fm.]. Type loc. on W. side of Indian Creek along the State road, about 1½ mi. NE. of Raines Corner, Monroe Co. Observed also in Mercer and Summers Counties, W. Va., and in Giles Co., Va.

Rainy limestone member (of Clear Fork formation).

Permian: Central northern Texas (Taylor County).

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 27, pl. 1). *Rainy ls.*—Dark-gray to brown fossiliferous ls., locally white, 1 to 3 ft. thick, separated from underlying Lueders ls. by red and blue sh. and lying considerably lower in the section than Standpipe ls., the intervening beds consisting of some unnamed lss. and blue and brown shales. Type loc. along Rainy Creek, 6 mi. E. of Abilene, Taylor Co. Forms escarpment S. of T. & P. R. R. The name is used in unpublished rept. of W. A. Riney. Included in Wichita-Albany fm.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, pl. 9, pp. 948, 949). *Rainy ls.* has been followed as far N. as eastern Haskell Co. and may be present as a thin stringer as far as southern Baylor Co. Lies in basal part of Clear Fork fm., about 70 ft. above its base and about 30 ft. below Lytle ls.

Rainy Mountain limestone.

Lower Ordovician: Southwestern Oklahoma.

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 138–140). *Rainy Mtn ls.*—Blue and gray ls. in Wichita Mtns, folded and metamorphosed by Quana granite. Conformable on Blue Creek series (Camb.). Assigned to Ord.

Appears to be same as Arbuckle ls. See **J. A. Taff, 1904 (U. S. G. S. P. P. 31, pl. 2).**

Named for Rainy Mtn, Kiowa Co.

†Raised Beach formation.

Pleistocene: Southern California (San Pedro and vicinity).

R. Arnold, 1902 (Calif. Acad. Sci. Mem., vol. 3), applied this nongeographic term to beds younger than San Pedro series.

Raisin River dolomite member (of Bass Islands dolomite).

Silurian (Cayugan): Southeastern Michigan, western Ontario, and northern Ohio.

W. H. Sherzer and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 546). *Raisin River beds.*—Top memb. of Lower Monroe fm. [Bass Islands dol.]. Discon. overlain by Sylvania ss. and underlain by Put-in-Bay dolomites. [On a later page (553–556) thickness is given as 200± ft.]

Named for exposures on Raisin River, Monroe Co., Mich.

Raker Peak pyroxene andesites.

See under *West Prospect basalt.*

Rakes Creek shale. (In Tecumseh shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 47, 53). *Rakes Creek sh.* is proposed for upper unit of Tecumseh sh. memb., i. e., for interval btw. Ost ls. below and Rock Bluff ls. above, from a locality in NW¼ sec. 5, T. 10 N., R. 14 E., on Rakes Creek, Cass Co., Nebr. Thickness 20± ft.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 48, 180). *Rakes Creek sh. memb.* of Tecumseh sh. is light-bluish to brownish clayey and sandy sh., and in most places includes a fairly persistent ss.; is mostly unfossiliferous. Thickness 10± ft. Overlies Ost ls. Recent study by me in Nebr., W. Iowa, and NW. Mo. indicates that Rock Bluff ls., which next overlies Rakes Cr. sh., is certainly = "middle Deer Creek ls." in Kans.; but this need not make use of Rakes Creek sh. inapplicable in Kans. Upper bdy of Rakes Creek may be considered as extending to slightly higher strat. plane in N. than in S. [Moore's 1936 revised classification for Kans. shows, on p. 48, Rakes Creek sh. separated from Rock Bluff ls. by Ozawkie ls. and Oskaloosa sh.]

Raleigh sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 493). *Raleigh ss.*—The cgl. bed at top of section exposed on road from Prince to Raleigh. Been traced by writers from Tug River and Great Flat Top Mtn. in Pocahontas field, through Wyoming and Raleigh Counties, to New River, and along that stream from Glade to Cotton Hill. Varies in thickness from 40 to 100 ft., and in character from a massive pebbly rock to a series of flaggy sss.; very often it is a cgl. Overlies Royal fm. and underlies Sewell fm.

M. R. Campbell, 1896 (U. S. G. S. Pocahontas folio, No. 26). *Raleigh ss.*—Coarse, massive ss., 80 to 150 ft. thick. Overlies Quinnimont fm. and underlies Sewell fm. Covers a large portion of surface of Raleigh Co., W. Va.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2a, p. 198), divided Raleigh ss. into *Upper Raleigh ss.*, 60 to 137 ft. thick, and *Lower Raleigh ss.*, 64 to 93 ft. thick, the two being separated by 1 to 37 ft. of sh., coal, and fire clay, and these names have been used in some subsequent W. Va. Geol. Surv. repts.

Ralls Ford shale.

See *Rolls Ford sh. memb.*

Ralston group.

Pennsylvanian and Permian: Central northern Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 7, 13). *Ralston group.*—Includes all beds btw. base of Pawhuska fm. of J. P. Smith below and base of Wreford ls. (or its southern continuation the Payne ss.) above.

Named for Ralston, Pawnee Co.

†Ralston formation.

Eocene (basal): Northern Wyoming (Bighorn Basin region).

W. J. Sinclair and W. Granger, 1912 (Am. Mus. Nat. Hist. Bull., vol. 31, pp. 60–62). *Ralston beds or fm.*—A vertebrate faunal horizon near top of Fort Union (?) fm. on N. side of Shoshone River in bluffs opp. Ralston Station, where the beds dip below *Systemodon* horizon. Appears to underlie Knight fm. (of Wasatch group), but discovery in them of *Limnocyon* and *Bathyopsis* makes further study desirable. If the beds prove to be older than the Knight, and it is deemed desirable to give them a fm. name, they may be referred to as *Ralston beds* or *Ralston fm.*

W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, pp. 202–205). The 1912 work in Clark Fork and Bighorn Basins proved the horizon for which *Ralston beds* or *Ralston fm.* was previously suggested is very distinct, older than Gray Bull, and perhaps representing top of Paleocene series. *Ralston* is preoccupied, so *Clark Fork beds* is here substituted, from Clark Fork Basin.

Ralston formation.

Pre-Cambrian: Central northern Colorado (Boulder region).

See under *Coal Creek qtzite*, 1934.

Ramah series.

Pre-Cambrian: Labrador.

A. P. Coleman, 1921 (Canada Geol. Surv. Mem. 124, p. 25).

†Rambler formation.

Miners' local name for 180 ft. of thin-bedded siliceous ls. in lower part of Oquirrh fm. (Penn.), lying 213± ft. below Galena King ls. and overlying the Rambler ls. of the miners. Exposed in Rambler claim of Stockton dist., central northern Utah. (See U. S. G. S. P. P. 173, 1932.)

Rambler limestone.

Miners' local name for 4 ft. of rather pure ls. underlying Rambler fm. of miners and lying 90 ft. above their Hercules ls., in lower part of Oquirrh fm. (Penn.) of Stockton dist., central northern Utah. Exposed in Rambler claim. (See U. S. G. S. P. P. 173, 1932.)

†Ramona formation.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 36). *Ramona fm.*—Strata btw. top of Skiatook fm. below and top of Avant ls. memb. above. Divided into three members, Dewey ls. at base, Ochelata sh. in middle, and Avant ls. at top. Thickness 100 ft. Name to be applied btw. Arkansas River and line approx. coincident with Claremore and Nowata quads.

Includes Dewey ls. and lower part of Ochelata fm. of present nomenclature. Named for Ramona, Washington Co.

Rampart group.

Mississippian (probably lower): Yukon-Tanana region, Alaska.

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 155–169). *Rampart series.*—Characterized by green color (which changes to dark red on exposure), by a peculiar massive structure and firm texture, and by presence of volcanic material. Consists of diabase flows, tuffaceous sediments, impure lss. (often glauconitic), hard green shales and slates, and some ss. Some of the rocks are light gray and appear to be very fine-grained siliceous sediments or novaculites. Green color is due partly to glauconite in tuffs and impure sediments, but chiefly to presence of serpentine, chlorite, and other green minerals arising from decomposition of the igneous rocks. The rocks of Rampart series are occasionally cut by diabase dikes and later intrusions. Thickness great. Overlies Fortymile series and underlies Upper Carbf. Tahkandit series. Named for fact they are exposed in Lower Ramparts of the Yukon.

Further work showed that Rampart series of Spurr included Middle Dev. and Miss. rocks equiv. to Woodchopper volcanics (Middle Dev.), Circle volcanics (Miss.), and probably a younger Miss. fm., but that at type loc. its fossils are Miss. (See J. B. Mertie, Jr., U. S. G. S. Bull. 816, 1930, pp. 75–95.) The name is now restricted to rocks corresponding to those at type loc.

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Rampart group* (Mississippian) of Yukon-Tanana region consists of sed. rocks (chert, sh., sl., argillite, ss., and a few beds of ls. and calc. grit) and bedded greenstones, tuffs, and breccias. Associated with the group are coarse-grained intrusives, in part contemp. and in part younger. Sediments probably constitute one-third to one-half of the group. The rocks are closely folded and locally faulted and brecciated. Of Miss. age. Thickness may be 5,000 to 10,000 ft.

Rampart limestone.

Ramparts limestone.

Devonian: Canada (Mackenzie).

T. O. Bosworth, 1921 (Geol. Mag., vol. 58, p. 287, and Inst. Pet. Technologists Jour., vol. 7, No. 28). [In both of these publications *Rampart ls.* is used. All subsequent Canada Geol. Surv. repts. by E. M. Kindle and G. S. Hume, use *Ramparts ls.*]

Ramp Creek member (of Harrodsburg limestone).

Mississippian: Southern Indiana.

P. B. Stockdale, 1929 (Ind. Acad. Sci. Proc., vol. 38, pp. 233–242). *Ramp Creek memb. of Lower Harrodsburg ls.*—Variable siliceous ls., with irregularly distributed crinoid lenses, and characterized by prevalence of geodes and chert. Thickness 16 to 28 ft. Basal memb. of Lower Harrodsburg ls. Underlies Leesville ls. memb. and overlies Borden group. Completely exposed in ravines tributary to Ramp Creek, SE. part of Monroe Co.

Ramsey sand.

A subsurface Penn. sand in NE. Okla., lying lower than Checkerboard lime and higher than Big lime (Oologah ls.). In Osage Co., Okla., the name has been applied to a sand, 5 ft. thick, lying 40 ft. above Peru sand. In SW. Okla. the name has been applied to a sand, 300 ft. thick, correlated with part of Wellington fm. (Perm.). The name has also been used in SE. Kans.

Ramsey Lake graywacke conglomerate.

Pre-Cambrian: Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept. 1905, vol. 14, pt. 3, p. 14).

Ramshorn slate.

Ordovician (Lower and Middle?): Central Idaho (Custer County region).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Ramshorn sl.*—Dark, thin-bedded unfossiliferous sl. and argill. qtzite containing Beekmantown graptolites. Thickness 2,000± ft. Older than Kinnikinic qtzite and overlies (uncon.?) Bayhorse dol. Named for well-known mine near head of Bayhorse Creek, Custer Co.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 945, etc.). *Ramshorn sl.*—Composes all Ord. argill. rocks below Kinnikinic qtzite in Bayhorse region. Overlies Bayhorse dol. Forms country rock of well-known Ramshorn mine. Extends in a band, 2 to 5 mi. wide, from Mill Creek, on N. border of Bayhorse quad., southward past Clayton, a distance of 20± mi. Smaller isolated outcrops emerge at intervals through the cover of Challis volcanics, all the way to S. bdy of Bayhorse quad. Is almost exclusively a thin-banded dark-green to purplish argill. rock with well-developed slaty cleavage cutting the banding at high angles. Locally (in N. part of quad.) cgl. at base; some beds are more qtzitic or more calc. than the average. Locally lenses of ls. and qtzite are interbedded. Max. observed thickness of conglomeratic beds is a little more than 500 ft. Est. thickness of fm. 2,000+ ft. Fossils.

Ramshorn volcanic series.

Tertiary (post-middle Eocene): Central Wyoming (Owl Creek Mountains).

D. Love, 1934 (Geol. Surv. Wyo. Bull. 24, pt. 4, pp. 21–22). At W. end of Owl Creek Mtns a series of [unnamed] aggls. and breccias of post-Green River age is uncon. overlain by 0 to 700 ft. of soft coarse-bedded white andesitic tuff, which forms lower part of the rocks here named *Ramshorn volcanic series*. Lying on these white tuffs is a series of tuffs, pink andesite flows, and coarse pink to gray aggl. or breccia, 0 to 600 ft. thick, which forms upper part of Ramshorn volcanic series. All that can definitely be said of the age of this series is that it is post-Green River. Named for The Ramshorn, a mountainous ridge lying 12 mi. W. of area studied, which is composed of rocks of this volcanic series.

Rancocas group (also **formation**).

Eocene (lower): New Jersey and Delaware.

W. B. Clark, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, pp. 337–338, and Jour. Geol., vol. 2, pp. 161–177). *Rancocas fm.*—Largely greensand, although much more highly glauconitic in lower than in upper half. Lower half largely a pure greensand, but in some parts of State it becomes very argill. toward base, forming the so-called "chocolate marl." Is Middle Marl Bed of previous repts. Thickness 45 ft. Underlies Manasquan fm. and overlies Redbank fm. Rancocas Creek, Burlington Co., N. J., cuts through the fm., exposing its full sequence.

Later repts give thickness as 0 to 125 ft., and divide the deposits in N. J. into Vincentown sand above and Hornerstown marl below. In Delaware the subdivisions are not recognized and the deposits are there called *Rancocas fm.*

Rand schist.

Pre-Cambrian: Southern California (Randsburg quadrangle, Kern and San Bernardino Counties).

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95, pp. 23–29, map). *Rand schist.*—Predominately mica-albite schist, showing highly developed schistosity; usually dark silvery gray, but weathers yellowish brown. Amphibole schists are next in order of abundance, and are only slightly subordinate in amount to the mica albite schist. Actinolite schist, actinolite-talc schist, talc schist, and hornblende schist also occur in minor amounts. The mica-albite schist and the amphibole schists are interbedded with qtzite and ls. in beds from 1 to 10 ft. thick. Greenstone schist, of igneous origin, is present in small, irregular, and isolated masses. Rest of fm. is of sed. origin. Is believed to uncon. overlie Johannesburg gneiss and to uncon. underlie the rocks of Paleozoic age. Assigned to Archean. Thickness exposed is probably btw. 1,500 and 2,000 ft. Composes bulk of Rand Mtns, Kern Co.

Randels Island gneiss.

R. P. Stevens, 1867 (N. Y. Lyc. Nat. Hist. Annals, vol. 8, pp. 116–120). [*Randels Id. gneiss* is used on "Section across New York [Manhattan] Island along southern shore of Spuyten-Duyvel Creek and Harlem River."]

Randlett horizon. (In Duchesne River formation.)

Oligocene: Eastern Utah (Uinta Basin).

J. L. Kay, 1934 (Carnegie Mus. Annals, vol. 23, pp. 357–359). To facilitate correlation and reference of specimens now in Carnegie Mus., Duchesne River fm. is divided into 3 horizons, from lowest to highest, the *Randlett*, the *Halfway*, and the *Lapoint*. Type loc. of Randlett horizon is N. and E. of town of that name, and it consists of 478½ ft. of brown, red, bluish-gray, and variegated clays alternating with brown and gray sss. These beds are capped by a 10-ft. stratum of cgl., which is taken as base of Halfway horizon. Latter horizon is well exposed along Halfway Hollow, the basin which drains that dist. in Twps 4 and 5 S., btw. Rs. 19 and 20 E. Salt Lake meridian. There are 557½ ft. of sediments, chiefly sss. and shales with several cgl. members, referred to *Halfway horizon*. The sss. in general are coarser than those of the Randlett. Overlying the Halfway horizon is 22 ft. of bluish-white clay, which can be seen just N. of Vernal-Lapoint road and which is quite persistent throughout the area. This is considered basal memb. of *Lapoint horizon*, the uppermost div. of Duchesne River fm. The Lapoint horizon is typically seen along head of Halfway Hollow E. and N. of town of Lapoint. The Lapoint includes 336 ft. of conglomeratic sss., sandy clays, and coarse cgls.

Randolph limestone.

Mesozoic (Lower Cretaceous?): Southeastern Arizona (Tombstone district).

W. P. Blake, 1902 (Tombstone and its mines). *Randolph ls.* (Paleozoic, probably Carbf.) overlies ancient sed. strata of ls.

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3–37). *Randolph ls.*, 300 ft. thick, underlies Ajax qtzite in Tombstone min. dist., Ariz. [Is oldest fm. mentioned.]

F. L. Ransome, 1920 (U. S. G. S. Bull. 710D). Randolph ls. of Church is Mesozoic, probably Comanche (Lower Cret.).

Randolph phyllite.

Middle Ordovician: Northeastern Vermont (Orange County) and southeastern Vermont (Windsor County).

C. H. Richardson, 1924 (14th Rept. Vt. State Geol., p. 90). *Randolph phyllite*.—Fine-grained phyllites, of either very dark-gray or bluish-gray color, and with schistose structure. Are interbedded and interstratified with Waits River ls. Are the phyllite part of Memphremagog group, and in Bethel Twp, and doubtless to southward, are the predominant phase of that group. Extend in N.–S. direction, entirely across Randolph Twp [Randolph quad., Orange Co.]. Are older than Bradford schists, which overlie Waits River ls., and younger than Orleans phyllite, which underlies Waits River ls.

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 208–246). *Randolph phyllite* belongs to Memphremagog group. This phyllite and younger Brattleboro phyllite are interstratified with Waits River ls.; all assigned to Ord. It forms a continuous terrane across W. part of Reading and Cavendish and extends into Chester.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 13, p. 360). In central Green Mtns, Vt., the Ord. consists of *Randolph phyllite* (correlated with Black River ls. of N. Y.), Waits River ls. (Chazy fossils), and Memphremagog sl. (Beekmantown fossils).

Randolph granite.

Late Devonian or late Carboniferous: Northern New Hampshire (White Mountains).

See 1928 entry under *Chatham granite*.

M. Billings, 1935 (letter dated July 19). Type loc. of *Randolph granite* is in Ravine of the Castles, 1 mi. NW. of Mount Jefferson, in Mount Washington quad. [This ravine lies S. of Randolph Range and Randolph Twp.]

M. Billings, 1935 (letter dated Aug. 27). *Randolph granite* belongs to New Hampshire magma series [which he classifies as late Dev. or late Carbf.].

Randolph granite.

Devonian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Quarried at Randolph, Randolph Twp, Orange Co.

Random formation.

Pre-Cambrian (Keweenawan): Newfoundland.

C. D. Walcott, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 3–5). *Random terrane*, Algonkian, Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Random fm.*—Red sss., shales, and qtzites, uncon. underlying Lower Camb. Bonavista fm. and uncon. overlying Signal Hill fm. (Huronian). No fossils. Assigned to Keweenawan epoch of Algonkian. [Derivation of name not stated.]

Random Sound series.

Cambrian: Newfoundland.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 196).

Randville dolomite.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Crystal Falls and other districts).

C. R. VanHise, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 9–16). *Randville dol.*—A nonclastic sediment in Crystal Falls dist., Minn. Believed to make a period of subsidence and transgression of the sea to NE. Thickness 500 to 1,500 ft. Thickest on Fence River. Overlies Sturgeon qtzite and underlies Mansfield sl. Correlated with Kona dol. of Marquette dist. [Also described by J. M. Clements on pp. 34+ of this rept. (in detailed description of Crystal Falls dist.), where Clements expressed opinion this dol. is same as Kona dol. of Marquette dist., but stated that, since Smyth had introduced Randville dol. for Crystal Falls dist., he would use Randville.]

H. L. Smyth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 110–114). *Randville dol.*—Consists, so far as known, almost wholly of crystalline dolomitic rocks. A few thin layers of schist and qtzite are shown by drills to be interbedded in the dol. Color most commonly pinkish or bluish white. Thickness 500 to 1,500 ft. Overlies Sturgeon qtzite and underlies Mansfield fm. Named for exposures within a short distance of Randville station.

Rangeley conglomerate.

Devonian (?): Western Maine (Franklin County).

E. S. C. Smith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 147–154). *Rangeley cgl.*—One memb. (probably the older) consists of about 400 ft. of dark-gray, coarse-grained arkose, containing much blue quartz and feldspar and some biotite. The other memb. consists of about 3,900 ft. of medium coarse cgl. with intercalated sandy or arkosic layers. Rests on argillite and is overlain by argillite. No fossils, but is probably Dev. Named for development near Rangeley and at SE. end of Rangeley Lake, Franklin Co.

On 1933 geol. map of Maine, by A. Keith, the rocks around Rangeley and Rangeley Lakes are mapped as Sil., Ord., and Camb.

†Ranger formation. (In Canyon group.)

Pennsylvanian: Central northern Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., p. lxvii), used *Brownwood-Ranger series*. See under †*Brownwood div.*

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Ranger fm.*, approx. 215 ft. thick, includes all strata btw. top of Graford ls. memb. of Graford fm. and top of heavy Ranger ls. (top memb. of Ranger fm.). Underlies Eastland fm. and overlies Graford fm.

Replaced by Brad fm. by F. B. Plummer and R. C. Moore, 1922.

Named for exposures in vicinity of Ranger, Eastland Co.

†Ranger series.

Pennsylvanian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). *Brownwood-Ranger series.* [See 1st entry under *†Brownwood div.* Later repts state †Brownwood is practically=Canyon group.]

Ranger limestone member (of Brad formation).

Pennsylvanian: Central and central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Ranger ls.*, top memb. of Ranger fm., forms a scarp that can be seen W. of Ranger and is responsible for the beautiful and wild topography in western Palo Pinto Co., where Brazos River has cut deep canyons into the scarp. The abundance of chert nodules and brown iron-stained layers in Ranger ls. distinguishes it from all other members of Canyon div.

C. S. Ross, 1921 (U. S. G. S. Bull. 726G, p. 306). *Ranger ls. memb. of Canyon fm.*, 66 ft. thick, is exposed in SE. part of Lacasa area. Consists of (descending): (1) Thin-bedded buff ls., 4 ft.; (2) sh., 12 ft.; (3) light-gray massive ls., 50 ft. [Nos. 1 and 2 are now included in overlying fm., and are not considered a part of Plummer's Ranger ls.]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 35; Univ. Tex. Bull. 2132, pp. 109+). *Ranger ls. memb.*, massive and very cherty ls., 10 to 50 ft. thick. Is here defined as top memb. of Brad. fm., of Canyon group. Occurs in both Colorado River Valley and Brazos River Valley. Is the "Cherty" ls. of Drake.

Named for exposures W. of Ranger, Eastland Co.

Ranger marble.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 622, 642). *Ranger marble.*—Massive light bluish-gray fine-grained marble of dolomitic composition is most characteristic rock. Comparatively little jasper or other siliceous material, and schistose members are few and thin. Thickness 2,395 ft. Underlies Towner greenstone with probable conformity and conformably overlies Anderson phyllite. Exposed at various points northeastward to Brooklyn ranger station, for which it is named. Assigned to early Algonkian.

Ranger oil sand.

A subsurface sand in Marble Falls ls. (Penn.) of Ranger field, central northern Tex., lying 190 to 200 ft. below top of Marble Falls ls.

Rapid limestone.

Middle Devonian: Central eastern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, p. 149) and 1913 (Iowa Acad. Sci. Proc., vol. 20, pp. 205, 206). *Rapid terrane.*—Series of lss. in lower part of Cedar Valley ls., consisting of (descending) 2 ft. of gray massive, compact coralline ls.; 3 ft. of bluish heavy-bedded ls. containing *Cladopora*; 6 ft. of blue massive, compact ls. containing ***Cystiphyllum***; and 20 ft. of gray shaly unfossiliferous ls. Overlies Solon ls. and underlies Coralville ls. Included in Senecan.

Named for locality (not stated) in Johnson Co.

Rapid River conglomerate.

Pre-Cambrian (Huronian?): Quebec.

J. B. Mawdsley and G. W. H. Norman, 1935 (Canada Dept. Mines, Bur. Econ. Geol., Geol. Surv. Mem. 186, Pub. 2409, p. 10).

†Rapids schist.

Early Paleozoic or older: Northern Alaska (Chandler River region).

F. C. Schrader, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 473). *Rapids schist.*—Narrow belt of highly metamorphosed or altered mica schist, traversed by Chandler River in region of the rapids, where it forms low anticline, with much quartz, in bight of the fold. Extends for several mi. downstream nearly to West Fork. Seems to underlie Lake qtzite schist, but may prove to be a lower memb. of that series. Supposed to rest on basal granite. Noted only along the river and does not seem to ascend high into mtns.

Is now considered to be an indefinite unit of early Paleozoic or older age.

†Rappahannock series.

Lower Cretaceous: Eastern Virginia.

L. F. Ward, 1895 (U. S. G. S. 15th Ann. Rept., p. 321). *Rappahannock series.*—Chiefly sands; in places clay seams and large masses of clay. Thickness 250 ft. The earliest mention I have been able to find of the principal rock by which this memb. is characterized is that of Mr. Latrobe in 1784, who called it "Rappahannock freestone," and mentioned fact that lighthouse at Cape Henry was constructed of it. In later times it has more frequently been called "Fredericksburg freestone" or "Aquia Creek freestone," from position of principal quarries. Fredericksburg is preoccupied, and in vicinity of Aquia Creek the most typical deposits belong to a higher series of Potomac fm. Uncon. underlies Mount Vernon series and uncon. overlies James River series, the basal clays of the Potomac fm.

W. B. Clark and B. L. Miller, 1912 (Va. Geol. Surv. Bull. 4). The *Rappahannock series* is included in Patapsco and Patuxent fms. of present nomenclature.

Rappahannock freestone.

Trade term for ss. quarried from Potomac group on Rappahannock River, Va.

See under †*Rappahannock series.*

Raquet series.

Carboniferous: Yukon-Alaska boundary, between Porcupine and Yukon Rivers.

D. D. Cairnes, 1912 (Canada Geol. Surv. Summ. Rept. for 1911, pp. 27–32). Mainly crystalline lss., of white, gray, and almost black colors, cherts, and cherty cgls. Thickness at least 1,500 ft. Underlies Mesozoic Orange group (whether conformably or uncon. not ascertained) and overlies Porcupine group (Sil. and Ord.). Named for Raquet Creek, a tributary of Stony Fork of Black River, Yukon. Of local significance only.

Rarden shale member.

Mississippian: Southern Ohio and northeastern Kentucky.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 762). *Rarden sh. memb.*—Alternating red and gray clay shales, 8½ ft. thick at Vanceburg, Ky., increasing northward to 58 ft. at Elm Grove, Pike Co., Ohio. Included in Cuyahoga fm. [Cuyahoga fm. as here used included lower part of Black Hand fm.] Underlies Vanceburg memb. of Cuyahoga and overlies Buena Vista ss. memb. Along W. margin of outcrop belt, in Adams Co., where Buena Vista memb. becomes insignificant, Rarden memb. probably rests on and is indistinguishable from underlying Henley memb. Not recognized outside of Vanceburg facies of Cuyahoga sh., upper limit being lost with disappearance of overlying ss.

Named for Rarden, Scioto Co., Ohio.

†Raritan clay.

Upper Cretaceous: New Jersey and eastern Maryland.

T. A. Conrad, 1869 (Am. Jour. Sci., 2d, vol. 47, pp. 360–363). *Raritan clay.*—Includes (descending) light-colored clay, 20+ ft.; black clay, 4 ft.; ash-colored clay, 4 ft. All contain fossil leaves. Considered by Rogers to be base of Cret. system. Plants go far to prove Raritan clay is Triassic. Rests uncon. on gray quartzose sand. Occurs along Raritan River, N. J.

G. H. Cook and J. C. Smock, 1877 (N. J. Geol. Surv. map of clay dist. of Middlesex Co.) *Raritan clay includes* (descending): *Raritan fire-clay bed*, 15 ft.; sand and lignite, 4 ft.; *Raritan potters clay bed*, 20 ft.

Is lower part of Raritan fm.

Raritan fire clay.

Economic term for bed of clay, 15 ft. thick, near base of Raritan fm. in NE. N. J. Lies 4 ft. above *Raritan potter's clay* (20 ft. thick), an economic term applied to basal bed of Raritan fm. in that area. See G. H. Cook and J. C. Smock, 1877 (N. J. Geol. Surv. map of clay dist. of Middlesex Co.), and G. H. Cook, 1878 (N. J. Geol. Surv. Rept. on clays, p. 34).

Raritan formation.

Upper Cretaceous: Eastern New Jersey, Delaware, and Maryland.

G. H. Cook, 1888 (Am. Geol., vol. 2, p. 260). *Raritan clays.*—Include (descending): Sand, clay, and lignite, 50 ft.; clay and sand, 40 ft.; stoneware clay bed, 30 ft.; sand and clay, 50 ft.; South Amboy fire-clay bed, 20 ft.; kaolin, 13 ft.; feldspar, 5 ft.; micaceous sand bed, 20 ft.; laminated clay and sand, 30 ft.; pipe clay, 15 ft.; Woodbridge fire-clay bed, 20 ft.; fire-sand bed, 15 ft.; Raritan fire-clay bed, 15 ft.; Raritan potter's clay bed, 24 ft. Underlies Clay Marls [Matawan group] and rests on Archean. [As thus defined Cook's *Raritan clays* are 347 ft. thick and include Magothy fm. of present nomenclature.]

W. B. Clark, 1893 (N. J. Geol. Surv. Ann. Rept. 1892, pp. 181–186). *Raritan fm.*—Largely sands and clays, many of them of great economic value. Thickness 347 ft. Underlies Clay Marl fm. [Matawan]. The term Raritan, employed as the distinctive name of this fm., is one which has been so long used by Cook, Newberry, Smock, and others for a greater or less portion of the series under consideration, that its retention and wider application seems fully warranted. Best exposed in vicinity of Raritan River [and Raritan Bay]. Is=Plastic Clays of Cook. [Clark then quoted Cook's subdivisions, enumerated above, as "affording the most accurate sequence of the chief deposits of Raritan fm. available at present time."]

The foregoing definition of Raritan fm. was employed until 1904.

W. B. Clark, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 435–440). *Magothy and Cliffwood beds.*—Transitional deposits, 10 to 100 ft. thick, btw. Matawan fm. above and Raritan fm. restricted below. Consist of a lens of clays and interbedded sands lying beneath typical Matawan at Cliffwood, N. J., on shores of Raritan Bay, and included by writer in that fm. in his "Prel. geol. map of portions of Monmouth and Middlesex Counties, N. J." accompanying rept of State Geol. for 1892. Kümmel and Knapp in recent rept have referred these beds to Raritan, but from structural relations, lithologic character, and contained fossils it is impossible to refer them to that fm., and they should be given independent rank as a fm. Darton was first to name this fm., should it be ultimately shown to represent a single strat. unit. But it is highly probable the Md. [Magothy] strata represent a somewhat lower horizon than the fossiliferous beds at Cliffwood, and may be=in part at least to the "laminated sands" which underlie the lignitic beds at Cliffwood. The base of Darton's Magothy may thus prove to be base of "laminated sands," and may necessitate the transfer everywhere of certain upper sands hitherto regarded as Raritan to the Magothy-Cliffwood series.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6), drew top of *Raritan clay series* at base of Merchantville clay, as did S. Weller, 1905 (N. J. Geol. Surv. Ann. Rept. 1904; Am. Geol., vol. 35, p. 179; Jour. Geol., vol. 13, pp. 324–337).

E. W. Berry, 1906 (N. J. Geol. Surv. Ann. Rept. 1905), drew top of Raritan fm. of N. J. at top of Amboy stoneware clay, which he stated is uncon. overlain by Magothy fm. (including "Cliffwood clays").

S. Weller, 1907 (N. J. Geol. Surv. Pal., vol. 4), described Magothy fm. of N. J. as consisting of (descending): (1) "Laminated sands" of Kümmel, 40 ft.; (2) Cliffwood clays; (3) sand. Conformably overlain by Merchantville clay marl and uncon. underlain by *Raritan fm., restricted sense*, the top memb. of Raritan being called Amboy stoneware clay. [This is commonly accepted definition of Raritan fm. In N. J. the thickness ranges from 150 to 500± ft., and in Md. from 0 to 100 ft. For several years the Raritan was included in Potomac group, but as its Upper Cret. age has been proved it is no longer included in that group.]

Raspberry Mountain granite.

See 1900 entry under *Pikes Peak granite*.

Rat Creek quartz latite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). A series of lava flows with some interbedded tuff, the flows and the tuff consisting of quartz latites of very similar character; differ but little from underlying quartz latite tuff and overlying Nelson Mtn quartz latite. Thickness 0 to 500 ft. A subdivision of Piedra group of Potosi volcanic series. Named for development on Rat Creek.

Raton formation.

Eocene: Southeastern Colorado and northeastern New Mexico.

F. V. Hayden, 1869 (U. S. Geol. Surv. Colo. and N. Mex. 3d Ann. Rept., pp. 89–91). The next group comprises the coal beds of the Raton Hills, which I suspect is also a portion of the great lignite group, and will eventually be found to be synchronous with it. I have called it *Raton Hills group.*

W. T. Lee, 1913 (Am. Jour. Sci., 4th, vol. 35, p. 531). *Raton fm.* is name recently adopted by U. S. Geol. Survey for the coal-bearing rocks above the uncon. in Raton Mesa region of southern Colo. and northern N. Mex. The coal-bearing rocks below the uncon. have been named *Vermejo fm.* The two constitute what has heretofore been called *Laramie* in this region. The data upon which they were separated are contained in a forthcoming paper by W. T. Lee and F. H. Knowlton, on Raton Mesa region, which will be published by U. S. Geol. Survey.

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 40, 56–61). *Raton fm.*—The name *Raton* was first used by Hayden to indicate all coal-bearing rocks which he observed near Raton Mesa. As used by him it included the beds now assigned to Vermejo fm., but as the Vermejo is not conspicuously exposed along the route traversed by Hayden, and as most of the rocks he called "Raton Hills group" belong to the coal-bearing fm. above the Vermejo, the name *Raton* has been adopted for this fm. The type area of *Raton fm.* is in the high mesa region btw. Trinidad, Colo., and Raton, N. Mex., erroneously called mtns, that culminates in Fishers Peak. No complete section of the rocks is exposed in the slopes of this highest mesa, called Raton Mesa, but in the side of Bartlett Mesa, N. of town of Raton [N. Mex.], from locality 75 (see pl. 1, in pocket) to S. point of the mesa, these rocks are well exposed. In Raton Mesa the top of Raton fm. is 2,000± ft. higher than its base, and probably at no other locality in region is so great a thickness of this fm. preserved. The rocks of the fm. vary in character from coal and carbonaceous sh. to sandy sh., ss., and cgl.; in most places they weather yellowish brown. Most of cgl. occurs at base of fm., but in SW. part of Raton field cgls. were found far above the base. The base in nearly all parts of Raton Mesa region is conglomeratic. Coal occurs throughout fm. In W. part of region the cgl. at base contains much arkosic material, is several hundred ft. thick, coarse, massive, and resistant, but it thins and becomes finer-grained toward E. The Raton (of Eo. age) rests uncon. on Vermejo fm. (of Montana, Upper Cret., age) and is overlain by Poison Canyon fm. Near Trinidad there are many places where it is difficult to draw line separating Raton fm. from the Vermejo, but in W. part of region, S. of Spanish Peaks, in southern and eastern parts as far N. as Canadian River, and in E. part of Trinidad coal field N. of Trinidad, there is little difficulty in recognizing the conglomeratic ss. that constitutes base of Raton fm. The Raton has generally been regarded as uncon, with Poison Canyon fm. It seems possible the Poison Canyon and Raton fms. may differ but little in age, and that their physical differences may be due to local variations in conditions of sedimentation.

F. H. Knowlton, 1917 (U. S. G. S. P. P. 101, p. 241). Plants correlate Raton fm. with Denver and Arapahoe fms. of Denver Basin, and latter is practically continuous with Dawson arkose.

Ratonan series.

A term introduced by C. [R.] Keyes to cover the earliest Eocene deposits of N. Mex., including Raton fm. (See Iowa Acad. Sci. Proc., vol. 22, 1915, pp. 257–259.)

†Raton Hills group.

Eocene and Upper Cretaceous: Southeastern Colorado (Raton Mesa region).

See first two entries under *Raton fm.*

Raton Pass coal group. (In Raton formation.)

Eocene: Eastern Colorado (Elmoro region).

R. C. Hills, 1899 (U. S. G. S. Elmoro folio, No. 58), applied "Raton Pass group" to 50± ft. of strata lying 500 ft. above Wooten coal. These strata belong to Raton fm. of present terminology.

Rattlesnake formation.

Pliocene: Central northern Oregon (John Day country).

J. C. Merriam, 1901 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 2, No. 9, p. 310). *Rattlesnake fm.*—Gravels, ash, tuff, and rhyolitic lava; mainly gravels derived from Columbia [River] lava. Sometimes confused with Mascall fm. Type exposure on Rattlesnake Creek about 1 mi. W. of Cottonwood. Includes (descending): Gravel, 100 ft.; rhyolite, 30 ft.; soft brown tuff, 25 ft.; coarse basal gravels, 30 to 200 ft. Uncon. overlies Mascall fm. (upper Mio.). Cannot be older than early or middle Plio. and cannot be later than Plio.

F. C. Calkins, 1902 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 3, No. 5). *Rattlesnake fm.* appears to be of fluviatile origin in large part.

†Rattlesnake beds.

†Rattlesnake formation.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 41–54). *Rattlesnake beds.*—Fossiliferous littoral deposits, 600 ft. thick, of white, gray, yellow, brown, and blue sss., muddy and peaty clays and silts, some ls., and some thin gravel beds. Grade into overlying Tornillo clays and into underlying Terlingua beds. Is=coal-bearing horizon at Eagle Pass.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, p. 505), introduced *Aguja fm.*, to replace *Rattlesnake fm.*, preoccupied by Plio. fm. in Oreg.

Named for Rattlesnake Mtn, Brewster Co.

Rattlesnake granite.

Probably pre-Cretaceous: Southern California (San Diego County).

F. S. Hudson, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 6, pp. 181, 207–208, map). *Rattlesnake granite.*—A true granite, varying from an alaskite to a biotite-hornblende granite. Intrudes rocks of probable Triassic age.

Named for Rattlesnake Valley, Cuyamaca region, San Diego Co.

Ravalli group (also **Ravalli formation**).

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and northwestern Montana (Cabinet Mountains, Mission Range, Philipsburg district).

C. D. Walcott, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 7, 9). *Ravalli series.*—Basal series of Belt terrane in Mission Range, Mont. Consists of (descending): (1) Purple and gray beds, 2,550 ft.; (2) gray beds, 1,060 ft.; (3) greenish gray beds, 4,645 ft. Underlies Blackfoot series.

F. C. Calkins, 1909 (U. S. G. S. Bull. 384, map, p. 38). *Ravalli group.*—Overlying Prichard fm. in this area [map covers Purcell Mtns, Cabinet Mtns, Bitterroot Mtns, and W. to Coeur d'Alene Lake, Idaho] is an assemblage of light-colored siliceous rocks varying from very pure white qtzite to siliceous sh., much of it in rather subdued tones of gray, green, purple, and red. In Coeur d'Alene dist. this group comprises 3 distinct fms., in ascending order Burke fm., Revett qtzite, and St. Regis fm. To N. and E. of Coeur d'Alene dist. the Revett is not everywhere present as a definite fm. and the Burke and St. Regis fms. are not sharply differentiated from each other. For this reason the name *Ravalli*, applied by Walcott to these rocks in Swan Range section, appears most suitable. Thickness of Ravalli group in Coeur d'Alene dist. is 4,200± ft.; increases to N. Is overlain by Newland ("Wallace") fm. [Geologic map of this rept covers the Purcell, Cabinet, and Bitterroot Mtns, the Coeur d'Alene dist., and extends nearly as far E. as Ravalli, which lies N. of Missouri and W. of Mission Range. The Ravalli group is mapped over large parts of this area and N. to and beyond Int. Bdy. The group was probably named for occurrence at or near town of Ravalli.]

Ravallian series.

A term applied by C. [R.] Keyes (Pan-Am. Geol., vol. 44, 1925) to part of Belt series of Mont.

Ravenna plutonic series.

Mesozoic (?): Southern California (Los Angeles County).

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [Maps but does not describe *Ravenna plutonics*. As mapped lies btw. Cret. shales above and the granite below.] Also Am. Geol., vol. 29, 1902, p. 284). *Ravenna plutonic series.*—I predict it will be found to be Mesozoic in age and just a little older than the granitic series.

Probably named for occurrence at Ravenna Station, Los Angeles Co., around which it is mapped.

Ravenscrag beds.

Upper Cretaceous or Tertiary: Saskatchewan.

N. B. Davis, 1918 (Canada Dept. Mines, Mines Branch, Rept. clay resources southern Saskatchewan, p. 10). [Assigned to Eocene.]

In subsequent repts, by other geologists, variously assigned to Cret., to Cret. or Tert., to Cret. and Tert., to Tert., to "Paleocene," to Mio., to Eo., to Olig., and to Upper Cret.

Ravenswood granodiorite.

Pre-Cambrian: Southeastern New York (Queens County).

C. P. Berkey, 1910 (N. Y. Acad. Sci. Annals, vol. 19, p. 250). *Ravenswood granodiorite* is massive rock intrusive into Fordham gneiss. Named for typical development in Long Island City [a part of which is called Ravenswood].

V. Ziegler, 1911 (N. Y. Acad. Sci. Annals, vol. 21, p. 1). *Ravenswood granodiorite* is light to dark gray rock. Believed to be distinct from Harrison diorite, which has been more thoroughly metamorphosed. Exposed along W. shore of Long Island.

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). *Ravenswood granodiorite* ranges from a true granite almost to a typical diorite. Probably most ancient igneous or strictly intrusive rock in N. Y. City. Type loc. is at Ravenswood, Queens Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 24). *Ravenswood granodiorite* is related to Harrison diorite and considered to be of essentially same age. Intrusive into Fordham gneiss.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, p. 140). *Ravenswood granodiorite* assigned to late pre-Camb., much later than Manhattan schist.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this fm. as post-Glenarm Algonkian.

Rawhide formation.

Carboniferous: British Columbia.

O. E. Le Roy, 1912 (Canada Geol. Surv. Mem. 21, pp. 19, 27, 40).

Rawley andesite.

Tertiary (Miocene?): Southern Colorado (Bonanza district, Saguache County).

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Rawley andesite.*—Mostly thin flows, with some latites and breccias. Thickness 1,000 to 1,500 ft., possibly 2,000 in places. Underlies Bonanza latite. Oldest of Tert. volcanic rocks in Bonanza dist. Exposed on slopes of Rawley Gulch and in Rawley mine.

Rawlins sandstone.

Commercial term for sss. quarried from basal part of Mesaverde fm. (Upper Cret.) in central part of Carbon Co., Wyo., in which is town of Rawlins.

Rawson moraine.

Pleistocene: Northern Indiana.

F. Leverett, 1915 (U. S. G. S. Mon. 53, table opp. p. 30).

Ray sand.

A subsurface sand, 20 to 45 ft. thick, in Strawn fm. (Penn.) of Ranger field of central northern Tex., lying 1,200 ft. below Ranger ls. The name has also been applied to a sand at base of Frio clay (Olig.?) in Pettus area, Bee Co., SE. Tex.

Raymond limestone. (In Monongahela formation.)

Pennsylvanian: Western West Virginia (Putnam County).

I. C. White, 1882 (The Virginias, vol. 3, p. 142). *Raymond ls.* (also *Raymond City ls.*).—Occurs in white-looking roundish nodules, 1 in. to 1 ft. diam., in a matrix of red sh. Thickness 5 ft. Lies 180 to 190 ft. above Pittsburg coal. Exposed at Raymond City P. O., Putnam Co.

I. C. White, 1885 (The Virginias, vol. 6, pp. 7–16). *Raymond City ls.*, 5 ft. thick, lies 75 ft. beneath Waynesburg coal and 130 ft. above Pittsburg ss. along Kanawha River btw. Point Pleasant and Quinnimont.

Raymond City limestone.

See *Raymond ls.*

Raymond Quarry beds.

Devonian: Central eastern Iowa.

M. F. Arey, 1906 (Iowa Geol. Surv. vol. 16, pp. 420–448), divided Cedar Valley ls. of Blackhawk Co. into (descending): Lithographic and stromatoporoid beds, 20 ft.; *Raymond Quarry beds*, 26 ft.; *Acervularia* beds, 7 ft.

Raysor marl.

Miocene (upper): Southern South Carolina (Colleton County).

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). *Raysor marl* is here proposed for deposits of upper Mio. age older than Duplin marl in S. C. The name is taken from Raysor Bridge, on Edisto River, 8 mi. SW. of St. George, near which the only known outcrops of the fm. occur, and where it comprises 3¼ ft. of marl consisting of shells in a dark-blue soft matrix and underlies Wicomico fm. and overlies Cooper marl. Believed to be=lower part of Yorktown fm. of N. C. and Va. W. C. Mansfield correlates it with *Ecphora* zone of Fla. and with contemp. *Pecten clintonius* zone, the basal part of Yorktown fm. of Md. and Va.

Raytown limestone bed. (In Kansas City formation.)

Pennsylvanian: Northwestern Missouri, eastern Kansas, and southwestern Iowa.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13, 2d ser., pp. 7, 27–28, 118). *Raytown ls. bed.*—Thin but fairly persistent bed of thin-bedded gray fossiliferous ls., lying 5 to 30 ft. below top of Chanute sh. memb. Thickness 3 to 6 ft. To N. becomes shaly in middle. Is "Calico ledge" of quarrymen. Possibly="Earlton ls." of Adams. Named for Raytown, Jackson Co., Mo.

R. C. Moore (1932) showed this ls. is top memb. of true Iola ls. (See 1932 and 1935 entries under *Iola ls.* and Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 113, 115). Raytown ls. is not a bed in Chanute sh. Main body of Iola ls. is traced into it at Kansas City. Accordingly 3 members of Iola ls. are recognized (descending)—Raytown ls., Muncie Creek sh., and Paola ls. It is clear the Raytown of Hinds and Greene did not include Muncie Creek and Paola. The Raytown is 5± ft. thick near Kansas City; 6± ft. in Miami Co., Kans; and 28 ft. near Iola. Is persistent in northern Mo. and Iowa, but locally absent where underlying Muncie Creek and Paola members occur.

Razburg sandstone member (of Pottsville formation).

Pennsylvanian: Northern central Alabama (Warrior coal field).

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, p. 9). *Razburg ss. memb.*—Gray, generally thick-bedded, rather coarse ss., 20 to 30 ft. thick. Gwin coal lies close above this ss., and Cobb coal lies 120 ft. below it, the two latter being separated by sh. Is top memb. of Pottsville fm. in Warrior coal field.

Named for Razburg, Jefferson Co., in Brookwood quad.

Razor Mountain group.

Pre-Ordovician: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 27).

Reade formation.

See *Reed fm.*, the approved spelling.

†Reading sandstone.

Lower Cambrian: Southeastern Pennsylvania (Berks County).

E. V. d'Invilliers, 1883 (2d Pa. Geol. Surv. Rept. D_3, vol. 2, pp. 99–100), proposed *Reading ss.* for ss. known as *Potsdam ss.* in Berks Co. Well exposed S. of Reading, in cuts of Phila. & Reading R. R.

Same as Chickies qtzite, the older name and the one in current use. Has also been called *Reading qtzite.*

Reading limestone. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

A. J. Smith, 1905 (Kans. Acad. Sci. Trans., vol. 19, p. 150). *Reading blue ls.*—Fossiliferous ls., 3 ft. thick, formerly called *Emporia blue ls.* Extends across Greenwood, Lyon, and Osage Counties, and probably much farther. Underlies Olpe shales (restriction of Adams' definition of Olpe) and overlies Humphrey shales.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). *Reading ls.*, bluish gray, 1 or 2 beds, weathers brownish; 3± ft. thick. Basal memb. of Preston ("Emporia") ls. fm. Underlies Harveyville sh. (memb. of Preston fm.) and overlies Auburn sh. fm. The Preston is overlain by Willard sh.

R. C. Moore's 1936 revised classification (Kans. Geol. Surv. Bull. 22, p. 49) showed *Reading ls.* (1) as basal memb. of old Emporia ls. (which he discarded); (2) as underlying Harveyville sh.; and (3) as overlying Auburn sh., the latter sh. resting on Wakarusa ls. On p. 219 Moore stated: Beede's original Wakarusa ls. is identified as unit here called *Reading ls.*, and Wakarusa ls. as now defined by usage, mainly by Condra, was included in upper part of Beede's "Stanton" (=Burlingame) ls. On pp. 224, 225 Moore made following statements: The name Wakarusa (Beede 1898) has priority over *Reading*, and if we are correct in concluding that Beede's term was applied to same unit later called *Reading*, then proper designation for this ls. is *Wakarusa*. Application of latter name to another unit by Condra, however, and desirability of retaining this usage as applied to many sections in recent papers, lead us to selection of Smith's term as next one available. Type loc. in vicinity of Reading, Lyon Co., Kans. Well exposed in roadcut near NW. cor. sec. 33, T. 17 S., R. 13 E., 1 mi. W. and 1 mi. N. of Reading. Thickness is 1½ to 15 ft., and fm. is continuous from southern Nebr. to northern Okla.

Reading gneiss.

Upper Cambrian: Southeastern Vermont (Windsor and Windham Counties).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., p. 237 and table opp. p. 288). *Reading gneiss.*—Embraces a widely distributed group of rocks in Reading, Cavendish, Baltimore, and Chester Twps, whose essential mineral composition is quartz, orthoclase, or microcline, or both, and albite to albite-oligoclase and muscovite or biotite, or both. Essentially an ortho-gneiss, that is, one derived from the shearing or metamorphism of a granite. It may be in part a para-gneiss, that is, one derived from the metamorphism of highly feldspathic sediments. It seems better to writer to regard Reading gneiss in all its variations as originally a great granite batholith, essentially a biotite granite, which has become subsequently sheared into a granite gneiss, rather than to believe that the foundation of this fm. was qtzite converted into gneiss by introduction of feldspars, albite to albite-oligoclase and orthoclase, and that the orthoclase was in part subsequently converted into microcline. As mapped some sed. beds may be included. Named for fact that its outcrops occupy whole of southern part of Reading. The rock cut just N. of village of Felchville is in this gneiss. [In chart opp. p. 288, prepared by Richardson and A. J. Foyles, this gneiss is assigned to Upper Camb.]

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., pp. 192–237). Most igneous gneisses of Springfield, Vt., are closely related in mineral composition and texture to Reading gneiss, and therefore they are listed as *Reading gneiss* in this rept. Occurs in Grafton and Rockingham.

C. H. Richardson and J. E. Maynard, 1933 (18th Rept. Vt. State Geol., pp. 316–347). *Reading gneiss* was named for Reading Twp [in Woodstock and Ludlow quads.], where this gneissoid rock is particularly rich in microcline, which shows the characteristic grating structure. Such a gneiss appears in Athens and Brookline Twps, Windham Co., and it does not seem necessary to introduce a new name for it. It is light-gray, fine-grained, well banded, and shows the biotite, feldspar, and quartz arranged in definite layers. [Is listed among the acid intrusives.]

Reading syenite.

A local quarry term for part of Quincy granite in Boston region, Mass.

Readsboro schist.

Upper Cambrian (?): Southwestern Vermont (Bennington County) and southeastern Vermont (Windham County).

G. D. Hubbard, 1924 (14th Rept. Vt. State Geol., pp. 282–288, 291, 294, and map). *Readsboro schist.*—Essentially quartz-biotite schist, with considerable variation in texture, general appearance, and mineral composition. Quartz usually makes up at least half of the rock, in places as much as 80 to 85 percent. Biotite may run as high as half, but usually constitutes 25 to 40 percent. Hornblende and, in some beds, calcite make up most of the rest of fm. Much of rock is so feldspathic as to be gniess, and it becomes more so northward. Is believed to be of sed. origin. Thickness 4,000 and may possibly reach 6,000 ft. Underlies Halifax schist, with which it is interbedded at contact, and overlies Hartwellville schist, from which it is rather sharply separated. Correlated with Hoosac schist, Rowe schist, and Chester amphibolite of Emerson's map of Mass.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this fm. to Upper Camb., but without discussion.

Named for extensive outcrops in Readsboro Twp and around Readsboro, Wilmington quad.

Reagan sandstone.

Upper Cambrian: Central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Reagan ss.* [incorrectly spelled Regan on map legends].—In Atoka quad. is represented by a single outcrop. [See 1903 definition in type region.]

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Reagan ss.*—Lower part (in contact with the granite) where fm. is thickest is poorly sorted coarse granitic material composed chiefly of grains of quartz with some feldspar. This basal arkose memb. is variable in occurrence as well as in thickness and in places is absent altogether, allowing the purer ss. beds higher in section to rest in contact with the granite. The middle part is composed chiefly of quartz grains, varying in size from that of a pea to fine particles. The upper part is calc. and shaly ss., successive beds of which become more limy upward until the purer ls. of Arbuckle fm. is reached. Thickness a few ft. to 500± ft. Named for village [10 mi. N. of Tishomingo], which is situated near the small area of the fm. on N. side of the granite.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 624, 642, 661, 666, pl. 27), introduced *Honey Creek ls. memb. of Reagan ss.* for lss. which he stated were originally included in Arbuckle ls. but are now transferred to Reagan ss.

H. D. Miser, 1926 (Okla. geol. map), followed Taff's original definitions of Arbuckle ls. and Reagan ss., and included the ls. memb. in Arbuckle ls. This is definition of Reagan ss. that is followed by U. S. Geol. Survey.

E. O. Ulrich, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, p. 742). *Reagan ss.* as defined by Taff (Atoka and Tishomingo folios) included a considerable thickness of calc. beds which were separated from Arbuckle ls. because they were thought to contain a Middle Camb. fauna. This fauna was subsequently recognized as Upper Camb., and in the Revision (Geol. Soc. Am. Bull. vol. 22, 1911) I proposed *Honey Creek ls. memb.* for these strata, still considering them a part of the Reagan. Later work in Llano-Burnet area in [central] Tex. has resulted in a threefold division of the Camb. into the Hickory, Cap Mountain, and Wilberns fms. The first corresponds essentially to the Reagan of Okla. and the main portion of the last to Honey Creek memb., leaving Cap Mtn fm. unrepresented in Okla. section except at a single locality on S. side of Arbuckle Mtns in Pickens ranch sec., 10 mi. NW. of Tishomingo. Because of known absence of strata corresponding to the Cap Mtn in most sections examined in Arbuckle and Wichita Mtns, Okla., it seems *advisable to raise Honey Creek memb. to rank of a fm.* which is essentially=Wilberns of [central] Tex., the Davis of Mo., and the Franconia of Wis.

The U. S. Geol. Survey now treats Honey Creek ls. as a distinct fm. This involves a slight redefinition of Arbuckle ls., in which the Honey Creek has heretofore been included.

Recapture shale member (of Morrison formation).

Upper Jurassic: Southeastern Utah (San Juan County).

H. E. Gregory (U. S. G. S. P. P. 188, in press). *Recapture sh. memb. of Morrison fm.*—Dark-red and variegated calc. and gypsiferous shales and thin white siliceous sss., 100 to 300 ft. thick. Overlain with local uncon., by Westwater Canyon ss. memb. and underlain by Bluff ss. memb. Well exposed near mouth of Recapture Creek, San Juan Co.

Recent epoch (or series).

The post-Pleist. part of Quat. period and the rocks formed therein. For definition see U. S. G. S. Bull. 769, pp. 46–47.

†Receptaculites limestone.

A paleontologic term applied in early Mo. repts to Kimmswick ls. of present nomenclature.

†Red Beds.

A term used in a titular sense in early repts for the Perm. and Triassic redbeds of Western States.

red clastic series.

A descriptive term that has long been applied to red sss. and shales underlying Mount Simon ss. (Upper Camb.) in SW. Wis. and SE. Minn.; also to similar rocks that outcrop at Hinckley and along Kettle River in Pine and Carlton Counties, central eastern Minn., which underlie the Hinckley ss., of pre-Camb. (Keweenawan) age. At present the U. S. Geol. Survey classifies these rocks as Camb. and pre-Camb. (See under *Hinckley ss.*)

Redbank sand. (In Monmouth group.)

Upper Cretaceous: New Jersey.

W. B. Clark, 1894 (N. J. Geol. Surv. Ann. Rept. 1893, p. 337, and Jour. Geol., vol. 2, pp. 165–166). *Redbank fm.*—Bright-red sands, glauconitic throughout, but great preponderance of coarse aren. sediments has facilitated oxidation of greensand, changing green color to red or brown. Lower part often black sand or sandy clay. At top an indurated clayey layer, generally of greenish color. Thickness 100 ft. Is Red Sand of previous repts. Underlies Rancocas fm. [group] and overlies Navesink fm. Well developed in vicinity of Red Bank, Monmouth Co.

S. Weller, 1905 (N. J. Geol. Surv. Ann. Rept. 1904, pp. 147, 154–159), separated 22 ft. of beds at top, under name *Tinton beds,* and restricted *Redbank sand* to the underlying beds.

The U. S. Geol. Survey has since 1909 (U. S. G. S. Trenton folio, No. 167) treated Redbank sand as top fm. of Monmouth group, and Tinton sand as top memb. of Redbank sand, but most repts of N. J. Geol. Survey still treat the Tinton as a distinct fm.

Red Bluff clay. (In Vicksburg group.)

Oligocene (lower): Southern Mississippi and southwestern Alabama.

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., p. 135). *Red Bluff group.*—Irregular masses of fine-grained ferruginous rock, embedded in a brownish or greenish clayey mass, both with well-preserved fossils. Thickness 12 ft. Seems to stand intermediate, by position as well as fossils, btw. Vicksburg group and Jackson group, but fauna seems on whole to approach more nearly the Vicksburg than the Jackson.

E. W. Hilgard, 1867 (Am. Jour. Sci., 2d, vol. 43, pp. 32, 37). *Red Bluff group*.—Concomitant green clays and stiff clay marls, 0 to 100 ft. thick. Treated as basal div. of Vicksburg group, because it seems to be more or less coextensive with Vicksburg group and regularly associated with it as a subordinate feature. At Red Bluff it rests on Jackson group.

E. W. Hilgard, 1871 (Am. Jour. Sci., 3d, vol. 2, geol. map of Miss. opp. p. 390), treated *Red Bluff* (12 ft. thick) as a distinct unit underlying Vicksburg and overlying Jackson. But A. Heilprin, 1884 (Jour. Acad. Nat. Sci. Phila., 2d ser., vol. 9, pt. 1, pp. 120, 144–150), included it in Vicksburg, as did W. B. Clark, 1891 (U. S. G. S. Bull. 83, pp. 66–67). W. H. Dall and G. D. Harris, however, excluded it from both Vicksburg and Jackson in U. S. G. S. Bull. 84, pp. 160–167, 1892, as did Harris in Am. Jour. Sci., 3d, vol. 47, pp. 303–304, 1894. In 1897 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 334, 337, 339, 341) Dall included it in his *Vicksburgian stage* but treated it as distinct from his *Vicksburg*. T. W. Vaughan, 1900 (U. S. G. S. Mon. 39, pp. 15–32), and C. J. Maury, 1902 (Bull. Am. Pal., vol. 3, No. 15, pp. 71–76, 81), followed Dall's 1897 treatment, Miss Maury stating that Red Bluff beds are now considered to be hardly separable faunally from the Vicksburg, of which they represent a lower phase. T. L. Casey, however (Phila. Acad. Nat. Sci. Proc., vol. 53, pp. 513–518, 1902), included the Red Bluff in the Jackson, stating: Because of existence of most of these Eocene forms [discussed] in *Red Bluff bed* I am inclined to consider that horizon more closely related to the Jackson than to the Vicksburg, in spite of greater proportion of its species which have been identified with the Vicksburgian.

C. W. Cooke, 1915 (U. S. G. S. P. P. 95), treated *Red Bluff clay memb.* (25 to 40± ft. thick) as basal memb. of Vicksburg ls. in Miss., as did E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12), who stated that its fossils are more closely related to Vicksburg than to Jackson, and who gave its thickness as 60 ft. But Lowe included his †Madison sands (50 to 75 ft. thick) in Jackson, although stating that they might belong to either Jackson or Vicksburg. The relations of the latter beds to Red Bluff clay had not at that time been established. But C. W. Cooke (Wash. Acad. Sci. Jour., vol. 8, No. 7, pp. 186–198, 1918) stated that the exceedingly shallow-water deposits of Forest Hill sand (which name he introduced to replace Madison sand, preoccupied) are "believed to be largely contemp. with Red Bluff clay," and he included both in Vicksburg group. He described *Red Bluff clay* as consisting chiefly of stiff blue or greenish gypseous marine clay, but containing discontinuous ledges of indurated marl or ss. and a thin bed of shell marl, as being 70 ft. thick on Buccatunna Creek, as resting conformably on the Jackson, and as overlain by Marianna ls. E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14), referred to Cooke's "recent" assignment of Forest Hill sand to Vicksburg group, and stated that "under present interpretation it is to be placed in Vicksburg group as a distinct facies of Red Bluff fm." The U. S. Geol. Survey treats the Forest Hill sand and Red Bluff clay as distinct contemp. fms., one nonmarine and the other marine.

The present generally approved definition of Vicksburg group includes at base the contemp. or approx. contemp. fms. Red Bluff clay (to east) and Forest Hill sand (to west).

Red Bluff formation.

Pleistocene: Northern California (Redding region).

J. S. Diller, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pp. 413–416 and map, pl. 44). *Red Bluff fm.*—Gravels, clay, and sand of Pleist. age, overlying Tuscan tuff.

J. S. Diller, 1906 (U. S. G. S. Redding folio, No. 138). *Red Bluff fm.*—Chiefly gravel and sands, with small proportion of clay and a few large boulders. Uncon. overlies Tuscan tuff. Thickness more than 200 ft.

Named for exposures at Red Bluff, Tehama Co.

See under *Klamath gravels*, N. E. A. Hinds 1933 entry.

†Red Bluff sandstone. (In Cimarron group.)

Permian: Central southern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 40). *Red Bluff sss.*—Light-red friable and porous sss. and shales, 175 to 200 ft. thick, composing next to lowest fm. and major part of Kiger div. Overlies Dog Creek shales and underlies Day Creek dol. [Later repts give max. thickness 500+ ft.]

Preoccupied. Replaced by Whitehorse ss.

Named for exposures at former post office of Red Bluff, Comanche Co., Kans.

Red Bluff epoch.

Pleistocene: California.

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pp. 1–29). *Red Bluff epoch (deposition).*—Divided into *Red Bluff proper* above, and below a sheet of alluvium of same material as Red Bluff proper. Believed that Arnold's Lower San Pedro series corresponds in part at least with Red Bluff fm. It seems proper to extend the term *Red Bluff* to the marine Pleist. in Los Angeles and to the alluvial material of the 400-foot terrace of Soledad Cañon. [See under *Sierran*.]

Red Bridge limestone member (of Liston Creek formation).

Silurian (Niagaran): Northeastern Indiana (Wabash County).

E. R. Cumings and R. R. Shrock, 1927 (Ind. Acad. Sci. Proc., vol. 36, pp. 74–75). *Red Bridge ls.*—Reddish-yellow impure argill. ls., 6 in. to 6 ft. thick. Overlies Mississinewa sh. and underlies Liston Creek ls. Outcrops along Mississinewa River at village of Red Bridge, Wabash Co., and elsewhere. No fossils found. Included in Niagaran.

E. R. Cumings and R. R. Shrock, 1928 (Ind. Cons. Comm., Div. Geol. Pub. 75, pp. 71–94). *Red Bridge ls. memb. of Liston Creek fm.*—[See explanation under *Liston Creek fm.*] No fossils yet identified. It is very doubtful if any of geologists who have worked in northern Ind. ever recognized this bed, for no mention is made of it. It has been seen in Wabash Co. only and probably was not deposited elsewhere. Thickness 0 to 12 ft.

Red Canyon member.

Triassic (?): Southeastern Colorado (Las Animas, Otero, and Bent Counties).

J. T. Duce, 1924 (Colo. Geol. Surv. Bull. 27, pt. 3, pp. 81–82). A massive cross-bedded oolitic maroon ss., upper part much cross-bedded and in some parts leached of its coloring matter. Possibly of eolian origin. Thickness 240 ft. Is upper memb. of Lykins fm. in counties mentioned. Overlies Chaquaqua memb. of Lykins fm. and uncon. underlies gypsiferous beds regarded as lower memb. of Morrison fm.

Probably named for exposures in E. end of Red Rock Canyon, Las Animas Co.

Red Cave.

A term applied by drillers of western Pa. to subsurface strata correlated with sh. beds in Conemaugh fm. that are known as "Pittsburgh Reds." Also applied to a subsurface sand in Double Mtn fm. (Perm.) of Tex.

Red Creek quartzite.

Pre-Cambrian: Northeastern Utah (Uinta Mountains).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 42, 62, 70, 137). *Red Creek qtzite.*—A qtzite (very crystalline and white) with intercalated beds of hornblendic, chloritic, and micaceous schists, all greatly implicated. Thickness 10,000 ft. Uncon. underlies the red Uinta ss. Well exposed in Red Creek Canyon and at head of Willow Creek. Believed to be Eozoic. Red Creek Canyon separates Quartz Mtn and Mount Wheeler [NE. corner of Uinta Co., Utah].

A. R. Schultz, 1920 (U. S. G. S. Bull. 702), remapped the white *Red Creek qtzite*, assigned it to the pre-Camb., stated that the intercalated schists are intrusives, and that H. S. Gale (U. S. G. S. Bull. 415, 1910) included these qtzites in his Uinta qtzite.

Redd sand.

A subsurface sand in the Penn. (probably in either Dudley or Ladore sh.) of SE. Kans. (Chautauqua and Montgomery Counties).

Red Eagle limestone member (of Elmdale formation).

Pennsylvanian: Central northern Oklahoma and southern Kansas.

K. C. Heald, 1916 (U. S. G. S. Bull. 641, p. 24). *Red Eagle ls.*—A number of distinct beds of ls., btw. which are beds of sh. in some localities. One of most distinctive features of top bed of the ls. in much of Foraker quad. is character of the fresh surface, which shows an abundance of tiny grains of crystalline calcite, giving the surface the appearance of having been covered with frost or light snow. Thickness of Red Eagle ls. is at least 17 ft. in some places; in other places probably much less. Lies 18 ft. above Foraker ls. and 71 ft. below Neva ls. Named for excellent exposures near Red Eagle School, SW. of Foraker.

H. D. Miser, 1926 (geol. map of Okla.). Cushing ls. memb. is same as Red Eagle ls. memb. [which has priority].

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 8), extended this name into NW. Mo. and SE. Nebr.; called it *Red Eagle ls. fm.*, which he defined as underlying his Roca sh. fm. and overlying his Johnson sh. fm.; and divided it into (descending) Howe ls., Bennett sh., and Glenrock ls. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

N. W. Bass, 1935 (personal communication). *Red Eagle ls.* persists into Kans. at least as far N. as Cottonwood River valley.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

†Red Eagle shale. (In Elmdale formation.)

Pennsylvanian: Central northern Oklahoma.

G. C. Clark and C. L. Cooper, 1927 (Okla. Geol. Surv. Bull. 40H), applied *Red Eagle* to 19 ft. of red and gray shales described as lying 65 ft. below Neva ls. and 12 ft. above Cushing [Red Eagle] ls. in T. 22 N., Rs. 2 W.–5 E., and as resting on 3 ft. of ls. The name is preoccupied by the ls. in the Elmdale.

Red Fork sand.

A subsurface sand, 0 to 60± ft. thick, in Cherokee sh. (early Penn.) of S. and SE. parts of Osage Co., NE. Okla. Said to lie higher than Glenn sand, lower than Skinner sand, and to be the upper sand of the series to which the name *Bartlesville sand* was formerly applied. In type loc. (Red Fork pool, Tulsa Co.) this sand lies at 1,275 ft. depth, at approx. horizon of Burbank sand.

Red Gap member (of Grinnell argillite).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Red Gap memb.*—Lower memb. of Grinnell fm. Consists of 1,050 to 1,800 ft. of metargillite, in thin minor but thick major beds, interbedded near bottom and top with minor layers of qtzitic ss. and red sandy argillite. Forms mass of Mount Rockwell, in Two Medicine Valley, Glacier Nat. Park. Underlies Rising Bull memb. of Grinnell fm. and overlies Rising Wolf memb. of Appekunny fm. [Derivation of name not stated.]

Redgut Bay granite.

Age (?): Ontario (Rainy Lake district).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 99).

Red Head formation.

Carboniferous: New Brunswick.

G. A. Young, 1913 (12th Int. Geol. Cong. Guidebook 1, pp. 369, 374).

Redhill sandstone.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 61, 80). *Redhill sss.* is local name used in Furnace Canyon borate camps for a thick aren. bed immediately and uncon. overlying Greenwater volcanics. Consists of fine-grained cgl. and ss. Thickness 300 ft. Underlies Millett clays. Is bottom fm. of Furnacean series in Nev. [Death Valley region]. Tentatively considered to be of Mio. age. [Derivation of name not stated, but may have been named for the red ss. mtn. N. of Ryan and E. of Furnace Creek Wash, Inyo Co., Calif.]

Redlands limestone.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group.* Derivation of name not stated.]
F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Redlands dolomitic ls.*—White crystalline cherty, dolomitic ls. in which bedding is not readily recognized. Probably a lenticular body. Thickness 600± ft. Conformably underlies Hanaupah fm. and conformably overlies Radcliff fm.; all included in Telescope group (lower Paleozoic?) of S. part of Panamint Range. [Derivation of name not stated and not apparent from his maps.]

Red Lion formation.

Upper Cambrian: Central western Montana (Philipsburg region).

F. C. Calkins and W. H. Emmons, 1913 (U. S. G. S. P. P. 78). *Red Lion fm.*—Upper 250 ft. consists of ls. with closely spaced siliceous laminae. Fossils are said by Walcott to be Upper Camb. Probably=Yogo ls. Lower 25 ft. is calc. sh., mostly coal black, locally interbedded with thin layers of mag. ls. The lower memb. probably=Dry Creek sh. [which is now considered Upper Camb.]. Named for a mine at head of North Fork of Flint Creek. The spur N. of this mine is a hogback of the fm. and affords good exposure of middle part.

†Red Medina.

Name applied in some early repts to Queenston sh. of N. Y. and to Juniata fm. of Pa. and Md.

Redmond formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Redmond fm.*—White ss. Overlain by unnamed ss. and sh. and underlain by unnamed grits and shales. Included in Bell Island series. [Derivation of name not stated.]

†Red Mountain group.

Devonian, Silurian, Ordovician, and Cambrian: Northern Alabama.

M. Tuomey, 1850 (Ala. Geol. Surv. 1st Bien. Rept., pp. 9, 10). The group of rocks under consideration is made up of common blue ls., white, gray, and variegated marble, mag. ls. (both the crystalline and earthy variety), cherty ls., hornstone, ss., cgl., iron ore, black aluminous sh., and clay sl. It would be premature to attempt a subdivision of the Sil. rocks of Ala. by referring them to those groups adopted in N. Y., where they are developed on a scale so magnificent. I shall therefore content myself by applying to our rocks the term *"Red Mtn group,"* already known in the State, which will distinguish them from the Carbf. system, with which they are intimately associated. Although these rocks occupy anticlinal valleys, they also rise into a range of hills which are generally known as "Red Mtns."

In above-cited rept the rocks of Ala. are divided into following systems: Tertiary system, Cretaceous system, Carboniferous system, Silurian system, Metamorphic system, and Primary system. As defined in this rept the "Red Mtn group" includes rocks of Dev., Sil., Ord., and Camb. ages, all of which are exposed on Red Mtn.

Named for Red Mtn, E. of Birmingham.

Red Mountain formation.

Silurian (Clinton and Medina): Northern Alabama and northwestern Georgia.

E. A. Smith, 1876 (Ala. Geol. Surv. Rept. Prog. for 1876, pp. 11, 23, 25, 34, 42, 207-208). Of these three groups [Medina, Clinton, Niagara] of Niagara period, so far as is known, only the second, *the Clinton*, has been certainly identified in Ala. In Tenn. the group has received name of *Dyestone group* from Prof. Safford, on account of occurrence in it of the red ore, or dyestone. In Ala. no more fitting name could be given to it than *Red Mtn group*, for outcrops of the rocks are found in ridges, or mtns, as they are called, extending almost without interruption from Bibb Co. to Ga. and beyond. From the red ore, which seems always to be present in them, in greater or less thickness, these ridges have local name of Red Mtn. The name Clinton, however, has already been applied to this group of rocks, and a multiplication of names for the same thing is to be avoided if possible. The rocks of the Clinton group in Ala. are chiefly thin sss. and shales, variously colored, green, yellowish, brown and red colors being predominant. The group contains also several beds of lenticular or fossiliferous red iron ore. For characteristic sections of strata of Clinton group the reader may be referred to section near Tannehill and that at mines of Eureka Co. The mtn near Columbiana has along its base a cgl. which probably underlies the Red Mtn rocks proper and belongs to Medina group. [According to C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14) the Red Mtn fm. is absent in Montevallo and Columbiana quads., and the cgl. referred to is of Dev. age.]

The rocks in northern Ala. that for many years were called "Clinton fm." have been shown, by E. O. Ulrich and C. Butts, to contain beds of both late Medina (Albion) and Clinton ages, and to them Smith's name *Red Mtn fm.* is now applied. In some places beds of Richmond age and of Dev. age have been mapped with the Red Mountain, but they are not properly a part of the fm. (See Ala. Geol. Surv. Spec. Rept. No. 14, 1926, and U. S. G. S. Bessemer-Vandiver folio, No. 221, 1927.) Big seam of iron ore is base of beds of Clinton age, according to C. Butts (U. S. G. S. Bessemer-Vandiver folio, No. 221, 1927, p. 7).

Named for development on Red Mtn (presumably East Red Mtn), E. of Birmingham, Ala.

Red Mountain formation.

Carboniferous or Triassic: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 45, 61). [Assigned to Carbf.]

H. S. Bostock, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, pp. 203, 207, 210), assigned this fm. to Triassic.

Red Mountain rhyolite.

Tertiary: Central Colorado (Bonanza-Monarch-Tomichi-Pitkin region).

J. V. Howell, 1919 (Colo. Geol. Surv. Bull. 17). *Red Mtn rhyolite.*—Light-gray to white siliceous rhyolite containing finely disseminated pyrite, which on weathering produces red iron oxide, the material which is responsible for the brilliant coloring of Red Mtn, Chaffee Co. Has two rather distinct phases—the normal or massive phase and a brecciated form. Is certainly older than Grizzly Peak rhyolite, which is believed to be of Tert. (Eocene?) age, and appears to be younger than late Cret. porphyry dikes, so it is certainly post-Cret.

This name has been discarded by J. T. Stark and F. F. Barnes, as explained under *Grizzly Mtn rhyolite.*

Red Mountain andesite.

Miocene (upper): Southern California (Randsburg quadrangle, Kern and San Bernardino Counties).

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95, pp. 55–58, map). *Red Mountain andesite.*—Chiefly lava flows, but with prominent amounts of aggls. and tuffs. General composition of series is that of basic andesite. Overlies Rosamond series, usually with angular uncon., and uncon. underlies Black Mountain basalt. Forms thick capping of Rosamond series in Red Mtn [San Bernardino Co.], where it reaches approx. thickness of 1,400 ft. of flows and pyroclastics. Believed to be early Plio. [On map is assigned to upper Mio.]

Red Mountain pyroxene basalts.

Age (?): Northern California (Lassen Volcanic National Park).

H. Williams, 1932 (Calif. Univ. Dept. Geol. Sci. Bull., vol. 21, No. 8, geol. map).

Redoak granite.

Pre-Cambrian: Central southern Virginia (Charlotte and Mecklenburg Counties).

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 35–36, map). *Redoak granite.*—Medium-grained light-gray biotite granite, rather quartzose, containing about equal amounts of orthoclase and plagioclase feldspars. Small masses or areas of coarse porphyritic granite which occur in Redoak granite in vicinity of Buffalo Lithia Springs are named *Buffalo granite.* [Named for occurrence at Redoak, Charlotte Co., Va.]

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Red Oak granite.*—Biotite-quartz monzonite with Buffalo granite porphyritic facies. Is of pre-Camb. age and intrusive into Glenarm series (Algonkian?).

Redoute limestone.

Cambrian: Quebec.

J. Marcou, 1862 (Boston Soc. Nat. Hist. Proc., vol. 8, pp. 248–253). St. Albans group divided into (descending): (1) Green, brown slates with large lenticular masses of whitish-gray ls. (*Redoute ls.*), which is very fossiliferous and 80 to 100 ft. thick; and (2) Sillery and Chaudiere red slates and sss. The Redoute ls. forms the lenticular mass of La Redoute, so called by older Canadians because there was a redoubt there during last French war.

†Red River group.

Upper Cretaceous (Gulf series): Northeastern Texas.

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, pp. 583, 589). *Red River group.*—Fossiliferous blue marly clay, occasionally variegated with red and brown, and with thin bands of ss. interstratified. Clay contains crystals of selenite and, in upper part, flattened nodules of compact brown and blue ls.; also, near base, septariae of compact blue ls. reticulated with brown, yellow, and purple spar. Thickness 50 to 150 ft. Underlies Fish Bed.

Includes Eagle Ford clay and Woodbine sand.

J. A. Taff, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 269–279), applied "Red River div." to beds beneath Eagle Ford sh. and uncon. above †Vola ls.

Named for exposures along Red River, NE. Tex.

Red River loess.

Pleistocene: Southwestern Arkansas, Louisiana, northeastern Texas, and southeastern Oklahoma.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 29–32, 188). *Red River loess.*—Intensely red loam, in color approximating present red sediments of the river. Is 50 ft. above present high-water mark, and extends inland, often several mi. from present stream. Continues far into La. and W. of Denison, Tex. In general appearance is difficult to distinguish from residual debris of Camden series and from the other aren. post-Cret. and Cret. fms. of the South, and writer will not attempt at present to differentiate it from them. Assigned to *Quaternary (pre-Recent).*

C. H. Dane, 1929 (Ark. Geol. Surv. Bull. 1, pl. 1), mapped the deposits in Red River Valley at Fulton as Recent and Pleistocene, the Pleistocene probably being Red River loess of Hill.

Named for exposures in Red River Valley at Fulton, Hempstead Co., Ark.

Red River formation.

Ordovician: Manitoba.

A. F. Foerste, 1929 (Denison Univ. Bull., vol. 29, No. 2, Sci. Lab. Jour., vol. 24, pp. 35, 37).

Red Rock channel sandstone.

Pennsylvanian: Central southern Iowa (Jasper and Marion Counties).

C. R. Keyes, 1891 (Am. Jour. Sci., 3d, vol. 41, pp. 273–276). *Red Rock ss.*—Bright vermilion, yellow, and buff ss., 0–150 ft. thick, chiefly massive but thin-bedded above, passing into fine-grained ferruginous cgl. Overlain uncon. by coal-bearing shales and underlain uncon. by St. Louis ls.

Represents sand deposited in old erosion channel in Des Moines group. May be of either Des Moines or Missouri age.

Named for Red Rock, Marion Co.

Red Rock member.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

See under *Temperance River memb.*

Redrock Canyon sandstone member (of Santa Margarita formation).

Miocene (upper): Southern California (Cuyama Valley, southwestern part of Kern County).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215). *Redrock Canyon ss. memb.*—Basal memb. of Santa Margarita fm. in small area in Redrock Canyon (Cuyama Valley), to which it is limited. Thickness 500 ft. Consists of bright-red ss., clay, and cgl., the materials of which were derived from an adjacent land mass of pre-Monterey rocks. Rests uncon. on pre-Monterey rocks, the Monterey group being absent, probably through erosion. Is conformably overlain by Whiterock Bluff sh. memb. of the Santa Margarita.

†Red Rock Canyon beds.

Pliocene (lower): Southern California (eastern part of Kern County).

J. C. Merriam, 1919 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, No. 5). There may be some justification for name *Red Rock Canyon beds, fm., or group*, for strat. sequence containing Ricardo fauna, but G. K. Gilbert (Geog. and Geol. Expl. W. 100th Mer., pp. 142–143, 1875) and H. W. Fairbanks (Am. Geol., vol. 17, pp. 68–69, 1896) did not use the name for nomenclature purposes. Following the discovery that the fauna from the beds in Red Rock Canyon [at Ricardo, E. part of Kern Co.] is sharply distinct from that in Barstow section, writer has described numerous mammalian forms from Red Rock Canyon section as representing the *Ricardo fauna, Ricardo beds*, or *Ricardo Pliocene*, and he therefore prefers the name *Ricardo fm.* or *Ricardo group* for the deposits containing them.

Red Spring sandstone member (of Hignite formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 43). *Red Spring ss. memb.*—Cliff-making ss., underlying Red Spring coal, topmost bed of Hignite fm.

Named for association with Red Spring coal in Cumberland Gap coal field.

Redstone limestone member (of Monongahela formation).

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_3, pp. 55–104, 286). *Redstone ls.*, 8 to 10 ft. thick, is basal memb. of Pittsburg ls. group, and lies 30 ft. above Pittsburg coal and below Redstone coal.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 62–63). *Redstone ls.*, 0 to 20 ft. thick, was so named because it occurs immediately below Redstone coal, which outcrops along Redstone Creek, Fayette Co., Pa.

†Redstone quartzite.

Name loosely applied by F. W. Sardeson (Geol. Soc. Am. Bull., vol. 19, pp. 221–242, 1908) to the qtzite composing Redstone Hill, in Courtland Twp, midway btw. towns of New Ulm and Courtland, central southern Minn. Although he used Redstone qtzite frequently throughout his rept, he stated that he intended the local geologic name to be *Courtland qtzite*, and that the qtzite is same as Sioux qtzite.

Redstone sandstone. (In Monongahela formation.)

Pennsylvanian: Western Maryland (Georges Creek Basin).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 567–596), and C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, p. 74, pl. 7). *Redstone ss.*—Underlies upper bench of Redstone coal and overlies lower bench of Redstone coal. In places is absent; in other places 40 ft. thick.

Probably named for its relation to Redstone coal.

Redstone granite.

Pennsylvanian (?): Southeastern Connecticut (Stonington region) and adjacent areas in Rhode Island.

L. H. Martin, 1925 (Conn. State Geol. and Nat. Hist. Surv. Bull. 33). *Redstone granite.*—The last distinct phase of Sterling granite gneiss. Resembles the granite gneiss in composition but is generally without banding. Cuts Sterling granite gneiss and also Stonington gneiss. Is a coarse-grained rock of medium-red to greenish-red color and much more massive than the other varieties of Sterling granite. At Redstone Ridge it broadens from a few ft. in thickness on W. to a mass ½ mi. wide near Westerly. It is the Westerly Red granite. Is at least post-middle Pennsylvanian.

Redstone clay. (In Monongahela formation.)

Name applied to clay underlying Redstone coal in western Pa. and eastern Ohio.

Redstone member. (In Monongahela formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include (descending) Fishpot ls., Redstone coal, and Redstone ls.

Redstone Ridge group.

Silurian: Central Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, p. 823). *Redstone ridge group.*—Hard strata, each 1 or 2 ft. thick and almost sandy enough to be called red sss. In some places the single group of 25 ft. is separated into two groups by 5 or 6 ft. of green limy sh. Traversed by irregularly segregated seams of quartz. These hard beds make Redstone ridge. Included in middle of lower Salina (Bloomsburg) red shales.

Redtop formation.

Carboniferous: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 43, 49). *Redtop fm.*, Carbf., B. C., included in Cache Creek group.

S. J. Schofield, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 38).

Red Top limestone.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 80; map). *Red Top ls.*—Varies in character, but is typically argill. bluish-gray ls. with good bedding planes. In places appears schistose and becomes a quartz-mica schist. On Red

Top Mtn it is white fine-grained banded marble interbedded with bluish-gray argill. ls. Thickness 1,000± ft. Relations to other named units not determined. Is separated from Fish Creek argillite by a fault.

Redtops formation.

Triassic: British Columbia.

H. S. Bostock, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, p. 203).

Red Valley sand.

Drillers' name for a sand composing lower memb. of Hundred-foot sand in Foxburg region, western Pa. Probably lies in upper part of Catskill fm.

Redwall limestone.

Mississippian (lower): Northern Arizona.

G. K. Gilbert, 1875 (U. S. G. and G. S. W. 100th M., vol. 3, pp. 162, 177–186, 197, figs. 81, 82). *Redwall ls. group.*—In descending order: (1) Alternating sss. and compact lss., 200 to 500 ft.; (2) *Redwall ls.* (sheer escarpment), 800 ft.; (3) lss. in lesser escarpments and calc. shales, 800 to 1,365 ft. Underlies Aubrey group and overlies Tonto group [Camb.]. May include some Dev. Named for red appearance of its escarpment on either side of Grand Canyon.

C. D. Walcott, 1889 (Geol. Soc. Am. Bull., vol. 1, p. 50), reported beneath Redwall ls. in Grand Canyon 94 ft. of Dev. ls., which he named *Temple Butte ls.*

N. H. Darton, 1910 (U. S. G. S. Bull. 435, pp. 21+). The name Redwall was given by Gilbert on account of red color of the cliffs, but the rock itself is light gray. A type loc. recently selected is Redwall Canyon, in Shinumo drainage basin, on N. side of Grand Canyon, where it consists mostly of the usual heavily bedded massive ls. and is 800± ft. thick. At other places in Grand Canyon region thickness varies from 550 to 992± ft. Gilbert gave thickness of 2,165 ft. at mouth of Grand Canyon, but this includes at top 510 ft. of alternating ls. and ss. which I believe belong to Supai fm. Fossils of Redwall ls. are Penn. and Miss., according to G. H. Girty.

L. F. Noble, 1923 (U. S. G. S. P. P. 131, pp. 26+, 54+). *Redwall ls. restricted* to Miss. part of original Redwall ls., which consists almost wholly of bluish-gray crystalline ls. whose distinctive features are massive appearance, hardness, and relatively great thickness. Thickness in Grand Canyon 500 to 700 ft. There is probably an uncon. at top of Redwall ls. as here restricted. The upper 250± ft. of red sandy sh., purplish and gray ls. with red chert, and reddish to buff calc. ss. of Penn. age, which have heretofore been included in Redwall ls., are here transferred to overlying Supai fm. [This is present adopted definition of Redwall ls.]

Redwall breccia.

Cambrian: British Columbia.

F. P. Shepard, 1926 (Jour. Geol., vol. 34, p. 626).

Red Warrior limestone.

Devonian (?) and Silurian (?): Southwestern Utah (southeast of Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Red Warrior ls.*—Heavy-bedded blue and gray ls., in part dolomitic; lenses of qtzite near base. Thickness 1,500 ft. Underlies (conformably) Mowitza sh. and overlies (apparently conformably) a qtzite that is tentatively correlated with Morehouse qtzite of Frisco region. Type loc., Red Warrior mine, SE. of Frisco dist. No fossils. Tentatively assigned to Dev. (?) and Sil. (?).

Red Wing stone.

Commercial term for stone quarried from Oneota dol. at Red Wing, Minn. (See O. Bowles, U. S. G. S. Bull. 663, 1918.)

Redwood formation.

Oligocene: Southeastern Alaska (Katalla district, Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 770–782). Writer has divided Katalla fm. of Martin into 2 conformable fms., largely on basis of lithology. There is no strat. break btw. the 2 fms., but a decided change in lithology. The lower, 3,600+ ft. thick, is here called *Katalla fm.;* the upper, 5,100± ft. thick, is here named *Redwood fm.* The Katalla occupies fully 85 percent of Katalla dist.; the Redwood is restricted to a broad, steeply plunging syncline btw. Redwood and Burls Creeks and to ridge btw. Cave and Hey Points. Fossils rare and as a rule poorly preserved, but the sediments (marine) are lithologically similar to the fossiliferous beds of Yakataga dist., which are pronounced by B. L. Clark to be upper Olig., and they are here designated upper Olig. The Redwood fm. is divided into 2 members: The upper (here named *Puffy sh.*) consists of 4,000+ ft. of sh. with many thin ss. layers and many sh.-matrix cgls., in part of glacial origin; the lower (here named *Point Hey ss.*) consists of 1,100 ft. of ss. and cgl. with thin sh. beds, and with heavy cgls. at top. The Redwood fm. overlies Katalla shales in Nichawak dist.

See also *Stillwater fm.*

The U. S. Geol. Survey classifies typical Katalla fm. as Mio. (?).

Ree beds.

E. D. Cope, 1892 (Am. Ass. Adv. Sci. Proc., vol. 40, p. 285), in a description of the Ree Hills, S. Dak., described a chalky matrix, of Olig. or Eo. age, underlying the glacial drift and containing many fossil fishes, "probably fresh water," but not enough fossils to determine age. "Should the calc. stratum in which these fossils are found not turn out to be an outlier of the White River beds I propose that they be called the *Ree beds.*" There is a Ree Heights in Hand Co., S. Dak.

Reed formation.

Mississippian (upper): Central northern Utah (central Wasatch Mountains).

F. F. Hintze, Jr., 1913 (N. Y. Acad. Sci. Annals, vol. 23, p. 109). *Reade fm.*—In descending order: (1) Light-yellow, cherty, argill. ls. with large zaphrentoid corals, 5 ft.; (2) thin-bedded fossiliferous blue ls., 350 ft.; (3) brown and red sh., 35 ft. (no fossils); (4) cream-colored ss., 250 ft. (no fossils); (5) massive blue ls. with *Productus*, 300 ft. Total thickness 940 ft. Overlies Benson ls. with no observed discon. Underlies, with angular uncon., Weber qtzite. Exposed in Big Cottonwood Canyon, at N. end of Reade & Benson Ridge, which separates South Fork from Day's Fork.

Fossils collected from this fm. in 1916 and 1917 have been identified by G. H. Girty as of upper Brazer (probably Chester) age.

The present approved spelling of the ridge for which this fm. was named is *Reed & Benson*, *Reed* being the name of the man for whom the ridge was named. This spelling has recently been adopted for the next edition of U. S. G. S. topog. map.

Reed dolomite.

Pre-Cambrian: Eastern California (Inyo Range).

E. Kirk, 1918 (U. S. G. S. P. P. 110). *Reed dol.*—Heavy-bedded dol., much jointed and breaking up into large angular blocks that form rough talus slopes. Varies from aphanitic to coarsely crystalline. White or slightly bluish on fresh fracture. Weathers slightly creamy to buff. Thickness about 2,000 ft. Uncon. underlies Deep Spring fm. Is underlain by thin-bedded aren. slates which grade down into more heavily bedded sss. Named for exposures for several mi. along E. side of Reed Flat; best section is in canyon at head of Wyman Creek, in sec. 7, T. 6 S., R. 35 E.

J. H. Maxson (1934) applied *Wyman fm.* to the rocks uncon. underlying Reed fm. in Wyman Creek section, Inyo Range.

†Reeder sandstone.

Upper Cretaceous: Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 381, 382). The leaf-bearing *Reeder (Dakota?) ss.* surmounts Kiowa shales [Lower Cret.] in upper valley of Medicine Lodge River near post office at Reeder.

C. N. Gould, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 169–175). Cragin's term *Reeder ss.* is here used to include all ss. btw. Kirby clays below and true leaf-bearing

Dakota ss. above. Consists of 20 to 150 ft. of dark-brown massive ss., often cross-bedded, containing many pebbles and nodular concretions. Is top fm. of Medicine beds (the transition series), and is separated from underlying Kiowa sh. by (descending) Kirby clays, Greenleaf ss., and Spring Creek clays.

W. H. Twenhofel, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 281-297) and 1924 (Kans. Geol. Surv. Bull. 9), discarded *Medicine beds* and treated *Reeder ss.* and *Kirby clay* as members of his *"Dakota" fm.*

The U. S. Geol. Survey several years ago discarded *Reeder ss.* as a synonym of Dakota ss.

There is no longer a post office or town in Kans. called Reeder. The upper valley of Medicine Lodge River is in Kiowa and Barber Counties.

Reeds Spring limestone.

Mississippian (Osage): Southwestern Missouri.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines, vol. 21, 2d ser., pp. 143-145, 161-163, 169, 170, 190, 191, 193, 225). *Reeds Spring ls. memb. of Boone fm.*—Blue ls., very compact, fine-grained, subcrystalline, in thin beds alternating with dark flinty bands of chert. In some sections a thin bed of sh. (4 in. to 1 ft. 4 in.) is included at base. It rests conformably on noncherty St. Joe ls. memb. of the Boone and is in most places discon. overlain by Grand Falls chert memb., the Upper Burlington ls. being absent, except near Mount Vernon (Lawrence Co.), at Crane (Stone Co.), and at Springfield and elsewhere in Greene Co., where it is intercalated btw. Reeds Spring ls. and strata of Keokuk age. Thickness varies from 130 to 225 ft.; average in Joplin dist. about 150 ft. Judged by lithologic characters in drill cuttings the Reeds Spring extends many mi. beneath the plains of Kans. and Okla. Fossils clearly indicate it is older than Upper Burlington. It is believed to be time equiv. of Lower Burlington (and possibly in part of Fern Glen age), although it is lithologically very unlike any part of typical Burlington of other dists.

R. H. Hall, 1933 (Kans. Geol. Soc. 7th Ann. Field Conf. Guidebook, pp. 9, 14, 16). *Reeds Spring ls.* (pp. 9, 16), *Reed Springs ls.* (p. 14).—Dove-colored ls., very fine-grained, well-bedded, becoming blue gray and cherty near top. Thickness 10 ft. Overlies St. Joe ls. [Rests uncon. on Pierson ls. in one section given.] Underlies Upper Burlington ls.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245) assigned this ls. wholly to Fern Glen epoch (basal Osage).

Named for exposures in vicinity of Reeds Spring, Stone Co.

Reedsville shale.

Upper Ordovician: Central Pennsylvania to southwestern Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). In central Pa. *Reedsville sh.* underlies Oswego (Bald Eagle) and overlies Lower Trenton ls. Includes beds of Upper Trenton, Eden, and lower Maysville age.

E. O. Ulrich, 1913 (12th Int. Geol. Cong., Canada, p. 42). *Reedsville sh.*—A great mass of sh., aren. at top, occupying whole interval btw. top of Trenton ls. and base of Oswego ss. Seems to constitute an indivisible formational unit. Top is characterized by fossils that seem to belong to top of Fairview div. of Maysville. Lower part is of Eden age.

Reedsville sh. as recognized by U. S. Geol. Survey applies to western belt of rocks of Utica, Eden, and lower Maysville age, from central Pa. to SW. Va., the eastern belt of rocks of these ages being represented in upper part of Martinsburg sh. In Blair Co., Pa., the Reedsville is 1,000 ft. thick. According to C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227) the Utica is represented in Reedsville. In SW. Va. the Reedsville is overlain by Sequatchie fm.

Named for exposures at Reedsville, Mifflin Co., Pa.

reef beds.

Miocene: Southern California.

See under †*Coalinga beds.*

Reef Ridge shale.

Miocene (upper): Southern California (Fresno, Kings, and Kern Counties).

W. F. Barbat and F. L. Johnson, 1933 (ms. read before Pal. and Min. Div. of A. A. P. G. at Houston meeting March 24, 1933).

W. F. Barbat and F. L. Johnson, April 1933 (Pan-Am. Geol., vol. 59, No. 3, p. 239). *Reef Ridge* is proposed for a sh. fm. exposed on Reef Ridge, Fresno and Kings Counties, that overlies siliceous sh. (McLure sh. of Henny) that is correlated with Santa Margarita (upper Mio.) and underlies lower Etchegoin sands (lower Plio.). In past this sh. has been grouped with both underlying and overlying fms.

T. W. Koch, 1933 (A. A. P. G. Bull., vol. 17, No. 6, p. 695). *Reef Ridge* (Upper Mio.); 550 ft. (in wells) of clay shales, slightly sandy at top. Underlies Etchegoin and overlies Maricopa.

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, pp. 1169, 1175). Blue sh. and sandy blue sh., 600 to 800 ft. thick, that weathers brown along flanks of Reef Ridge just SW. of Kettleman Hills has been named *Reef Ridge sh.* by Barbat and Johnson. Arnold and Anderson (U. S. G. S. Bull. 398, 1910) included this sh. as an upper memb. of their Santa Margarita (?) fm. in SE. end of Reef Ridge, but in NW. end of Reef Ridge they mapped it as "Transition zone mapped as Jacalitos." [See also under *McLure sh.*]

R. D. Reed, 1933 (Geol. Calif., p. 254, footnote). *Reef Ridge sh.* seems to be Mio., rather than Plio. [On several preceding pp. he assigned it to Plio.]

W. F. Barbat and F. L. Johnson, 1934 (Jour. Pal., vol. 8, No. 1, pp. 1–17). *Reef Ridge sh.* is proposed for a fm. of uppermost Mio. age underlying Etchegoin sands (lower Plio.) and overlying the redefined "McClure" sh. of Coalinga dist. The Reef Ridge sh. and "McLure sh." correlate with parts of Maricopa sh. and Monterey sh. The Reef Ridge sh. is upper div. of "Santa Margarita (?)" of Arnold and Anderson in U. S. G. S. Bull. 398, p. 92, 1910. It is typically exposed in a belt of degraded relief on NE. side of Reef Ridge, Fresno and Kings Counties, from Little Tar Canyon to Jasper Canyon. The belt is flanked on SW. by the more resistant "McLure sh." and the underlying ridge-forming Temblor fm. In type area the fm. is chiefly characterized by soft blue (brown-weathering) clay sh. with minor beds of sandy sh. Toward NW. end of type belt there is increase in sandiness, and beds of brownish-gray ss. occur. Thickness, 170 to 855 ft. North of Reef Ridge the fm. overlaps onto Cret. It contains a small but distinctive foraminiferal fauna; is stratigraphically higher than Santa Margarita beds; and in certain areas there is uncon. at top and also at base.

W. P. Woodring, 1934 (U. S. G. S. geol. map and structure sections of Kettleman Hills). *Reef Ridge sh.* (caving sh. of drillers) overlies McLure sh. (brown sh. of drillers) and underlies Jacalitos ss. (Plio.) in this area.

B. L. Clark, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 7, pp. 1049–1050), assigned this fm. to Plio.

H. W. Hoots, S. C. Herold, W. D. Kleinpell, 1935 (Geol. of nat. gas, A. A. P. G., pp. 126, 145). *Reef Ridge fm.* is herein considered upper fm. of Monterey group and of Upper Mio. age.

Reelsville limestone.

Mississippian (Chester): Southwestern Indiana and northern Kentucky.

C. A. Malott, 1919 (Ind. Univ. Studies, vol. 6, No. 40, pp. 7–20). *Reelsville ls.*—Compact to semicrystalline ls., frequently quite oolitic in texture, and almost always suboolitic. Contains considerable pyrite. Persistent over wide areas. Exposed at Reelsville, Putnam Co., Ind. From there to middle part of Crawford Co. it forms a single ledge, but in middle Crawford several other thin ledges come in on top of the main one. Underlies Elwren ss. and overlies Brandy Run ss. Can be traced over a wide area in Meade and Breckinridge Counties, Ky. [Later repts give thickness 0 to 35 ft.]

Reese formation.

Tertiary? (Eocene?): Central southern Montana (Livingston quadrangle).

W. R. Calvert, 1912 (U. S. G. S. Bull. 471, p. 412). *Reese fm.*—Water-laid material, mainly of volcanic origin and Eocene (?) age, uncon. overlying beds of Montana (Upper Cret.) age and uncon. underlying igneous flows called Neocene in Yellowstone folio. Consists of (descending): Coarsely conglomeratic strata; poorly exposed, 100 ft.; coarsely cross-bedded sandy beds; light-colored nearly structureless beds, largely volcanic ash and andesitic pebbles; coarse to pebbly bedded ss. of reworked volcanic material. Thickness 600 ft. in Electric coal field.

Type loc., Reese Creek, Park Co.

Reeve meta-andesite.

Pennsylvanian: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Reeve meta-andesite.*—Volcanic, tuffaceous porphyritic meta-andesite, about 200 ft. thick. Occurs as a definite flow and tuff. Is intimately associated with Robinson fm., into which it grades. Appears to be younger than Kettle meta-andesite.

Named for an unidentified locality near Genesee, E. of Taylorsville.

Reformatory granite.

Pre-Cambrian: Southwestern Oklahoma (Greer County).

C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). Coarsest granite in Wichita Mtns. Is medium-grained, flesh red. Intruded after solidification of Headquarters granite. Earlier than Lugert granite. [Appears to be named for State Reformatory, at Granite, Greer Co.]

Refugian stage.

Tertiary: California.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, pp. 215–225), introduced *Refugian stage* for a faunal zone of the Pacific slope Tert. of Calif., Wash., and Oreg. "Probably=in age part of upper Eo. or lower Olig. series of Europe," and including Lincoln, San Emigdio, Tumey, and Gaviota fms., also lower part of Pleito, lower and middle parts of San Lorenzo, lower part of Kirker, and *Turritella variata* zone; also many fms. (enumerated) of Wash. and Oreg. Type loc. is Cañada de Santa Anita, on S. side of Santa Ynez Mtns, Santa Barbara Co., Calif., about 5 mi. W. of Gaviota pass, the name being derived from the Spanish land grant "Nuestra Señora del Refugio," shown on Lompoc topog. sheet of U. S. Geol. Survey, 1905 ed. The base of the stage corresponds to base of Gaviota fm. at its type loc. in Cañada de Santa Anita. Fossils discussed.

Refugio sand.

A subsurface sand in Frio clay of Driscoll pool, Duval Co., Tex.

Regan sandstone.

See *Reagan ss.*

Regina clay.

Pleistocene: Saskatchewan.

H. E. Simpson, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 73).

Reklaw member (of Mount Selman formation).

Eocene (middle): Eastern Texas (Houston to Sabine Counties) and northwestern Louisiana.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). (Name proposed by E. A. Wendlandt and G. M. Knebel.) *Reklaw memb. of Claiborne fm.*—A series of chocolate-brown glauconitic shales with glauconitic concretionary ledges; brown, carbonaceous, micaceous sandy shales, in places lignitic; and greensands; lignitic brown sands in lower part. Occurs below Queen City memb. and above Carrizo sands in Tex. and above Cane River memb. [restricted] of Claiborne in La. Thickness 1 mi. E. of Reklaw, Cherokee Co., Tex., on Tex. & New Orleans R. R., 20½ ft.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, pp. 1351–1355). *Reklaw memb. of Mount Selman fm.*—Consists of those glauconites and glauconitic clays above the Carrizo and underlying the sands and clays of Queen City memb. of Mount Selman. Line btw. Reklaw and Queen City memb. is usually arbitrarily drawn where the glauconitic streaks end upward in the section. Consists of (descending): (1) 0 to 100 ft. of brown clay with streaks of sand and greensand and zones of clay-ironstone concretions; (2) 4 to 15 ft. of rather pure clayey glauconite containing plentiful fossils; (3) 20 to 40 ft. of brown to dark-blue micaceous sandy clay with stringers of glauconite and zones of clay-ironstone concretions. Well exposed at Reklaw, Cherokee Co., Tex.

In NW. La. these beds form part of Cane River glauconitic memb. of St. Maurice fm. as originally defined by Spooner and used by U. S. Geol. Survey. In eastern Tex., as far W. as Atascosa Co., the basal memb. of

Mount Selman is the Reklaw; to S. of Atascosa Co. the contemp. beds, which differ lithologically, are now called *Bigford memb. of Mount Selman fm.* by U. S. Geol. Survey. The Bigford was formerly included in Wilcox group, but is now assigned to Claiborne group by most geologists.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 619–620), treated Reklaw as a *fm.* and recommended that Bigford be replaced by Reklaw.

Relay quartz diorite.

Pre-Cambrian: Northeastern Maryland (Baltimore County).

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 104, 130). *Relay quartz diorite.*—Pink quartz diorite, composed of oligoclase, quartz, and muscovite, which occurs at Relay, on Patapsco River. Intrudes Glenarm series. Is assigned to late pre-Camb.

Relay Creek dolomite.

Permian: Northwestern Oklahoma.

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 405–432). The dolomites at or near top of Marlow memb. of Whitehorse fm. have been known as "Greenfield" dolomites, but this name is preoccupied, and it seems well to offer a new name. The name *Relay Creek* is suggested for these beds, from exposures both N. and S. of Relay Creek, in T. 15 N., R. 12 W., and adjoining twps on S. and E. There are ordinarily 2 beds of dol. separated by approx. 25 ft. of red ss. and sh. Each bed is 1 or 2 ft. thick, but in other areas the thickness decreases to almost nothing. Locally there is a third bed of dol. 7 or 8 ft. below the lower of the two. The 2 beds commonly occurring are here designated Upper Relay Creek dol. and Lower Relay Creek dol. The third or lowest bed is associated so closely with Lower Relay Creek dol. that it is merely mentioned, with no distinguishing name. Color of these dolomites varies from light gray, where the beds are 1 or 2 ft. thick, to almost black, where the beds are very thin. In type area, where thickness is almost maximum, the color is gray.

See also under *Day Creek dol.*

Relief quartzite.

Mississippian: Northern California (Colfax quadrangle).

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66). *Relief fm.*—Very hard grayish or yellowish siliceous rock of fine grain and clastic origin, which might be characterized as very fine-grained qtzite alternating with streaks of siliceous clay slates. The qtzite is completely filled by small irregular bunches and veinlets of white quartz. No fossils. Corresponds to part of Calaveras fm. Overlies Blue Canyon fm. and underlies Cape Horn sl. Named for exposures at Relief. Best exposures in canyons of South Fork of Yuba River below Relief, in canyon of Bear River and of Steep Hollow N. of Dutch Flat.

According to later work by H. G. Ferguson (Am. Inst. Min. and Met. Engrs. Tech. Pub. 211, p. 4, 1929, and U. S. G. S. P. P. 172, 1932) two fms. (Tightner below and Kanaka above), composed of interbedded sed. and igneous rocks, are now discriminated btw. Blue Canyon fm. and Relief qtzite.

Relizian stage.

Tertiary: California.

See under *Zemorrian stage*, R. M. Kleinpell, 1934.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224). *Relizian stage* includes Gould sh., "button bed," and *Siphogenerina hughesi* zone, etc.

Remick tonalite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke, Littleton, and Whitefield quadrangles).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., maps, p. 28). *Remick tonalite* is late Dev. or late Carbf. Assigned to New Hampshire magma series.

Named for Remick Park, in town of Littleton, according to letter dated Aug. 20, 1935.

Remmel granodiorite.

Jurassic (?): Southern British Columbia and central northern Washington (Okanogan batholith).

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). "Seems to compose the cliffs of Mount Remmel, Wash., 5 mi. S. of Int. Bdy."

Renault formation. (Of Chester group.)

Mississippian: Southwestern and southeastern Illinois and western Kentucky.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 122). *Renault fm.*—Series 80 to 100 ft. thick, of sss., aren. shales, variegated shales, calc. shales with thin platy ls. layers, dense aren. lss., nearly pure crystalline lss., oolitic lss., and, in N. part of Waterloo quad., ls. cgl. Uncon. overlies Brewerville [Aux Vases] ss. and underlies, probably uncon., Yankeetown chert.

Named for Renault Twp, Monroe Co., SW. Ill. Typically developed in valley of Horse Creek and its tributaries in E. part of the Twp.

See under *Ohara ls. memb.*

Rench sand.

A name locally applied, in Mount Poso oil field (E. side of San Joaquin Valley, NE. of Bakersfield, Kern Co., Calif.), "to basal sand of Jewett micaceous silt memb. of the Lower Temblor." (See A. Diepenbrock, Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, 1933, p. 16, pl. 2.)

†Renfroes marl.

Upper Cretaceous: Western Georgia.

J. O. Veatch, 1909 (Ga. Geol. Surv. Bull. 18, pp. 86–89). *Renfroes marl.*—Massive gray micaceous, calc. sands, with layers of nodular lss.; black plastic clays, fossil-bearing; and various colored sands with layers of laminated silty clays. Thickness 500 ft. Is upper marl of Ripley fm. Underlies, through gradual transition, the Providence sand, and overlies Cusseta sand. Below Florence, Stewart Co., probably merges with Blufftown marl, which underlies Cusseta sand.

Comprises bulk of Ripley fm., and name is therefore unnecessary. (See J. O. Veatch and L. W. Stephenson, Ga. Geol. Surv. Bull. 26, p. 153, 1911.)

Named for exposures at Renfroes, Chattahoochee Co.

Rennie shale.

Middle Cambrian: Northern Idaho (Pend Oreille district).

E. Sampson, 1928 (Idaho Bur. Mines and Geol. Pam. 31, p. 9). *Rennie sh.*—Consists of "paper" sh.; in outcrop in stream along W. side of Rennie Ridge (one of the spurs on S. side of Packsaddle Mtn) it is a very thin-bedded yellowish sh. Is very soft and so easily eroded and covered with debris that there are few places where its presence would be suspected. Thickness probably 50 to 75 ft. Contains abundant Middle Camb. fauna. Underlies Lakeview ls. and overlies Gold Creek qtzite.

Rennix limestone.

Upper Ordovician (Richmond): Southeastern Kentucky.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, p. 435). *Rennix lss.*—Thin-bedded nonfossiliferous lss., 21 to 56½ ft. thick, in southern Ky. Lithologically do not resemble Sil., and hence are included in top of Richmond. Underlain by Fowler ls. and uncon. overlain by Chattanooga black sh.

Named for Rennix Creek, Cumberland Co.

Reno formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1934 (Canada Dept. Mines, Geol. Surv. Mem. 172, No. 2345, p. 8).

Rensselaer graywacke.

Lower Cambrian (?): Eastern New York.

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pp. 301–340 and map). *Rensselaer grit.*—Grit or graywacke, a dark-green, exceedingly tough rock, in some places calc. and generally thick-bedded and granular; quartz grains apparent, and upon closer inspection the feldspar grains also. Traversed by numerous veins of quartz and sometimes of epidote. Is interbedded with strata of purplish or greenish sl. (phyllite) varying in thickness from a few in. to perhaps 100 ft. Rests uncon. on Hudson River sh.; also, without evidence of uncon., on Berkshire schist, which is contemp. with and grades into Hudson River sh. Is of Upper Sil. age and=Oneida cgl. Thickness 1,200 to 2,000 ft. Forms upper part of E. side of Rensselaer grit plateau, eastern N. Y., also the SE., W., and N. faces of the plateau.

In 1906 (N. Y. State Mus. 60th Ann. Rept., vol. 1, pp. 53–58) J. M. Clarke expressed opinion that this nonfossiliferous grit is of Dev. age and "most naturally connected with either the Oriskany invasion or the Catskill embayment," and he reiterated this opinion in 1909 (N. Y. State Surv. Mem. 9 and Bull. 133).

In 1907 (N. Y. State Mus. Bull. 107, pp. 51–52) C. A. Hartnagel expressed opinion that Rensselaer grit is not of Shawangunk age and that it cannot be correlated with Oneida cgl. In 1912 (N. Y. State Mus. Hdb. 19, p. 70) he expressed opinion that it is of Dev. age, and in his chart he doubtfully assigned it to Catskill epoch.

In 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 448–449) J. Barrell assigned the Rensselaer to Middle Dev., stating that it resembles Bellvale flags of Middle Dev. much more closely than it does the Oneonta or Catskill fm. In 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 410+) R. Ruedemann assigned *Rensselaer grit* to Upper Dev., and stated that it is underlain by Tackawasick ls., of Trenton age. He repeated his assignment of *Rensselaer grit* to Upper Dev. in 1930 (N. Y. State Mus. Bull. 285, pp. 25, 27).

In 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 283–284) L. M. Prindle and E. B. Knopf tentatively assigned *Rensselaer graywacke* to Lower Camb. because it dips in apparent conformity under Rowe schist of Taconic Mtn, which is considered by writers to represent the horizon of Lower Camb. Mettawee sl.; and the U. S. Geol. Survey accepted *Lower Camb. (?)* as the age of the Rensselaer. In 1932 (Am. Petrol. Inst., Div. of Production, Dallas, Tex., p. 4) P. D. Torrey and others stated that *Rensselaer grit* is believed to be an outlier of Catskill shore line, and that recent work by Ruedemann has shown it to be of Upper Dev. age. In 1933 (16th Int. Geol. Cong. Guidebook 1, p. 15, map), Ruedemann assigned *Rensselaer graywacke* to *Camb. (?)*. (This map accompanies Ruedemann's text, but whether he is author of map, and assigned the Rensselaer to Camb. (?) is not explained.) H. Vaughan and T. Y. Wilson, 1934 (Am. Jour. Sci., 5th, vol. 27, p. 460) definitely assigned *Rensselaer graywacke* to Lower Camb. on basis of fossil evidence "presented here for the first time."

Renwick shale member.

Upper Devonian: Central southern New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 202). *Renwick sh. memb.* (basal memb. of Middlesex sh.), 8 to 20 ft. thick, underlies Six Mile sh. memb. and overlies West River and Standish fms. in Ithaca region. Is Middlesex according to Fralich. Has been correlated, erroneously, with Rhinestreet in the past. [Derivation of name not stated.]

Repetto formation.

Repetto siltstone.

Pliocene (lower): Southern California (Los Angeles region).

R. D. Reed, 1932 (16th Int. Geol. Cong. Guidebook 15, p. 31). *Repetto fm.* is here used for the siltstone exposed in Repetto Hills. This name was proposed in 1930, by a committee of Pacific section of Soc. of Econ. Paleontologists and Mineralogists, and is now in general use among Calif. geologists. Type loc. lies along W. side of Atlantic Boulevard, where exposed thickness is 2,000± ft. Foraminifera abundant. Lower part of fm. not exposed along Atlantic Boulevard but may be imperfectly seen along Fremont Ave., ½ mi. farther W., where an additional thickness of 500 ft. is represented by poorly exposed siltstone that carries only a few fossils. The siltstone rests on diatomaceous shales referred to Puente fm. (upper Mio). Top of Repetto fm. is drawn at top of 3 beds of coarse feldspathic ss. ranging in thickness from a few inches to several ft. Siltstone similar to the siltstone of Repetto fm. overlies the ss. It carries a mixture of Repetto Foraminifera, possibly reworked, and others characteristic of younger horizons and probably represents lower part of overlying Pico fm. The Repetto is a mappable unit in Repetto, Puente, and San Pedro Hills and in Ventura Basin. On basis of strat. position and distinctive foraminiferal fauna it is referred to lower Plio.

W. P. Woodring, 1932 (16th Int. Geol. Cong. Guidebook 15, p. 35), showed Repetto fm. (lower Plio.) in San Pedro Hills as resting conformably on Modelo fm. and as uncon. overlain by Pleist. calc. beds.

W. S. W. Kew, 1932 (16th Int. Geol. Cong. Guidebook 15, p. 49), in describing region btw. Los Angeles and Santa Barbara, stated that *Repetto fm.* consists of siltstone, ss., and cgl. which are considerably more indurated than those of conformably overlying Pico fm. Grades down into the brown sandy sh. that forms uppermost memb. of Modelo fm.

According to W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, fig. 1, pp 129, 146), the Repetto of Palos Verdes Hills is all siltstone, and they called it *Repetto siltstone.* [Elsewhere *Repetto fm.* is regarded as the preferable name.]

†Republic formation.

Pre-Cambrian (Huronian): Northwestern Michigan (Marquette district).

M. E. Wadsworth, 1890 and 1891 (Lake Superior along the south shore, by Julian Ralph, pp. 77–99; 1st ed. 1890; 2d ed. 1891). *Republic fm.*—Fragmental jaspilite and ore, with their associated qtzites and schists, of Cascade, Republic, Humboldt, Ishpeming, Negaunee, and elsewhere in Marquette dist. Overlies Cascade fm. and underlies Holyoke fm. Named for town in Marquette region.

M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891–92, pp. 63–66, 84–85, 102–127). *Republic fm.*—Consists of porphyrite, diabase, diorite, porodite, granite, felsite, argillite, schist, jaspilite and associated iron ores, dol., qtzite, and (at base) cgl., breccia and conglomeratic schist. Uncon. underlies Holyoke fm. and uncon. overlies Cascade fm. [The qtzite immediately overlying the basal cgl. is called *Republic qtzite* on p. 103.]

Named for occurrence at Republic, Marquette Co.

Republic quartzite.

Pre-Cambrian (Huronian): Northwestern Michigan (Marquette district).

See 1893 item under †*Republic fm.*

Republic chert.

Pennsylvanian: Southwestern Missouri.

E. M. Shepard, 1898 (Mo. Geol. Surv. vol. 12, pt. 1, pp. 125–126, 141). *Republic chert.*—Peculiar knotted chert in alternating light and dark bands highly fossiliferous, also in places conglomeratic. Included in top of Cherokee stage of Des Moines series in Greene Co. Nowhere found bedded. Seems to be widely spread in small blocks and masses as residual material left by breaking down and destruction of superincumbent beds.

Named for Republic, Greene Co.

†Republic reef.

Name locally applied to basal mottled ls. memb. of Gallatin fm. in New World ("Cooke City") mining dist., SE. cor. of Park Co., central southern Mont.

Republic granite.

Pre-Cambrian: Northern Michigan.

C. A. Lamey, 1933 (Jour. Geol., vol. 41, No. 5, pp. 487–500). The larger part of the pre-Camb. rocks of northern Mich. known as Southern Complex, and previously designated Archean, is thought to be composed of a post-Upper Huronian granite which has intruded and extensively metamorphosed the Huronian sediments and which probably extends westward some distance beneath the Upper Huronian rocks in vicinity of Lake Michigamme. Because of its excellent development in vicinity of Republic, it is suggested this granite be called *Republic granite*.

Republican Creek limestone.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 78; map). *Republican Creek ls.*—Chiefly massive white to light bluish-gray fine-grained ls., in places banded and stratified; locally coarse-grained and slightly argill.; in places alternates with argill. lss. of medium bluish-gray tint. Occupies belt a little over 1 mi. wide just S. of Lead Point argillite. Extends from head of Republican Creek SW. past N. end of Deep Lake. Thickness 1,200± ft.

†Republican River formation.

Pliocene (lower): Northern Kansas and central southern Nebraska.

H. F. Osborn, 1907 (Am. Mus. Nat. Hist. Bull., vol. 23, pp. 250, 251), and W. B. Scott, 1907 (Textbook geol., p. 724), applied this name to lower Plio. strata exposed along Republican River in southern Nebr. and northern Kans. that form part of Ogallala fm.

†Requienia ("Caprotina") limestone.

A paleontologic name applied by R. T. Hill (Biol. Soc. Wash. Proc., vol. 8, pp. 10–15, 1893) to a bed of aggl. lying 100 ft. below top of Glen Rose ls. of Tex.

Reserve shale member.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 5, 9). *Reserve sh.*—Middle memb. of Falls City ls. fm. Is blue-gray, argill., and about 4½ ft. thick. Underlies Lehmer ls. memb. and overlies Miles ls. memb. Type loc. in upland near State line NW. of Reserve, Kans.

Reservoir granite.

Pre-Cambrian: West Point quadrangle, southeastern New York.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, map and passim). *Reservoir granite.*—Rather coarse-grained gray gneissoid granite, including large blocks of dark banded gneiss. Differs from Canada Hill granite in its higher biotite content and greater continuity of mica bands. Intrusive into Grenville series. [Map block includes Mahopac granite.] Type loc. at N. end of Boyd Corners reservoir, Putnam Co.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this granite as of post-Glenarm pre-Camb. age.

Reservoir Hill granite.

Pre-Cambrian: Northwestern New York (Gouverneur quadrangle, St. Lawrence County).

H. P. Cushing and D. H. Newland, 1925 (N. Y. State Mus. Bull. 259, pp. 42–47). [In several places the pre-Camb. granite of Reservoir Hill is called *Reservoir Hill granite*, which is described as comparatively fine-grained, with only traces of porphyritic texture, and with few inclusions. It is also called *Reservoir sill*. Intrudes Grenville rocks.]

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 55-59). *Reservoir Hill granite mass* forms Reservoir Hill phacolith, lying just SE. of Gouverneur. Writer believes this mass belongs with Alexandria type, as it is nonporphyritic. Intrudes Grenville series.

Restigouche volcanic series.

Devonian: New Brunswick.

W. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 479).

Rest Island granite.

A name applied by I. H. Cram (Jour. Geol. vol. 40, No. 3, 1932, pp. 270-278) to the granite of Rest Island batholith, in Rainy Lake area of Minn. and Ont., which he classified as Algoman.

Restoration Point horizon.

Oligocene: Washington.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, btw. pp. 751 and 770). *Restoration Point horizon* has been described by C. E. Weaver as *Blakeley horizon*, locally known as *Sala gettysburgensis* zone.

Revard sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

D. E. Winchester, K. C. Heald et al., 1918 (U. S. G. S. Bull 686G, pp. 60-64). *Revard ss.*—Massive ss., very similar to the younger Cheshewalla ss., with lentils of red sh. which range in length from a few ft. to a mile or more and in thickness from a few in. to 6 ft. Top interfingers with overlying red sh. Thickness 30 to 80 ft. in T. 25 N., R. 10 E. Lies 145± ft. below Labadie ls. and 70± below Cheshewalla ss. Type loc. is at Revard Point, sec. 13, T. 26 N., R. 10 E.

P. V. Roundy, K. C. Heald, and G. B. Richardson, 1922 (U. S. G. S. Bull. 686Z, pp. 398-399, pl. 55). *Revard ss.* in T. 26 N., R. 10 E., is a massive ss. 30 to 40 ft. thick. In its NE. extension into T. 27 N., R. 11 E., it thickens and in places contains much sh. In T. 27 N., R. 12 E., it is 70± ft. thick and becomes differentiated into 3 distinct medium-heavy to massive-bedded ss. zones, separated by shales containing thin sss. In T. 28 N., R. 12 E., the Revard ss. breaks up into more ss. zones separated by shales, so that, for purposes of oil geology, it is better considered as several separate sss. In that twp parts of the Revard were mapped under following names (descending): (1) Mission ss. at top; (2) Possum ss. 13± ft. lower; (3) Gap ss. 15± ft. lower; and (4) Hulah ss. 18± ft. above base. Lies 20 to 50± ft. above Buck Point ss.

Revett quartzite. (Of Ravalli group.)

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and northwestern Montana.

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277-285). *Revett qtzite.*—White qtzites, generally rather thick-bedded, interstratified with subordinate quantities of micaceous ss. Thickness 1,000± ft. Underlies St. Regis fm. and overlies Burke fm. Named for exposures surrounding Revett Lake, Coeur d'Alene dist., Idaho. Description of general geol. of region is based almost wholly on work of F. C. Calkins.

Reward conglomerate.

Pennsylvanian: Eastern California (Inyo Range).

E. Kirk, 1918 (U. S. G. S. P. P. 110). *Reward cgl.*—Cgl. of coarse material, of both angular and rounded fragments of red, brown, and white grits, together with jasper, brown hornstone, and green cherty pebbles firmly held together by a siliceous cement. A brownish-weathering ss. with dark-brown patches and layers forms uppermost 100 ft. of the Reward N. of Union Wash. Thickness of fm. 100 to more than 350 ft. Uncon. underlies Owenyo ls. (Perm.), and conformably overlies Penn. ls. and sh. Named for bold exposures just S. of Reward mine.

Rex chert member (of Phosphoria formation).

Permian: Eastern Idaho, northeastern Utah, southwestern Montana, and southwestern Wyoming.

R. W. Richards and G. R. Mansfield, 1912 (Jour. Geol., vol. 20, pp. 683-689). *Rex chert memb.*—Top memb. of Phosphoria fm. Thickness in region of Bannock overthrust (SE. Idaho and NE. Utah) 0 to 450 ft. In sec. 12, T. 10 S., R. 44 E., it consists of (descending): (1) Black cherty sh. weathering red brown to purple, 80 ft.; (2) chert in heavily iron-stained ledges, 60 ft.; (3) gray ls. banded with ashy-gray to black chert, 100 ft. Rests on phosphatic shales comprising rest of Phosphoria fm. and is overlain by Woodside sh. (Triassic). Named for Rex Peak, in Crawford Mtns, 4 mi. E. of Randolph, Rich Co., Utah, where the chert forms an anticlinal cap. This locality has been described by H. S. Gale, and the selection of the name for the memb. was originally made by him. Gale regards upper 129 ft. of Boutwell's typical section of Park City fm. as approx.=Rex chert memb., and the underlying 112 ft. as representing the phosphatic shales of Phosphoria fm. The hard Rex chert memb. is conspicuous part of Phosphoria fm. Locally 50 to 75 ft. above its base the Rex chert gives way to ls., and in other places a dark-gray to black or purplish flinty or cherty sh. occupies major part of Rex chert interval, but more generally the shaly facies is present near top and is occasionally with difficulty distinguished from Woodside sh. [Fossils listed.]

Rexmount volcanics.

Eocene (?): British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 78).

Rexmount porphyry.

Tertiary: British Columbia.

W. S. McCann, 1922 (Canada Geol. Surv. Mem. 130, p. 39).

Reynales limestone member (of Clinton formation).

Silurian: Western New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Reynales ls.*—Fossiliferous ls. [in lower part of Clinton fm.] exposed at Rochester, Lockport, and Niagara. Is older than Wolcott ls., with which it has heretofore been confused, and is overlain by true Sodus sh. Westward it is a persistent massive memb., but eastward it grades into sh., and finally is indistinguishable in the sections from overlying Sodus sh. Thickness 7 to 24 ft. In Lakeport well is underlain by 7 ft. of unnamed dark sh. that may be a part of Reynales. Fossils listed. Named for exposures at Reynales Basin (also spelled Reynolds), 8 mi. E. of Lockport.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 191), placed *Reynales ls.* below Bear Creek sh. and above Maplewood sh., and included *Furnaceville sh.* in the Reynales. This classification was followed by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 324–326). She stated: Above Maplewood sh. is a tripartite ls. about 18 ft. thick, called *Reynales ls.* Lower 4 ft. of this ls. contains representation of *Furnaceville iron ore.* This lower part is typical Reynales ls., consisting of thin ls. and sh. The overlying thicker beds, which for present are also referred to Reynales ls., consist of dark-gray or bluish even-grained, sometimes dolomitic ls. The upper 5 ft. contain some nearly pure ls. layers filled with *Pentamerus oblongus.* While the name is provisionally adopted for all of this ls., it is believed (Ulrich) that this name should be restricted to lower 4 or 5 ft. (the typical Reynales), which alone are present at Reynales Basin. It pinches out about 100 mi. E. of Rochester at some place beyond Lakeport.

J. T. Sanford, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 194). The former *Bear Creek* of Genesee Gorge is designated as *Brewer Dock memb.* of the Reynales, as the fm. at Bear Creek is younger.

Reynolds sandstone member (of Hignite formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 43). *Reynolds ss. memb.*—Massive cliff-making ss., 50 to 100 ft. thick, in Hignite fm., lying 180 ft. above base of fm.

Named for Hanging Rock of Reynolds Mtn, Bell Co., Ky.

Reynolds limestone. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 426). *Reynolds ls.*—Gray shaly bed, 10 to 75 ft. thick, with marine fossils. Underlies Ada sh. and overlies Bickett sh.; all members of Bluefield

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group [fm.]. Type loc. in public road 0.3 mi. eastward from Reynolds School and 0.6 mi. NW. of Knobs village, Monroe Co. Also observed in Mercer and Summers Counties.

†Reynosa formation.

Reynosa limestone. (Mexico.)

Pliocene and late Pleistocene or Recent: Tamaulipas, Mexico, and southern Texas.

R. A. F. Penrose, Jr., 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 57, 58, 63). *Reynosa ls.*—Hard white ls., composed of very hard calc. nodules ½ inch to 3+ in. diam., of white to creamy-brown color, in places showing concretionary structure, embedded in soft white material of same composition. Though usually hard, yet in places on surface it is soft and crumbly, and in this softer material were found many specimens of *Bulumulus alternatus* Say, a shell found now in great quantities on Rio Grande. These prove the late origin of at least the material in which they were embedded, and it apparently blends into the harder rock. Unfortunately time did not permit a thorough investigation of the region, and consequently, though it is probably true that the whole of the ls. is of same late origin, its relations and extent have not been studied. It undoubtedly overlies Fayette beds, a small outcrop of which occurs at water edge at Reynosa, Tamaulipas, Mexico.

W J McGee, 1891 (U. S. G. S. 12th Ann. Rept., pt. 1, p. 500). Dumble has announced (Geol. Soc. Am. at Columbus, Dec. 30, 1891) a division of Fayette beds, and designated the uncon. upper portion the *Reynosa marl*. It is this upper memb. which represents Lafayette fm. in Tex.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 229–230). *Reynosa beds.*—In May 1889 I observed along line of Southern Pacific R.R. btw. San Antonio and Eagle Pass and N. of Eagle Pass a deposit usually consisting of a larger or smaller quantity of gravel cemented by a very porous or tufaceous ls. In some places the gravel seemed to be entirely missing and only the ls. present. Thickness of this deposit, 3 to 30 ft. In some places overlain by the yellow silt flanking the Rio Grande. At town of Reynosa, in Mexican State of Tamaulipas, and opposite Edinburg, Tex., we found a much larger and firmer deposit of ls. (containing such fossils as *Bulimus alternatus*), which was described by Penrose in 1st Ann. Rept. of Tex. Surv. under name *Reynosa ls.* This lies higher than Fayette sands. J. A. Taff, of Tex. Survey, in his work along line of Texas-Mexican Ry btw. Corpus Christi and Laredo, observed the same lime and gravel with *Bulimus alternatus* overlying Fayette sands at various places. I joined his party at Cotulla, and during my work with them up the valleys of Nueces and Leona Rivers I found many exposures of the gravel and lime and of the firmer ls. in such connection as to prove conclusively that they are mere local variations of one and same deposit. I therefore extend name *Reynosa* to include the entire series of deposits for the present. These deposits cover a very large area in western Tex. and extend into Mexico. They appear to rest uncon. on underlying Cret., Eocene, and Neocene beds. They lie above the Fayette sands and beneath the coastward clays of the Port Hudson (Columbia fm. of McGee) and appear to be a different phase of Lafayette fm. to E. Assigned to Neocene.

E. T. Dumble, 1894 (Jour. Geol., vol. 2, pp. 560–563). *Reynosa div.*—Lithologically the most characteristic of all Neocene deposits. Is a very variable series of beds. Usually has at base a cgl. of pebbles of various sizes, embedded in a lime matrix, often indurated, sometimes tufaceous, sandy, or even clayey. Above this is often, but not always, a series of interbedded clays, lime clays, limy sands, and sss., with some pebbles. This closely resembles Lagarto clays. *The whole is capped by Reynosa ls.*, a tufaceous lime rock, often so mixed with clay or sand as to lose that character. There are few exposures which show entire series of beds. In places along middle Rio Grande the basal bed of cgl. is all that is present, while on the divides the basal and uppermost beds are usually found, but without the intermediate Lagarto. The Reynosa in its typical form is only found W. of the Colorado, so far as I have observed. East of the Guadalupe the lime is gradually replaced by iron; the Orange sand phase appears in the Colorado drainage and E. of that stream becomes the prevailing form, although some lime is present at many localities. No fossils have been found which can be said to be indigenous to this deposit. A number of shells of *Bulimus* were found embedded in an upper crumbly layer of it, but they are simply on the surface and probably later. No other Tert. bed has anything like so wide a distribution. I found it at top of the escarpment of Llano Estacado in Garzo Co. at point marked "T i" on map of Llano Estacado accompanying 3d Ann. Rept. of this Survey, and also just S. of Big Springs, resting on N. slope of Cret. hills. In canyons on S. edge of plateau its presence has been reported by Hill and Taff. While erosion has removed the Reynosa from a large part of Guadalupe and Nueces Valleys, it still caps the divides and higher elevations and forms the surface of that plateau btw. the Nueces and the Rio Grande which is in many respects the homolog of the Llano Estacado and may well be called Reynosa Plateau. On this plateau it attains an elevation of over 800 ft. above sea level in an area which appears on all topog. maps as lying below the 200-ft. contour.

A. Deussen, 1924 (U. S. G. S. P. P. 126). *Reynosa fm.* of Tex. Coastal Plain W. of Brazos River is 560 to 1,505 ft. thick. It is of Tert. (?), Plio. (?) age, uncon. underlies Lissie gravel (Pleist.), and uncon. overlies Lagarto clay (Plio.). Is of nonmarine origin. Until more definite information can be obtained regarding age of Reynosa ls. of Penrose it is considered advisable to continue Reynosa as it was used by Dumble and Kennedy, it being well established in the literature with that significance. The "Uvalde fm." of previous repts is now regarded as an upstream facies of Reynosa. The Reynosa consists of a cgl. of flint or siliceous manganese-stained ls. pebbles, cemented with lime, very hard in some places but in others soft and tufaceous; lenses of pink manganese-stained limy clay; coarse limy sand and ss.; and soft tufaceous ls. Bedding very irregular. Small ridges and knolls are capped with the ls., and the intervening depressions are occupied by red or brown loam. No fossils have been found in fm., which extends NE. through Duval, McMullen, Live Oak, Bee, Goliad, DeWitt, Lavaca, Waller, Colorado, and Austin Counties.

A. C. Trowbridge, 1932 (U. S. G. S. Bull. 837, pp. 20, 201–202, as summarized by W. A. Price in A. A. P. G. Bull., vol. 17, No. 5, p. 492, 1933), pictures the post-Oakville or post-Lagarto peneplain as accumulating, to an appreciable depth, residual material which, with the uplift of Edwards Plateau, and perhaps of plateaus and mtns farther W., was washed down seaward across the plain by the rejuvenated rivers, collecting in greater thickness toward the coast. This alluvium formed "a sort of compound fan" upon which stretched "a sort of piedmont plain." Some rivers, as the Nueces W. of Bordas scarp, have eroded this alluvium so deeply as to expose the underlying rocks, in which they have cut "gorgelike trenches."

Further work by many geologists raised considerable discussion regarding the appropriateness of the name *Reynosa* as applied in the literature. J. T. Lonsdale and J. R. Day stated (U. S. G. S. Press Bull. 68861, Feb. 9, 1933) that *Goliad fm.* had been proposed by Tex. geologists and is being considered as a substitute for *Reynosa*.

A. W. Weeks, 1933 (A. A. P. G. Bull., vol. 17, No. 5, May, pp. 455–487). *Reynosa caliche* (*Pleist.*).—In this paper *Reynosa* is applied to the caliche deposits of Reynosa Plateau region, and thus is limited to a variety of deposits similar to that of type section. From data thus far collected no objection can be seen to assigning a Beaumont (Pleist.) age to much of the caliche, although it may have begun to form during Leona time. I consider Leona to be younger than Uvalde, and Uvalde to be=Lissie fm. (Pleist.). Some question may be raised as to advisability of giving the caliche a name. If the main caliche mantle in area discussed should not be given a name, then *Reynosa* should be abandoned. Thickness of the caliche is 1 to 12 ft. It is younger than Upper Lagarto, which contains Plio. fossils. The Reynosa ls. of Penrose at Reynosa, Tamaulipas, Mexico, rests on the Lagarto instead of on Fayette.

A. Deussen, 1933 (A. A. P. G. Bull., vol. 17, No. 5, pp. 483–484). *Reynosa fm.* should not be abandoned, although it may be that some material that has been included in Reynosa should be excluded, notably the high-level gravels referred to the *Uvalde* and the limy flint cgl. capping Bordas escarpment, both of which I now think are probably interior equivalents of the Lissie. But there is a definite strat. unit in Live Oak, Bee, Goliad, and Victoria Counties, lying uncon. above the Lagarto and dipping below the Lissie, which was included by me in the Reynosa. It is this series of beds to which I would prefer to apply *Reynosa*. This unit consists of lss. and some characteristic pinkish-red and white mottled clays, that are readily distinguished from underlying Lagarto and overlying Lissie. There is pronounced uncon. at base, and in many places a gravel bed or cgl. forms the base, in which late Plio. fossils have been found. The *Goliad ss.* of geologists in SW. Tex. I consider to be the basal portion of Reynosa fm.

A. W. Weeks, 1933 (A. A. P. G. Bull., vol. 17, No. 5, pp. 485–486). I understand Deussen would like to give name *Reynosa* to all or part of what I have called

Upper Lagarto. This would exclude from his Reynosa all material from other strat. units which he and [A. C.] Trowbridge once included in it. I do not advise adoption of *Reynosa* for all or part of my Upper Lagarto, because it appears Dumble gave name *Lagarto* to this section in 1894, and because *Reynosa* was applied by Penrose to the caliche deposits at Reynosa, Tamaulipas, Mexico, and vicinity in 1890.

W. A. Price, 1933 (A. A. P. G. Bull., vol. 17, No. 5, pp. 488–520). Reynosa ls. of Penrose is calc. caliche (porous earthy, impure ls.). The ss. on which it rests is not Fayette ss., as Penrose thought, but belongs to Reynosa fm. of later writers. Dumble's Reynosa included Penrose's ls. bed at top. Other geologists have divided Reynosa of Dumble and Deussen into two divisions, the upper of which is caliche of early Pleist. age, and the lower of which consists of sss. and clays containing fossil bones of horses that seem to indicate Plio. age. The max. thickness of 600 to 1,500 ft. that has been assigned to the Reynosa by various authors is greatly in excess of true thickness. Max. thickness of Reynosa caliche or Upper Reynosa is 85 ft. The Lower Reynosa uncon. underlies Upper Reynosa; its thickness is not much greater than that of Upper Reynosa. The Reynosa is uncon. overlain by Lissie sands and it overlaps Lagarto, Oakville, Catahoula tuff, and Frio in Reynosa Plateau. Some geologists think *Reynosa* should be restricted to Upper Reynosa and a new name be given to Lower Reynosa. H. A. Noble and I. K. Howeth have called (but not yet published) it *"Goliad ss.,"* but that name has not yet any standing.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 751, 755, 761, 777, 782). Old name *Reynosa*, which has been applied by Dumble, Udden, Baker, Böse, Trowbridge, and Deussen to the beds here named *Goliad fm.*, is considered invalid for these beds, because the gravels at type loc. for the Reynosa, at Reynosa, Mexico, are terrace gravels and are of same age or younger than Lissie fm., while the Goliad strata are below and older than Lissie fm.

A. N. Sayre, 1933 (letter dated Dec. 29). Reynosa at Reynosa, Mexico, is not a ls. It is younger than Lissie and younger than Uvalde. Penrose found Recent shells in it. It may = Leona fm. At least part of it is late Pleist. or Recent. I recommend restricting name to its type loc. at Reynosa, Mex.

The Tex. Geol. Survey and U. S. Geol. Survey have discontinued the use of *Reynosa fm.* in Tex. The U. S. G. S. now divides the late Cenozoic deposits of southern Tex. into (descending):

Beaumont clay Lissie fm.	Leona fm.	Pleist.
Uvalde gravel Goliad sand	Tert.? (Plio.?).	
Lagarto clay (Plio.).		

†Rhems shale.

Eocene (lower): Eastern South Carolina (Williamsburg County).

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 449, 451, 452, 453). *Rhems sh. or subphase*.—Light-gray to black sh. interlaminated with thin seams of fine-grained sand and mica. Some layers partly silicified. Encloses small variety of *Venericardia planicosta*. Overlain by Williamsburg pseudobuhr. Is initial phase of Upper Black Mingo. Best exhibited at Rhems Landing, on Black Mingo River.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). †*Rhems sh.*, placed by Sloan at bottom of his †Upper Black Mingo, is gray to black brittle clay or fuller's earth exposed at Rhems Landing, on Black Mingo Creek. It appears not to differ materially from his †Lower Black Mingo or †Black Mingo shales, the type loc. of which is Perkins Bluff, Black River, only 5 mi. from Rhems, Williamsburg Co.

Is a part of Black Mingo fm., of Wilcox age.

Rhinestreet shale.

Upper Devonian: Western and west-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 23 and chart). *Rhinestreet sh.* (black sh.) underlies Angola sh. and overlies Cashaqua sh. Included in Naples beds of western N. Y. [See also N. Y. State Mus. Mem. 6, 1904.]

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1000–1029). *Rhinestreet black sh.* extends from Yates Co. to Lake Erie. Thickness 53 ft. In gorge of Genesee

River underlies Hatch sh. and overlies Cashaqua sh. In Lake Erie section underlies Angola sh., overlies Cashaqua sh., and is 185 ft. thick. Included in Portage group.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 75–76). *Rhinestreet sh.* named for exposures along Rhinestreet N. from Naples, Ontario Co. Is 200 ft. thick on Lake Erie; thins to 2 ft. in Seneca Lake Valley, where it overlies Parrish ls., the intervening upper part of Cashaqua sh. having thinned out. In western N. Y. overlain by Angola sh.; in west-central N. Y. overlain by Hatch sh.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157) and 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), showed that Rhinestreet sh. of Lake Erie section includes at top the Hatch sh. of Genesee River section, and is larger unit than typical Rhinestreet (which lies btw. Cashaqua sh. below and Hatch sh. above). He therefore (1923 citation) applied *Attica sh.* to the Lake Erie Rhinestreet.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). Rhinestreet sh. underlies Hatch sh. and overlies Cashaqua sh. All included in Portage group.

Rhinoceros Hill beds. (In Ogallala formation.)

Pliocene (lower): Western Kansas (Wallace County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, pp. 159–163). *"Rhinoceros Hill" beds and diatomaceous marl of the Ogallala.*—In NE. part of Wallace Co., in basin of north fork of Smoky Hill River near Marshall ranch, a somewhat different type of Tert. sediments occurs, which, according to rich vertebrate fauna collected in them, must be contemp. with typical "mortar beds" of Wallace Co. referred by writer to the Ogallala. The large collection [listed] of fossil mammals was obtained from greenish-gray sand immediately underlying a bed of snow-white diatomaceous marl (4 to 11 ft. thick) that lies near top of the local Tert. section, and that must belong to about middle of Ogallala fm. These bones are pronounced by H. T. Martin to be Lower Plio. The marl is capped by a thin ledge of white ls., overlain by 10 ft. of slightly cemented grit, containing fragments of similar mammal bones, which completes the 115-ft. local Tert. section. The bones were collected on Rhinoceros Hill, SE¼ NE¼ sec. 11, T. 11 S., R. 38 W., in NE. part of Wallace Co. The hill was named by H. T. Martin, "the head of the expeditions." About 3 mi. N. and slightly W. of Rhinoceros Hill in SW¼ sec. 26, T. 10 S., R. 38 W., in Sherman Co., Kans., another "sand quarry" in the "fine silty deposit" of the Tert. was opened by Martin, the fauna of which, though closely related to "Rhinoceros Hill" vertebrates, includes some varieties that are considered by him to indicate a slightly greater age than latter, though still in Lower Plio. It appears to writer that these unconsolidated "fine silty" beds of Sherman Co., which are called by Martin "Edson beds" (from a small town in Sherman Co.), must belong somewhere low in "Rhinoceros Hill" section, probably about 50 to 80 ft. below the bed from which fauna of "Rhinoceros Hill" was collected. Pierre sh. must not be far below "Edson beds" of Sherman Co. and at a somewhat lower elev. than the fossiliferous sand of Rhinoceros Hill.

Rhode Island formation.

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 159–201). *Rhode Island Coal Measures.*—Alternations of fine and medium quartz, qtzite, and granitic pebble cgls. with pebbly sss., graywacke, shales, and coal beds, becoming metamorphic southward. Underlies Dighton cgl. group and overlies Wamsutta group of red beds, but lower part is believed to be time equiv. of part of Wamsutta red beds. Thickness 10,000 ft. Includes [descending order as arranged in table on p. 134] Westville shales and Seekonk sss., Tenmile River beds, Mansfield beds, and Cranston beds.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 54–55 and map). *Rhode Island fm.*—Makes up greater part of rocks of Narragansett Basin, both in thickness and extent. Consists of shaly and slaty coal-bearing beds intercalated with sss. and cgls. Named for fact that the graphite coal beds of Rhode Island are a part of it. Underlies Dighton cgl. to N. and Purgatory cgl. to S. Overlies Wamsutta fm.

Rhodes sand.

A subsurface sand, of early Penn. (Cherokee) age, in central and central northern Okla., lying lower than Bartlesville sand and correlated with Dutcher sand.

Rhododendron formation.

Pliocene or Pleistocene: Central northern Oregon (east side of Cascade Mountains).

E. T. Hodge, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 157). The *Coriba erosion surface* (late Plio.) was buried beneath late Plio. or early Pleist. pyroclastics (*Rhododendron fm.*) which are water-sorted only adjacent to valleys of the Coriba stage and on E. side of Cascade Mtns. These pyroclastics buried all lowlands of Coriba surface and created a barrier across the small progenitor of Columbia River which had a course many miles to S. This stream aggraded its course to elev. of 1,900 ft. above sea level and produced shallow Condon Lake E. of the volcanic zones. The aggraded stream and playa lake eventually transgressed Horse Heaven Hills and diverted waters of upper Columbia-Snake River drainage systems westward. Thus "foreign" gravels were carried westward by this extended river to Willamette Valley, where they were deposited in a great piedmont fan (Pleist. *Troutdale fm.*); these "foreign" gravels are more numerous and the fm. is thickest 15 mi. S. of Columbia Gorge. In gorge itself they occur only on E. slope of Willamette Valley. The new Rhododendron surface then was at same elev. as north-central Oreg., except for widely scattered explosive volcanoes. This surface was eventually buried by basaltic, andesitic, and trachytic lava flows which formed the constructional Cascade Mtns. The lava flows dammed Columbia River and deepened Condon Lake until it spilled over the col formed by Cascade fm. on S. and by the south-dipping Coriba surface on N. In this new course the still consequent Columbia River rapidly superposed itself on *Troutdale*, Columbia River basalt, and Eagle Creek fms. and quickly cut a gorge at places 4,000 ft. deep.

Derivation of name unknown.

Ribbon gneiss.

Pre-Cambrian (?): Central Washington (Douglas County).

A. Waters, 1927 (Jour. Geol., vol. 35, pp. 159–160). *Ribbon gneiss.*—Granitic gneiss of unknown age in Lower Corbaley Canyon. In most localities intruded by innumerable stringers and veinlets of alaskitic and pegmatitic material, which follow the planes of the gneissic banding and produce a ribboned effect. Ribbon Rock, Ribbon Cliff, and Ribbon Mesa have been named for this peculiarity. Following this system of nomenclature the writer has called this series of *metamorphosed igneous rocks* the *Ribbon gneiss.* Has general petrographic resemblance to Orient gneiss of Ferry and Stevens Counties, which C. E. Weaver regards as possibly pre-Camb.

Ribbon limestone.

Carboniferous: Cape Breton Island, Nova Scotia.

P. D. Trask, 1929 (Nova Scotia Rept. on Mines 1928, p. 279).

Rib Hill quartzite.

Pre-Cambrian (middle Huronian?): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 41). *Rib Hill qtzite.*—Coarse white qtzite. Estimated thickness btw. 1,000 and 4,000 ft. Occurs in irregular areas partly or wholly separated from one another. Largest single exposure is Rib Hill, SW. of Wausau, Marathon Co. Assigned to lower Huronian (?). May be=Powers Bluff qtzite.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this qtzite to middle Huronian.

Ribolt clay shale.

Silurian (Niagaran): Northeastern Kentucky (Lewis County) and southwestern Ohio (Hillsboro).

A. F. Foerste, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 171, 172, 173, 189, 202). In Lewis Co., Ky., no trace of Waco ls. can be identified. Here a clay sh., at least 100 ft. thick, directly overlies Dayton ls. At Peebles, Ohio, it is 85 ft. thick; at Hillsboro, Ohio, it is 75 ft. thick. At all these localities the upper part of the clay sh. is interbedded with thin indurated layers, often only ¼ in. thick, which are characterized by a distinctively Clinton fauna (listed), which corresponds to middle part of upper Clinton of N. Y., Pa., Md., and Va. That part of the clay sh. section which includes the indurated layers containing this middle upper Clinton fauna is here named *Ribolt sh.*, to distinguish it from underlying Estill sh., which is not known to be fossiliferous. The Ribolt has been identified with certainty only in Lewis Co., but it may extend farther southward.

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 128). Type exposure of *Ribolt sh.* is at Ribolt, Lewis Co., 10 mi. W. of Vanceburg. In Lewis and Adams Counties it is 30± ft. thick; at Hillsboro, Ohio, 20± ft. No trace of this sh. N. of Hillsboro. [On pp. 134–140 he amplified his description, under heading *Ribolt clay sh.* See also under *Alger fm.*]

Ribstone Creek formation.

Cretaceous: Alberta.

S. E. Slipper, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 8). Included in Belly River series.

Rican series.

A term applied by C. R. Keyes to Carbf. deposits in Colo. stated by him to be older than his Moenkopian series and younger than his Aubreyan series. Is probably applied to Rico fm. (Perm.) of other geologists.

Ricardo formation.

Pliocene (lower): Southern California (Kern and San Bernardino Counties).

J. C. Merriam, 1914 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 8, pp. 276, 278). The *Ricardo Plio.* is next faunal stage known after the Mohave in the Great Basin. A series of beds, occurring at Ricardo [Kern Co.], on W. border of Great Basin, representing a faunal and strat. stage which is distinctly pre-Pleist., is certainly much later than the Mohave Upper Mio., and presumably represents early Plio. Doubtful that much, if any, of the Plio. of King really represents the *Ricardo stage*.

J. C. Merriam, 1915 (Pop. Sci. Monthly, vol. 86, pp. 252–254). The *Ricardo beds* contain Plio. mammals.

J. C. Merriam, 1917 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 10, pp. 430–443). *Ricardo fm.*—Thickness 3,000 to 5,000 ft. Contains Plio. fauna. The beds in which the fauna occurs consist in large part of tuffs with desert cgls. or fangls. and other deposits formed on land or in evanescent water bodies. Fauna seems to be a unit not divisible into sharply separated stages and indicates an earlier stage than Thousand Creek and Rattlesnake, which is supported by greater degree of induration and deformation of the Ricardo. **Is younger than Barstow fm.**

J. C. Merriam, 1919. (See under †*Red Rock Canyon beds*.)

Rice Bay granite gneiss.

Pre-Cambrian (Laurentian): Western Ontario (Rainy Lake region).

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 55).

Rice Brook sand.

A subsurface sand, of probable Dev. age, in western N. Y., lying higher than Richburg sand.

Rice Lake series.

Pre-Cambrian: Manitoba.

E. S. Moore, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 264).

Riceville shale member (of Chemung formation).

Upper Devonian: Northwestern Pennsylvania (Erie and Crawford Counties).

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q4). *Riceville shales.*—Very fossiliferous drab or bluish-gray sandy shales, sometimes shaly sss.; no black or red layers. Thickness 80 ft. Well exposed on Oil Creek in bluff just W. of Riceville, Crawford Co. Contain Chemung fossils. Underlie Cussewago ss. and overlie Venango oil sand group.

W. A. VerWiebe, 1917 (Am. Jour. Sci., 4th, vol. 44, pp. 39–47), gave 50 to 200 ft. as thickness of *Riceville fm.* and assigned it to Dev.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), correlated *Riceville sh.* with Oswayo fm.; called overlying beds *Cussewago ss.* and underlying beds

Venango group; correlated Venango with Cattaraugus fm.; correlated both Riceville and Venango with upper part of Chagrin sh. of Ohio; and treated Riceville and Venango as basal part of Bradfordian. He repeated this classification in 1924 (N. Y. State Mus. Bull. 251, p. 157) and in 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 455–464). [The U. S. Geol. Survey at present classifies Chagrin sh. of Ohio as Upper Dev. and Bradfordian and Oswayo as Dev. or Carbf.]

K. E. Caster, Feb. 28, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Riceville fm.* restricted to lower part of Riceville of previous repts, and included in Venango group. Oswayo sh. memb. of Riceville fm. restricted (lower Riceville of previous repts) represents all of Riceville fm. restricted. Upper or Miss. part of Riceville of previous repts here named *Smethport sh. memb. of Knapp fm.* The Oswayo includes Wild Cat coquinite and Smethport includes Marvin Creek ls.

G. H. Chadwick, Oct., 1933 (Pan-Am. Geol., vol. 60, No. 3, pp. 195, 197), included Riceville restricted in Conewango (=Venango group) and stated (pp. 197 and 281) that Caster's fossils locate Miss.-Dev. bdy within former Riceville sh.; and he adopted Caster's restricted Riceville.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61), divided his *Riceville stage* (*Riceville monothem*) into Oswayo sh. memb. and Roystone (replaces Wild Cat, preoccupied) coquinite memb., excluded it from his Venango stage, and treated it as a distinct "stage." On p. 47 he stated: Riceville fm. is dual sequence, lower part of which is of Dev. age and upper part of basal Miss. age. Riceville sh. proper is here included in Dev. The Miss. portion is called *Kushequa sh. memb.* of Knapp monothem and included at base of Oil Lake series, of the Miss.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 305–354), adopted Riceville restricted, but he included both Riceville and overlying Kushequa in Upper Dev.

The U. S. Geol. Survey has not yet had occasion to modify its classification, which treated Riceville sh. as a memb. of Chemung fm.

Riceville stage.

Riceville monothem.

See 1934 entry under *Riceville sh. memb.*

Richard sandstone member (of Pierre shale).

Upper Cretaceous: Central northern Colorado (Larimer County).

M. W. Ball, 1924 (A. A. P. G. Bull., vol. 8, pp. 81–87). *Richard ss.*, 59 ft. thick, lies 171 ft. above Larimer ss. Is exposed along N. bank of Richard Lake, sec. 30, T. 8 N., R. 68 E. [In Larimer Co.] Named and mapped [unpublished repts] by A. T. Schwennesen, E. W. Krampert, and C. H. Henley. [See also 1924 entry under *Hygiene ss. memb.*]

K. F. Mather, J. Gilluly, and R. G. Lusk, 1924 (U. S. G. S. Press Bull. 1825) and 1928 (U. S. G. S. Bull. 796B). *Richard ss. memb. of Pierre sh.*—Ordinarily thin-bedded and somewhat limy, with many concretionary masses. Thickness 0 to 70 ft.; usually btw. 25 and 60 ft. Lies 2,775 to 5,275 ft. below Fox Hills ss. and 100 to 200 ft. above Larimer ss. memb.

Richardson subgroup.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 4, 5, 9). Top subgroup of Wabaunsee group. Includes Brownville ls. at top and extends down to top of Tarkio ls. Named for Richardson Co. Type loc., the Big Nemaha Valley of southern Richardson Co. btw. points S. of Humboldt and SW. of Falls City.

Richburg sand.

An oil sand in northern Bolivar Twp, Allegany Co., N. Y. Lies 1,600 ft. below Olean cgl. Mentioned by J. F. Carll in 1883 (2d Pa. Geol. Surv. Rept. I_4, p. 165). According to C. A. Ashburner (Am. Inst. Min. Engrs. Trans., vol. 16, pp. 927–928, 1888) is local name for Allegany oil and gas sand, of Allegany Co., N. Y., and top is 1,729–1,734 ft. below base of Olean cgl. According to C. R. Fettke (Geol. Soc. Am. Bull., vol. 44, No. 3, pp. 625, 631, 1933) the *Richburg sand* is 28 ft. thick in Gilbert No. 1 well, on Gilbert farm, 2 mi. N. of Richburg, Allegany Co., N. Y., and occupies interval btw. 1,156 and 1,184 ft., the *Richburg Stray sand*, 16 ft. thick, lying 26 ft. higher and occupying interval btw. 1,114 and 1,130 ft.

Richfield formation.

Pre-Cambrian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 12). [Assigned to pre-Camb. (?), but many later repts. by other geologists, definitely assign the fm. to pre-Camb.]

Rich Hill limestone member (of Cherokee shale).

Pennsylvanian: Central western Missouri (Bates and Vernon Counties).

F. C. Greene and W. F. Pond, 1926 (Mo. Bur. Geol. and Mines vol. 19, 2d ser., pp. 37, 51–53). *Rich Hill ls. memb. of Cherokee fm.*—Ls. beds in upper part of Cherokee fm., commonly known as "Rich Hill Lime" in Rich Hill-Panama dist., of Bates and Vernon Counties. Upper 12 ft., gray nodular concretionary and unevenly bedded ls., which in places is represented by 10 ft. of ls. nodules embedded in clay and in places, in W. part of Co., is absent. Middle part consists of 4 to 5 ft. of sh., which in places thins to a shaly parting. Basal 2 ft. is dark-gray and dense ls., locally called, in W. part of Vernon Co., the "Diamond Rock," because of tendency to break into diamond-shaped or rhomboidal blocks. The memb. is overlain by clay bed beneath Williams coal and underlain by sh. Probably same as "Ardmore" ls. of Gordon of Bevier dist. of northern Mo.

This ls. is now called *Ardmore ls. memb.* by Kans. Geol. Survey.

Named for occurrence at Rich Hill, Bates Co.

Richland limestone and flint.

Mississippian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pl. opp. p. 933). *Richland ls. and flint* shown in columnar section of vicinity of Hamden Junction, Vinton Co. Overlain by cgl. in places, which is succeeded upward by Logan ls.; underlain by traces of coal resting on cgl.

Probably belongs to Logan fm.

Probably named for Richland, Vinton Co.

†Richland sandstone.

Pennsylvanian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxv). *Richland-Gordon sss.*—Basal rocks of undoubted Carbf. age on eastern border. In Colorado coal field these sss., with the underlying clays and sands, are given name of Richland sss., and in Brazos coal fields sss. of similar position and composition have been named *Gordon sss.* (probably for Gordon, Palo Pinto Co.).

R. S. Tarr, 1890 (Am. Geol., vol. 6, pp. 147–153; Tex. Geol. Surv. 1st Ann. Rept., p. 204). *Richland ss.* consists of ss., with some interbedded sh. and cgl.; upper 3,500 ft. coal-bearing. Includes, at top, Rochelle cgl. bed (50 ft. max. thickness). Total thickness 4,500 ft. Is Tex. equiv. of Millstone grit. Underlies Milburn shales and uncon. overlies Lower Carbf.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 98). Milburn shales are now included in Brownwood div., which rests on Richland ss.

C. H. Gordon, 1911 (Jour. Geol., vol. 19, p. 117). Richland of Tarr=Strawn fm.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 35; Univ. Tex. Bull. 2132, p. 13), show Richland of Tarr practically=Strawn fm. and treat Rochelle cgl. as basal bed of Brownwood.

Named for Richland Creek, San Saba Co.

Richmond group.

Upper Ordovician: Indiana, southwestern Ohio, Kentucky, Illinois, Missouri.

N. H. Winchell and E. O. Ulrich, 1897 (Minn. Geol. and Nat. Hist. Surv. Final Rept. vol. 3, pt. 2, p. ciii). *Richmond group.*—Alternating thin-bedded shales and lss., with, at some localities, a ss. at top. Overlies Lorraine group and forms uppermost part of Lower Sil. [Ord.] in SW. Ohio, SE. Ind., and north-central Ky. Thickness 350 ft.

In some early repts the Arnheim sh. was excluded from Richmond group, but for many years it has been included in the Richmond by most geologists and is so included by U. S. Geol. Survey. In SE. Ind. and SW. Ohio the Richmond group includes the deposits that have been called (descending) Elkhorn ls., Whitewater fm., Saluda ls., Liberty ls., Waynesville sh., and Arnheim sh. In southern Ill. and eastern Mo. it includes Maquoketa sh. (also the contemp. Thebes fm.) and the underlying Fernvale ls.

The age of the Richmond group has been the subject of much discussion in recent years. Originally (1897) it was assigned to the Ord. by Winchell and Ulrich. Subsequently it was thus classified by all geologists and paleontologists until 1911, when E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22) placed it in Sil. At present the group is classified as Ord. by apparently all geologists and paleontologists except E. O. Ulrich, R. S. Bassler, and R. Ruedemann, but the present N. Y. State Survey (W. Goldring, N. Y. State Mus. Hdb. 10, 1931) assigns Queenston sh. (which is generally regarded as of Richmond age) to Sil., and the present Pa. Geol. Survey assigns Juniata fm. (=Richmond) to Sil.

Named for Richmond, Ind.

†Richmond earth.

Miocene: Eastern Virginia (Richmond region).

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, p. 197). The nearly pure diatomaceous earth of Chesapeake fm. can be traced from Eastern Shore of Md. entirely across the State and thence southward into Va. From its wide occurrence in vicinity of Richmond it is sometimes known as "Richmond earth."

W. B. Clark and B. L. Miller, 1906 (Va. Geol. Surv. Bull. 2, pt. 1). Diatomaceous earth is present in Choptank fm. and is especially well developed in lower part of Calvert fm. It has been called "Richmond earth."

Richmond formation.

Eocene: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, pp. 53–56).

Richmond group.

Pre-Cambrian (middle Huronian?): Canada (east shore of Hudson Bay).

C. K. Leith, 1910 (Econ. Geol., vol. 5, pp. 232–245). A thick series of clastics, of possible Middle Huronian age, underlying Nastapoka series with some erosional uncon. Occurs on Richmond Gulf.

†Richmond sandstone.

A name applied in some early repts of Wis., Minn., and Iowa, also in late papers by C. R. Keyes, to the ss. beds long known as *New Richmond ss.*

Richmondian.

A time term that has been used by some geologists to cover the epoch during which the Richmond group was deposited.

Richmondville sandstone.

Mississippian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891–92, p. 66). *Richmondville or Berea ss.*, 65 ft. thick, underlies Coldwater shales and overlies St. Clair shales.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, btw. pp. 1 and 31). *Richmondville or Berea ss.*, 65 ft. thick, underlies Black bituminous sh. and overlies St. Clair black shales.

C. H. Gordon, 1900 (Mich. Geol. Surv. vol. 7, pt. 3, btw. pp. 1 and 20). *Richmondville ss.*, 50 to 80 ft. thick, lies in Coldwater shales, 100 to 200 ft. below their top. Has been erroneously correlated with Berea ss. of Ohio.

W. H. Sherzer, 1913 (Mich. Geol. and Biol. Surv. Pub. 12, geol. ser. 9, btw. pp. 187 and 221). *Richmondville ss.* first defined by Lane as=Berea grit, but has since been regarded by Lane as a "stray ss." somewhat higher up.

Named for exposures at Richmondville, Sanilac Co.

Rich Mountain conglomerate. (In middle of Pottsville group.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1918 (W. Va. Geol. Surv. Rept. Barbour and Upshur Counties, p. 292). Writer has no hesitation in declaring his belief that *Rich Mtn cgl.* of this region, often so called from its abundant exposure along that range, will prove to be Sharon cgl. of western Pa. and same as Upper Raleigh ss.

Richter sand.

A subsurface sand, of Penn. age and 50± ft. thick, in Tonkawa field, Kay Co., central northern Okla., which lies lower than Tonkawa sand, higher than Layton sand, and is correlated with a part of Ochelata fm.

Richter Mountain hornblendite.

Age (?): Southern British Columbia and central northern Washington.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 433). Cuts Anarchist series (Carbf.?).

Ricker sandstone member (of Mineral Wells formation).

Pennsylvanian: Central Texas (Brown County, Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 386). *Ricker bed.*—Ss. and cgl., 50 to 200 ft. thick, with 25 to 75 ft. of sandy clay at top; usually of bluish color, though purple or yellowish clays occur. Top memb. of Strawn div. Overlies Indian Creek bed and underlies Canyon div.

Wallace Lee and C. O. Nickell (Univ. Tex. Bull. about to go to press) included *Ricker ss. memb.* in Mineral Wells fm., the upper fm. of Strawn group.

Named for Ricker, Brown Co.

Ricketts oil sand.

A subsurface sand in lower part of Penn. section in Graham field, NW. part of Carter Co., southern Okla., 78 to 125 ft. below Atlantic oil sand and 54 to 110 ft. above Graham oil sand.

Rico formation.

Permian: Southwestern Colorado, southeastern Utah, and northwestern New Mexico.

W. Cross, 1899 (U. S. G. S. Telluride folio, No. 57). In Rico quad. an invertebrate fauna has been found in lower 200 or 300 ft. of "Red Beds," which is assigned by G. H. Girty to Permo-Carbf., in the sense of a transition series. The complex of strata characterized by this fauna will be described as *Rico fm.* In absence of fossil evidence the red strata btw. the Rico Permo-Carbf. and the overlying beds containing Triassic remains are grouped with latter, here named *Dolores fm.*

W. Cross, 1899 (U. S. G. S. La Plata folio, No. 60, p. 8). [See 1st entry under *Hermosa fm.*]

A. C. Spencer, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 59). It is here proposed to apply the name *Rico* to a fm. assumed to be about 300 ft. thick, occurring btw. the Hermosa or characteristic Penn. Carbf. and strata assigned at present to Trias of San Juan region—the *Dolores fm.* The Rico is composed of sss. and cgls. with intercalated shales and sandy fossiliferous lss. In Rico region is conformable on Hermosa and is followed by the Dolores with seemingly perfect parallelism of stratification. The bdy btw. Rico and Dolores fms. is at present entirely artificial, being based upon highest known occurrence of Rico fossils. [In 1905 the Dolores fm. as first defined was divided into Cutler fm. below and Dolores fm. (restricted) above. (See under *Cutler fm.* and *Dolores fm.*) The fm. that overlies Rico fm. is therefore now called *Cutler fm.*, instead of *Dolores*.]

W. Cross, 1905 (U. S. G. S. Rico folio, No. 130). *Rico fm.*—Consists of 300 ft. of sss. and cgls. with intercalated sandy shales and thin fossiliferous sandy lss.; color chocolate or dark maroon. Rests conformably on Hermosa fm. Conformably overlain by Cutler fm., which comprises lower 1,600 ft. of Dolores fm. as originally defined. Base of Rico fm. can usually be very accurately located in field by its lowest fossil-bearing stratum. The bdy btw. Rico and Cutler fms. is, however, quite arbitrary, being based on highest known occurrence of Rico fossils. The former is made to include only that part of the section characterized by the Permo-Penn. fauna, while the Cutler comprises the apparently unfossiliferous "Red Beds" of this region, extending to horizon at which Triassic fossils are known to occur. The fm. was named by A. C. Spencer.

Where the lss. of Rico fm. are absent in SE. Utah, the red beds corresponding to Rico fm. are now included in Cutler fm. (See U. S. G. S. Bull. 863, 1935, by C. H. Dane.)

Named for exposures in Rico Mtns, Colo.

Riddlesburg shale member (of Pocono formation).

Mississippian: Western Pennsylvania (Bedford County) and southwestern Virginia (Alleghany County).

D. B. Reger, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 156–157, abstract, March; vol. 38, pp. 397–410, June 30). In type section, 1½ mi. N. of Riddlesburg, Bedford Co., Pa., the *Riddlesburg sh.* consists of 75 ft. of greenish-black siliceous sh., exfoliating into pencil forms, with marine fossils in lower part. Included in Pocono series, lying 410 ft. below base of Logan (Burgoon) ss., the top div. of Pocono series. Overlain by 20 ft. of green ss. and underlain by 15 ft. of greenish-gray shaly ss. Also present 1½ mi. SE. of Saxton, Bedford Co., and probably near Hopewell, Bedford Co. Preserves its lithology NE. to Lehigh Valley, but loses its fauna. What seems to be same black sh. occurs also in Alleghany Co., Va., along Chesapeake & Ohio Ry btw. Alleghany Station and Lewis tunnel, but with a somewhat changed fauna.

Rideau sandstone.

Ordovician: Ontario, Canada.

H. M. Ami, 1902 (Sci., vol. 15, p. 82). *Rideau ss.* overlies pre-Camb. rocks and is succeeded, without break, by Birdseye, Black River, and Trenton.

See also Ont. Bur. Mines, 25th Ann. Rept., pt. 3, pp. 2, 40, 1916; Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 21, 1932.

G. M. Kay, 1935 (Geol. Soc. Am. Bull., vol. 46, p. 227), included *Rideau* in Pamelia and tentatively included Pamelia in Black River group, at base.

Ridenhower shale. (Of Chester group.)

Mississippian: Southeastern Illinois and western Kentucky.

C. Butts, 1917 (Ky. Geol. Surv., Mississippian fms. of western Ky., pt. 1, p. 73). *Ridenhower sh.*—Predominantly sh. Underlies Cypress ss. and overlies Bethel ss. in Crittenden and Livingston Counties, Ky., and in southern Ill. Named, at suggestion of S. Weller, for Ridenhower, Johnson Co., Ill., where it is 60 ft. thick and includes considerable ls., which is fairly fossiliferous, and some thin sss. The Gasper oolite is not known W. of E. part of Crittenden Co., Ky. The Ridenhower is regarded = in part at least Gasper oolite, but possibly represents only upper part of Gasper.

Riders Brook formation.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Riders Brook fm.*—Gray sandy ls. carrying *Bellerophon randomi.* Overlain by sh. Forms top fm. of Clarenville series. Overlain discon. by Kelly Island fm. and underlain by Maidment fm. [Derivation of name not stated.]

†Ridge limestone.

A descriptive term locally applied to Nineveh ls. memb. of Greene fm. of Pa.

Ridgeley sandstone. (In Oriskany group.)

Lower Devonian: Central Pennsylvania to central western Virginia and eastern West Virginia.

C. K. Swartz et al., 1913 (Md. Geol. Surv. Lower Devonian vol., p. 92 and table opp. p. 30). *Ridgely ss. memb.*—Calc. ss., which passes into an aren. ls. Top memb. of

Oriskany fm. Thickness 50 to 250 ft. Closely resembles Oriskany of N. Y. in lithology and fauna. Overlies Shriver chert memb. and uncon. underlies Romney fm., which contains Onondaga fauna in basal beds. Named for Ridgely, W. Va. [This town is spelled *Ridgeley* in U. S. Postal Guide, and that is spelling adopted by U. S. Geographic Board in 1924.]

Ridgely sand.

A subsurface sand in Pottsville fm. (Penn.) of Lawrence Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

†Ridgely sandstone.

Lower Devonian: Pennsylvania, Maryland, Virginia, and West Virginia. See *Ridgeley ss.*, the approved spelling.

Ridgetop shale.

Mississippian (early): Western Tennessee (Tennessee Valley region).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29). *Ridgetop sh.* [Shown in chart as overlying Chattanooga sh. and uncon. underlying New Providence fm.]

R. S. Bassler, 1911 (U. S. Nat. Mus. Proc., vol. 41, p. 216). *Ridgetop sh.* (*Kinderhook*).—Underlies Fort Payne chert and overlies Maury green sh. Locally developed along N. and W. sides of Nashville dome. In section along Louisville & Nashville R. R. from Bakers to Ridgetop, the fm. consists of (descending): (1) Light-blue to green clay sh. holding many ostracodes and brachiopods, 15 to 20 ft.; (2) aren. sh. with bands of porous chert, yielding silicified fossils, 2 ft.; (3) light-blue to green sh. with same fossils as in No. 1, 36 ft.; (4) unfossiliferous blue sh., 4 ft.; (5) thin-bedded argill. ls. and compact dark sh. with many fossils, 5 ft.; (6) dark compact clay sh. with few fossils, 15 ft.; (7) fine-grained argill. ss. weathering red and forming a conspicuous line in the section, 1 ft.; (8) light-blue to green unfossiliferous sh., 20 ft.; and (9) sandy unfossiliferous chert, 1 ft. All these beds were included in Tullahoma by Safford and Killebrew and by Hayes and Ulrich, but they represent a distinct group—the Kinderhook—and hence the new name *Ridgetop sh.* is proposed. In section 12 mi. N. of Nashville 35 ft. of New Providence fm. intervenes btw. Ridgetop sh. and Fort Payne chert.

N. F. Drake, 1914 (Tenn. Geol. Surv. Res. of Tenn., vol. 4, No. 3, p. 105), included in base of Ridgetop sh. of Waynesboro quad. the Maury glauconitic memb., a thin bed closely associated with overlying sh. and carrying similar fossils. There is some question whether the Ridgetop of Hardin Co. is of same age as typical Ridgetop.

R. S. Bassler, 1932 (Tenn. Dept. Ed., Div. Geol. Bull. 38, p. 144). More recent study of type section of Ridgetop sh. (along Louisville & Nashville R. R. btw. Bakers and Ridgetop) has shown that upper 30 ft. of supposed Ridgetop held the bryozoan fauna of New Providence sh. These New Providence beds consist of blue calc. sh. with occasional thin argill. ls. bands with 2 ft. of sandy layers at base, and they are here called *New Providence sh.*, and *Ridgetop sh.* is restricted to the underlying beds, consisting of (descending): (1) Gray-green sh. becoming calc. toward top, 12 ft.; (2) blue-green to gray-green soft sh. with 6-in. glauconite band at top and at base, 4 ft.; (3) gray-green siliceous sh., 10 ft.; (4) siliceous ls. with conchoidal fracture weathering yellow and containing Ostracoda, 1 to 2 ft.; (5) calc. green and finely sandy gray-green sh. with a few geodes in upper half and ostracodes in several layers, 20 ft.; (6) yellow platy chert with fossils [listed], 1 to 1.3 ft.; (7) green sh. with phosphated nodules 0.5 to 1 ft.; (8) green sh. passing gradually downward into black Chattanooga sh., 0.25 to 0.33 ft.

C. W. Wilson, Jr., and E. L. Spain, Jr., 1936 (Geol. Soc. Am. Proc. 1935, p. 375). Faunal and strat. studies show "Ridgetop sh." to be a phase of New Providence fm., and to be of Fern Glen, rather than Kinderhook, age, as previously assigned. Of 22 sp. of invertebrates collected by writers from this sh. at its type loc. (Ridgetop Station, Robertson Co., Tenn.), 21 commonly occur in Fern Glen or younger beds, and 3 occur also in the Kinderhook, but only 1 is typically Kinderhook. Detailed tracing of beds through the 5 mi. btw. type loc. of "Ridgetop sh." and the local type loc. of New Providence fm. shows that the drab-green and gray siltstones of the "Ridgetop" can be traced laterally into green sh. and the local crinoidal ls. lenses of the New Providence. Similar lateral correlation has been made at other localities in central Tenn. The green sh., the local crinoidal ls., and the drab siltstone (that was formerly separated as "Ridgetop") of New Providence fm., contain fossils characteristic of each different facies, but all are predominantly of Fern Glen age. [Type loc. of New Providence fm. is in Clark Co., Ind.]

Named for Ridgetop, Robertson Co.

Ridgway till.

Ridgway glacial epoch.

Eocene: Southwestern Colorado.

W. W. Atwood, 1915 (U. S. G. S. P. P. 95, p. 16, map). *Ridgway till.*—Upper memb. is pebble till; lower memb. is boulder till. Type loc. is 1 mi. W. of Ridgway, where the till is overlain by Telluride cgl. (of Eo. age) and underlain by Mancos sh.

W. W. Atwood and K. F. Mather, 1932 (U. S. G. S. P. P. 166). A long erosion interval separates *Ridgway till* from underlying Animas fm., of late Cret. or earliest Tert. age.

†Ridgway shale member.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). [See 1933 entry under *Knapp fm.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 61, 112), replaced this preoccupied name with *East Kane sh.*

Riding Mountain beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 124).

Ridley limestone. (In Stones River group.)

Lower Ordovician: Central Tennessee.

J. M. Safford, 1869 (Geol. Tenn., pp. 258–267). *Ridley ls.*—Heavy-bedded light-blue or dove-colored fossiliferous ls., 95 ft. thick. Included in Trenton or Lebanon [Stones River] group. Underlies Glade [Lebanon] ls. and overlies Pierce ls.

Named for Judge Ridley's mill (now Davis's mill), near Old Jefferson, Rutherford Co.

Ridout series.

Pre-Cambrian (Keewatin): Ontario.

W. H. Collins, 1933 (Canada Geol. Surv. map 155A, 3d ed., Lake Huron sheet, Pub. 1553).

H. C. Rickaby, 1933 (Canadian Min. and Met. Bull. 253, p. 207).

Rift shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 217). *Rift sh.*—Dark gray, laminated, argill., with siliceous layers carrying thin lenses of iron ore. Thickness 15 to 30 ft. Underlies Flattop Mtn ss. and overlies Pocahontas No. 7 coal. Exposed at Rift, McDowell Co.

†Riga schist.

Ordovician: Northwestern Connecticut and southwestern Massachusetts.

W. H. Hobbs, 1893 (Jour. Geol., vol. 1, pp. 717–736, 780–802). *Riga schist.*—Porphyritic rock, strictly speaking a gneiss, but in order to distinguish it from more feldspathic and more or less granitoid gneisses lying E. of Housatonic River, it is best to refer to it as a schist, which it most resembles in structure. Underlies Egremont ls. and overlies Canaan dol. Most typically developed on Mount Riga Peak, Conn. Correlated [correctly] with Berkshire schist. Included in Mount Washington series.

Same as Berkshire schist. The supposedly overlying "Egremont ls." is now known to be a local bed of Stockbridge ls., which underlies Berkshire schist. See U. S. G. S. Bull. 597, 1917, and Conn. Geol. Surv. Bull. 7, 1907, in which this schist is mapped as Berkshire schist.

†Riley series.

Upper Cambrian: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxi, 286–289). *Riley series.*—In general sss., light red, shiny black, brown, yellow, and white. Includes some compact light-colored ls. Thickness probably 300 to 400 ft. Uncon. overlies Hickory series and uncon. underlies Katemcy or "Potsdam" series.

Includes Hickory ss. and part of Cap Mtn fm. of present nomenclature. Named for Riley Mtns, Llano Co.

Riley sand.

A subsurface sand, of Upper Dev. (Chemung) age, in W. Va. that lies at or near horizon of Cooper sand.

Rincon shale.

Miocene (middle or lower): Southern California (coastal region from Ventura to Santa Barbara).

P. F. Kerr, 1931 (Econ. Geol., vol. 26, No. 2, pp. 156, 157). *Rincon fm.*—A sequence of gray sh. containing concretionary dolomitic layers, underlying the bentonite bed at base of Modelo fm. in Ventura quad., and overlying Vaqueros fm. Thickness 2,150± ft. as exposed in a type section along Los Sauces Creek E. of Rincon Mtn, Ventura Co.

W. P. Woodring, 1932 (16th Int. Geol. Cong. Guidebook 15, pl. 2), showed *Rincon sh.* as (1) underlying Modelo fm. and overlying Vaqueros ss. on S. slope of eastern Santa Ynez Range; (2) as in part equiv. to Topanga fm. in Santa Clara and Simi Valleys, and as both underlain and overlain by Topanga deposits. He stated (personal communication) that in his opinion Rincon and Topanga fms. are two distinct facies, with distinct faunas, and that the Rincon facies is not present in type Topanga, but that it includes time equiv. of at least part of the Topango and of upper part of Vaqueros.

W. S. W. Kew, 1932 (16th Int. Geol. Cong. Guidebook 15, p. 50). *Rincon fm.* is a well-defined strat. unit that can be traced along the coast for nearly 100 mi. Consists essentially of dark-gray clay sh. or mudstone, which commonly contains concretions of impure yellow ls. and carries Foraminifera of late lower or early middle Mio. age. Thickness 300 to 2,000 ft. Underlies Modelo fm. and overlies Vaqueros fm.

R. M. Kleinpell, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 165), stated that foraminiferal fauna of uppermost typical Vaqueros fm., middle typical Rincon fm., and lower middle typical Temblor fm. is of equiv. age and characteristic of a distinct subzone.

Rincon limestone.

Upper Cambrian: Southeastern Arizona (Whetstone Mountains).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 469, 471, 472, 480–482). *Rincon ls.*—Youngest Upper Camb. fm. in Whetstone Mtns. Is cliff-forming pink, mostly crystalline ls. carrying *Billingsella coloradoensis* and abundance of other fossils. Thickness 42 ft. Overlies Abrigo fm. [as here restricted] and underlies Martin ls. (Dev.). Type loc., Rincon Mtns, 25 mi. SE. of Tucson. Correlated with Copper Queen ls. (new) of Bisbee dist. and with Peppersauce Canyon ss. (new) of Santa Catalina Mtns. [See last sentence under *Peppersauce Canyon ss.*]

Rindgemere formation.

Carboniferous (Pennsylvanian?): Southwestern Maine and southeastern New Hampshire.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 199). *Rindgemere fm.*—Qtzite, slates, and mica schists, but predominantly carbonaceous sericite phyllites which contain chiastolite. Occupies broad area in Rochester, N. H., and Acton and Lebanon [Twps], Maine.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, pp. 173–175). *Rindgemere fm.*—Sl., phyllite, and schist derived from somewhat carbonaceous sh. and argillite, with subordinate amounts of interbedded argill. qtzite, graywacke, and ls. Generally thin-bedded and fine-grained. White and light-gray or bluish colors in qtzite, graywacke, and ls. beds; dark bluish, gray, and black in argill. beds. Estimated thickness about 1,000 ft. Underlies Towow fm. Believed to overlie Gonic fm. Assigned to Penn. (?). Named for exposures at Rindgemere Station (East Rochester), Strafford Co., N. H.

Ringold formation.

Probably Pleistocene: Southeastern Washington (Franklin County) and northwestern Oregon.

J. C. Merriam and J. P. Buwalda, 1917 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 10, No. 15, pp. 255–266). *Ringold fm.*—Chiefly light-colored muddy sss. and sandy clays, and in minor part fine gravels, volcanic ash, and calc. strata. [Detailed section.] From 12 mi. above town of Pasco, bluffs several hundred ft. high extend 30± mi. NW. along E. bank of Columbia River. Because of their light color these magnificent exposures have commonly been known as the White Bluffs. They clearly represent a fm. distinct from the Ellensburg, as indicated by their faunas and by the physical evidence. Known thickness is 500± ft., but as Columbia River has not cut down to base of the fm. the total thickness is not known. Appears to occupy an area of at least 300 sq. mi. and may extend over 500 or 600 sq. mi. These beds have formerly been included in Ellensburg fm. [Miocene] as that name has been applied in this area, but they are now known to be younger than Ellensburg, and evidence favors Pleist., rather than latest Plio., as their age. Named for Ringold P. O., which is situated at base of the White Bluffs.

Rio conglomerate.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 278).

Rio Blanco series.

Cretaceous: Puerto Rico.

B. Hubbard, 1923 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 26).

Rio Culebrinas series.

Cretaceous: Puerto Rico.

B. Hubbard, 1923 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 1, p. 25).

Rio de la Plata series.

Lower Cretaceous: Puerto Rico.

E. T. Hodge, 1920 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 130).

Rio Descalabrados series.

Eocene: Puerto Rico.

E. T. Hodge, 1920 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 161).

Rio Dulce limestone.

Miocene: Guatemala and British Honduras.

C. Schuchert, 1935 (Hist. geol. of Antillean-Caribbean region, pp. 346, 355).

Rio Grande series.

Tertiary (late): Central northern New Mexico (Albuquerque region).

C. L. Herrick, 1898 (Am. Geol., vol. 22, pp. 26–43), called the river gravels overlying Cret. sss. and shales in environs of Albuquerque *Rio Grande series*, also *Albuquerque series*, and divided them into (descending): (1) Yellowish white marl, 6 ft., "which occurs on both sides of Rio Grande, and which may henceforth be known as the *Albuquerque marl*;" (2) gravel and rounded sands, 2 to 20+ ft. thick, evidently the debris from the metamorphic series, and designated "*Rio Grande gravels*;" (3) sandy loess passing into clay, depth not known, but recognized everywhere, designated "*Rio Grande loess.*"

K. Bryan, 1909 (N. Mex. Univ. Bull., geol. ser., vol. 3, No. 1). *Rio Grande gravels* extend up Galisteo Creek and form part of group described there as *Santa Fe marl.* One of most prominent features of deposits of valley is the marl bed which caps the mesas. That over Sandia Mesa has been described by Herrick as *Albuquerque marl*, while that on Albuquerque Mesa he called *Santa Fe marl.* It seems best to place both under one name—*Albuquerque marl.* [See also under *Rio Grande loess.*]

Rio Grande gravels.

Tertiary: New Mexico.

C. L. Herrick, 1898. [See under *Rio Grande series.*]

K. Bryan, 1909 (N. Mex. Univ. Bull., geol. ser., vol. 3, No. 1). [See under *Rio Grande series.*]

Rio Grande loess.

C. L. Herrick, 1898. [See under *Rio Grande series.*]

K. Bryan, 1909 (N. Mex. Univ. Bull., geol. ser., vol. 3, No. 1). The term "Rio Grande loess" was applied by Herrick to the portion of Rio Grande beds exposed underneath the Rio Grande gravels. The term does not seem applicable, for reason that these stratified silts and sands can hardly be called loess.

†Rio Grande series.

Pennsylvanian: New Mexico.

A time term used by C. R. Keyes (Rept. Gov. N. Mex. to U. S. Secy Interior, 1903) to cover 500 ft. of Penn. lss. which he calls Madera terrane.

Rio Grande marl.

See 1903 entry under *Placita marl.*

Rio Grande drift.

Pleistocene: Southwestern Texas (Presidio County).

J. A. Udden, 1904 (Tex. Univ. Min. Surv. Bull. 8, p. 41, on Shafter dist.). As we approach the flats of the Rio Grande the bedrock everywhere disappears under a drift, which at first seems to be a continuation of the land drift, but which, as we come near to the great waterway, becomes mingled with material of distant origin. Still farther out this becomes intermingled with layers of finer alluvial material which has been deposited by that stream before it had cut its changing channel down to its present depth. All of this material may properly be called the *Rio Grande drift.*

Rio Jueyes series.

Eocene: Puerto Rico.

E. T. Hodge, 1920 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 149).

Rio Yauco series.

Cretaceous: Puerto Rico.

G. J. Mitchell, 1922 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 3, p. 249).

Ripley formation.

Upper Cretaceous: Southern Illinois, southeastern Missouri, western Kentucky and Tennessee, northern and central Mississippi, Alabama, and Georgia.

E. W. Hilgard, 1860 (Geol. and Agric. Miss., pp. 3, 62, 83–95). *Ripley group.*—Consists of (1) hard crystalline white lss., generally somewhat sandy, and often glauconitic; underlain by (2) black or blue micaceous marls containing admirably preserved fossils. Thickness 45 to 50 ft. Uppermost Cret. fm. Underlies Northern Lignitic group and overlies Rotten ls. group. [The hard crystalline white lss. described by Hilgard as composing upper part of Ripley group are of Eocene (Midway) age, according to L. W. Stephenson, and were long ago separated from the Ripley and named *Clayton fm.*]

L. W. Stephenson, 1914 (U. S. G. S. P. P. 81). The typical beds of *Ripley fm.* consist of more or less calc, and glauconitic sands, sandy clays, impure lss., and marls of marine origin, reaching estimated max. thickness of 250 to 350 ft. in eastern Gulf region. Rest conformably in part upon Paleozoic rocks, in part upon Eutaw fm. (in Tenn.), and in part upon Selma chalk. In some areas Ripley replaces Selma chalk and upper part of Eutaw fm. and rests on Tombigbee sand memb. of Eutaw. Includes McNairy sand memb. [See also L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26), and 1917 (Wash. Acad. Sci. Jour., vol. 7, No. 9).]

Later the Owl Creek deposits (which overlie the McNairy sand memb. of the Ripley in western Tenn. and NE. Miss.) were treated as a tongue of Ripley fm. (See L. W. Stephenson, Wash. Acad. Sci. Jour., vol. 7, 1917, pp. 243–250, and many subsequent repts.) In April 1937 L. W. Stephenson and W. H. Monroe proposed (and U. S. Geol. Survey adopted): (1) The elev. of Owl Creek to rank of a fm., called *Owl Creek fm.*, and the corresponding restriction of Ripley fm. to the beds beneath the Owl Creek and the Prairie Bluff deposits; and (2) the restriction of Selma chalk to the beds underlying the Prairie Bluff, the chalk beds formerly called *Oktibbeha tongue of Selma chalk* to hereafter be included in Prairie Bluff chalk (redefined) and "Oktibbeha" to be discarded. (See L. W. Stephenson and W. H. Monroe, A. A. P. G. Bull., 1937.)

Named for Ripley, Tippah Co., Miss.

Ripleyan series.

A term applied by C. [R.] Keyes to *Ripley fm.* (See Iowa Acad. Sci. Proc., vol. 22, 1915, p. 252.)

Ripogenous series.

Silurian: Western Maine (Piscataquis County).

F. W. Toppan, 1932 (Geol. of Maine, Contr. Dept. Geol. Union Coll., Schenectady, pp. 71–72). *Ripogenous series.*—In ascending order: Coarse grit, 15 ft.; sandy ls. with a few ft. of greenish banded qtzite and Niagara fossils, 50± ft.; clean white qtzite, 50± ft.; a monotonous series of gray-green qtzites. Thickness 2,000± ft. Exposed in Ripogenous Gorge, where it is intruded by Katahdin granite, just below the prominent rock known as the "Little Heater." [On p. 93 he said the lss. occur at Ripogenous.]

Ripple quartzite.

Pre-Cambrian: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, map 7, 117° to 117°30'). *Ripple fm.*—Massive white qtzite. Underlies Beehive fm. and overlies Dewdney fm.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 155, tables at 178, 194). *Ripple fm.*—Heavy-bedded rippled white qtzite, 1,650 ft. thick. Forms summit of Mount Ripple, B. C. Conformably underlies Beehive fm. and conformably overlies Dewdney fm., all of which belong to Summit series of Selkirk Mtns at 49th par.

Ripton conglomerate.

Pre-Cambrian: Northwestern Vermont (Addison County, Brandon quadrangle).

W. G. Foye, 1919 (11th Rept. Vt. State Geol., pp. 84–85, in description of Rochester quad.). *Ripton cgl.* is basal layer of Mendon series (Algonkian). Is iron-gray and contains distorted and elongated pebbles of blue quartz, phyllite, and gneiss. To E. it is so metamorphosed that its conglomeratic appearance is lost.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 284). *Ripton cgl.*—Quartz-mica schist showing pyrite in striking amounts, muscovite, microcline, and microperthite; in places looks like augen gneiss. Is Lower Camb.

See also L. M. Prindle and E. B. Knopf, Am. Jour. Sci., 5th, vol. 24, p. 266, 1932, who assign Mendon schist to pre-Camb.

Ripton is in Brandon quad., Addison Co.

Rising Bull member (of Grinnell argillite).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Rising Bull memb.*—Upper memb. of Grinnell fm. Consists of 425 to 750 ft. of dark-red to greenish metargillite, in beds 1 to 3 ft. thick, showing slaty cleavage, interbedded with red, gray, white, and greenish qtzite and cgl. Argillite balls abundant in some qtzite layers. Mud cracks and coarse current ripple marks common. Some layers bear rain prints. Qtzite increasingly prevalent toward top. Base intergrades with Red Gap memb. (lower memb. of Grinnell fm.). [Derivation of name not stated.] Well exposed along trail over Gunsight Pass, in Two Medicine region, and on mtns bordering Swift Current Valley.

Rising Wolf member (of Appekunny argillite).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Rising Wolf memb.*—Top memb. of Appekunny fm. Consists of 200 to 500 ft. of thick-bedded greenish to red qtzite, with subordinate beds of gray and reddish metargillite. Mud cracks and ripple marks common. The metargillites contain much sand in thin sheets and lenses. Overlies Appistoki memb. of Appekunny fm. Is exposed on S. flank of Rising Wolf Mtn and on many other peaks.

Ritchie red beds. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia and eastern Ohio.

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 30, 44). *Ritchie red beds* (also *Ritchie reds*).—Underlie Uniontown coal bed or its place, and overlie Tyler red beds. Have been reported from southern Marshall, Marion, Wetzel, Doddridge, Tyler, Ritchie, Jackson, southwest Harrison, and northeast Gilmer [Counties] of W. Va., as well as Washington, Monroe, Meigs, and Guernsey [Counties] of Ohio. Are seldom more than 20 ft. thick in Ohio, and at times continuous with Tyler reds below. Chief area is in Ritchie [Co.], W. Va.

Rittman conglomerate lentil (of Cuyahoga formation).

Mississippian: North-central Ohio (Wayne County).

G. W. Conrey, 1921 (Ohio Geol. Surv., 4th ser., Bull. 24, p. 56). *Rittmann cgl. lentil of Cuyahoga fm.*—At Rittmann, Wayne Co., consists of (descending): (1) Medium-grained grayish-buff fossiliferous ss. with pebbles, 1 ft. 3 in.; (2) brown sh., 4 in.; (3) coarse cgl., 6 in.; (4) coarse-grained ss., in part conglomeratic, 1 ft.; (5) fine-grained ss., 2 ft.; (6) yellowish green ss., 1 ft. 4 in. Underlies 2 ft. of Armstrong memb. [P. O. Guide spells the town *Rittman*.]

River John series.

Mississippian: Nova Scotia.

W. A. Bell, 1926 (Canada Geol. Surv. Summ. Rept. 1924, pt. C, p. 158). [Assigned to Carbf.]

J. S. Stewart, 1932 (Nova Scotia Dept. Pub. Works and Mines Ann. Rept. on Mines, 1931, pt. 2, p. 36). River John series assigned to Miss.

River Portal mica schist.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). Quartz-mica schists of metamorphic complex of Gunnison River region found on Vernal Mesa and along adjacent portion of Black Canyon from a little more than 1 mi. E. of mouth of Cimarron Creek to beginning of Vernal Mesa granite mass, in vicinity of Big Draw and Grizzle Gulch. These rocks may for convenience of description be divided into 2 types—the mica schists proper, with local quartzose phases, and the quartz-mica schists of Mesa Creek zone. The portion of the Black Canyon walled by these rocks is one of wildest and most picturesque along the Gunnison, being in few places less than 1,000 ft. deep. Named for excellent exposures in vicinity of the river portal of Gunnison tunnel. Might be regarded as a part of Black Canyon schist, or may be younger.

On 1935 geol. map of Colo. this fm. was assigned to Gunnison River series (pre-Camb.), which comprises all of oldest exposed sed. and igneous rocks in Colo.

†River Quarry beds.

Middle Ordovician: Southwestern Ohio.

E. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 370–387). *River Quarry beds.*—Alternating beds of thin-bedded compact crinoidal blue ls. and blue sh., 50 or 75 ft. thick, forming lowest div. of Cincinnati beds proper. Inferior limit low water of the Ohio at Cincinnati. Overlain by Eden sh. and underlain by Point Pleasant beds; all included in Cincinnati group.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, pp. 53+). Point Pleasant beds are same as River Quarry beds. Unquestionably of Trenton age.

Named for river quarries at Cincinnati.

Riversdale formation.

Carboniferous: Canada.

H. M. Ami, 1900 (Canadian Rec. Sci., vol. 8, pp. 154–160).

Riverside sandstone.

Mississippian: Western and southern Indiana.

T. C. Hopkins, 1896 (Ind. Dept. Geol. and Nat. Res. 20th Ann. Rept., pp. 196, 317, pl. 9). *Riverside ss.*—Fine-grained impure ss. [thickness not stated] forming topmost Miss. fm. in Fountain Co., where it is uncon. overlain by Mansfield ss. and underlain by Miss. lss. and shales with some sss. Included in Knobstone group. Quarried at Riverside [Fountain Co].

E. M. Kindle, 1899 (Bulls. Am. Pal., vol. 3, No. 12). *Riverside ss.* in southern Ind. consists of 200 ft. of massive sss. and sandy shales overlying New Providence sh. and underlying Harrodsburg ls.

J. F. Newsom, 1903 (Ind. Dept. Geol. and Nat. Res. 26th Ann. Rept.). Knobstone group of Ind. divided into (descending): Knobstone ss. (called "Riverside ss." by Hopkins and quarried at Riverside), 75 to 450 ft.; Upper Knobstone sh., 200 to 250 ft.; New Providence sh., 50 to 120 ft.

T. C. Hopkins, 1904 (Ind. Dept. Geol. and Nat. Res. 28th Ann. Rept.). New Providence sh.=*Riverside ss.*, which should be abandoned.

H. S. Williams and E. M. Kindle, 1905 (U. S. G. S. Bull. 244, pl. 1, pp. 17–19). *Riverside ss.*—Massive to shaly ss. and sandy shales, with 1 to 10 ft. of oolitic ls. in upper part. Thickness 200 ft. Underlies Harrodsburg ls. and overlies New Providence sh.

E. R. Cumings, 1912 (Ind. Acad. Sci. Proc. for 1911, pp. 111+). Upper 100 ft. of Knobstone fm. is known as *Riverside ss.* It underlies Harrodsburg ls. and overlies New Providence sh., which is 400 to 500 ft. thick.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, p. 150). *Riverside ss.* of Ind. is represented in Rosewood sh. and probably in lower part of Holtsclaw ss.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, p. 76). At Borden, Clark Co., Ind., the upper 100 ft. or so of Keokuk rocks is ss., of which upper 20 ft. is rather massive and probably represents Holtsclaw ss., while lower 80 ft. probably represents upper part of Rosewood sh. and may be same as *Riverside ss.* of Ind. repts.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 490). It seems very probable that Holtsclaw is a synonym of *Riverside*, and writer has therefore given latter name preference.

W. N. Logan, 1923 (Pan-Am. Geol., vol. 40, p. 111), and 1926 (Ind. Dept. Cons., Div. Geol., Pub. 55, p. 8), applied *Riverside ss.* to ss. underlying Harrodsburg ls. and overlying Rosewood sh., or to Holtsclaw ss. of Butts.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 293). The original "Riverside ss." of Hopkins (1896, pp. 196, 293–297) is northern Ind. representative of Edwardsville fm. and not=Holtsclaw ss., but younger. There are several reasons for not continuing the use of "Riverside ss." for a subdivision of fm. rank in Borden group. In first place the name is from a locality remote from the unglaciated region of abundant exposures in southern Ind. Writer has selected all fm. names of Borden group from southern area, where the relations of the fms. to one another are seen within short distances. Also, at type loc., in quarries near

Riverside, the strat. boundaries of fm. are not shown, the bottom not being reached and the top eroded. Hopkins himself applied the name to rocks much lower than those intended by definition, and other geologists have applied the name to various Borden units. The rock in quarries at Riverside is of Edwardsville age. Fauna in upper part resembles that in Mount Ebel ss. memb. Hopkins recognized that the stone at Riverside is very different from any Borden stone in S. part of Ind., being a quarry ss. of commercial value. Since the rock is somewhat different, as well as quite remote from the Edwardsville facies, the writer proposes to call it *Riverside ss. facies of Edwardsville fm.* In quarry ¼ mile SW. of Riverside, Fountain Co., its exposed thickness is 50 ft.

Riverside sand.

Tertiary (Miocene?): Northwestern Iowa.

H. F. Bain, 1896 (Iowa Geol. Surv., vol. 5, pp. 255, 277–279). *Riverside sands.*—[Name used, in table only, for coarse white sand in Woodbury Co., Iowa, that is described (pp. 277–279) as containing small pebbles, chiefly granitic, with chips of wood and a few fossils. In general character resembles Neocene or Plio. sands a few mi. to W. in Nebr. and S. Dak. Age doubtful. Overlain uncon. by Kansan drift and underlain uncon. by Cret.]

According to C. [R.] Keyes (1912, 1913, 1914) this sand is of Mio. age, and an eastward outlier of Arikaree fm.

Named for Riverside, Woodbury Co.

Roan gneiss.

Pre-Cambrian: Western North Carolina, northwestern South Carolina, eastern Tennessee, and northern Georgia.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 2). *Roan gneiss.*—Hornblende gneiss, hornblende schist, and diorite, with some interbedded mica schist and gneiss. Chiefly hornblende schists. The hornblendic beds are dark greenish or black; the micaceous beds dark gray. The mica schist and gneiss beds range in thickness from few in. to 100 ft., and are frequent only near Carolina gneiss, into which they form transition. Assigned to Archean. Appears to cut Carolina gneiss, but contacts so metamorphosed that the fact cannot be proved. [Is now known to cut Carolina gneiss.]

Named for development on Roan Mtn, Carter Co., Tenn.

Roaring Branch sandstone. (In Pocono formation.)

Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 56–57, 235). Buffish-white and massive ss., 125 ft. thick. Overlain by 200± ft. of buff sandy shales and underlain by *Roaring Branch shales* (265 ft. of shales with gray current-bedded sss.). All included in Pocono. Along Roaring Branch it is an uninterrupted pile of layers from 1 to 4 ft. thick, of moderately fine-grained, very hard, somewhat current-bedded buff-colored ss. [On pp. 56–57 he calls this ss. *Lackawanna ss.*; on p. 235 he calls it *Roaring Branch ss.*]

Roaring Branch shales. (In Pocono formation.)

Mississippian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 56–57, 235). [See under *Roaring Branch ss.*]

†Roaring Creek sandstone. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 462). *Roaring Creek ss.*—Very massive and often pebbly ss., 50 to 200 ft. thick, cropping a short distance below Upper Freeport coal [not Upper Freeport]. Well developed along Roaring Creek, Randolph Co., forming the falls of that stream, 50 ft. or more in height. Appears to be same as Upper Freeport ss.

This name is no longer in use, the equivalency of the ss. along Roaring Creek to Homewood ss. memb. having been established many years ago.

Robbins shale member.

Pennsylvanian: Southeastern Kansas.

R. C. Moore and N. D. Newell, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 153, etc.). *Robbins sh. memb. of Stranger fm.*—Marine gray argill. and silty sh., 1 to 100 ft. thick, forming top memb. of Stranger fm. in southern Kans. In Chautauqua Co. some massive ss. beds appear abruptly in the Robbins and probably continue into Okla. Is uncon. overlain by Ireland ss. and underlain by Haskell ls. Heretofore included in Lawrence sh., but uncon. at base of Ireland ss. memb. of Lawrence sh. restricted extends clear across Kans. Therefore Lawrence sh. is restricted to beds above the uncon. Type loc., the Robbins farm, in sec. 11, T. 26 S., R. 15 E., SW. of Yates Center, Kans.

Roberts sand.

Miocene (?): Southwestern Alabama.

W. H. Dall and J. Stanley-Brown, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 167, 170). Chipola series may be summarized as containing Chipola marl, the *Roberts* (Escambia Co., Ala.) *sands*, and the Alum Bluff beds.

W. H. Dall, 1903 (Wagner Free Inst. Sci. Trans., vol. 3, pt. 6, pp. 1563, 1564). *Roberts sand.*—Included in "Grand Gulf." Underlies Hattiesburg clays and overlies Grand Gulf ss. Correlated with Chipola marl.

Appears to be same as Catahoula ss., which is present at Roberts.

Named for exposures at Roberts, Escambia Co.

Roberts formation.

Pre-Cambrian: Central eastern California (Inyo Range).

J. H. Maxson, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 311). Wyman Canyon section, Inyo Range, consists of Silver Peak shales, lss. and sss. bearing *Olenellus;* the Campito ss., 2,000 ft.; Deep Springs fm., 2,100 ft.; Reed dol., 2,900 ft.; *Wyman schists*, 3,700 ft.; and *Roberts schist*, 2,500 ft.

J. H. Maxson, 1935 (Geol. Soc. Am. Proc. 1934, p. 314). *Roberts fm.*—Contorted schists and dolomites, 2,500± ft. thick in Wyman Canyon section, Inyo Range, in Bishop quad. Underlies (uncon.?) Wyman fm. Is pre-Camb.

Robervel formation.

Pre-Cambrian: Quebec.

J. A. Dresser, 1916 (Canada Geol. Surv. Mem. 92, p. 26).

Robervel granite.

Pre-Cambrian: Quebec.

J. H. C. Martens, 1927 (Canadian Min. and Met. Bull. 177, p. 116).

Robinett flags.

Trade name of ss. in Pleasanton group (Penn.) of SE. Kans., quarried on land of A. G. Robinett, in sec. 13, T. 30 N., R. 20 E. E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 108), stated: The flagging stone on Neosho River may be called *Robinett flags*, while of course those at Fort Scott will retain the name of the city near which they occur.

Robinson limestone member (of Maroon formation).

Pennsylvanian (?): Tenmile district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215-230), 1886 (U. S. G. S. Mon. 12, pp. 69, 198, 279, 598, 646), and 1898 (U. S. G. S. Tenmile Special folio, No. 48). *Robinson ls.*—Light bluish-gray or drab compact ls., resembling lithographic stone; conchoidal fracture; somewhat dolomitic at base. Basal memb. of Maroon fm.

Named for fact it forms the ore-bearing horizon of Robinson mine, in Tenmile dist.

Robinson formation.

Pennsylvanian: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370-394). *Robinson beds.*—Slates, cgls., tuff, and ss., of which the last two are most important. Thickness

1,150 ft. Uppermost Carbf. fm. in Taylorsville region. Fossiliferous. Younger than Shoofly beds and older than Hosselkus ls. and Swearinger sl.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Robinson fm.*—A succession of variable sediments ranging from sh. to cgl., and composed chiefly of igneous material with occasional lentils of ls. Most characteristic part is gray ss. that weathers reddish brown. Contains more or less disseminated carbonate of lime forming small lentils up to 15 ft. in thickness. Below the calc. horizon the reddish-brown thin-bedded tuffaceous ss. and sh. extend to bottom of fm. Above the calc. horizon the pyroclastic material becomes somewhat coarser and passes into a tuffaceous cgl. containing fossiliferous ls. nodules and beds of reddish-brown ss., with here and there crinoid stems like that of principal horizon below. [Fossils listed.] Is separated from the older Peale fm. by Reeve meta-andesite. Is uncon. overlain by Hosselkus ls.

Named for exposures on Robinson ranch (where it makes up the mound E. of the house), near Taylorsville.

†Robinson quartzite.

Lower Cambrian: Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 620–622). *Robinson qtzite.*—White qtzite, with several beds of greenish, yellowish, and reddish clay slates near top, and occasionally beds of fine quartz cgl. The fm. weathers brownish red. Exposed thickness 7,000 ft. Is oldest fm. in Tintic dist. Underlies Eureka ls. In Tintic folio the Robinson qtzite will be renamed *Ophir fm.*, to avoid duplication of names. [Map shows that it forms qtzite ridge N. of town of Robinson, Juab Co., and that it is exposed in Tintic Canyon and at other places in Tintic dist. In Tintic folio (No. 65, 1900, by G. O. Smith) the fm. was not named *Ophir fm.* but was named *Tintic qtzite*, by which name it has since been known.]

Robinson diorite.

Miocene or Pliocene: Central southern Montana (Little Belt Mountains).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Diorite whose composition is nearly monzonite. Occurs on W. of main summit of Castle Mtn, btw. Robinson and Blackhawk. Assigned to Neocene.

Robinson sands.

Subsurface sands in Carbondale and Pottsville fms. (Penn.) of Ill. (See Ill. Geol. Surv. Bull. 54, index.) According to T. E. Savage (Ill. Geol. Surv. Bull. 40, 1919) the Robinson sand of Flat Rock oil pool, Crawford Co., Ill., is in Pottsville fm. and is also known as *Flat Rock sand*.

†Robinson shale.

Mississippian: Central eastern Nevada (Ely district).

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 52) and 1924 (Pan-Am. Geol., vol. 41, p. 78). *Robinson shales*, 1,000 ft. thick, underlie Joana ls. and overlie Combs ls. Basal fm. of Pincan series. [The 1924 definition is as follows: "Name is proposed for A. C. Spencer's Pilot sh. of Ely dist., which term is preoccupied in Missouri [not preoccupied in Mo.] for the Pilot (Knob) conglomerates."]

Roca shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 84, 86, 88). *Roca sh.*—Bluish-gray, olive-green, and reddish argill. sh.; thin seams of fossiliferous ls. in upper part. Thickness 18 to 20 ft. in Nebr., 20 to 44 ft. in Kans. Top bed of Elmdale sh. memb. Overlies Howe ls. memb. and underlies Neva ls. Named for Roca, Lancaster Co., Nebr.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 8), showed *Neva ls.* as separated from *Roca sh. fm.* by (descending): Salem Point sh., 7 to 8 ft.; Burr ls., 10 to 11 ft.; Legion sh., 6 ft.; and Sallyards ls., 1± ft.; but stated that "Kans. Geol. Surv. correlates Legion sh. and Sallyards ls. with Roca sh. fm."

In 1936 (Kans. Geol. Surv. Bull. 22) R. C. Moore transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Rochdale limestone. (In Beekmantown group.)

Lower Ordovician: Southeastern New York (Dutchess County).

W. B. Dwight, 1887 (Am. Jour. Sci., 3d, vol. 34, p. 32; and Vassar Bros. Inst. Trans. Sci. Sect., vol. 4, pt. 2, p. 213; both papers describing the rocks of Dutchess Co., N. Y.). *Rochdale group (Calciferous?)*.—This group, with its unique set of numerous fossils, yet only very partially described, is the one which in previous papers I have called the "Calciferous," because I consider it manifestly most closely related to what has been generally covered by that title. It is evident, however, that the proper limits of both "Calciferous" and "Chazy" are undergoing severe review in light of recent developments, and that many fossils heretofore assigned to one may ultimately be found to belong to the other. I have therefore decided to designate these strata provisionally by the name of the locality where their faunas are most richly represented. It must not, however, be inferred that these are the only strata found at Rochdale, for at least the Trenton and Hudson River strata are also well represented there. The rocks of Rochdale group are apparently found everywhere in this ls. belt. Conformably underlies Trenton ls. and overlies Potsdam or Upper Camb.

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148), describing the rocks of Poughkeepsie quad., recognized *Beekmantown (Calciferous-Rochdale group)* along W. margin of Fishkill ls., where it was said to be uncon. overlain by Trenton ls. and underlain by ls. containing Potsdam fossils.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 31). The *Rochdale group* (1887, Dwight) consists of a series of beds typically exposed at Rochdale, Dutchess Co. They are regarded as=Beekmantown but have not been mapped separately from Wappinger ls.

E. B. Knopf, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 429–458), divided the rocks of Beekmantown age in E. part of Dutchess Co. into two fms., Copake ls. above and *Rochdale ls.* below, both of which were included in Dwight's Rochdale group. She described her Rochdale ls. as consisting of (1) a thick succession of thin-bedded gray banded lss. weathering to a bluish surface, and mottled blue and gray lss. that weather to a reticulated aren. surface, alternating with thicker beds of fine-grained pale-gray dol. that weathers to a chamois or cream-colored surface; (2) thin-bedded white dolomitic lss. that weather into snow-white flat blocks. The mottled blue and gray lss. of No. 1 contain Beekmantown fossils. Thickness of fm. probably 600 ft. in Wappinger Valley. Is overlain, probably conformably, by Copake ls., also of Beekmantown age, and underlain, apparently conformably, by Hoyt dol. Is="lower Calciferous" of Dwight. Named for village of Rochdale, where upper strata are richly fossiliferous.

Rochdale group.

See under *Rochdale ls.*

Rochelle conglomerate. (In Graford formation.)

Pennsylvanian: Central Texas (McCulloch County, Colorado River region).

R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 204, 205; Am. Geol., vol. 6, pp. 147–153). *Rochelle cgl.*—Band of cgl. of variable thickness but 50 ft. thick at Rochelle, forming top memb. of Richland ss. At SW. end is coarsely conglomeratic; to NE. is finer-grained, cross-bedded, and interbedded with ss. layers, becoming, near the Colorado, a conglomeratic ss. with thin layers of cgl. Of Upper Carbf. age.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, p. 388). *Rochelle cgl.*, 20 to 50 ft. thick, underlies Brownwood bed and seems to have been deposited shortly after the Coral ls. beds, 10 to 12 ft. thick, which form basal bed of Canyon div.

L. S. Kempher, 1918 (Remarks on geol. of north-central Tex. oil and gas region). The *Rochelle cgl.* described by Drake as one of lowermost members of Canyon div. is in reality of Trinity (Cret.) age. It carries pebbles containing Fort Scott and Canyon fossils.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 35; Univ. Tex. Bull. 2132, pp. 59, 96, 97). *Rochelle cgl. memb.* is basal bed of Brownwood memb. of Graford fm. in Colorado River Valley, and rests on Palo Pinto ls. Is best exposed on San Saba-Brady road, 4 mi. E. of Rochelle (McCulloch Co.). The true Rochelle cgl. was deposited only near the mtns, probably slightly before but almost contemporaneously with Capps ls. lentil of Brownwood area. Thickness 6 to

25± ft. [In this rept the Rochelle cgl. is in places included in Brownwood memb. and in other places excluded from the Brownwood and treated as basal memb. of Graford fm.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 111). *Rochelle cgl.* occurs locally in Colorado River Valley near base of Brownwood sh.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 198), treated this cgl. as basal memb. of Graford fm., underlying Brownwood sh. memb.

Roche Miette limestone.

Devonian: Alberta.

D. B. Dowling, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 206).

Roche Percée group.

Eocene: Canada.

G. M. Dawson, 1875 (Geol. and res. 49th Par., p. 86), and 1879 (Canada Geol. Surv. Rept. 1879–80, pp. 12A–55A).

Rochester shale member (of Clinton formation).

Silurian: New York.

T. A. Conrad, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 62–63). [Lists fossils from *Rochester shales.*]

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 289, 327). *Rochester shale.*—Calc. sh. underlying Lockport ls. and overlying green sh. and iron ore [Clinton fm. as used until redefined by E. O. Ulrich in 1911 (Geol. Soc. Am. Bull., vol. 22, p. 392 and pl. 28), to include Rochester sh.]. Named for exposures at Rochester.

The Rochester sh. was treated as a distinct fm., btw. Lockport dol. above and Clinton fm. below, until 1911, when E. O. Ulrich included it in the Clinton. (See further explanation under *Clinton fm.*) In some early repts the Rochester sh. memb. was called "Niagara sh." According to E. O. Ulrich the Rochester sh. is included in and forms top div. of typical Clinton.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29), proposed to restrict Rochester sh. by removal of 20 ft. of calc. beds ("really a ls.") at its top, which are present at Rochester and heretofore included in Rochester sh. He named these beds *Gates ls.*, q. v.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), treated *Rochester sh.* as top memb. of *Clinton*, and included in it the limy beds at top.

Rochester quartzite.

Name casually applied by W. G. Foye (11th Rept. Vt. State Geol., 1919, p. 87) to pre-Camb. qtzite exposed along the Mine R. R. in Rochester, Vt.

Rochester biotite granite.

Devonian (?): Southeastern New Hampshire.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 148, 149). *Rochester biotite granite* cuts Gonic schist and may be a pre-Carbf. intrusive. Is cut by pegmatite veins.

Probably named for exposures at Rochester, Strafford Co.

Rochester trachyte.

Triassic (Middle ?): Northwestern Nevada (Rochester district).

A. Knopf, 1924 (U. S. G. S. Bull. 762). *Rochester trachyte.*—Lavas, tuffs, and breccias; more than half is breccias and tuffs. "Felsite is a highly appropriate field name for these volcanic rocks." Thickness exposed 5,000 ft. Oldest fm. in Rochester dist. Is prevailing rock in Rochester Canyon. Of Triassic (Middle ? Tr.) age.

Rochester rhyolite.

Triassic: Nevada.

C. P. Jenney, 1935 (Nev. Univ. Bull., vol. 29, No. 6, p. 23). "Same as Rochester trachyte of Knopf."

Rochester moraine.

Name applied to a Pleist. moraine in central N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627+, 1932.)

Rociada limestone.

Pre-Cambrian: Central northern New Mexico (Las Vegas region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 10). *Rociado lss.*—Main body of Archeozoic lss. in Solitario Mtn dist., NW. of Las Vegas. Thickness 250 ft. [Derivation of name not stated. On p. 4 is spelled with final *a;* on p. 10 with final *o*. The P. O. is spelled with final *a*.]

Rock Bluff limestone. (In Deer Creek limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 43, 50). *Rock Bluff ls.*, basal bed of Deer Creek ls., 8 in. to 2½ ft. thick in Nebr., and thickens somewhat southward to NW. Mo. (5+ ft.) and NE. Kans. (6 ft.). Underlies Larsh sh. and overlies Tecumseh sh. Named for exposures high in Missouri River bluffs NE. of Rock Bluff, Nebr. [This definition was followed by Condra and R. C. Moore in several charts up to and including Oct. 1932.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12). *Rock Bluff ls.* underlies Larsh sh. and is separated from Tecumseh sh. by Oskaloosa sh. (4 to 7 ft.) and the underlying Ozawkie ls. (5 ft.). [This is definition of Rock Bluff ls. followed by R. C. Moore in his 1936 rept. (Kans. Geol. Surv. Bull. 22). Moore explained (pp. 163, 182–187) how he came to misidentify *Rock Bluff ls.* and *Larsh sh.* in Kans., and introduced *Ozawkie ls.* and *Oskaloosa sh.* as names for the beds in Kans. that he previously had called *Rock Bluff ls.* and *Larsh sh.*]

Rock Canyon conglomeratic member (of Moenkopi formation).

Lower Triassic: Southwestern Utah (Washington County) and northwestern Arizona.

H. Bassler and J. B. Reeside, Jr., Aug. 15, 1921 (U. S. G. S. Bull. 726C, pp. 90–92). *Rock Canyon conglomeratic memb. of Moenkopi fm.*—Irregular complex of ls., ls. and chert cgl., sh., and gyp. Thickness 0 to 170 ft. [0 to 288 ft. in U. S. G. S. P. P. 129D, p. 55, 1922]. Basal memb. of Moenkopi fm. in this region. Lies 360 ft. below Virgin ls. memb. of Moenkopi. Rests uncon. on Kaibab ls. Named for Rock Canyon, 5 mi. N. of Antelope Spring, Mohave Co., Ariz.

†Rockcastle group. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky.

A. R. Crandall, 1889 (Ky. Geol. Surv. Whitely Co. Rept.). *Rockcastle group.*—Name provisionally applied to cgls., with interbedded shales and sss., 10 to 450 ft. thick, forming lower part of Coal Measures along border of coal field. Overlies Chester group and underlies 1,500 ft. of Coal Measures shales and sss. Its greatly thickened (1,500 ft.) equiv. in Pine Mtn region is called Pine Mtn group.

Includes Lee fm. and probably younger rocks.

Named for Rockcastle River, central Ky.

Rockcastle sandstone. (In Lee group.)

Rockcastle conglomerate member (of Lee formation).

Pennsylvanian: East-central Kentucky to central Tennessee.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46, p. 3). *Rockcastle cgl. lentil.*—Coarse cgl., 0 to 175 ft. thick, forming basal memb. of Lee fm. in Richmond quad., Ky. Underlain uncon. by Pennington sh. (Miss.).

Rockcastle ss. adopted by U. S. Geol. Survey for topmost fm. of Lee group in central Tenn., where it consists of 200–300 ft. of coarse qtzite or conglomeratic ss., underlain by five fms., aggregating 840 ft., belonging to Lee group. In some parts of eastern Ky. this ss. represents all of Lee group that is present; in other places the *Rockcastle cgl. memb.* is top memb. of Lee fm.

Named for exposures along Rockcastle River, Ky.

Has also been called "Rockcastle series." (A. M. Miller, 1910, Ky. Geol. Surv. Bull. 12.)

Rockcastle freestone.

Trade name for Wildie ss. memb. of Warsaw fm. in SE. Ky.

†Rock City conglomerate.

Name applied in some early repts to Olean cgl. of Cattaraugus and Chautauqua Counties, N. Y., which has been undermined and separated, by vertical joints, into huge blocks, often many ft. apart, called "rock cities," for which the village of Rock City, SW. of Olean, N. Y., was named.

Rock Creek limestone member (of McLeansboro formation).

Pennsylvanian: Central western Illinois (Menard County).

A. H. Worthen, 1873 (Ill. Geol. Surv., vol. 5, pp. 309, 312, 314, 315). *Rock Creek ls.*—Fine-grained, compact, bluish gray ls., in upper Coal Measures of Menard Co., and probably also in Sangamon Co., lying 85 ft. above Coal No. 5. Regarded as strat. equiv. of Collinsville ls.

Is a local memb. of McLeansboro fm. Lies in interval btw. coals Nos. 7 and 8, and is=Lonsdale ls., according to G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Series Bull. 26, pp. 203–223), and according to T. E. Savage, 1921 (Ill. Geol. Surv. Extr. from Bull. 38). Named for outcrops along Rock Creek, Menard Co.

†Rock Creek beds.

Pleistocene: Panhandle of Texas.

J. W. Gidley, 1903 (Am. Mus. Nat. Hist. Bull., vol. 19, pp. 622, 625). *Rock Creek beds.*—Fine white sand, coarse sand, bluish clay, and gravel, sharply cross-bedded and indicating alluvial depositions by river or smaller streams. Fossiliferous. Thickness at least 90 ft. Uncon. overlies Plio. Blanco beds. Local name proposed for equiv. of Sheridan (*Equus*) beds.

W. D. Matthew, 1925 (Geol. Soc. Am. Bull., vol. 36, p. 221). *Rock Creek beds* are later than Panhandle beds, except perhaps the capping layers.

Named for Rock Creek, Swisher Co.

Rock Creek granodiorite.

Rock Creek gabbro and diorite.

Jurassic: Southern British Columbia and northeastern Washington.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 401). *Rock Creek gabbro and diorite,* Jurassic, intrusive. *Rock Creek granodiorite,* Jurassic intrusive, cuts Rock Creek diorite. Occurs near forks of Rock Creek. Uncon. underlies Kettle River fm. (Olig.).

Rock Creek limestone. (In Nelagoney formation.)

Pennsylvanian: Central northern Oklahoma (Osage County).

F. C. Greene, 1918 (A. A. P. G. Bull., vol. 2, p. 122). About 220 ft. above Wild Horse ls. is *Rock Creek ls.,* well developed in T. 26 N., R. 10 E., but very thin in SW. corner of next twp to S. Is probably about 325 ft. below top of Elgin ss., and immediately overlain by 150 ft. of ss. interbedded with red sh. Assigned to Penn. [Type loc. not stated.]

Rockdale formation. (In Wilcox group.)

Eocene: Eastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 583). *Rockdale fm.* is proposed to designate all nonmarine strata of Wilcox group, which extend from top of Caldwell Knob oyster bed (top memb. of Seguin fm.) or its equiv. beds to base of marine strata of Sabinetown fm. Where Sabinetown fm. is absent the Rockdale is limited at top by Carrizo sand, of Claiborne group. Type loc., exposures in central Milam Co., in vicinity of Rockdale, where the lignitic members of fm. are mined. The fm. occupies approx. middle ⅗ of Wilcox section and comprises all its nonmarine strata. Most of its strata are lenticular and it is impossible to divide the fm., but in central and southern Tex., especially btw. Brazos and Frio Rivers, it is divided into following 3 members (descending): Calvert Bluff clay beds, 1,000 ft.; Simsboro sand, 240 ft.; and Butler clay, 400 ft. Thickness of fm. 1,000 to 1,640 ft. Rests conformably on Seguin fm. (marine).

Rockdale moraine.

Rockdale drift.

Pleistocene (late Wisconsin): Northeastern Illinois (Joliet quadrangle). See D. J. Fisher, 1925 (Ill. Geol. Surv. Bull. 51, pp. 17, 69, 71, 87–89, and map), and M. M. Leighton, 1932 (16th Int. Geol. Cong. Guidebook 26, pp. 16, 51). Named for village of Rockdale, 2 mi. SW. of Joliet.

Rock Falls series.

Mississippian: Eastern Michigan (Huron County).

A. C. Lane, 1900 (Mich. Geol. Surv., vol. 7, pt. 2, pp. 252–253), in a description of fossils collected from Marshall and Coldwater fms. in Huron Co., used, in heading, *Rock Falls series* (*Cuyahoga*), and described it as consisting of blue shales, poor in fossils, except in thin sandy seams and nodules of carbonate of iron. Derivation of name not stated.

Rockfish conglomerate.

Pre-Cambrian (Glenarm series): Western Virginia (Nelson County).

W. Nelson, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 15, pp. 456–457). *Rockfish cgl.*—Coarse cgl., about 800 ft. thick, forming basal cgl. of Lynchburg gneiss. Lower 120 ft. contains pebbles and boulders, both angular and rounded (of quartz, granite, and fine-grained siliceous gneiss), from 2 to 12 in. diam., embedded in metamorphosed sediment now composed of feldspar, blue quartz, and mica; it lies next to Lovingston quartz monzonite and has appearance of augen gneiss or mylonite; its pebbles and boulders occur in clusters, generally 1 to 2 ft. apart separated by 4 or 5 ft. of almost barren cgl. Above this lower 120 ft. occurs 285 ft. of cgl. full of pebbles, from 2 to 6 in. diam., which become more scattered toward top. Next above lies 345 ft. of cgl. containing pebbles from 1 to 4 in. diam. This upper part grades into mica gneiss that is correlated with Lynchburg gneiss. The Lynchburg gneiss occupies belt about 1 mi. wide at this point and its exposed thickness is 5,000± ft. The cgl. and Lynchburg gneiss strike N. 30° E., dip 70°–80° NW., and are slightly overturned. On N. side of Rockfish River the Lovingston quartz monzonite outcrops at base of the cgl., while on S. side of the river an amphibolite dike crops out which occupies the place of contact btw. the Lovingston and the cgl. Near middle of the cgl. occurs a 75-foot offshoot of this dike. This cgl. does not contain any pebbles of amphibolite, granodiorite, or Catoctin schist. Type loc. is on Rockfish River. Further work will probably show that this cgl. extends to S. in Lynchburg area and to N. into edge of Albemarle Co.

Rockford limestone.

Mississippian (Kinderhook): Indiana.

F. B. Meek and A. H. Worthen, 1861 (Am. Jour. Sci., 2d, vol. 32, pp. 167–177). *Rockford goniatite bed.*—Mottled brownish and ash-colored argill. ls. overlying the Black sl. Only 2 ft. exposed.

E. M. Kindle, 1899 (Bull. Am. Pal., vol. 3, No. 12). *Rockford ls.*, 3 to 6 ft. thick in southern Ind., underlies New Providence sh. and overlies New Albany black sh.

E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4, Sep. Pub. 21, pp. 486, 487). *Rockford ls.* is thin and local in its distribution. Typically exposed in bed of White River at Rockford, Jackson Co., but may be seen wherever contact of Knobstone and New Albany fms. come to view btw. Rockford and Ohio River. It does not extend into Ky.

Basal fm. of Mississippian in Ind.

†Rockford shale.

Upper Devonian: Central northern Iowa.

S. Calvin, 1878 (Am. Jour. Sci., 3d, vol. 15, pp. 460–462). *Rockford shales.*—Argill. shales exposed at and near Rockford, Iowa, and frequently called Rockford shales. Thickness 70 ft. Included in Dev. Overlie Dev. lss.

See under *Hackberry sh.*

Named for Rockford, Floyd Co.

Rockfordian series.

A term employed by C. [R.] Keyes (Pan-Am. Geol., vol. 60, No. 3, 1933, p. 226) to include the Upper Dev. deposits of Iowa that have been variously designated Chemung, Rockford, Hackberry, Owen, Sheffield, Cerro Gordo, and Juniper. (See Iowa correlation chart.)

†Rock Fort sandstone.

Lower Ordovician: Central eastern Missouri.

H. King, 1851 (Am. Ass. Adv. Sci. Proc., vol. 5, p. 189). Generally white ss.; occasionally slightly colored by iron; sometimes hard but usually soft or friable and easily reduced to condition of sand. No fossils. Thickness 150 or 250 ft. Underlies Blue ls. regarded by Hall as=Trenton ls. of N. Y. Overlies 500 ft. of light-yellow or buff mag. ls. Frequently appears in top of hills btw. Ste. Genevieve and Meramec River, presenting a bold wall-like escarpment or bluff. In these cases it has received the common name *Rock Fort* in the county.

Same as St. Peter ss., older name.

Not geographic name.

Rock Grove substage.

Upper Devonian: Central northern Iowa.

C. H. Belanski, 1927 (Am. Mid. Nat., vol. 10, No. 10). *Rock Grove substage.*—Mag. ls., shaly ls., and impure dol., 21+ ft. thick, uncon. underlying First *Actinostroma* zone of Nora ls. [redefined] and uncon. overlying Mason City substage [restricted use of Mason City]. Divided into *Schizophoria* zone above and *Paracyclas* zone below. Named for great development in *Rock Grove Twp*, Floyd Co. Typically developed on E. (left) bank of Shell Rock River a short distance SE. of Nora Springs. Is middle substage of Shell Rock stage, which is assigned to Upper Dev.

See also under *Shell Rock ls.*

Rockhill limestone. (In Graford formation.)

Pennsylvanian: Central northern Texas (Wise County).

E. Böse, 1918 (Univ. Tex. Bull. 1758, pp. 14–16). *Rockhill ls.*—In Dry Creek is generally light-gray or dark-gray ls. in layers of moderate size. Very good horizon marker. In certain parts contains numerous crinoids and brachiopods. To SW. a mass of gray marls, 25 to 30 ft. thick, is intercalated in lower part. Thickness of fm. 30 to 150 or more ft.; thickest to W. It forms high part of Rockhill Range. Rests on a series of gray marly shales with intercalated sss., and is separated from overlying Devils Den ls. by 305± ft. of sss. with intercalated shales. Lies 180± ft. above Bridgeport ls. Appears to belong to Strawn fm.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 30). *Rock Hill ls. memb. of Graford fm.* overlies Lake Bridgeport shales and underlies Jasper Creek shales. It forms the flat top of the long, narrow ridge (Rock Hill) that extends SW. from S. end of Lake Bridgeport dam. It is a tongue of Chico Ridge ls.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105, 111), included this ls. in Graford fm.

Rock House sandstone.

Mississippian: Western Kentucky.

See under *Tar Springs ss.*, 1856 item.

Rockhouse shale.

Lower Devonian (Helderbergian): Western Tennessee.

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 736). *Rockhouse sh.*—Bluish-green or greenish-gray calc. glade-forming sh. interbedded with occasional thin bands of light-gray crystalline ls. Fauna is very early Dev., near Siluro-Dev. bdy. Treated as basal fm. of Helderbergian or Linden group. Occurs in S. part of Hardin Co. Not before described. Uncon. underlies Ross ls. (basal memb. of Olive Hill fm.) and discon. overlies Decatur ls. Max. thickness 26 ft. at Rockhouse, a hunters' clubhouse on Horse Creek, 5 mi. NW. of Lowryville, for which it is named.

†Rockingham schist.

Pre-Cambrian and Pennsylvanian (?): Southeastern New Hampshire.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545). *Rockingham mica schist.*—Generally uncouth mica schist. Occupies principal part of Rockingham. Underlies Merrimack group.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, btw. pp. 518 and 591). *Rockingham mica schist.*—Very convenient name to designate a large mass of mica schists, with the mica often in coarse blotches and the predominant mineral, until its proper geological place is known, and therefore we cannot yet dispense with the term. Closest resemblance is to the micaceous portion of Montalban series. No difficulty in discerning relations to Merrimack group, but bdy line btw. them is not satisfactory. The fm. is better developed in Strafford than in Rockingham Co. [On a later page he gave thickness as 6,000 ft., and placed it as younger than Merrimack group and older than Kearsarge andalusite group.]

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 178–179). Part of *Rockingham mica schist* belongs to Huronian.

F. J. Katz, 1917 (U. S. G. S. P. P. 108 I). *Rockingham schist* of Hitchcock included Gonic fm. (Penn.?), part of Kittery qtzite (Penn.?), and part of Berwick gneiss (pre-Camb.), as mapped in this rept (on SE. N. H. and SW. Maine).

Rock Lake shale. (In Stanton limestone.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 41, 59, 156, 157). *Rock Lake sh.*—Basal 6 ft. of Scranton sh. Upper 1 to 2 ft. bluish; rest maroon; all argill. Underlies South Bend ls. and overlies Howard ls. Named for outcrop at Rock Lake, sec. 3, T. 12 N., R. 10 E., Sarpy Co., Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 13, 26, 27, 31, 32, 33, 34, 36). The *Rock Lake sh.* and overlying South Bend ls. belong in top of Stanton ls. The Rock Lake sh. rests on Stoner ls., also included in Stanton ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 135–136). *Victory Junction sh. memb.* of Kans. is possibly same as *Rock Lake sh.* of Condra in Nebr., which was originally erroneously included in Scranton sh., but which belongs in Stanton ls.

†Rockland sandstone.

Miocene (?): Eastern Texas.

E. T. Dumble, 1901 (Geology of Beaumont oil field). *Rockland ss.*—Series of hard sss. and clays [thickness not stated] underlying Lagarto beds in Beaumont oil field.

Is a ss. bed in Catahoula ss.

Named for Rockland, Tyler Co.

Rockland formation.

Cambrian or Ordovician: Central southern Maine (Rockland region).

E. S. Bastin, 1908 (U. S. G. S. Rockland folio, No. 158). *Rockland fm.*—Folded and metamorphosed sed. rocks, best developed just W. and SW. of Rockland. Includes 3 members. The upper memb. (Rockport ls. memb.) comprises major part of fm. It consists of white to purple crystalline ls., ls. cgl., and shaly ls.; its thickness is at least 400 or 500 ft. and may reach 2 or 3 times that figure. The middle memb. consists of greenish siliceous ls. (100 to 150 ft. thick). The basal memb., local, is Weskeag qtzite memb. (0 to 300 ft. thick). Conformably overlies Penobscot fm. and is overlain by surficial deposits. Is Cambro-Ord. and apparently = Stockbridge ls.

On 1933 geol. map of Maine, by A. Keith, these rocks are included in Ord. and Camb. block.

†Rockland sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, p. 610). *Rockland or National ss.*—Rockland seems to be the older name, being used in George D. Emerson's 1859 rept. But Broughton's map uses *National ss.*, from National mine, and that is more current. [The compiler is unable to find any published rept by George D. Emerson.]

Named for occurrence at Rockland, in Ontonagon Co.

Rockland formation.

Ordovician (Middle): Ontario and northern New York.

P. E. Raymond, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 348), 1916 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, pp. 255, 260), 1921 (Canada Geol. Surv. Mus. Bull. 31, p. 1). *Rockland fm.*, Ord., Ontario. Included in Trenton.

This name was used in several subsequent Canadian repts.

G. M. Kay, 1929 (A. A. P. G. Bull., vol. 13, No. 9, p. 1214), defined *Rockland ls.* in Jefferson Co., N. Y., as consisting of 40 ft. of ls. forming basal fm. of Trenton group, underlying Hull ls. and overlying Watertown ls. of Black River group. In Geol. Soc. Am. Bull., vol. 46, pp. 227, 228, 1935, Kay defined *Rockland fm.* as separable into a lower memb., in which *Doleroides gibbosus* is characteristic, and an upper memb., having abundance of *Triplecia cuspidata* at top. Max. observed thickness is 64 ft. at Dexter, N. Y. Lower memb. is 24 ft. thick at Lonsdale, Ont.

G. M. Kay, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 2+). *Rockland fm.* is 55 ft. thick W. of Watertown, N. Y., and less than 20 ft. thick 60 mi. to SE. of westernmost N. Y. exposure. Was formerly called "Triplecia beds." Overlaps onto Watertown ls. and underlies Hull fm. Type loc. is at Rockland, Ont., 30 mi. E. of Ottawa. Fossils listed. Is basal part of Trenton group.

Rockland Valley basalt.

Pliocene (middle?): Southern Idaho (Power County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Rockland Valley basalt.*—Even-bedded blue and black basalt flows, partly weathered. Contains at least one bed of clay, 15 ft. thick in Rock Creek Canyon. Thickness may be 647 ft.; 250 ft. exposed in walls of Rock Creek Canyon. Named for exposures on N. side of Rockland Valley, Power Co. Older than Raft lake beds and younger than Massacre volcanics.

Rockmart slate.

Ordovician (Middle): Northwestern Georgia.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 143) and 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 469–470, 478). North of Coosa Valley the Knox dol. is followed by the Chickamauga, a series of blue, dove-colored, and purple lss.; also at a few points S. of Coosa fault the dol. is overlain by blue ls., although in greater part of this region a strat. break, which will be described more fully later, occurs at this point; also S. of the fault the purple earthy lss. are replaced by a great thickness of black slates. They have been placed in a separate fm., the *Rockmart sl.*, although they probably represent same period of deposition as the earthy lss. farther N., but it is impracticable to separate the latter from the purer lss. beneath. Underlies Rockwood fm.

J. W. Spencer, 1893 (Ga. Geol. Surv., Paleozoic group). Chickamauga series of NW. Ga. is divided into (descending): (1) *Rockmart sl.* (semimetamorphic sl.), 1,200 ft.; (2) Deaton ore beds or series, 100 to 200 ft. of ferruginous lss.; (3) *Maclurea ls.*, 600 to 800 ft.; (4) heavy bed of breccia in ridges S. of Rockmart.

J. O. Veatch, 1909 (Ga. Geol. Surv. Bull. 18). *Rockmart sl.* is chiefly sl. but includes some ls., sh., and cgl. Thickness 2,500 to 3,000 ft. Overlies Chickamauga ls. and underlies Rockwood fm.

S. W. McCallie, 1910 (Ga. Geol. Surv. Bull. 23, pp. 51, 184). *Rockmart shales* are= upper part of Chickamauga fm., but are so well defined that they are mapped as a distinct fm.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), assigned *Rockmart sl.* to Blount group (=upper Chazy) and correlated it with Athens sh. of Tenn.

T. P. Maynard, 1912 (Ga. Geol. Surv. Bull. 27). *Rockmart shales and slates* of eastern basin are 2,500 ft. thick. They are blue to black, weather olive green and yellow, uncon. overlie 100 to 200 ft. of dark-blue and gray Chickamauga ls., and are=upper part of Chickamauga fm. of western basin. [This description was repeated by H. K. Shearer, 1918 (Ga. Geol. Surv. Bull. 34).]

A. Keith and L. La Forge, 1925 (Ga. Geol. Surv. Bull. 42, p. 7), show *Rockmart sl.* as Middle Ord. but leave indefinite the question whether it includes any Lower Ord.

R. W. Smith, 1931 (Ga. Geol. Surv. Bull. 45). *Rockmart sl.* is probably of Blount age.

Named for Rockmart, Polk Co.

Rockport shales.

Pennsylvanian: Northwestern Missouri.

C. R. Marbut, 1904 (The State of Mo., p. 69). *Rockport shales*, top fm. of coal measures of Mo.

Rockport limestone member (of Rockland formation).

Cambrian or Ordovician: Central southern Maine (Knox County).

E. S. Bastin, 1908 (U. S. G. S. Rockland folio, No. 158, pp. 3–4). *Rockport ls. memb.*—Virtually a marble, although it is either too coarse, too dark-colored, or too much fractured to be used for ornamental or building purposes. Ranges from dark purplish gray to pure white, the commonest colors being light gray and dark blue gray; banded varieties showing alternate grayish-white and dark blue-gray layers are also very common. Is top and major memb. of Rockland fm. Thickness at least 400 or 500 ft. and may reach two or three times this figure.

Named for exposures on E. shore of Rockport Harbor, Knox Co.

Rockport limestone. (In Greene formation.)

Permian: Western West Virginia.

C. E. Krebs, 1911 (W. Va. Geol. Surv. Rept. Jackson, Mason, and Putnam Counties, p. 102). *Upper Rockport ls.*, hard gray ls., 7 ft. thick; containing minute freshwater fossils; underlying Gilmore ls., and lying 30 ft. above *Middle Rockport ls.*, which is hard, gray, and also contains minute fossils. *Lower Rockport ls.* is dark gray, weathering white; lies 29 ft. below Middle Rockport ls., and overlies Nineveh ss. Named for occurrence at Rockport, Wood Co.

Rockport sandstone.

Pennsylvanian: Southwestern Indiana (Spencer County). See under †*Martha Washington ss.*

Rockport limestone.

Middle Devonian: Northeastern Michigan (Alpena County).

R. A. Smith, 1916 (Mich. Geol. and Biol. Surv. Pub. 21, geol. ser. 17, pp. 172–175). *Rockport ls.*—Thick, massive, and extremely fossiliferous bed at base of Long Lake series. At Rockport, Alpena Co., it rests directly on the soft blue Bell sh., and is 25 to 30 ft. thick. It is essentially stromatopora, coral, etc., with matrix of dark or black crystalline and very bituminous ls., and forms bluff extending from N. line of sec. 6, T. 32 N., R. 9 E., SE. along shore of Lake Huron for more than 1 mi.

W. A. VerWiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 184). *Rockport ls.*—Ls., most of it very bituminous; upper 10 ft. buff-colored and very fine-grained. Thickness 40 ft. Basal memb. of Long Lake or Lower Traverse series. Overlies Bell sh.

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526), excluded Rockport ls. from Long Lake stage and treated it as a separate fm., underlying Long Lake stage and overlying Bell sh.

Named for exposures at Rockport, Alpena Co.

Rockport formation.

C. Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 36, 61–62, 280, 301). Sss. or brownish sandy shales, 2,000 ft. thick in Utah and 1,000 ft. thick in Colo., uncon. below Bearian series and above Dakota ss. in Utah and Wyo. Composes upper fm. of Henryan series [Upper Cret.].

Named from hamlet of Rockport, Summit Co., NE. Utah.

Rockport granite.

Local quarry term for a part of Quincy granite, which has been quarried at Rockport, Essex Co., Mass.

Rock River formation.

Upper Cambrian: Quebec.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 185, 1931) to A_1 of Logan's section of Philipsburg series of Quebec. McGerrigle mapped his *Rock River fm.* in small area in St. Albans quad., NW. Vt., stating that it extended about 4 mi. into that State. Logan described A_1 as consisting of 400 ft. of dark-gray and yellowish-white dolomites. McGerrigle gave thickness as 500 ft. (See 1931 entry under *Philipsburg series.*) Rock River rises in Quebec, but flows into Missisquoi Bay in St. Albans quad., Vt. T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6), assigned this fm. to Upper Camb., which is where paleontologists of U. S. Geol. Survey place it.

Rock Run limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

See under *Aux Sable ls.*

Rock Springs formation. (In Mesaverde group.)

Upper Cretaceous: Southwestern Wyoming (Sweetwater County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Rock Springs coal group.*—White to yellow ss., interbedded sh. and clay, with several coal beds; heaviest ss. beds near base. Thickness 600–1,400 ft. Basal fm. of Mesaverde group. Overlies Blair fm., and is separated from the younger Almond coal group by 800 to 1,000 ft. of massive white and yellowish ss., the upper third of which is conglomeratic.

J. D. Sears, 1926 (U. S. G. S. Bull. 781, p. 20, pl. 5). [See under *Almond fm.*]

Rocktown channel sandstone member (of Dakota sandstone).

Upper Cretaceous: North-central Kansas.

W. W. Rubey and N. W. Bass, 1925 (Kans. Geol. Surv. Bull. 10, pp. 16, 57–65). Occurring locally at almost any horizon from top to 125 ft. below top of Dakota ss. in Russell Co. is a series of very discontinuous, highly cross-bedded ss. strata here named *Rocktown channel ss. memb. of Dakota ss.* Thickness 15 to 100± ft. Named for excellent exposures at and near the large group of "hoodoos" or houselike blocks of ss. in NW¼ sec. 4, T. 13 S., R. 11 W., locally known as Rocktown.

Rockvale sandstone member (of Vermejo formation).

Upper Cretaceous: Eastern Colorado (Fremont County).

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 163–169). *Rockvale ss. memb. of Vermejo fm.*—Massive yellow to brown ss.—the ss. separating the two groups of coal-bearing beds in Vermejo fm. Contains marine invertebrate fossils [listed] of Fox Hills type, and great numbers of *Halymenites major*. Thickness 33 to 65 ft. Lies 300 to 382± ft. above Rockvale coal (basal bed of Vermejo fm.) and 30 ft. above Royal Gorge coal beds. Named for typical development near Rockvale, Fremont Co.

†Rockville sandstone.

Upper Devonian: Southwestern New York.

H. S. Williams, 1887 (U. S. G. S. Bull. 41, pp. 51 and 73), under heading "The Portage sss. and the faunas of the Chemung group," described the *stations* where these rocks had been studied. On p. 73 is subheading "Rockville, Allegany Co., N. Y.—479," and statement that at base of the section near old canal lock at Rockville is a thick ss., 6 ft. of which is visible. On pp. 78–79 he stated that the ss. (quarried) at Belmont, Allegany Co., N. Y., lies at elev. of 1,450± ft. and "represents very closely the horizon of *Rockville ss.* 479." This is the only place where the compiler has found *Rockville ss.* previous to Chadwick.

G. H. Chadwick, Nov., 1933 (Pan-Am. Geol., vol. 60, p. 200), in a chart from Olean to Genesee River, showed *Rockville ss.* as underlying Cuba ss. and overlying

Rushford ss. and as=in age Northeast sh. He stated (personal communication dated Jan. 24, 1936) that present Rockville (railway station and stores) is about 1 mi. W. of old Rockville, where occur the exposures of this ss., and that he is not author of the name, as he did not define it.

B. Willard and A. B. Cleaves, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 4, p. 780). Skaneateles fm. of eastern Pa. divided into (descending): (1) Unnamed ss. and sh.; (2) Colgate memb. (?); (3) Berwyn memb.; (4) Delphi memb.; (5) *Rockville memb.* (light-colored ss., hard, fossiliferous, present in western sections only); (6) Mottville memb., at base.

Rockville conglomerate.

Cretaceous or Tertiary: Central eastern Iowa.

W J McGee, 1891 (U. S. G. S. 11th Ann. Rept., pt. 1, p. 304). *Rockville cgl.*—Scattered bodies of either dark-brown puddingstone of well-worn quartz pebbles in matrix of earthy limonite, or obscurely stratified ferruginous ss. Thickness 0–20 ft. Seems to uncon. overlie Niagara ls. and to be composed in part of materials derived from that fm. Is littoral deposit. Provisionally assigned to Cret. and correlated with Nishnabotany ss. of SW. Iowa and Fort Dodge gyp. of west-central Iowa.

Named for Rockville, Delaware Co.

Rockville member (of Skaneateles formation).

Middle Devonian: Eastern Pennsylvania (Dauphin County).

B. Willard and A. B. Cleaves, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 4, pp. 768, 781). The 30 ft. of barren dark to olive-gray or black sh. at base of Skaneateles fm. may be Mottville memb. Overlying this is *Rockville memb.*, a name introduced for a light-colored ss. first studied at Rockville, on the Susquehanna. In Schuylkill Valley, btw. Schuylkill Haven and Auburn, it is 60 ft. of light-gray medium-grained buff to light-brown weathering, more or less cross-bedded flaggy to heavy ss. underlying the Delphi memb. The Rockville is fossiliferous, characterized by many specimens of *Stropheodonta* and *Chonetes*.

Rockville granite.

Trade name for granite quarried at Rockville, Minn.

Rockwell formation.

Mississippian: Northeastern West Virginia and western Maryland.

G. W. Stose and C. K. Swartz, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Rockwell fm.*—Soft arkosic ss., fine hard cgl., and buff hackly sh.; crumbly dark-gray carbonaceous sh. with thin coal seams near base in W. part of area. Thickness 500 to 540 ft. Basal fm. of Pocono group. Underlies Purslane ss. and overlies Catskill fm. Named for exposures in Rockwell Run, Morgan Co., W. Va.

Rockwood formation.

Silurian (Clinton and Medina): Eastern Tennessee and northwestern Georgia (?).

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 143). *Rockwood fm.*, 1,000 to 1,500 ft. thick, is of Sil. age and=Clinton or Dyestone of Smith and Safford. Underlies Dev. Chattanooga black sh. and overlies Chickamauga ls. and Rockmart sl. in NW. Ga.

C. W. Hayes, 1894 (U. S. G. S. Kingston folio, No. 4, p. 2). *Rockwood fm.*—Highest div. of Sil. in this region. Varies widely in character and thickness within limits of quad. Forms narrow strip about head of Sequatchie Valley, where it is 165 ft. thick and composed of calc. shales interbedded with blue ls. Along foot of Cumberland escarpment is about 600 ft. thick and consists of calc. and sandy shales. Still farther E., in ridge which extends from Iron Divide to Ten Mile Stand, is 850 to 1,000 ft. thick, a considerable part of which is coarse ss. interbedded with sandy shales. Toward top are sandy shales and a few calc. beds, with which is associated the iron ore that gives the fm. great economic importance. Takes its name from Rockwood, Tenn. [in Kingston quad.], where the rocks are intermediate in character btw. the western and eastern phases, and where the ore is extensively mined. Underlies Chattanooga black sh. To W. overlies Chickamauga ls.; to E. overlies Athens sh. Is=Dyestone group and White Oak Mtn ss. of Safford.

Includes rocks of Clinton and Medina ages, according to studies of E. O. Ulrich and C. Butts. As mapped in some early repts it also included, in some areas, rocks of Richmond age and also possibly rocks of Lockport age.

Named for Rockwood, Roane Co., Tenn., where, according to E. O. Ulrich, the rocks are all of Medina age.

†Rockwood sandstone.

Silurian: Northwestern Georgia.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2, columnar section sheet). *Rockwood ss.*—White or brown ss. or cgl. forming a middle memb. of Rockwood [Red Mtn] fm. E. of Chattooga Valley.

Undesirable name, because of extended usage of *Rockwood* in broader sense.

Rockwood sandstone. (In Chester group.)

Mississippian: Southwestern Illinois (Randolph and Monroe Counties).

S. Weller, 1913 (Ill. Geol. Surv. Bull. 22, p. 31). *Rockwood ss.*—Ss., 100 ft. thick, forming topmost memb. of Birdsville fm. in Randolph and Monroe Counties. [Only use is in table.]

Probably named for Rockwood, Randolph Co. Appears to be=Palestine ss.

Rockwood oolite.

Mississippian: Northwestern Alabama (Franklin and Lawrence Counties).

W. B. Jones, 1928 (Ala. Geol. Surv. Circ. 8, pp. 13-15). *Rockwood oolite*, 0 to 55 ft. thick; much less variable in occurrence and having greater extent than Burgess oolite; beds at top and bottom carry abundance of fossils. Type loc. near Rockwood, Franklin Co., where it is 55 ft. thick and uniformly oolitic throughout. Lies 100 ft. above base of Bangor ls. and 100 ft. below Burgess oolite—all in Bangor ls. The underlying beds are blue to gray flinty fossiliferous lss. and dolomites; the overlying beds are blue fossiliferous lss.

Rocky Canyon granite.

Jurassic or Cretaceous: Northwestern Nevada (Humboldt Range).

C. P. Jenney, 1935 (Univ. Nev. Bull., vol. 29, No. 6, pp. 37-42). *Rocky Canyon granite.*—White to gray granitoid rock, spotted with many flakes of biotite and in places containing biotite segregations and bunches. Frequently weathers to coarse arkosic gravel. Outcrops over 6± sq. mi. in lower Rocky and Wright's Canyons, and elsewhere. Last of major intrusives of region. Called pre-Camb. by 40th Par. Surv., but Louderback has shown it is post-Triassic intrusive, and probably of Jura-Cret. age.

Rocky Cedar Creek limestone lentil. (In Kincaid formation.)

Eocene: Northeastern Texas (Kaufman County).

G. D. Harris, 1896 (Bull. Am. Pal., vol. 1, No. 4, p. 41), divided the Midway of Kaufman Co. into (descending) Wills Point clays and sands (upper Midway); *Rocky Cedar Creek ls.* (middle Midway); and clays W. of Rocky Cedar Creek (lower Midway). [On p. 16 he listed the fossils from 5 mi. W. of Wills Point on Rocky Cedar Creek.]

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 536, 539, 540, 541, 553). *Rocky Cedar Creek ls. lentil.*—A local thin bed of gray fossiliferous ls. similar to Tehuacana ls. lentil of Pisgah memb. of Kincaid fm., but occurring slightly lower in Pisgah memb. Thickness 12-16 ft. Typically exposed in Ola quarry, 1 mi. S. of Ola, and along Rocky Cedar Creek btw. Ola and Wills Point, Kaufman Co.

†Rocky Comfort chalk.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 89-95, 188). *Rocky Comfort chalk.*—Massive fossiliferous, nearly pure-white chalk, usually free from grit. Thickness 500 ft. at Rocky Comfort, where 100 ft. is exposed and 400 ft. is penetrated in wells. Is a continuation into Ark., from Tex., of fm. called *Dallas ls.* and *Austin ls.* Relations to overlying fms. in Ark. undet.

Is upper part of Annona chalk, and of same age as Pecan Gap tongue of the Annona, according to 1925 and 1926 work of L. W. Stephenson and C. H. Dane. (See C. H. Dane, U. S. G. S. Press Bull. 8823, Sept. 10, 1926; L. W. Stephenson, A. A. P. G. Bull., vol. 11, No. 1, Jan. 1927; and C. H. Dane, Ark. Geol. Surv. Bull. 1, 1929.) The Pecan Gap chalk is now treated by U. S. Geol. Survey as a memb. of Taylor marl.

Named for exposures at Rocky Comfort, Little River Co.

Rocky Gap sandstone. (In Helderberg group.)

Lower Devonian: Southwestern Virginia.

F. M. Swartz, 1929 (Pa. Acad. Sci. Proc., vol. 3, p. 80), applied *Rocky Gap ss.* to 10 to 100± ft. of sandy and cherty beds in SW. Va., extending from Tumbling Creek, near Saltsville [Saltville], to Gala, Va. He showed these beds (in section) as underlying Saltsville chert, as correlated with Shriver chert (=Becraft ls.) and the older New Scotland ls., and as having nearly their max. thickness in Rocky Gap, Va., section.

†Rocky Hill trap.

Name applied by H. B. Kümmel, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, p. 62), to a sheet of diabase that intrudes Brunswick and Lockatong fms. of Newark group (Upper Triassic) of N. J. Exposed at Rocky Hill village, Somerset Co. This local geographic name considered unnecessary, and is not used by U. S. Geol. Survey. (See U. S. G. S. Trenton folio, No. 167.)

Rocky Hill volcanics.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 74–75). *Rocky Hill basalt* [mapped in Tantalus-Roundtop dist.] overlies black ash and associated aggl. [mapped], and the 2 fms. compose Rocky Hill.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii; Div. Hydrog. Bull. 1). *Rocky Hill volcanics.*—Cinders and basalt, chiefly basalt. Mapped. Included in lower part of Honolulu volcanic series [q. v.]. Type loc. Rocky Hill.

Rocky Mound limestone member (of Graham formation).

Pennsylvanian: Central northern Texas (Young County).

Wallace Lee (Univ. Tex. Bull. soon to be published). The group of lss. outcropping conspicuously on SW. slope of Rocky Mound, 3 mi. NE. of Graham, Young Co., and erratically overlain by Avis ss. memb., is here named *Rocky Mound ls. memb. of Graham fm.* It comprises the lss. of No. 8 post-Bunger cycle, and generally consists of gray crystalline fossiliferous ls. 33 to 35 ft. thick. Lies about 250 ft. above Bunger ls.

Rocky Mountain quartzite.

Carboniferous: Alberta and British Columbia.

D. B. Dowling, 1907 (Rept. on Cascade coal basin, Alberta; Canada Geol. Surv., p. 9). *Rocky Mtn qtzite*, Carbf., Alberta.

In subsequent Canada Geol. Surv. repts (by Shimer, Allan, Daly, Adams and Dick, Kindle, and Warren) this fm. has been assigned to Penn. In 1927 Shimer assigned it to Perm. P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 300), assigned it to Penn. (?).

Rocky Mountain limestone.

Cretaceous: Alberta.

D. B. Dowling, 1915 (Canada Geol. Surv. Summ. Rept. 1914, p. 48).

Rocky Ridge sandstone member (of Pierre shale).

Upper Cretaceous: Central northern Colorado (Larimer County).

M. W. Ball, 1924 (A. A. P. G. Bull., vol. 8, No. 1, pp. 81–87). *Rocky Ridge ss.* was named and mapped [unpublished repts] by A. T. Schwennensen, E. W. Krampert, and C. H. Henley. It is 97 ft. thick; lies 163 ft. below Larimer ss. and 604 ft. above Terry ss. Forms prominent cliff around N. and E. banks of Rocky Ridge

Reservoir [about 4½ mi. SW. of Wellington, Larimer Co.] and is also prominent in cliff outlining Douglas Lake. [See also 1924 entry under *Hygiene ss. memb.*] Is included in Mesaverde fm.

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B). *Rocky Ridge ss. memb. of Pierre sh.* reaches thickness of 165 ft.; ordinarily btw. 50 and 100 ft.; but at many places it merges so gradually into the very sandy sh. which overlies and underlies it that no definite top nor bottom can be ascertained. It lies 0 to 170 ft. below Larimer ss. and 300 to 600 ft. above Terry ss.

Rocky Ridge sandstone member (of Pottsville formation).

Pennsylvanian: North-central Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14) and 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221). *Rocky Ridge ss. memb.*—Thick-bedded conglomeratic quartzose ss., 50 to 100 ft. thick. A memb. of Pottsville fm. in Cahaba field, lying about 3,000 ft. above base of Pottsville. Recognized only in Little Cahaba syncline. Lies about 900 ft. below Straven cgl. memb. and about 2,760 ft. above Chestnut ss. memb.

Named for fact it forms Rocky Ridge, E. and NE. of Cahaba pumping station, in NW. part of Vandiver quad.

Rocky Run conglomerate.

Upper Devonian: Northeastern Pennsylvania (Pike County).

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, p. 1553). *Rocky Run cgl.*—A very coarse massive ss., with large fish bones. Outcrops on Rocky Run, Montour Twp, Pike Co. In view of large number of fish beds known to exist in Chemung and Catskill series it is hazardous to identify it with other fish-bed cgls. in distant counties.

Rocky Woods conglomerate.

Carboniferous: Southeastern Massachusetts (Taunton area).

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, p. 134, table). *Rocky Woods cgl.* included in Dighton group. [On p. 185 he says: "In this northern part of the basin the several exposures of cgl. referred to the Dighton group lie in the inner or upper part of synclines. This is true of the Great Rock area in Rehoboth, whence the rocks extend eastward to 'Rocky Woods' near Taunton."]

Rod Club sandstone member (of Springer formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 12, 13). *Rod Club ss. memb.*—A sandy zone, 250 to 400 ft. thick, containing several sss. ranging up to 25 ft. in max. individual thickness. Basal memb. of Springer fm. Lies 1,000± ft. below Overbrook ss. memb.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, pp. 15–16). *Rod Club sandy memb.*—Sandy zone, usually containing 4 or more ledges, each 2 to 25 ft. thick, of rather hard greenish to buff fine- to medium-grained ss. Named for outcrops at the smaller Rod and Gun Club lake in NW¼ sec. 7, T. 4 S., R. 2 E., on SE. plunging nose of Caddo anticline.

Rodemar sand.

A subsurface sand, of Sil. age, in western Ky.

Rodeo shale. (In Monterey group.)

Miocene (middle): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Rodeo sh.*—Bituminous sh., mostly chalky and more or less stained with oxide of iron, but locally cherty. A subdivision of Monterey group. Underlies Briones ss., and overlies Hambre ss. Thickness 670 ft. Named for exposures along Rodeo Creek, in NW. part of Concord quad., Contra Costa Co.

Rodman limestone. (In Black River group.)

Middle Ordovician: Central Pennsylvania (Blair to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 525, 533, 537). *Rodman ls.*—Dark crystalline ls. weathering with rough granulated surface. Thickness 30 ft. Upper fm. of Black River group. Overlies Lowville ls. and underlies Trenton ls.

Named for exposures at Rodman Station, Blair Co.

Rogers chalk lens. (In Taylor marl.)

Upper Cretaceous (Gulf series): Northern central Texas (Bell County).

W. S. Adkins and M. B. Arick, 1930 (Univ. Tex. Bull. 3016, p. 65). *Rogers chalk lens*, in Taylor marl, is probably less than 50 ft. thick. It is a soft marly chalk, bluish gray on original exposure, dull grayish white on exposure, with mostly poor but locally platy bedding and little clay or iron segregations. Fossils. Is overlain by 424 ft. of Upper Taylor marl and underlain by 350± ft. of Lower Taylor marl. Type loc., several exposures on a small creek from about 1 mi. to 1¼ mi. S. and a little W. of Rogers. Fairly persistent in SE. Bell Co.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 270, 456), placed this chalk below Lott chalk and higher than Durango sand.

Rogers Gap division. (In Cynthiana formation.)

Middle Ordovician: Central Kentucky.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17, pp. 19, 23, 42, 44). *Rogers Gap div.*—Fossiliferous strata [not described] at base of Eden in central Ky. Regarded as probably contemp. with Economy memb. of Eden.

A. F. Foerste, 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, pp. 109–145), described fauna of *Rogers Gap beds*, and included them in Cynthiana fm., stating that they were older than Eden.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2) and 1919 (Md. Geol. Surv. Camb. and Ord. vol., p. 51), and A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided Cynthiana fm. (of late Trenton age) into (descending) Rogers Gap, Gratz, Bromley, and Greendale.

Probably named for Rogers Gap, Scott Co.

Rogersian series.

A term applied by C. [R.] Keyes to upper part of the pre-Camb. rocks of Mont. and Alberta, and divided by him into *Donald qtzite* (above), 5,000 ft. thick, and *Ross qtzite* (below), 2,500 ft. thick. Derivation of names not stated. (See Pan-Am. Geol., vol. 44, 1925.)

Rogers Spring limestone.

Mississippian (lower): Southeastern Nevada (Muddy Mountains).

C. R. Longwell, 1921 (Am. Jour. Sci., 5th, vol. 1, p. 46) and 1928 (U. S. G. S. Bull. 798). *Rogers Spring ls.*—Granular lss., in part crystalline; beds regular and heavy, 1 to 20 ft. thick, dark gray or almost black to light gray; much carbonaceous matter; heavy beds of dark fine-grained qtzite and siliceous ls. in Muddy Peak and Rogers Spring horst probably belong to this fm. Madison (lower Miss.) fossils found 200 ft. above base. Thickness 600± ft. Underlies Bluepoint ls., with probable uncon., and rests on Muddy Peak ls., with probable discon. Occurs along Rogers Spring fault scarp, Clark Co.

Rogersville shale.

Middle Cambrian: Northeastern Tennessee, southwestern Virginia, and western North Carolina.

M. R. Campbell, 1894 (U. S. G. S. Estillville folio, No. 12, p. 2). *Rogersville sh.*—Blue calc. sh. 0 to 120 ft. thick, abundantly fossiliferous and remarkably persistent over large area in NE. Tenn. In Carter Valley E. of Cloud Ford the fm. becomes a dark siliceous ls. which cannot be separated from the lss. above and below. Overlies Rutledge ls. and underlies Maryville ls. [This quad. adjoins type loc.]

The foregoing is first appearance in print of *Rogersville sh.* The fm., however, was named by A. Keith, whose description of it in its type area was not published until 1896 (U. S. G. S. Morristown folio, No. 27). He described it as consisting chiefly of bright-green argill. shales with occasional beds of thin red sandy sh.; in its eastern and southern areas divided by a bed of massive blue ls.; and in its NW. outcrops contains many small beds of shaly ls. Thickness 70 to 250 ft. Overlies Rutledge ls. and underlies Maryville ls. Named for excellent exposures at and near Rogersville, Hawkins Co., Tenn.

Rogersville limestone. (In Greene formation.)

Permian: Southwestern Pennsylvania (Greene County).

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 97, 106). *Rogersville ls.*—Lies lower than Jollytown [Claysville?] ls. and higher than Pursley coal. Included in Greene fm. Is No. VIII of vol. K. Is confined to central Greene Co., where it lies 19 to 35 ft. above Ten-mile ls. Is an earthy ls.

Rogue River group.

Cretaceous: Southwestern Oregon (Rogue River Valley).

See under *Willamette group.*

Rolland granite.

Pre-Cambrian: Quebec.

F. F. Osborne, 1935 (Quebec Bur. Mines Rept. Minister Mines 1934–35, pt. E, pp. 18, 19, 24, map).

Rollins sandstone member (of Mesaverde formation).

Upper Cretaceous: Central western Colorado (Delta County region).

W. T. Lee, 1909 (U. S. G. S. Bull. 341, pp. 20, 23). *Rollins ss. memb. of Mesaverde fm.*—White cliff-making ss. containing marine invertebrates. Thickness 100± ft. Basal memb. of Mesaverde fm. in Grand Mesa coal field. Underlies Bowie sh. memb. of Mesaverde fm. Forms conspicuous cliff at Rollins mine, N. of Delta, Delta Co.

Roll Quarry limestone.

Age (?): West-central Vermont.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 283). *"Roll" Quarry ls.*—A black platy shaly ls. exhibiting slickensides and pyrite. A blue-gray massive ls. shot with calcite lies beneath the black platy ls. [All there is about it.]

Rolls Ford shale member (of McLeansboro formation).

Pennsylvanian: Central western Illinois (Springfield quadrangle).

T. E. Savage, 1915 (Ill. Geol. Surv. Bull. 20, pp. 99–107). In McLeansboro fm., btw. coals Nos. 6 and 7, are several ft. of red mottled shales which are exposed at Ralls Ford on Sangamon River, and constitute a very characteristic and easily recognized horizon throughout this region [Springfield quad.]. For convenience may be called *Ralls Ford sh. memb.* [In correlation table, pl. 12, he carried this name into Peoria section, to N.]

Some repts spell this name *Rolls Ford sh.*, and the locality is spelled *Rolls Ford* on Springfield topog. map.

Roma sandstone member (of Fayette formation).

Eocene (upper): Southern Texas (Starr County) and adjacent part of Tamaulipas, Mexico.

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1376, 1383, 1387). *Roma ss. memb. of Fayette fm.*—In lower part of Fayette fm. Exposed at Int. Bridge, San Pedro de Roma on Mexican side of Rio Grande from Roma [Starr Co.], Tex. Consists of 362 ft. of soft coarse- to medium-grained light-gray ss. with several horizons containing hard dark-brown calc. concretionary masses and others containing brown hard nodular ss. masses in very soft sandy matrix. Several gravelly and conglomeratic beds near base. A few oysters throughout the ss. and a good fossiliferous bed of small bivalves at its base. Lies 183 ft. above base of Fayette fm. in section measured along both sides of Rio Grande btw. Roma and Rio Grande City [Starr Co.], Tex.

Romaine formation.

Ordovician: Quebec (Mingan Islands).

C. Schuchert and W. H. Twenhofel, 1910 (Geol. Soc. Am. Bull., vol. 21, p. 686).

Romance arkose.

Pre-Cambrian: Northwestern Vermont (Rochester quadrangle).

W. G. Foye, 1919 (11th Rept. Vt. State Geol., p. 84, in description of Rochester quad.). *Romance arkose* is thought to form basal part of qtzite memb. of upper Mendon series, of later Algonkian age. [Probably named for Romance Mtn, in W. part of Rochester quad., in Addison Co.]

Rome formation.

Lower Cambrian: Northwestern Georgia, northern Alabama, western North Carolina, eastern Tennessee, and southwestern Virginia.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. on Cahaba coal field, p. 149), described Weisner qtzite as "interpolated in Coosa and Montevallo shales, at no definite horizon but most commonly in their lower parts." (The Montevallo is now known to be same as Rome fm.)

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 143–146) and 1892 (Ala. Geol. Surv. Bull. 4, pp. 31, 33, 34–39). *Rome ss. and Weisner qtzite.*—Sandy shales, sss., and qtzites, 2,000 to 3,500 ft. thick, overlying Coosa [Conasauga] shales and underlying Connasauga sh. At base several hundred ft. of highly indurated greenish sandy sh.; succeeded upward by great thickness of purple or reddish-brown sss. (generally thin-bedded and frequently passing into sandy shales), in which are intercalated beds of white ss. or qtzite, from a few ft. to many hundred ft. thick, called *Weisner qtzite.* Upper part of fm. consists of highly colored shales. Rome ss. and Weisner qtzite are not regarded as distinct fms. but as different lithologic types of same fm., due to local differences in condition of sedimentation.

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala. with explanatory text), excluded Weisner qtzite from †Montevallo sh. (=Rome fm.), and treated it as a distinct fm. resting on the crystalline rocks.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2, p. 1). *Rome fm.*—Sss. and shales, 3,000 to 4,000 ft. thick, overlying Apison sh. and underlying Connasauga sh. Basal 1,500 to 2,000 ft. (consisting of alternating layers of purple, brown, and white sss. interbedded with sandy shales) called *Rome ss.* Rest of fm. consists chiefly of brown or dark olive-green shales with some thin siliceous layers. [This area adjoins, on N., Rome quad., the type loc. of the fm.]

C. W. Hayes, 1895 (U. S. G. S. 16th Ann. Rept., pt. 3, pp. 554–559), treated Weisner qtzite as a distinct fm., in places separated from overlying Rome fm. by a blue siliceous ls., which he correlated (erroneously) with †Beaver ls. of Tenn., and which is now known as *Shady dol.*, 800 to 1,200 ft. thick. (See L. LaForge, Ga. Geol. Surv. Bull. 35, 1919, pp. 43–45; also C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1926, p. 64.)

C. W. Hayes, 1902 (U. S. G. S. Rome folio, No. 78, p. 2). *Rome fm.*—Brilliantly colored (various shades of red, purple, green, yellow, and white) thin-bedded fine-grained sss. and sandy shales, 700 to 1,200 ft. thick. Overlies Beaver [Shady] ls. (which rests on Weisner qtzite), and underlies Conasauga fm. Basal part, thin-bedded red sss. [the *Rome ss. lentil* of many previous repts]; top characterized by rather heavy bed of white ss. Type loc. is S. of Rome, Ga. [See also description of *Conasauga sh.* in regard to drawing top bdy of Rome fm.]

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, p. 65). The *Rome fm.* (called "Montevallo or Choccolocco shales" by Ala. Geol. Surv.) is a rather heterogeneous unit, composed of red sh., green sh., reddish or chocolate ss., light-gray, rusty-weathering calc. ss., and local beds of fairly pure ls. and dol. The red sh. and rusty-weathering calc. ss. are its most characteristic features. Thickness in Ala. 700 to possibly 4,000 ft. Underlies Conasauga fm. and overlies Shady ls.

Named for exposures S. of Rome, Ga.

†Rome sandstone.

Lower Cambrian: Northwestern Georgia and southeastern Tennessee.

C. W. Hayes, 1894 (U. S. G. S. Ringgold folio, No. 2, columnar-section sheet). *Rome ss.*—Purple, brown, and white ripple-marked sss. interbedded with sandy shales and forming basal part of Rome fm.

Conflicts with Rome in broader sense.

Romney shale.

Middle Devonian: Eastern West Virginia, central and northern Virginia, western Maryland, and southern Pennsylvania.

N. H. Darton, 1892 (Am. Geol., vol. 10, pp. 13, 17). *Romney sh.*—Basal series of Dev. sediments in central Appalachian Va., consisting of dark fissile shales, in greater part black or dark brown, containing occasional thin beds of ss. and ls. Thickness 500 to 900 ft. Uncon. overlies Monterey ss. and underlies Jennings fm. Contains Hamilton fossils.

According to G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg, Pa., folio, No. 170), E. O. Ulrich, 1911 (G. S. A. Bull., vol. 22), E. M. Kindle, 1912 (U. S. G. S. Bull. 508), G. W. Stose, 1912 (Pawpaw-Hancock, Md., folio, No. 179), C. Prosser, 1915 (Jour. Geol., vol. 23), G. P. Grimsley, 1916 (W. Va. Geol. Surv. Rept. on Jefferson, Berkeley, and Morgan Counties), G. W. Stose, 1922 (Va. Geol. Surv. Bull. 23), and W. F. Prouty, 1927 (W. Va. Geol. Surv. Rept. on Hampshire and Hardy Counties) the Romney sh. included the Hamilton, Marcellus, and Onondaga, and the overlying Jennings fm. included the Genesee, Portage, and Chemung. In 1932 (Va. Geol. Surv. Bull. 34, pp. 63, 64) and 1933 (Map of Valley of Va. and accompanying text) C. Butts did not recognize the presence of any beds of unquestioned Genesee age, and divided the beds of Portage age into two parts, to the upper of which he applied the central Pa. name *Brallier sh.*, and the lower of which he included in a map unit (which he stated consisted "mainly of black sh.") which he designated *Romney sh.* Named for exposures at Romney, Hampshire Co., W. Va.

Rondout limestone. (In Cayuga group.)

Silurian: New York.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874–878). *Rondout waterlime.*—Underlies Manlius ls. and overlies Salina beds. Named for fine development in extensive cement quarries at and near Rondout. Middle fm. of Cayugan group.

E. O. Ulrich and C. Schuchert, 1901 (N. Y. State Mus. Bull. 52, pp. 650–653). *Rondout fm.* is but base of the Manlius, and former is completely transitional downward into Coralline ls. We know the Coralline ls. lies just below the Rondout at Rondout, N. Y.

C. Schuchert, 1903 (Am. Geol., vol. 31, pp. 160–175), restricted *Rondout ls.* to upper part (39 ft. at Schoharie) of strata originally apparently included under that name, and applied *Cobleskill ls.* to the 7 to 30 ft. or more of strata formerly called "Coralline ls." and apparently composing basal part of the Rondout as originally defined, since it overlies Salina fm. He stated: Clarke and Schuchert in proposing *Rondout* intended to apply this name to the "Waterlime" fm., characterized by an abundance of *Eurypterus*. It now turns out that the fm. at type loc. at Rondout, N. Y., is younger and lies above Cobleskill memb. of the Manlius, and it has therefore lost its intended significance. He also stated that the Cobleskill is inseparably connected with Rondout memb., and that it overlies Bertie fm. of the Salina. In this 1903 paper Schuchert assigned the Rondout to Cayugan, as before. This has for many years been the commonly accepted definition of Rondout ls.

C. A. Hartnagel, 1903 (Am. Geol., vol. 31, pp. 160–175), described *Rondout waterlime* as consisting of 0 to 40 ft. of sandy hydraulic ls. underlying Manlius ls. and overlying Cobleskill ls. In 1905 (N. Y. State Mus. Bull. 82) J. M. Clarke and D. D. Luther described the Rondout of Tully quad. as consisting of 40 ft. of hard dark blue-gray dolomitic ls. weathering light drab, in layers 6 in. to 2 ft. thick; overlain by Manlius ls. and underlain by Cobleskill dol. In 1906 A. W. Grabau described the Rondout of Schoharie Valley as consisting of 42 ft. of mostly lime mudrocks, but with frequent layers of more aren. texture, and at base a 6-ft. "cement bed," bluish gray, massively bedded; rests on Cobleskill ls. and is overlain by Manlius ls.

E. O. Ulrich in 1913 (Md. Geol. Surv. Lower Dev. vol., pp. 115–116) assigned the Rondout to Lower Dev., called the overlying fm. *Keyser ls.* (a name taken from W. Va. and stated by Ulrich to replace "the Manlius of the literature"), called the underlying fm. *Decker Ferry* (which he also included in Dev.), and stated that *typical* Manlius is of Sil. age, is older than Decker ls., and rests on Cobleskill ls. In same volume C. K. Swartz, C. Schuchert, and C. S. Prosser classified the Rondout of N. Y. and N. J. as Lower Dev. Geologists generally continued to place Rondout in Sil., which is where Schuchert's 1924 textbook of geol. placed it, also R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, p. 41).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10) and 1935 (N. Y. State Mus. Bull. 303), included *Rondout* in Sil., and placed it below Manlius ls. and above Cobleskill ls.

Ronkonkoma moraine.

Pleistocene (Wisconsin stage): Southeastern New York (Long Island).

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). *Ronkonkoma moraine*, name proposed by M. L. Fuller in manuscript discussion. Assigned to early Wisconsin. Older than Harborhill moraine, and followed Vineyard interval of uplift and erosion.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). Early part of Wisconsin stage of Mississippi Valley is represented on Long Island by Harbor Hill or inner moraine (0 to 30 ft. thick) and associated till and outwash and Ronkonkoma or outer moraine (0 to 150 ft. thick) and associated till and outwash.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). Probable equiv. of *Ronkonkoma moraine* on Cape Cod is designated as *Nantucket moraine*.

Ronkonkoma substage.

The time during which *Ronkonkoma moraine* was deposited.

Rooney chert member.

Mississippian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 14, 47, and passim). *Rooney chert memb. of Madison ls.*—Shows 3 striking differences when compared with underlying Dean Lake chert: (1) The chert is white; (2) it is usually in form of grossly vesicular nodules which break down to form angular fragments averaging 1 to 1½ in. diam.; (3) the lss. that form great bulk of the Rooney are always light-colored, in contrast to those forming part of Dean Lake memb. Rocks of entire memb. are massive, generally coarsely crystalline cream-colored lss. interbedded at irregular intervals with thin zones of calc. buff sh., and with white to white-gray chert disseminated throughout. Thickness 202 to 578 ft. Fossiliferous throughout. Forms upper part and top of higher peak of Lone Butte, where it is well exposed. Type loc. on S. slope of top of Lone Butte, in SE¼ sec. 23, T. 23 N., R. 13 W.

Roosville formation.

Pre-Cambrian: Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, map 2, 114°30′ to 115°). *Roosville fm.*—Light-green and gray thin-bedded metargillite. Overlies Phillips fm. [Assigned to Middle Camb. (?), but correlated with fms. which U. S. Geol. Survey classifies as pre-Camb. Later Canadian repts assign it to *Belt series*.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 109+, table at 178). *Roosville fm.*—Chiefly thin-bedded light-green, light-gray, and greenish-gray siliceous metargillite bearing thin, more qtzitic interbeds. Weathers light gray or brownish gray. Thickness 600+ ft. No fossils. Top fm. of Galton series. Conformably overlies Phillips fm. Appears to be younger than any beds of Lewis series. May prove to be = upper div. of the Kintla or may represent westward extension of a distinct fm. Top removed by erosion. Named for post-office recently opened on Phillips Creek, at Roosville, B. C.

†Rosalie granite.

Pre-Cambrian: Central northern Colorado (Georgetown quadrangle).

S. H. Ball, 1906 (Am. Jour. Sci., 4th, vol. 21, p. 383). *Rosalie granite.*—Biotite granite; massive granular rock, whose predominant constituent is a salmon-pink microcline often showing carlsbad twinning. Forms ridge btw. Mount Evans and Mount Rosalie. Cuts the quartz monzonite and is intruded by Silver Plume granite.

T. S. Lovering, 1929 (Colo. Sci. Soc. Proc., vol. 12, pp. 69–70). "Rosalie" granite is same as Pikes Peak granite. Latter name has priority, so "Rosalie" is abandoned.

†Rosamond series.

Tertiary (Miocene?): Southeastern California (southeastern Kern County and northern Los Angeles County).

O. H. Hershey, April, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [On legend of map *Rosamond series* appears btw. Cret. shales below and Escondido series above, and is mapped to N. of Rosamond, Kern Co.]

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349–372). *Rosamond series.*—A rhyolite series, 1,650 ft. thick, consisting of interbedded ss. and rhyolite tuff with one massive bed of dark-red lava. Uncon. underlies Barstow series. Type section near Rosamond Station.

J. C. Merriam, 1919 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, No. 5, pp. 440–448). While the name *Rosamond series* may tentatively be used for middle and late Tert. sediments of Mohave area, it has not been demonstrated that the several fms. represented are as closely related in their depositional history as they appeared in first investigations. If Barstow fm. is a memb. of Rosamond series of Hershey it is a late memb. It will be recognized as a div. of Rosamond series. It is doubtful if Rosamond series comprises sediments of the stage represented at Ricardo.

C. D. Hulin, 1925 (Calif. State Min. Bur. Bull. 95), assigned *Rosamond series* to upper Mio.

E. C. Simpson, 1934 (Calif. Dept. Nat. Res., Div. Mines, Calif. Jour. Mines and Geol., vol. 30, No. 4, p. 400). Only fossils found in *Rosamond fm.* of Elizabeth Lake quad. are reeds, calc. algae, and fragments of silicified wood, all rather useless in correlation. But abundant mammalian remains have been found in upper members of Rosamond fm. at Barstow and determined by J. C. Merriam (1919) to be upper Mio. This age may be accepted as not far wrong for the Rosamond of Elizabeth Lake quad.

C. D. Hulin, 1934 (p. 420 of book cited above under *E. C. Simpson*). Age of middle and upper phases of *Rosamond series* can be fixed as early Upper Mio. on basis of vertebrate fossils in Barstow syncline; and it appears probable base of the Rosamond is not older than Middle Mio., but this needs verification.

Rosario formation.

Cretaceous: Mexico (Baja California).

F. M. Anderson and G. D. Hanna, 1935 (Calif. Acad. Sci. Proc., 4th ser., vol. 23, No. 1, p. 7).

Rosebud beds.

Miocene (lower and early middle): Central southern South Dakota.

W. D. Matthew and J. W. Gidley, 1904 (Am. Mus. Nat. Hist. Bull., vol. 20, pp. 241–246). The lower Mio. fm. (probably the lowest stage of the lower Mio.) of southern S. Dak., for which we propose the local term *Rosebud beds*. Best exposed along Little White River and in vicinity of Rosebud Agency [Todd Co.]. Closely resembles portions of upper Olig. beds, both in character and general appearance, except that they contain a little more sand. Lithology of these river and plains deposits is so unreliable that paleontological evidence is necessary to determine horizon. Overlain uncon. by Loup Fork beds (uppermost Mio.). No traces of middle Mio. in region. Is possibly=Gering beds of Darton in NW. corner of Nebr.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 65), shows these beds as of lower and early middle Mio. age, and as=Arikaree fm. of NW. Nebr. and SE. Wyo. Arikaree has priority.

Rose Canyon shale.

Eocene: Southern California (San Diego County).

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). *Rose Canyon sh.*—Mudstones, gray shales, fine sands, cgls., and a few thin beds of ls. The sss. are usually fine-grained and vary from light to dark brown. Lower part is cross-bedded. Thickness about 300 ft. Is upper div. of La Jolla fm. Discon. underlies Poway cgl. and grades into underlying Torrey sand. In NW. part of quad. rests with marked angular uncon. on Black Mtn volcanics. Named for exposures at big bend in Rose Canyon, La Jolla quad. Contains brackish water fauna.

Rosedale member.

Upper Ordovician: Toronto, Canada.

W. A. Parks, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 103–104).

See quotation under *Dundas fm.* Type loc. not stated.

Rosedale gas sand.

A subsurface sand, 40 to 85± ft. thick, in Pottsville fm. (Penn.) of W. Va. Believed to correspond to Guyandot ss. memb. The *Rosedale salt sand* is an older sand and believed to correspond to Sharon cgl. memb. of Pottsville fm. The sands were named for occurrence near Rosedale, Braxton Co., W. Va.

Rose Hill formation.

Silurian (Niagaran): Maryland, northern Virginia, and Pennsylvania.

C. K. Swartz, 1923 (Md. Geol. Surv. Sil. vol., see index), introduced *Rose Hill fm.* for pre-Rochester part of *Clinton group* (as he called the Clinton) of Md. Defined it as consisting of 300 to 550 ft. of fossiliferous sh. interbedded with subordinate amounts of thin argill. ss. and a few bands of ls.; the sh. being argill., thin-bedded, fissile, of drab or olive color, but with pink or reddish beds in upper part. Comprises all beds in Md. btw. top of Tuscarora fm. and base of Keefer ss., and is divisible into: (1) Upper sh. beds with some purplish bands and some thin lss.; (2) Cresaptown iron ss., 10 to 30 ft.; (3) lower sh. and ss. beds, 175 ft. Named for exposures on Rose Hill, Cumberland, Md. Correlated with pre-Rochester part of Clinton of N. Y. by its "fauna, lithology, strat. position and geographic variation." [Swartz expressed opinion that Clinton might still fittingly be retained for the beds beneath the strata containing the Rochester fauna, although "some at least of the iron ores occur in the beds assigned to the Rochester by Ulrich."]

In several subsequent repts (1930, 1931, and 1934) Swartz continued to use this name.

Rose Island arkose.

Carboniferous: Southern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 308, 380). *Rose Island arkose.*—Occurs on Rose Island [one of Newport Harbor Islands]. Probably contemp. with some part of Aquidneck sh. series. Not so thick as Conanicut arkose.

A part of Wamsutta fm. as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

Rosendale limestone member (of Salina formation).

Silurian: Eastern New York.

J. Hall, 1893 (N. Y. State Mus. 46th Ann. Rept., pp. 156, 159). At Rosendale [Ulster Co.] we find most southern exposure of these high escarpments of Lower Helderberg lss. underlain by a great development of the Waterlime, which is here extensively manufactured into hydraulic cement [p. 156]. It is only those parts of Waterlime group (=*Rosendale ls.*) where these turbid sediments are not deposited, that the characteristic fauna of that horizon, the Eurypteridae, flourish. [p. 159.]

In 1894 (N. Y. State Geol. 13th Ann. Rept., pp. 15–18) James Hall included in Salina "group" the "waterlime" extensively quarried at Rosendale, Ulster Co. [8 mi. SW. of Kingston].

C. A. Hartnagel, 1905 (N. Y. State Mus. Bull. 80, pp. 342–357). *Rosendale cement.*—Lower cement bed at Rosendale and High Falls. Thickness 14 ft. Holds strat. position of Bertie waterlime of western N. Y., which is characterized by *Eurypterus* fauna. Absence of *Eurypterus* from Rosendale bed of eastern N. Y. is attributed to fact that this section of State belonged to another sea province. We therefore propose to meet this difference in the E. by introducing *Rosendale cement* for lower cement bed in Ulster and adjoining counties. Is top memb. of Salina beds. Overlain by Cobleskill ls. and underlain by Wilbur ls.

In 1913 (Md. Geol. Surv. Lower Dev. vol.) C. K. Swartz, C. Schuchert, and C. S. Prosser classified the Rosendale as Lower Dev., but later Schuchert (1924 Textbook of geology) assigned it to Sil. (Cayugan).

Is top memb. of Salina fm. in eastern N. Y., and is thus classified by N. Y. State Survey and U. S. Geol. Survey.

See also under *Bertie ls. memb.*

Rosewood shale. (In Osage group.)

Mississippian: Western and northern Kentucky and southeastern Indiana.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, p. 150). *Rosewood sh.*—Bluish-gray, unevenly fissile and siliceous sh., 190 ft. thick. Middle fm. of Osage group in Jefferson Co., Ky. Underlies Holtsclaw ss. and overlies Kenwood ss. The Riverside ss. of Ind. is represented in Rosewood sh. and probably in lower part of Holtsclaw ss. Is "Knob" sh. of early repts. Contains Keokuk fossils.

E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4. Sep. Pub. 21, pp. 408, 489, 490). It seems very probable that *Holtsclaw ss.* is a synonym of Riverside ss., which has priority and is therefore used by writer for the ss. overlying Rosewood sh. and underlying Warsaw (Harrodsburg) ls. in Ind. The Rosewood has not been certainly identified N. of Clark Co., Ind.

P. B. Stockdale, 1931 (Ind. Dept. Cons. Div. Geol. Pub. 98, pp. 52, 111, 124). Above Kenwood ss. of Butts (1915, pp. 150–151), which is here included in New Providence fm., is a very fine-grained siltstone, 125± ft. thick in Floyd Co., Ind., which weathers to a decided shaly appearance. This siltstone, which is [in part] the Rosewood sh. of Butts, is here named *Locust Point fm.* The rest of Rosewood sh. of Butts and his overlying thin Holtsclaw ss. are here included in Carwood fm. Writer concludes, from great number of observations in Ind. and adjacent Ky., that upper part of Butts' "Rosewood" cannot be differentiated lithologically from Butts' "Holtsclaw ss." where exposures with same degree of weathering are compared. Butts apparently based his subdivisions "Rosewood sh." and "Holtsclaw ss." partly upon faunal characteristics, believing that certain large brachiopods were restricted to "Holtsclaw ss." Butts' list of "Rosewood sh." fauna did not include *Orthotetes keokuk* or *Syringothyris textus*, but writer found former fossil well down in "Rosewood sh." In numerous Ind. exposures "typical Holtsclaw fossils" occur 125 ft. below top of Holtsclaw ss. Type loc. of "Rosewood sh." is also objectionable. Instead of village of Rosewood, Harrison Co., Ind., "being located on the outcrop of the sh.," as stated by Butts (1915, p. 150), it is situated on the alluvium of Ohio River, and lies much higher than the rock to which Butts applied the name "Rosewood" in Jefferson Co., Ky. The base of bluff nearest village of Rosewood is about 125 ft. above base of Butts' "Rosewood sh." As the rocks in lower part of bluff are covered, but little exposure of rock can be found that belongs to the 190-foot strat. interval of the Jefferson Co., Ky., "Rosewood sh." These facts all indicate that the term "Rosewood" is unsuitable and confusing. The misapplication of "Holtsclaw" in Ind. has also added to the confusion [see p. 125 of book cited]. All facts oppose placing dividing plane at position given by Butts and call for a resubdivision and renaming of the rocks. [See also under *Carwood fm.* and *Locust Point fm.*]

Rosiclare sandstone member (of Ste. Genevieve limestone).

Mississippian: Western Kentucky and southern Illinois.

E. O. Ulrich and W. S. T. Smith, 1905 (U. S. G. S. P. P. 36, pp. 24, 40). *Rosiclare ss.*—Highly calc. ss., laminated, soft, and porous; 1 to 25 ft. thick; of light-red or reddish-brown color in natural exposures. Middle memb. of Ste. Genevieve ls. Underlies Ohara ls. memb. and overlies Fredonia ls. memb.

Named for Rosiclare, Hardin Co., Ill. Typical development in Ohio River bluff just below town.

Rosita andesite.

Tertiary (Eocene): Central southern Colorado (Silver Cliff-Rosita region, Custer County).

W. Cross, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 285). *Rosita andesite tuff and breccia.*—Massive andesite, breccia, and tuff. Chief occurrence is beneath and about town of Rosita, "whence the local name."

Roslyn formation.

Eocene: Central Washington (Mount Stuart and Snoqualmie quadrangles).

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137, map). *Roslyn ss.*—Thick-bedded light-colored ss. at top and base; rest of fm. shales and coals, latter mined at Roslyn; locally includes a sheet of Columbia [River] basalt resting on 100 to 150 ft. of tuff. Total thickness of fm. 200 to 3,500± ft. Separated from overlying Ellensburg ss. by several later sheets of Columbia [River] lava and associated tuffs. Overlies lowest sheet of Columbia [River] lava. Fossil plants assigned to Eo. by F. H. Knowlton.

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Roslyn fm.* (Eo.) rests on Teanaway basalt (Eo.). [See also U. S. G. S. Mount Stuart folio, No. 106, 1904, and Snoqualmie folio, No. 139, 1906, both by G. O. Smith.]

Ross limestone member (of Olive Hill formation).

Lower Devonian (Helderbergian): Western Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 579, 685). [See explanation in 1903 item under *Pyburn ls.*]

C. O. Dunbar, 1918 (Am. Jour. Sci., 4th, vol. 46, p. 739). *Ross ls. memb.*—Impure dense fine-grained thin-bedded cherty ls. in layers 2 to 5 in. thick; hard and compact when fresh; weathers to soft, porous shaly ss. of rusty-brown color. Thickness 0 to 80± ft. Heretofore regarded as oldest Dev. bed in Tenn. Basal memb. of Olive Hill fm. Uncon. overlies Rockhouse sh. (basal Dev.) to S., but to N. rests on Decatur ls.

Named for exposures on Ross farm, near Sulphur Spring, Hardin Co.

Ross quartzite.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 137). Included in Beltian series.

†Ross limestone. (Lower Triassic.)

See *Ross Fork ls.*, the approved name.

Ross Brook formation.

Silurian: Nova Scotia.

M. Y. Williams, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 240).

Ross Fork limestone. (Of Thaynes group.)

Lower Triassic: Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492) and 1916 (Wash. Acad. Sci. Jour., vol. 6, Jan., 1916, pp. 33, 35). *Ross ls.*—Consists of (descending): (1) 500± ft. of dense calc. sh., gray to olive greenish, weathering brown to yellow; (2) 800± ft. of massively bedded and thin-bedded gray to brown lss. with large numbers of small brachiopods and pelecypods, with intervening shales; (3) *Meekoceras* zone, consisting of 50 ft. of gray to reddish-brown lss. Thickness of fm. 1,350± ft. Is basal fm. of Thaynes group in Fort Hall Ind. Res. Conformably underlies Fort Hall fm. and conformably overlies Woodside sh. Named for Ross Fork Creek, in upper waters of which it is well exposed.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713, p. 46, and Bull. 716, p. 128). *Ross Fork ls.*, previously described under name *Ross ls.* [preoccupied by a Lower Dev. ls. in Tenn.].

Rossian series.

A term employed by C. [R.] Keyes to cover rocks of Cordilleran region interpreted by him as formed during Keweenawan epoch. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.) Probably covers Ross qtzite of Daly.

Rossie intrusive complex.

Pre-Cambrian: Northwestern New York (St. Lawrence County).

A. F. Buddington, 1929 (N. Y. State Mus. Bull. 281, pp. 81–86, 89). *Rossie intrusive complex*, mapped in Hammond quad., near Rossie. Intrudes Grenville series. Consists of gabbro, diorite, quartz diorite, etc. [According to p. 52 the Rossie phacolith belongs to his Hermon type of granite.]

See also Buddington, 1934 (N. Y. State Mus. Bull. 296, pp. 105–108, 149, etc.).

Ross Lake shale member (of Ptarmigan formation).

Middle Cambrian: Alberta and British Columbia.

C. D. Walcott, 1917 (Smithsonian Misc. Coll., vol. 67, No. 1, Pub. 2444, pp. 1-5). *Ross Lake sh. memb. of Ptarmigan fm.* is name proposed for the 7 to 11 ft. of dark-gray fine siliceous sh. with local fillets and thin layers of gray ls., carrying *Albertella* fauna and lying about 100 ft. below top of Ptarmigan fm. Type loc. is cliffs above Ross Lake, 1 mi. S.-SW. of Stephen Station on Continental Divide and S. of Canadian Pacific Ry. [Fauna listed.] It may be an error to include Ross Lake sh., with its *Albertella* fauna, in Ptarmigan fm. That is problem for future worker in field to determine.

Rossland volcanic group.

Age? (Carboniferous?, Triassic?, Jurassic?): Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, maps 7, 8, 9, 117° to 118°30'). *Rossland volcanic fm.*—Flows and pyroclastic deposits of latites, andesites, and basalt. [Mapped at and around Rossland, B. C., just N. of Int. Bdy. Assigned to *Carbf. to Cret.* (?).]

O. E. LeRoy, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 143). [Assigned to *Carbf. and post-Carbf.*]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 323, 385, etc.). If in future *Rossland volcanic group* can be analyzed with sufficient accuracy to permit of its subdivision on the map, it would be appropriate to reserve the name for the latitic lavas and associated pyroclastics, for these seem to be the dominant extrusives of the area.

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, pp. 47-49). *Rossland volcanic series.*—Voluminous series of lavas and tuffs. Extends along Int. Bdy for distance of one-half width of Stevens Co., Wash. Has been referred to Triassic and Jurassic but may include also lavas of Tert. age. Overlies Pend Oreille group.

R. W. Goranson, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 69). *Rossland group* is Triassic.

Rossland monzonite.

Mesozoic: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 8, 117°30' to 118°). *Rossland monzonite (stock)*, Mesozoic.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 337). *Rossland monzonite.*—Shonkinitic rocks; hornblendite at Columbia River. Underlies city of Rossland [B. C., just N. of Int. Bdy]. Assigned to Mesozoic. Dr. Young has suggested possible Jurassic age for this monzonite.

Rossland alkali granite.

O. E. Le Roy, 1913 (12th Int. Geol. Cong. Guidebook 9, p. 62). Tertiary, British Columbia.

Rossland Mountain group.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 319). *Rossland Mtn group,* Wash. and B. C. [Apparently same as Rossland volcanic group.]

Rossville shales and sandstone.

Pennsylvanian: Northeastern Kansas.

J. W. Beede, 1898 (Kans. Acad. Sci., Trans., vol. 15, p. 31). *Rossville shales and ss.*—Nearly unfossiliferous shales and soft sss. of various colors, with occasional streaks of ls. Thickness about 100 ft. [From statement on p. 28 appear to constitute topmost part of Upper Coal Measures in Shawnee Co. and to overlie Dover ls.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 235, 255), discarded this term but did not explain its limits.

Apparently named for Rossville, Shawnee Co.

†Rotten limestone.

Upper Cretaceous: Alabama, western Tennessee, and Mississippi.

A. Winchell, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pt. 2, p. 91), appears to have been the first to use "Rotten ls." in a titular sense although M. Tuomey, 1850 (Geol. Ala., 1st Rept.), and perhaps earlier repts, divided the Cret. rocks of Ala. into *rotten ls.* above and *marls, etc.* below. The first geographic name introduced to replace this descriptive term was "Tombigbee chalk" (preoccupied). The second geographic name appears to be "Demopolis." The third geographic name was "Selma chalk," by which name "Rotten ls." has been known since 1894.

Roubidoux formation.

Lower Ordovician (Beekmantown): Eastern and central Missouri.

F. L. Nason, 1892 (Mo. Geol. Surv. vol. 2, pp. vii, 12, 93, 114–115). *Roubidoux ss.*—Fossiliferous sss. overspreading Ozark region from Cabool to Gasconade City and from Salem to Doniphan, embracing much, if not all, of what has been called Second ss., and will undoubtedly include the areas of so-called First ss. as well, which is believed to be same as Second ss. The Roubidoux is upper fm. of Ozark series. Overlies Gasconade ls., the lower fm. of Ozark series.

C. R. Keyes, 1894 (Mo. Geol. Surv. vol. 4). *Roubidoux ss.*, 0 to 75 ft. thick, underlies First Mag. ls. and uncon. overlies Second Mag. ls. Is=First or Saccharoidal ss. and not believed=St. Peter ss.

A. Winslow, 1894 (Mo. Geol. Surv. vols. 6 and 7), and 1895 (Am. Geol., vol. 15, pp. 81–89). *Roubidoux or Saccharoidal ss.* overlies Jefferson City ls., and is=Joachim ls. and Crystal City ss.

C. F. Marbut, 1904 (The State of Mo., pp. 63–70). *Roubidoux ss.* underlies Jefferson City ls. and overlies Gasconade ls.

E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 41–42). *Roubidoux ss.*, 100 ft. thick, underlies Jefferson City ls., overlies Gasconade ls., and is=Moreau ss. and St. Elizabeth in part.

E. R. Buckley, 1905 (Mo. Bur. Geol. and Mines vol. 3, 2d ser., pp. 3–9). *Roubidoux ss.* of Nason, Winslow, and Marbut is=Bolin Creek ss., upper part of St. Elizabeth fm.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 267). *Roubidoux fm.*—A complex of ss., chert, qtzite, dol., and sh., of uncertain thickness and areal extent. Thickness 70 to 225+ ft. Underlies Jefferson City ls. and overlies Gasconade ls. Includes Bolin Creek ss. memb. Is=Second ss., Moreau ss., St. Elizabeth fm., and doubtfully Marshfield ss. and Bolivar ss. [This is commonly accepted definition of Roubidoux fm.]

C. L. Dake, 1922. (See under *Bolin ss. memb.*)

Named for Roubidoux Creek, Mo. (in Texas and Pulaski Counties).

Rough Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374–383). *Rough Creek bed.*—In descending order: 25 to 40 ft. of ss., partly massive; 50 ft. of blue sandy clay; and 150 ft. of sss., usually massive and containing considerable cgl., especially at top. Memb. of Strawn div. Underlies Buffalo Creek bed and overlies Hanna Valley bed.

Named for Rough Creek, Mills Co.

†Rough Creek shale member (of Tesnus formation).

Pennsylvanian: Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 45). *Rough Creek sh. memb.*—Hard, compact, and brittle dark-green, occasionally black sh., 865 ft. thick. Basal memb. of Tesnus fm. Probably disappears in E. part of Marathon region. [Type loc. not stated.]

Because of prior use of *Rough Creek* for a Penn. deposit in central Tex. the U. S. Geol. Survey has discarded this name and calls the bed *lower sh. memb. of Tesnus fm.*

Named for exposures on Rough Creek, in Dove Mtn quad.

Roulet conglomerate.

Upper Devonian: Central northern Pennsylvania (Potter County).

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. G_3, pp. 97–104). *Roulet cgl.* is name given to Mr. Sherwood's Chemung cgl., supposed by him to be represented by scattered blocks in vicinity of Roulet [Potter Co.]. From position of the scattered masses at Hebron I think it more than probable that they have descended from the stratum which may form top of Oswayo Mtns at the road crossing. In other words the exposure of Mr. Sherwood's typical Chemung cgl. would be above the exposure of his typical Pocono.

Apparently named for *Roulette* (Potter Co.), the spelling adopted by U. S. Geog. Bd. and U. S. Postal Guide.

Roulette conglomerate. (See above.)

Round Knob horizon (also shale member). (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio and western Pennsylvania.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, p. 35). *Round Knob horizon.*—Purple-red clay to deep-red even-bedded sh., 34 ft. thick, designated "Pittsburg red sh." by I. C. White. In many places entirely replaced by cross-bedded ss., the Saltsburg ss. of Stevenson. Underlies Harlem coal and overlies Barton coal. A memb. of Conemaugh fm.

W. Stout and R. E. Lamborn, 1924 (Ohio Geol. Surv., 4th ser., Bull. 28, p. 342), called these beds *Round Knob sh. memb.* and gave their thickness as 0 to 80 ft. "Normal position is btw. Harlem and Barton coals, but locally it extends up to Ames ls. and down to Anderson coal. Is usually red, but also gray, yellow, and buff."

Named for Round Knob, a hill in Madison Twp, Columbiana Co., Ohio.

Round Mountain silt.

Miocene: Southern California (Kern County).

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, pp. 14, 16, pl. 2). *Upper Temblor (Round Mtn silt).*—In wells in Round Mtn and Mount Poso oil fields, NE. of Bakersfield, Kern Co. Consists, in Mount Poso field, of 220 ft. of gray and brown siltstone including a 50-ft. bed of diatomite 70 ft. below top, and 57 ft. of gray silty sand 3 ft. above base. Overlies Middle Temblor (Olcese sand).

Round Rock member (of Esmeralda formation).

Miocene (upper): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Round Rock memb.*—Chiefly rhyolitic breccia, tuffs, and rhyolite; contains a little bedded material, including some lenses of ss. Lithologically similar to Fraction breccia of Tonopah dist. and believed equiv. to the Fraction. Thickness 800 ft. Separated from overlying Diamond King memb. by 0 to 80 ft. of thin-bedded quartzose ss., which, for convenience, is mapped with the Round Rock memb. Overlies Hedwig breccia memb. Exposed in vicinity of Round Rock, about 1 mi. N. of Manhattan.

Rouzer sand.

A subsurface sand in Big lime of W. Va.

Rove slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Vermilion district) and western Ontario.

J. M. Clements, 1903 (U. S. G. S. Mon. 45, index). *Rove sl.*—Chiefly black carbonaceous sl., with graywacke, some quite slaty, others very massive; some qtzite. Thickness 2,600± ft. Overlies Gunflint fm. Uncon. below Duluth gabbro. Named for Rove Lake, just N. of Int. Bdy.

Rowan County stone.

Trade name for Berea ss. in Rowan Co., Ky. (See J. B. Hoeing, Ky. Geol. Surv. Bull. 1, 1905.)

Rowe schist.

Lower Cambrian (?): Western Massachusetts and southwestern and southeastern Vermont.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Rowe schist.*—Sericite schist, with amphibolite beds. Underlies Chester amphibolite and overlies Hoosac schist.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 76–78, 158, pl. 34). *Rowe schist.*—Quartzose sericite or hydromica schist with amphibolite beds. Thickness 4,000 (?) ft. Grades into underlying Hoosac schist, and to S. is indistinguishable from the Hoosac. Underlies Chester amphibolite. [See also U. S. G. S. Bull. 597, p. 41, and map, where it is assigned to Ord.]

Named for occurrence at town of Rowe, Mass.

Age changed to Lower Camb. (?) in 1932, because L. M. Prindle and E. B. Knopf, who have studied and mapped the fm., consider it to be Lower Camb. or older. (Am. Jour. Sci., 5th, vol. 24, Oct. 1932.)

Rowes vent-agglomerate.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series*. Is ½ mi. wide on Rowes Hill.

Rowlandville granite.

Age (?): Northeastern Maryland.

G. P. Grimsley, 1894 (Cincinnati Soc. Nat. Hist. Jour., vol. 17, pp. 79, 81, 88). *Rowlandville granite.*—Eruptive granite at Rowlandville, Cecil Co. Originally a normal granitite or biotite granite. May be much younger than Port Deposit granite gneiss.

Rowlesburg sandstone. (In Chemung formation.)

Upper Devonian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Preston Co., pp. 97, 194). *Rowlesburg ss.*—Bluish-gray hard fine-grained micaceous ss. with numerous fossil plants and strong odor of oil. Thickness 18 ft. Long quarried at Rowlesburg, Preston Co., where it lies 737 ft. below top of Chemung.

Rowley Creek slate.

Pre-Cambrian: Central southern Wisconsin (Sauk County).

A. Leith, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 216, pp. 329–330). *Rowley Creek sl.*—This sl. does not outcrop and is known only by drill records of 8 holes in E. part of Baraboo dist., all of which passed through Camb. ss., Rowley Creek sl., and underlying Dake qtzite. Occupies middle of synclinal trough where found but is apparently absent over most of dist. Thickness 40 to 149 ft. Gray on fresh surface but oxidized to red along some bedding and cleavage surfaces. Dominantly sericitic. Contains some chlorite and quartz. Is folded; bedding inclined from 20° to 60°. Named for small creek that flows through E. part of Baraboo syncline immediately above the known occurrence of the sl. Assigned to Algonkian.

Roxbury conglomerate.

Devonian or Carboniferous: Eastern Massachusetts (Boston Basin).

E. Hitchcock, 1861 (Am. Jour. Sci., 2d, vol. 31, p. 377). [See first entry under †*Newport cgl.*]

N. S. Shaler, 1871 (Boston Soc. Nat. Hist. Proc., vol. 13, pp. 173–175). *Roxbury cgl.*—Mass of stratified pebbles with intercalated sss. and grits, the whole capped by a series of ripple-marked sss., about 100 ft. thick, and at certain points overlain by masses of amygdaloidal trap. Thickness can not be less than 1,200 to 2,000 ft. and may be 4,000 ft. Assumed to belong to same great series of beds as Cambridge slates.

J. B. Woodworth, 1895 (Boston Soc. Nat. Hist. Proc., vol. 26, pp. 125–126). *Roxbury cgl.* underlies Cambridge sl.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, No. 4, pp. 94–260). *Roxbury cgl.*—A series of ancient sediments which occupy large part of so-called Boston Basin. Consists of arkoses and coarse and fine cgls. interbedded with sss. and shales or slates. One of conglomeratic members is well developed and exposed in Roxbury, where it has long been known as "Roxbury Pudding-Stone." Since this rock is, on the whole, one of the most important and characteristic members of the series, its name has been extended to include the entire fm. Accompanying the Roxbury cgl. are contemp. intrusions or outflows of basic lava that are intimately related to the sed. series. The true northern bdy of Roxbury cgl. series is enveloped in some obscurity on account of uncertainty regarding age and strat. position of Cambridge and Somerville slates, which have been variously considered as underlying the cgl., as overlying the cgl., and as forming part of the cgl.

R. W. Sayles and L. LaForge, 1910 (Sci., n. s., vol. 32, pp. 723–724). *Roxbury cgl.* underlies Cambridge sl. Is of glacial origin. Upper part consists of 60 ft. of stratified cgl., ss., and interbedded sl., underlain by 500 to 600 ft. of tillite. [Lower part of fm. not described.]

R. W. Sayles, 1914 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, p. 164). *Roxbury series* consists of *Roxbury cgl. proper*, Squantum tillite, and Cambridge sl. [Diagram on p. 157 shows a *lower sl.* [Dorchester sl. memb.] btw. Roxbury cgl. and Squantum tillite.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 56–57). *Roxbury cgl.*—Thick cgl. and some ss. and sl. In S. part at least of Boston Basin it can be divided into 3 members (descending), Squantum tillite, Dorchester sl., and Brookline cgl. Underlies Cambridge sl. and overlies rocks belonging to Mattapan volcanic complex, but the later flows of Mattapan volcanic complex, chiefly amygdaloidal melaphyr, are at several places interstratified with the Brookline and Dorchester members. [L. LaForge (U. S. G. S. Bull. 839, 1932) separated these so-called "later flows of Mattapan volcanic complex" as a distinct fm., called *Brighton melaphyr*, which he mapped separately.]

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 97–134), treated Squantum tillite as a distinct fm.; separated as a distinct fm. (called *Milton qtzite*) 450 to 500 ft. of coarse greenish qtzite or grit, which he stated had formerly been included in Roxbury cgl. but which he considered to probably be of Camb. age; and assigned *Roxbury cgl.*, Squantum tillite, and overlying fms. to Perm.

L. LaForge, 1932 (U. S. G. S. Bull. 839), included Squantum tillite in Roxbury cgl.; did not mention Milton qtzite of Billings; stated that the 3 members of Roxbury cgl. (Squantum tillite, Dorchester sl., and Brookline cgl.) do not persist throughout Boston area; separated the so-called "later flows of Mattapan volcanic complex" as a distinct fm., called *Brighton melaphyr;* and assembled Roxbury cgl., Brighton melaphyr, and Cambridge sl. into Boston Bay group, which he assigned to Dev. or Carbf.

Roxbury puddingstone.

A name applied in some early repts (see W. W. Dodge, 1881, Boston Soc. Nat. Hist. Proc., vol. 21, pp. 201–205) to Roxbury cgl. of present nomenclature, and also probably applied to Brookline cgl. memb. of Roxbury cgl. (see G. R. Mansfield, 1906, Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, p. 95).

†Roxbury conglomerate proper.

A term applied by R. W. Sayles (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, pp. 164, 165, 1914) to basal memb. (Brookline cgl. memb.) of Roxbury cgl. of present nomenclature.

†Roxbury conglomerate series.

†Roxbury series.

Terms that have been used in some repts to include Cambridge sl. and Roxbury cgl. of present accepted nomenclature. R. W. Sayles, 1914 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, No. 2, p. 164), stated that *Roxbury series* consists of *Roxbury cgl. proper* [Brookline cgl. memb.], Squantum tillite, and Cambridge sl. His diagram on p. 157 shows a *lower sl.* [Dorchester sl. memb. of present nomenclature] btw. his Roxbury cgl. and Squantum tillite.

†Roxton beds.

Upper Cretaceous (Gulf series): Northeastern Texas and southwestern Arkansas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 114, 340). *Roxton beds.*—Glauconitic calc. stone outcropping near Roxton [Lamar Co.] and Honey Grove, Tex., and at base of White Cliff section on Little River, Ark. Memb. of Navarro fm. Overlies Brownstown beds and underlies Anona chalk.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Is a part of Gober tongue of Austin chalk in Tex., as now interpreted by L. W. Stephenson. In Ark. the beds btw. Brownstown marl and Annona chalk are now known as *Ozan fm.*

Royal formation.

Pennsylvanian: Southern West Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 490). *Royal fm.*—Lower 150 to 200 ft. red and green shales and argill. sss., which lithologically clearly belong to Hinton fm.; upper part typical coal-bearing strata, which, according to David White, contain a true Pottsville flora. Natural line btw. lower Carbf. and Pottsville series seems to be at top of red shales, but geologists have generally regarded that horizon as variable and unsatisfactory. The practical difficulties in mapping the red shales which lie above Princeton cgl. are so great that present writers prefer to group them with the coal-bearing rocks above, although they are lithologically different and may belong to another series. Above this soft basal portion occurs a band of prevailingly aren. strata 400 to 500 ft. thick, chiefly beds of ss., usually coarse, heavy-bedded, and frequently conglomeratic; associated shales generally sandy; no workable coals, but thin coal seams at several horizons. The remaining beds are more argill. and valuable commercially because they include the Quinnimont-Fire Creek coal; also include at least one heavy ss., 50 or 60 ft. below Raleigh ss. Overlies Princeton cgl. and underlies Raleigh ss. along New and Kanawha Rivers, W. Va. [In U. S. G. S. Pocahontas folio (No. 26) the rocks btw. Princeton cgl. and Raleigh ss. are divided into following fms., descending order: Quinnimont sh., Clark fm., Pocahontas fm., and Bluestone fm.]

Named for Royal (P. O. Prince), Fayette Co.

Royal shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western Mercer and Summers Counties, p. 366). *Royal sh.*—Buff sandy sh. containing marine fossils. Thickness 2 to 4 ft. Lies 0 to 40 ft. below Pierpont ss. and overlies Pocahontas No. 6 coal. Occurs at Royal, Raleigh Co.

†Royalton formation.

Mississippian: Northeastern Ohio.

C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 33, 72, 144, 493). *Royalton fm.*—Blue argill. shales, with thin layers of ss. and ls.; 12 to 250 ft. thick; composing upper part of Cuyahoga terrane in Cuyahoga Valley, NE. Ohio. Underlain by Orangeville fm. and overlain by Sharon cgl. Includes Sharpsville sss.

Replaced by Meadville sh. and Sharpsville ss. (See U. S. G. S. Bull. 818, 1931.)

Named for exposures in Royalton Twp, Cuyahoga Co.

Royer marble.

Upper Cambrian: Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 28). Marine deposition in Arbuckle uplift began with Reagan ss., an Upper Camb. fm. with abundant fauna. Over this comes *Royer marble*, a previously unnamed Lower Ozarkian fm., about 500 ft. thick, that was included by Taff in basal part of his great Arbuckle ls. The fauna found in this fm. invaded from W. of Rocky Mtns by way of Marathon Basin of western Tex. Neither Middle nor Upper Ozarkian deposits occur in Okla. The remainder of Taff's Arbuckle ls. is assigned to Canadian period. It includes Lower, Middle, and Upper Canadian.

E. O. Ulrich, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 742+). In Wichita Mtns, Okla, the Signal Mtn fm. is everywhere underlain by Fort Sill fm. In Arbuckle Mtns the *Royer marble*, 100 to 600 ft. thick, wedges in btw. Signal Mtn and Fort Sill fms. The *Royer fm.* consists of massive dolomitic marbles with intercalations of thinner-bedded pure ls. Along Honey Creek, sec. 1, T. 2 S., R. 1 E., Okla., the Royer rests uncon. on Honey Creek fm., which in Wichita Mtns uncon. underlies Fort Sill fm. Named for old Royer ranch, near East Timbered Hills, along Ardmore-Davis highway, Arbuckle Mtns, where a good section is exposed.

Royston formation.

Permian: Central northern Texas (Fisher County).

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 26, pl. 1). *Royston fm.*—A series of about 100 ft. of red shales, gyp., thin dolomites, and white calc. shales in Double Mtn group. Type loc. at Royston, Fisher Co. Older than Eskota dol. and younger than Aspermont dol.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 177). *Royston fm.* (Cheney, 1929) is probably basal part of Peacock fm. as defined by Patton and is probably chiefly within the Whitehorse as mapped by Lloyd and Thompson (Univ. Tex. Bull. 2913, 1929).

Royston gypsum.

A name that has been applied (W. E. Hubbard and R. W. Fischer, Tex. Bur. Econ. Geol. geol. map of King Co., central northern Tex., 1930) to 8± ft. of gyp. that lies within Royston fm. of Cheney, 1929.

Roystone coquinite member.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 61, 97). *Roystone coquinite memb.* (also *zone*).—Massive coquinite zone in lower part of Oswayo sh. memb. While coquinite layers are common throughout the Oswayo, this basal zone is so persistent in NW. Pa. that it seems worthy of memb. designation. Is of great correlation value. Well developed along Kinzua Creek, McKean Co.; exposed on Roosevelt Highway btw. Roystone and Ludlow, McKean Co., and on Wild Cat Creek at Ludlow, also on highway to Olean Rock City from Olean, N. Y., at the side road going W. to former trolley stop known as Flat Iron Station. Has frequently been mistaken for the younger Marvin Creek ls. Replaces Wild Cat coquinite (preoccupied), proposed by writer in 1933.

Rubio shale.

Cretaceous: Mexico.

E. Ordóñez, 1908 (Min. and Sci. Press, vol. 96, p. 363).

Rubio diorite and metadiorite.

Pre-Cretaceous (pre-Cambrian?): Southern California (San Gabriel Mountains).

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. Math. and Phys. Sci., vol. 1, No. 1, pp. 7–12, 49–65, 83, map). *Rubio diorite and metadiorite.*—About 30 bodies occur in western San Gabriel Mtns. Name *Rubio diorite* is here proposed because of its typical occurrence in large area extending from Rubio Canyon into Eaton Canyon. The rock varies to metadiorite on top of ridge 1¼ mi. NW. of top of Mount Wilson. Almost certainly younger than Placerita fm., which it cuts; is cut by Echo granite; is intimately associated with San Gabriel fm.; and is assigned to pre-Cret. [On map part of it is called *pre-Camb.* (?).]

†Ruby formation.

Eocene: Western Colorado (Gunnison County).

W. Cross, 1892 (Am. Jour. Sci., 3d, vol. 44, pp. 21–23). *Ruby beds.*—Cgls., sands, and shales, composed almost entirely of debris of volcanic rocks of andesitic character, much hardened and metamorphosed by later eruptive rocks, which pierce them in numerous dikes. At base a cgl. of small pebbles, some of which contain crinoid stems of identical character to those in Ohio Creek beds. These facts suggest that the chert pebbles of *Ruby cgl.* may be the residuum from destruction of Ohio Creek beds formerly existing to N. of Anthracite Range. Thickness of Ruby beds 300 to 2,000+ ft. Rest uncon. on Laramie fm. on Grand River, Gunnison Co. To N. there are soft yellowish sss. btw. the firm gray sss. of Laramie coal measures and Ruby cgl., which Hills suggests may possibly correlate with Ohio Creek beds. Underlie Wasatch fm., which consists of shales and brownish sss. No fossils except carbonized plants. Lithologic and strat. evidence suggests Ruby beds may = Denver fm. Named for Ruby Peak, near Irwin, Gunnison Co., where they are more than 2,000 ft. thick.

W. T. Lee, 1912 (U. S. G. S. Bull. 510, p. 51). G. H. Eldridge says (U. S. G. S. Anthracite-Crested Butte folio, No. 9, 1894) that "Ruby" fm. extends W. from Ruby Range and disappears beneath Wasatch fm. Present investigation shows his "Ruby" fm. is probably identical with that mapped as Wasatch in Grand Mesa region by geologists of Hayden Survey. No fossils found by Eldridge in his "Ruby" of Anthracite-Crested Butte region, nor did writer find any in this region or in Grand Mesa field, but in Book Cliffs, W. of Grand Mesa, G. B. Richardson found Wasatch fossils in variegated beds that are apparently identical with those of Grand Mesa. R. C. Hills states "Ruby" fm. extends N. to and beyond Grand River, and H. S. Gale and A. L. Beekly have traced a fm. that is apparently the same into the characteristic Wasatch of southern Wyo. For these reasons "Ruby" fm. is here referred to Wasatch.

Ruby limestone and gneiss.

Pre-Cambrian: Southwestern Montana (east of Dillon).

E. Douglass, 1905 (Carnegie Mus. Annals, vol. 3, pp. 407–428). Crystalline ls. and gneiss exposed in Ruby Canyon, W. of Old Baldy, and on E. slope of Ruby Mtns [Dillon quad.]. Probably are=Cherry Creek fm. of Peale, but to avoid possible confusion I will call these for the present the *Ruby crystalline ls. and gneiss.*

Rubyan series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, pp. 38, 78), to upper 1,100 ft. of Eldorado ls. (Middle Camb.) of Nev. ("well displayed on Ruby Hill at Eureka"), and to Bloomington fm. (Middle Camb.) of Utah.

Rudolph quartzite.

Pre-Cambrian (middle Huronian): Central northern Wisconsin (Wood County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16). [*Qtzite at Rudolph* (in heading), but on later pp. he calls the fm. *Rudolph qtzite.*]—Largest area is immediately E. of Rudolph, Wood Co. Probably 300 to 400 ft. thick. May be same as Junction City qtzite. Assigned to lower Huronian (?).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pl. opp. p. 598), assigned the qtzites of this area to middle Huronian.

Ruffner fire clay. (In Allegheny formation.)

Pennsylvanian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., p. 202). *Ruffner fire clay.*—Bluish-buff clay, 5 to 7 ft. thick, underlying Lower Freeport coal. Named for Ruffner, 2 mi. E. of Charleston, Kanawha Co.

Rugg Brook dolomite conglomerate.

Middle (?) Cambrian: Northwestern Vermont (Franklin County).

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 356, 359, 365, 366, 368, etc.). The Middle Camb. of NW. Vt. consists of St. Albans sl. and its basal *Rugg Brook dol. cgl.*, which Keith thinks should be regarded as a separate fm. Thickness of the cgl. is 0 to 20 ft. It uncon. overlies Parker sl. (Lower Camb.). The St. Albans sl. is underlain basally in at least 3 places by the Rugg Brook dol. cgl., which weathers salmon yellow and is usually less than 20 ft. thick. These 3 localities are on Rugg Brook, on Conner's farm, and near Rockledge. Type loc. is on Rugg Brook, less than 3 mi. SW. of St. Albans. The dol. blocks, up to 2 ft. across, are out of either the Parker or the Mallett fm., and rarely there are also pieces of Winooski red dol. The paste is the usual round-grained sand cemented by dol. No fossils known in Rugg Brook cgl. but St. Albans sl. contains Middle Camb. fossils.

Keith correlated his Clarendon Springs dol. (Lower Camb.) with his so-called Milton dol., which Schuchert has renamed *Rugg Brook dol. cgl.* and assigned to Middle Camb. If this correlation is correct, the Rugg Brook cgl. may be Lower Camb. or the Clarendon Springs dol. may be Middle Camb.

Ruin granite.

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Ruin granite.*—Granitite or biotite granite. Intrudes Pinal schist, which is overlain by Apache group. Is frequently found overlain by basal cgl. of Apache group. Occurs in Ruin Basin, Globe quad.

Rulo limestone. (In Scranton shale.)

Pennsylvanian: Southeastern Nebraska and eastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 8, 14, 26). *Rulo ls.*—Light-colored hard massive ls., 12 to 20 in. thick, lying 8 to 12 ft. below Burlingame ls. and overlying City Bluffs (Scranton) shales. Type loc. 2½ mi. N. of Rulo, Richardson Co., Nebr.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 41, 58, 105, 106), included in Scranton sh. his *Rulo ls.* and the sh. (named *Silver Lake sh.*) separating it from overlying Burlingame ls.; and this classification was adopted by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans. Condra's 1927 publication stated that Elmo-Silver Lake coal is just below Rulo ls.

G. E. Condra in 1930 named the sh. bed underlying Rulo ls. the *Cedarvale sh.*, and his 1935 classification adheres to that nomenclature.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), discarded Scranton sh. and treated Rulo ls. as a fm. in his redefined Wabaunsee group.

†Ruma formation. (In Chester group.)

Mississippian: Southwestern Illinois.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 126). *Ruma fm.*—Series of variegated shales and thin-bedded sss., 40 to 50 ft. thick, shales predominating. Underlies Okaw fm. and overlies Paint Creek fm.

Later work by S. Weller revealed fact that upper part of Ruma consisted of Cypress ss. and that lower part "properly belongs with Paint Creek fm." The name "Ruma fm." has therefore been abandoned. (See Jour. Geol., vol. 28, No. 4, 1920, pp. 281-290, and No. 5, pp. 395-416; also Ill. Geol. Surv. Bull. 41, 1920.)

Named for Ruma, Randolph Co. Typically exposed in some tributaries of Horse Creek, near Ruma.

Rundle limestone.

Pennsylvanian: British Columbia.

E. M. Kindle, 1924 (Pan-Am. Geol., vol. 42, pp. 115-123).

Later repts, by other geologists, assign Rundle ls. of *Alberta* to Penn. and Miss.; to Miss. (?) and Penn.; to Dev.; to Miss.; to Carbf.; and to Penn.

Rundlian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, pp. 285-288). Lss., 2,300 ft. thick, lying stratigraphically and uncon. below Weberian (?) series and stratigraphically and uncon. above Kinderhookian series in Banff, Alberta. Should the Rundle ls. prove to be a valid series the terrane should be given a serial ending to indicate its proper taxonomic rank; otherwise it shall have to be restricted or abandoned.

Rupert formation.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 222).

Rush member (of Tully limestone).

Upper Devonian: Central Pennsylvania (Northumberland County).

B. Willard, 1934 (Pa. Acad. Sci. Proc., vol. 8, pp. 57-62). *Rush memb. of Tully ls.* proposed for 10 ft. of more or less shaly to compact, dark ls. that weathers brown, exposed in road cut E. of small brook ½ mi. from railway station at South Danville (Riverside), in Rush Twp, Northumberland Co. Carries diagnostic Tully fossil *Hypothyridina venustula*, the first known occurrence of this fossil in Pa. Overlain by 13 ft. of gray sh. considered to be basal part of Genesee sh., and underlain by 21 ft. of dark limy sh. with pyrite nodules, which has strong Hamilton affinities and is here classed as Hamilton. [See further statement under *Tully ls.*, 1934 entry.]

See also *Rush fm.*

Rush formation.

Upper Devonian: Central Pennsylvania.

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1199 et seq). *Rush fm.*—Lower fm. of Portage group. Includes Burket memb. and underlying Tully memb. The name was originally used by writer for Tully ls. memb. where first recognized in Pa. It is now raised to formational rank. [The Burket memb. as defined by C. Butts, its namer, was included in Harrell sh., of Portage age. Willard stated it is of nearly equal distribution to Harrell, and that it replaces Genesee of his 1934 paper, which he defined as overlying his Rush memb. of Tully ls.] Named for Rush Twp, Northumberland Co. The intergradation of Burket and underlying Tully members and lack of intergradation of Burket and overlying Harrell memb. [restricted] have influenced the decision for grouping them into a single fm. Is separated from Harrell memb. by sharp lithologic change (practically a break) accompanied by appearance of a plentiful Naples fauna. Is discon. on Hamilton and is overlain by Fort Littleton fm., of Portage group. [The typical Tully ls. of N. Y. underlies Genesee sh., which is overlain by Portage group.]

Rushford sandstones.

Upper Devonian: Western New York.

D. D. Luther, 1902 (N. Y. State Mus. Bull. 52, p. 619). The Wiscoy shales (top fm. of Portage or Nunda group in Genesee River section) are overlain by band of flags and thin sss. that form "Long Beards riffs" and carry Chemung fossils. which are succeeded by nearly 300 ft. of shales and flags carrying Chemung fossils and overlain by the heavy *Rushford sss.* exposed in hills W. of Caneadea.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), showed Cuba ss. and Gowanda beds of Allegany Co. separated by *"Chemung," "Rushford ss."*

C. A. Hartnagel, 1927 (letter dated Sept. 13, 1927). These heavy sss. at Rushford appear to lie at least 450 ft. above base of Chemung. Until more field work is done it will be impossible to say whether the Rushford sss. correlate with any known fms. to E. or W. of Genesee River section.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, p. 862). *Rushford*=Shumla, Westfield, and Laona; is younger than Gowanda and older than Machias.

Rush Lake moraine (also **morainic system**).

Pleistocene (Wisconsin stage): Southeastern Wisconsin and southern Minnesota. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for development at S. end of Rush Lake, Winnebago Co., Wis. Also described in U. S. G. S. P. P. 161, 1932, where it is called, in Minn., *Rush Lake morainic system*, and divided into Pine City, Cambridge, Isanti, and Harris moraines, named in order from oldest to youngest.

Rush Run sandstone. (In Greene formation.)

Permian: Northern West Virginia.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties, p. 191). *Rush Run ss.*—Massive ss., resembling in color and structure the Fish Creek ss. above. Thickness 10 to 25 ft. Lies 30 to 40 ft. below Fish Creek coal and a few in. to 20 ft. above Dunkard coal. Named for Rush Run, which empties into Fish Creek ¾ mi. SE. of Hundred, Wetzel Co. [Later repts give max. thickness 50 ft.]

Rush Springs member (of Whitehorse sandstone).

Permian: Southwestern Oklahoma (Wichita Mountains region).

R. W. Sawyer, 1929 (Okla. Geol. Surv. Bull. 40HH). Two divisions of Whitehorse ss. can be recognized in Kiowa and Washita Counties. The lower (Marlow memb.) consists of red even-bedded sss. and red shales, with some regular bands of fine white sand and much disseminated gyp.; the upper (*Rush Springs memb.*) consists almost entirely of red cross-bedded ss. and has little or no sh. or gyp. in this area. The Rush Springs memb. is Whitehorse ss. of Reeves. In Grady Co. the Marlow memb. is 110 ft. thick and Rush Springs memb. 240 to 280 ft. thick. The Greenfield dol. is near bdy btw. Marlow and Rush Springs members. In Kiowa and Washita Counties Whitehorse ss. is overlain by Cloud Chief fm.

C. M. Becker, 1930 (A. A. P. G. Bull., vol. 14, pp. 48, 50). The name *Marlow* (for basal Whitehorse ss., 110 to 135 ft. thick) and *Rush Springs* (for upper

Whitehorse ss., 250 to 300 ft. thick) are suggested by R. W. Sawyer and F. C. Greene. The upper Whitehorse or Rush Springs seems to be nearly all wind-blown sand, although local clay and gyp. deposits indicate presence of shallow ponds and small lakes within area of the Perm. desert. [Derivation of name not stated.]

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 408, 415–431). The top of *Rush Springs* is base of the Cloud Chief. The *Rush Springs* is "Whitehorse" of Reeves' rept on Cement field, Okla. (U. S. G. S. Bull. 726B, 1921). (See also under *Marlow fm.*)

S. Buckstaff, 1931 (A. A. P. G. Bull., vol. 15, No. 4, pp. 434–437). Evans' grouping of Marlow, Rush Springs, and Cloud Chief in a single unit is a logical step, but his separation and correlation of the members within that group is open to serious question. [Long discussion.]

F. C. Greene, 1932 (Tulsa Geol. Soc. Summ. and Abstracts, 1932, Tulsa Daily World), stated that *Rush Springs memb. of Whitehorse ss.* overlies Marlow memb. of the Whitehorse and underlies Weatherford dol.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454–1475). *Rush Springs ss.* is given fm. rank, because of uncon. at its base and at its top. It underlies Quartermaster fm. and overlies Marlow fm.

Apparently named for Rush Springs, Grady Co.

Rushville group.

Mississippian: Central Ohio.

E. B. Andrews, 1879 (Am. Jour. Sci., 3d, vol. 18, p. 137). *Rushville group.*—About 50 ft. of fossiliferous Lower Carbf. clay sh., with thin ls. in lower part and coarse ss. at top, underlying Maxville ls. (approx. Chester group of Ill.) and overlying the Waverly (=Kinderhook of Ill.) in Perry Co.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 771–779). The *Rushville group* of Andrews, 22½ ft. thick, possibly should be a 4th memb. of Logan fm., overlying Vinton memb.

Probably named for Rushville, near E. border of Fairfield Co.

†Russell formation.

Lower and Middle Cambrian: Southwestern Virginia and southeastern Kentucky.

M. R. Campbell, 1894 (U. S. G. S. Estillville folio, No. 12, p. 2). *Russell fm.*—Alternating sh., ss., and impure ls., more than 1,000 ft. thick (base not exposed). Top usually brown argill. sh., growing more sandy below, and varying in thickness from 200 to 600 ft. Oldest fm. known in this region. Underlies Rutledge ls. [In a later folio (Bristol, No. 59, 1899), which covers a large part of Russell Co., the type loc., the Russell is described as consisting, N. of Clinch Mtn, of 1,000 ft. of shales, sss., and impure lss. of various colors, green and red predominating, with thick bed of brown, slightly calc. sh. at top, overlain by Rutledge ls.; and S. of Clinch Mtn as consisting of more than 400 ft. of red and green shales and thin-bedded sss. and lss. of Lower Camb. age, overlying [uncon.] more than 600 ft. of sandy sh. of Lower Camb. age called *Hampton sh.*, and underlying Honaker ls., the equiv. of Rutledge ls. and two overlying fms. N. of Clinch Mtn.]

Same as Rome fm., and discarded.

Named for Russell Co., Va.

†Russell formation.

Upper Cretaceous: Central and western Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 49). *Russell fm.*—Alternating lss. and bluish carbonaceous to light-gray calc. shales, constituting lower fm. of Benton div. in Kans. Underlies Victoria clays, or upper fm. of Benton. Includes Downs or Fence-post ls. and *Globigerina bulloides* "Lincoln marble."

Same as Greenhorn ls. plus Fairport chalky sh. memb. of Carlile sh.

Named for exposures at Russell, Russell Co.

Russell serpentine.

A name loosely applied by B. K. Emerson (U. S. G. S. Mon. 29, p. 90, 1898) to a bed of serpentine exposed in Russell, Old Hampshire Co., Mass.

Russell Street Road moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County).

Named for road. See N. Y. State Mus. Bull. 187, 1916.

Russellville shale. (In Atoka formation.)

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Russellville shales.*—Shales, 500 to 600 ft. thick, underlying Cross Plains ss. and overlying Washburn sss. Middle memb. of Appleton stage.

Probably named for Russellville, Pope Co., Ark.

Rustler formation.

Rustler limestone.

Permian: Western Texas and Pecos Valley of southeastern New Mexico.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 44). *Rustler fm.*—Fine-textured white mag. ls. and less abundant ss. Thickness 200 ft. In southern outcrops there is no ss. and hills are capped by 150 ft. of massive gray ls. In Horseshoe Draw the fm. consists of 100 ft. of calc. buff ss. overlain by 50 ft. of ls. Overlies Castile gyp. and is clearly older than "Red Beds" but may be contemp. with part of Capitan ls. [Now considered to be much younger than Capitan. See 1931 entry under *Castile gyp.*]

In Delaware Basin of SE. N. Mex. and western Tex. there occurs, btw. the Rustler ls. and Castile gyp. of Richardson, an unexposed series of salt beds (1,400 ft. thick in well borings) known as upper salt series, in contradistinction to lower salt series or Castile fm. To these unexposed rocks W. B. Lang in 1935 (A. A. P. G. Bull., vol. 19, No. 2) applied the name *Salado halite*. Neither the Castile nor the Rustler fm. is restricted by the introduction of Salado, because in all surface exposures the Rustler rests upon the Castile. (See under *Salado halite*.) Lang also applied *Pierce Canyon redbeds* to the fm. overlying the Rustler.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), discriminated *Rustler fm.* much farther N. in Pecos Valley of SE. N. Mex., where it also rests on Salado halite and is overlain by Pierce Canyon redbeds.

Named for exposures in Rustler Hills, Culberson Co., Tex.

†Rustler Springs formation.

Permian: Western Texas.

J. A. Udden, 1915 (Am. Jour. Sci., 4th, vol. 40, pp. 151–155). *Rustler Springs fm.*—Same as Richardson's Rustler fm. Named for Rustler Springs, Culberson Co.

rusty beds.

See under *Thermopolis sh.*

†Ruth limestone.

Pennsylvanian: Eastern Nevada (Ely region).

A. C. Lawson, 1906 (Univ. Calif. Pub., Bull. Dept. Geol., vol. 4, No. 14, p. 292). *Ruth ls.*—Heavy but distinctly bedded blue-gray ls. carrying fossils identified by G. H. Girty as Upper Carbf. Characterized by abundance of flint or chert nodules. Thickness 500 ft. Overlies Arcturus ls. Named for Ruth mine, Robinson mining dist., Egan Range, White Pine Co. [This dist. is in Ely quad.]

A. C. Spencer, 1917 (U. S. G. S. P. P. 96, pp. 26, 28). "Ruth" ls. of Lawson is same as Ely ls. [See explanation in 1917 entry under *Ely ls.*]

Ruth argillite.

Carboniferous: British Columbia.

S. J. Schofield, 1920 (Canada Geol. Surv. Mem. 117, p. 16).

Rutland dolomite.

Lower Cambrian: Southwestern Vermont (Rutland County).

J. E. Wolff, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 331–338). *Rutland ls.* [long in use as a commercial term] is Lower Camb. and overlies Pine Hill qtzite. [Pine Hill is a short distance NW. of Rutland, in Castleton quad.]

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 128). *Rutland dol.*—Mainly dol.; generally gray; beds of dark bluish-gray dol. numerous in lower and upper parts of fm., while light- and dark-gray layers occur throughout its thickness. In upper part just N. of Rutland occur a few beds of light-buff, almost white ls.; a few layers of blue ls. are scattered at various horizons through the fm. At base are interbedded sss., but such beds are rare at other horizons. Mostly fine-grained, but here and there are beds of medium-grained dol., and a few coarse layers occur. Here and there are small scattered nodules or geodes of vein quartz. The fm. is=combined Winooski marble and Mallett dol. of central sequence. Thickness 1,000± ft. There are no continuous sections of the fm., and its full content has to be built up from scattered sections. Underlies Danby fm. and overlies Cheshire qtzite. Contains Lower Camb. fossils. Well developed in valley around Rutland, for which it is named.

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., p. 284). *Rutland dol.* is a light-brown and white rock 4,500 ft. thick.

F. A. Burt, 1931 (17th Rept. Vt. State Geol., p. 118), included *Rutland dol.* in Stockbridge ls.

†Rutledge limestone. (In Midway group.)

Eocene (basal): Southern Alabama.

E. A. Smith, 1892 (Sketch of geology of Ala., Birmingham, Ala., Roberts & Son, pam. of 36 pp.). *Clayton or Rutledge ls.*—Thin to W.; 200 ft. thick on Chattahoochee River. Impure ls. formerly known as Midway group. [The name *Rutledge* appears only in the table.]

Same as Clayton fm., the earlier and established name.

Probably named for exposures at Rutledge, Crenshaw Co.

Rutledge limestone.

Middle Cambrian: Northeastern Tennessee, southwestern Virginia, and western North Carolina.

A. Keith, 1896 (U. S. G. S. Morristown folio, No. 27, p. 2). *Rutledge ls.*—As a whole the strata are ls., but there are many beds of green and yellow calc. sh. toward base, which form a passage into underlying Rome fm. The lss. are massive and range in color from blue to dark blue, black, and gray. Thickness 250 to 500 ft. Underlies Rogersville sh.

Foregoing is original definition at type loc. The name, however, first appeared in print in 1894, in U. S. G. S. Estillville folio (No. 12), by M. R. Campbell, who accepted Keith's name, correlating the rocks of Estillville quad. with those of Morristown quad. He described the fm. as consisting of 200 to 240 ft. of very dark impure mag ls. at top, its base being quite siliceous and containing many thin beds of sandy sh., and as overlying Russell fm. and underlying Rogersville sh. Keith also published the name in 1895, in U. S. G. S. Knoxville folio (No. 16), in which area the fm. is described as 350 to 450 ft. thick, with same lithology as in Morristown quad., and as overlying Rome fm. and underlying Rutledge ls.

Named for exposures in valley of Rutledge, Grainger Co., Tenn.

Ryan sandstone.

Pennsylvanian: Central southern Oklahoma (Jefferson County).

J. R. Bunn, 1930 (Okla. Geol. Surv. Bull. 40PP, pp. 10+). *Ryan ss.*—A ss. having same general description and occurring in approx. same strat. position as Asphaltum ss. Typically exposed in scarps SE. and NW. of town of Ryan, Jefferson

Co., where it usually consists of one massive to thin-bedded memb. 17 to 28 ft. thick. In bluffs bordering "Dead Man's Gulch" it consists of at least 3 distinct members aggregating 60 ft. Underlies Claypool fm., and top lies 100 to 125 ft. higher than Oscar ss., the interval consisting largely of brown sh. with occasional thin sandy streaks.

Ryans Ford limestone. (In McLeansboro formation.)

Pennsylvanian: Central eastern Illinois (Coles and Cumberland Counties).

See 1934 entry under *LaSalle ls. memb.*, the only known use of name. Derivation unknown.

Rye gneiss.

Pre-Cambrian (?): Southeastern New Hampshire and southwestern Maine.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 141, 143–144). *Rye gneiss.*—The Algonkian complex of Katz. [Katz used Algonkian (?).] Most northerly outcrops occur on Gerrish's Island, Kittery, Maine. Has been traced S. and SW. into Portsmouth, Rye, North Hampton, and Hampton, N. H. At type loc. is well banded, consisting of alternations of light feldspathic layers, which become pegmatitic, with dark fine biotite-rich schistose bands. On Gerrish's Island the rock is fine-grained, but banding is absent. As narrow stringers of feldspathic material penetrate the rock it loses its sedimentary habit. A number of dikes cut the gneisses. Grouped with these gneisses are some rocks which suggest altered basic volcanic flows. [According to Katz's map (U. S. G. S. P. P. 108, pl. 61, 1917) this complex is throughout its area overlain by Kittery qtzite.]

Named for development in Rye Twp, Rockingham Co., N. H.

Ryegate granite.

Devonian: Northeastern Vermont (Caledonia County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of eastern Vt., but without definition. Quarried in NE. part of Ryegate Twp, Caledonia Co.

Ryegrass sandstone. (In Bearpaw shale.)

Upper Cretaceous: Southern Alberta (Lethbridge region).

T. A. Link and A. J. Childerhose, 1931 (A. A. P. G. Bull., vol. 15, No. 10, pp. 1232, 1237). *Ryegrass ss.*—That part of Bearpaw sh. above Kipp ss. memb. shows considerable amounts of fine-grained laminated ss. interbedded with sh., so that it is difficult to decide whether the beds are shaly ss. or sandy sh., but the sh. does predominate. However, one conspicuous light greenish-blue bentonitic ss., with a dark-blue 4-ft. sh. break, emerges 30 ft. above water level on E. bank of Oldman River, just above its junction with Belly River, in form of a sharp fold. About 30 ft. of this ss. is exposed during low water, but diamond-drill holes reveal a section at 90 ft. which is dominantly ss. This ss. was seemingly mistaken for part of Fox Hills ss. by Dowling. Locally it is very coarse, cross-bedded, and ripple-marked. Its top is 642 ft. above base and 84 ft. below top of Bearpaw sh. Its base lies 150± ft. above Kipp ss. Named for proximity of outcrop to Ryegrass Flats.

Rykert granite.

Jurassic (?): British Columbia, Washington, and northern Idaho.

R. A. Daly, 1912 (Canada Dept. Mines Mem. 38, p. 284).

Rysedorph conglomerate.

Middle Ordovician (lower Trenton): Eastern New York.

R. Ruedemann in defining Normanskill sh. (N. Y. State Mus. Bull. 42, 1901) included in it the *lower Trenton ls. cgl. of Rysedorph Hill*. In N. Y. State Mus. Bull. 49, 1901, Ruedemann described *Trenton cgl. of Rysedorph Hill* as an intraformational ls. cgl., containing pebbles of Lower Cambric ls., probably of Potsdam ss., of Beekmantown ls., Chazy ls., Lowville ls., and lower or lowest Trenton ls. He frequently called it *Rysedorph Hill cgl.*, and stated that it is intercalated in Normanskill sh.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 17 and chart). Normanskill sh. of eastern N. Y. is underlain by Rysedorph cgl., of Trenton age.

In 1912 (N. Y. State Mus. Hdb. 19, p. 35) C. A. Hartnagel stated that "*Rysedorph cgl.* (1901 Ruedemann)" is intercalated in or overlies Normanskill sh., and on his chart stated that Normanskill sh. includes at top Rysedorph cgl.

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 66-99). [See 4th item under *Normanskill sh.*]

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 412, 414) and 1930 (N. Y. State Mus. Bull. 285, pp. 103-104), transferred *Rysedorph cgl.* to Middle Ord. (stating that its pebbles contain fossils ranging in age from Lower Camb. to lower Trenton); excluded it from *Normanskill sh.* (which he assigned to Lower Ord. (Chazy) and possibly Middle Ord. (Lowville)); and showed Rysedorph as lying uncon. on Normanskill sh. This is present accepted classification of Normanskill and Rysedorph. He also showed (pp. 27 and 72) *Tackawasick ls. and sh.* as younger than Rysedorph cgl. but on p. 25 the Rysedorph is placed above Tackawasick. In one place in this paper Ruedemann stated that Rysedorph cgl. is "probably on the Normanskill, though at most places inclosed in it by close folding."

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 279-281). ***Rysedorph cgl.*** occurs in Rysedorph Hill (locally called Pinnacle or Sugar Loaf Hill), 2 mi. SE. of Rensselaer (across river from Albany), and overlies Normanskill sh. Contains pebbles of Lower Camb. to Trenton age. At type loc. it is 2½ ft. thick, but elsewhere it varies in thickness up to 50 ft. (Moordener kill, near Castleton).

†Rysedorph Hill conglomerate.

Same as *Rysedorph cgl.*

Saanich granodiorite.

Jurassic: British Columbia.

J. A. Allan, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 99). Upper Jurassic (?). [Later Canada repts assign this fm. to Jurassic.]

Saanich formation.

Pleistocene: Northwestern Washington and British Columbia (Vancouver Island); also western Oregon.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 565-595). *Saanich fm.*—Raised-beach deposit. Benches Olig. and glacial deposits at Alki Point and Bainbridge Island in Puget Sound; fills glacial depressions at various points N. of Victoria on Saanich Peninsula, Vancouver Island, and terraces length and breadth of Straits of Georgia, notably Sucia Islands. Tentatively includes widespread raised beaches on W. coast of Oreg. and Wash. containing marine shells at Cape Blanco, Bandon, and Newport, Oreg., and at Bay Center, Wash.

Sabattisville moraine.

Pleistocene (Wisconsin): Southwestern Maine.

G. H. Stone, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 380). *Sabattisville moraine.*—A terminal moraine of till, named for occurrence a short distance S. of bridge at Sabattisville, Androscoggin Co.

Sabetha limestone. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 232, 234). *Sabetha ls.*, about 12 ft. thick, underlies Speiser sh. and overlies Easly Creek sh. Consists of (descending): (1) Fossiliferous gray ls., weathering gray or yellowish brown, 3 to 4 ft.; (2) bluish-gray calc. sh. with limy nodules, 6 to 7 ft.; (3) gray ls., 2 to 3 ft., fossiliferous. Named for exposures on Omaha-Tulsa highway 1 mi. N. of Sabetha, Kans.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 21). Investigation shows that "Sabetha ls." is correlative with Crouse ls., which has about 10 yrs. priority, and is here used instead of "Sabetha."

†Sabine formation.

Eocene (lower): Eastern Texas, Louisiana, Arkansas, and Alabama.

A. C. Veatch, 1905 (La. Geol. Surv. Bull. 1, pt. 2, Rept. 1905, pp. 84, 85, 88, letter of transmittal of La. Director to Governor dated Dec. 9, 1904; U. S. G. S. W. S. P. 114, on La. and southern Ark., pp. 180, 184–185, ms. sent to Govt Ptg Office Aug. 2, 1904). *Sabine (Lignitic) sand* (also *Sabine group*).—Name adopted to supplant nongeographic name *Lignitic*. Under this head is classed not a single well-defined horizon, like Nacatoch, or Bingen, or other Cret. horizons, but a number of somewhat irregular water sands occurring throughout a fm. which in W. part of this area [NW. La. and SW. Ark.] attains thickness of perhaps 1,000 ft. The lowest of these sands is about 700 ft. above the Nacatoch, and like it is very nearly horizontal over considerable area. Eastward and southward this bed dips gently toward Mississippi Valley and the coast. Other sand beds occur in the fm. above this one, at varying distances from each other and of varying thicknesses. Underlies Lower Claiborne and overlies Midway. Named for typical fossiliferous development on Sabine River in Sabine Co., Tex., and Sabine Parish, La.

E. C. Eckel, 1905 (Iron ores of NE. Tex., U. S. G. S. Bull. 260, pp. 349–350; ms. sent to Govt Ptg Office Mar. 10, 1905). Underlying the Claiborne and overlying the Wills Point clays is *Sabine fm.*, a thick series of chocolate-colored clays and various colored sands, with occasional beds of lignite or brown coal. White and reddish clays occur in places, being particularly well exposed near Queen City, Marshall Co.

On Mar. 23, 1905, the U. S. Geol. Survey, in connection with repts then in preparation on geol. and underground-water resources of Miss. (under supervision of E. C. Eckel) and Ala. (by E. A. Smith), formally adopted *Wilcox* as geographic name to replace the nongeographic term *Lignitic* in this, its typical region. This name was selected after correspondence (by E. C. Eckel) with State Geologist E. A. Smith of Ala., and type loc. was specifically stated in the records to be Wilcox Co., Ala., "which affords good exposures of the entire 'Lignitic' section." At the time *Wilcox* was adopted, the Survey also had in course of preparation (by A. C. Veatch) a rept (U. S. G. S. P. P. 46) on geol. and underground water resources of La. and northern Ark., and it was decided that if author of that rept was unwilling to correlate the Lignitic of that area with typical Lignitic of Ala., the name *Sabine* would be acceptable W. of Miss. River. The repts on Miss. (U. S. G. S. W. S. P. 159 and U. S. G. S. Bull. 283) were published Aug. 20, 1906, and Sept. 25, 1906, respectively.

A. C. Veatch, 1906 (Geology and underground-water resources of northern La., with notes on adjoining districts: La. Geol. Surv. Bull. 4, pp. 14, 26–29, map, etc.; letter of transmittal of W. R. Dodson, La. Director, to the Governor, dated Aug. 1, 1906). *Sabine fm.*—Overlies Midway lss. and calc. clays and underlies Claiborne beds. In Ala. this fm., which has long been called the Lignitic, contains several fossiliferous horizons that are closely related from a paleontologic standpoint, but show faunal differences which have led to recognition of 4 substages, named (ascending) Nanafalia, Bells and Greggs Landing (Tuscahoma), Woods Bluff, and Hatchetigbee. No distinctive marine fossils have yet been found in the lignitiferous time equivalents of this fm. in Miss., Ark., and upper embayment region, but along Sabine River in La. and Tex., in the same position relative to the embayment as the Ala. deposits, are developed fossiliferous beds showing same facies. *Ostrea thirsae*, an oyster common in Nanafalia horizon in Ala., occurs in abundance at Marthaville, La., and the fossils from Pendleton and Sabinetown bluffs on Sabine River, Sabine Co., Tex., show very close affinities to Greggs Landing and Woods Bluff horizons of Ala. These beds are limited above by a well-preserved and abundant lower Claiborne fauna, and below by the Midway (Wills Point) fossiliferous clays and lss. The name *Sabine fm.* is adopted to replace *Lignitic fm.* (nongeographic), *Chickasaw fm.* (inappropriate), *Lagrange* [more inclusive], and *Mansfield group* and *Camden group* (both of doubtful definition and without marine fossils at type localities). Named for typical development of fm. along Sabine River, Sabine Co., Tex., and Sabine Parish, La., and from noteworthy exposures at Sabinetown Bluff. The Sabine fm. and its equiv. beds in the undiff. Eocene underlie whole of La. except the limited areas occupied by the outcrops of the Cret. and Midway domes, and all of Ark. S. and E. of the Cret. and Midway outcrops. Thickness ranges from 300 ft. in northern Bossier Parish to 800 to 900 ft. near Natchitoches and on Sabine River.

A. C. Veatch, 1906 (U. S. G. S. P. P. 46, p. 34). [Same description as in La. Geol. Surv. Bull. 4, summarized above.]

Other users of *Sabine fm.* in La. and Tex. are G. D. Harris (La. Geol. Surv. Bull. 5, p. 21, 1907, and Econ. Geol., vol. 4, p. 15, 1909); E. T. Dumble (Tex. Univ. Bull. 1869, p. 38, 1920); H. V. Howe, 1933 (A. A. P. G. Bull., vol. 17, No. 6, pp. 617–621).

On Jan. 15, 1910, the U. S. Geol. Survey decided to use *Wilcox fm.*, instead of *Sabine fm.*, in the rept by A. Deussen entitled "Geology and underground-water resources of Texas Coastal Plain east of Brazos River" (which was published in 1914 as U. S. G. S. W. S. P. 335), and to abandon the admittedly synonymous term *Sabine fm.* Since that time *Wilcox* has been the generally accepted name for the Eocene deposits underlying Claiborne group and overlying Midway group in Gulf Coastal Plain, and it has been employed in more than 100 repts on Ala., Ga., Miss., Tenn., Ky., Ill., Ark., La., Tex., and Mexico.

†Sabine phase of Wilcox formation.

A term applied in some Tex. repts to upper part of so-called Wilcox fm., the lower part being called "Lignitic phase of Wilcox." Later work showed that the "Sabine phase" is of Claiborne age and that the "Lignitic phase" is in part of Claiborne age.

E. T. Dumble, 1920 (Univ. Tex. Bull. 1869). *Sabine phase of Wilcox fm.*—The exposures along Sabine River described by Harris and Veatch seem to correspond in large measure to the Ala. section and show an interbedding of the lignitic and marine phases. The Sabine phase succeeded the Lignitic phase of the Wilcox.

Sabine formation.

Upper Cambrian: Alberta and British Columbia.

S. J. Schofield, 1921 (Roy. Soc. Canada Trans., 3d ser., vol. 14, sec. 4, p. 76). *Sabine fm.*, Cambrian, B. C.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, p. 49), and 1928 (ditto, p. 227). *Sabine fm.*, Camb., B. C.

E. M. Kindle, 1924 (Pan-Am. Geol., vol. 42, p. 117). *Sabine fm.*, Camb., B. C.

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 300–307). Fauna of *Sabine fm.* is Upper Camb. Underlies Mons fm., which as restricted by Walcott in 1928 is Lower Ord. (Beekmantown).

†Sabine River beds.

Eocene: Eastern Texas.

E. T. Dumble and R. A. F. Penrose, Jr., 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. xxxvi, 17, 22). [See under *†Timber Belt beds*. Included Wilcox group and part of Claiborne group.]

Named for Sabine River, eastern Texas.

Sabinetown formation. (In Wilcox group.)

Eocene (lower): Eastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 574, 601, 634). *Sabinetown fm.*—Top fm. of Wilcox group in eastern Tex. Underlies (uncon.?) Carrizo sand (of Claiborne group) and uncon. overlies Rockdale fm. Contains marine fossils of upper Wilcox age. Outcrops as remnants. Occurs at Sabinetown, on Sabine River, Sabine Co., and other places. Thickness 40 to 100 ft. Absence in many places may be due to erosion before deposition of Carrizo sand. Consists of near-shore and shallow-water deposits of thinly laminated light-gray sand, lentils and thin beds of blue sandy clay containing thin partings of impure sand and numerous large, somewhat flat and smooth-surfaced ferruginous concretions. In some places base is a layer of cgl., in other places a layer of glauconitic sand. Distinguished from Carrizo by its finer sand grains, its smooth ferruginous and in places fossiliferous concretions, and by its fossils (listed). Correlated with Bashi of Ala.

Sabula dolomite.

Silurian (Niagaran): Central eastern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 149, 150). *Sabula terrane.*—Dol., 50 ft. thick, composing bottom fm. of Niagaran series. Underlies Colesburg dol. of Niagaran series, and overlies Maquoketan series. Separated from Colesburg dol. by its fauna.

Named for Sabula, or Sabula Junction, Jackson Co.

Sac limestone.

Lower Ordovician (Beekmantown): Southwestern Missouri.

E. M. Shepard, 1898 (Mo. Geol. Surv. vol. 12, pt. 1, pp. 49, 74–77). *Sac ls.*—Massive purplish, gray, or drab-colored mag. ls. 1 to 18 ft. thick, uncon. underlying Phelps ss. and overlying King ls. All included in Hamilton stage of Dev.

Later repts by S. Weller (1901) and other geologists assigned this ls. to Kinderhook group.

R. C. Moore, 1928. [See 1928 entry under *King ls.*]

The Sac ls. belongs to Powell ls. (which uncon. underlies Sylamore ss. in SW. Mo.), according to J. Bridge (1937 personal communication).

Named for outcrops on Sac River, Greene Co.

Sacajawea formation.

Mississippian: Wyoming.

C. C. Branson, 1936 (Geol. Soc. Am. Proc. 1935, p. 391). Lower part of Amsden fm. of Darton is Miss., and is here designated *Sacajawea fm.*, with type section on Bull Lake Creek. Upper part of Amsden is Penn., and is not separable stratigraphically or faunally from rest of the Tensleep.

Sacandaga quartzite.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199, pp. 94, 121). *Sacandaga qtzite.*—Thickness 70 ft. Included in Grenville series. Underlies Johnsburg ls. Type loc. Sacandaga River, Sacandaga mine, Day Twp, Saratoga Co.

†Saccharoidal sandstone.

A descriptive term applied, in a titular sense, in early Mo. repts to ss. now called *St. Peter ss.* and the underlying Everton ls., the lower part of which is sandy. So called because when struck with hammer it crumbles into fine white sand resembling granulated sugar.

Sac-Fox subgroup.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 4, 5, 10–11). *Sac-Fox subgroup* (of Wabaunsee group) hereby named from Iowa-Sac-Fox Indian Res. in SE. Nebr. and NE. Kans. Includes (descending) Scranton sh. fm., Howard ls. fm., and Severy sh. fm. Type loc. in Mo. River blufflands, btw. mouth of Big Nemaha and Iowa Point, Kans.

Sachuest arkose.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 284–288, 379). *Sachuest arkose.*—Arkose interbedded with more or less coaly sh. Thickness 200± ft. Composes W. and S. shores of Sachuest Neck, N. shore at Flint Point, and a small exposure offshore at a headland ¼ mi. S. of Flint Point. Believed to rest on Camb. cgl. and sh.

A part of Wamsutta fm., as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

Saclin formation.

Quaternary: Nicaragua.

O. H. Hershey, 1912 (Geol. Soc. Am. Bull., vol. 23, p. 507).

Sacramento porphyry (also porphyrite).

Eocene: Leadville region, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230), 1883 (U. S. G. S. Leadville Atlas, cross section sheet), and 1886 (U. S. G. S. Mon. 12, p. 81). Dark-gray granular, rather even-grained rock, of same general appearance as the variety of Lincoln porphyry which has no large crystals. [On p. 341 of Mon. 12 Whitman Cross described the rock as *Sacramento porphyrite*.]

In U. S. G. S. P. P. 148, pl. 2, 1927, this rock was mapped with the other masses of Gray porphyry, without a distinctive name.

Named for occurrence under Gemini Peaks, btw. heads of Big and Little Sacramento Gulches, vicinity of Leadville.

†Sacramento formation.

Middle Devonian: Northern California (Redding region).

J. P. Smith, 1894 (Jour. Geol., vol. 2, pp. 591 and 592). [In heading and table *Sacramento fm.* is used to cover *Kennett lss. and shales*, and is credited, in footnote, to H. W. Fairbanks ms. A later (1916) publication by J. P. Smith (Calif. State Min. Bur. Bull. 72) stated that the Middle Dev. lss. of Kennett and Lower Soda Springs occur in Sacramento Canyon.]

Same as Kennett fm.

Saddleback series.

Pre-Cambrian: British Columbia.

C. W. Drysdale, 1917 (Canada Geol. Surv. Summ. Rept. 1916, p. 59).

Saddle Creek limestone member (of Harpersville formation).

Pennsylvanian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 416). *Saddle Creek bed.*—Ls., usually massive, light gray, 6 to 12 ft. thick. Underlies Camp Creek bed and overlies Waldrip bed in Colorado coal field of Tex. Is memb. of Cisco div.

N. F. Drake, 1917 (Univ. Tex. Bull. 1755). *Saddle Creek bed* is finely exposed 1 to 2 mi. S. of mouth of Saddle Creek [McCulloch Co.]. On N. side of Colorado River it remains N. of the river from N. of mouth of Saddle Creek to NW. of Waldrip.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, p. 136). *Saddle Creek* of Drake immediately underlies Pueblo fm.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132). *Saddle Creek ls.* (=Saddle Creek bed of Drake) is top memb. of Harpersville fm. [Many details.]

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 18–42). *Saddle Creek ls.* (top memb. of Harpersville fm.) consists of 2 or 3 beds 1 to 3 ft. thick separated by sh. To N. the Saddle Creek bed changes to calc. ss.

Saddlehorse gypsum lentil (of Quartermaster formation).

Permian: Panhandle of Texas.

C. N. Gould, 1907 (U. S. G. S. W. S. P. 191, pp. 16–20). *Saddlehorse gyp. lentil.*—One to three ledges of massive white gyp. interstratified with red shales. Total thickness 10 ft. Local lentil in Quartermaster fm., 60 to 80 ft. above base. Separated from overlying Alibates dol. memb. of Quartermaster fm. by 50 to 60 ft. of red sh. with white bands and ledges of soft ss.

C. N. Gould and F. E. Lewis, 1926 (Okla. Geol. Surv. Circ. 13, pp. 14–15). Day Creek (Alibates) dol. of Carson Co., Tex., is separated from underlying Blaine gyp. by 300 or 400 ft. of red sands, red shales, and occasionally a thin bed of gyp. or lime and probably anhydrite. The most prominent of gyp. lenses is *Saddlehorse gyp.* [Day Creek dol. is much older than Quartermaster fm., from which it is separated by Cloud Chief gyp.; and Saddlehorse gyp. is older than Alibates dol.]

W. W. Rubey, 1926 (personal memo.). Gould now thinks Quartermaster fm.=the supposedly underlying Woodward group. This new interpretation is based upon lithologic similarity, tracing of outcrops, and well-log correlations, and makes Alibates dol.=Day Creek dol. and underlying beds=Whitehorse ss. of Kans. and Okla. This revised correlation has been concurred in by Messrs. Trager, McCoy, and Howell, geologists of Marland Oil Co.

C. N. Gould and R. Willis, 1927 (Geol. Soc. Am. Bull., vol. 38, No. 3, pp. 431–438), correlated Alibates dol. with Day Creek dol.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 167, 243), placed Alibates dol. and Saddlehorse gyp. in Quartermaster fm., stating that the Alibates is in upper part of the Quartermaster and the Saddlehorse 60 to 80 ft. above base of Quartermaster.

Named for Saddlehorse Creek, Potter Co.

Saddle Mountain porphyry.

Pre-Cambrian: Southwestern Oklahoma (Wichita Mountains).

H. F. Bain, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 135, 136). [See 1st entry under *Carlton porphyry*.]

M. G. Hoffman, 1930 (Okla. Geol. Surv. Bull. 52, pp. 40–48). *Saddle Mtn granophyre.*—Very dark-gray dense and porphyritic granophyre. Red orthoclase crystals, 1 to 4 mm. long, are set in groundmass and compose about 20 percent of the rock. Occurs near Saddle Mtn and centers in and around sec. 36, T. 5 N., R. 15 W. Intrudes Meers qtzite. Considered older than Davidson granophyre. Is intruded by Lugert granophyre.

Sadlerochit sandstone.

Permian: Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103, 113, map). *Sadlerochit ss.*—About 300 ft. of light ss. or dark qtzite, conformably overlying Lisburne ls. (Miss.) and underlying (probably conformably) Shublik fm. (Upper Triassic). In Sadlerochit Mtns it is light-colored heavy-bedded fine ss. that weathers dark brown. Is very fossiliferous. Fauna is Penn.

Saegerstown shale.

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 457–464). [See definition under *Woodcock ss*. Outcrops mentioned. Fossils. Included in Bradfordian and also treated as a memb. of Chagrin fm., which U. S. Geol. Survey classifies as Upper Dev.]

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Saegerstown sh. memb.* included in Cattaraugus fm., of Dev. age. Underlies Woodcock ss. memb. and overlies Millers ss. memb. [The U. S. Geol. Survey classifies Cattaraugus fm. as *Dev. or Carbf.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 89), stated that Millers ss. of Chadwick is same as Salamanca cgl. memb. of Butts and Glenn, which he assigned to Dev. He also stated that Saegerstown sh. of Chadwick was named for exposures along French Creek, in village of Saegerstown, Crawford Co.

Sagamore sandstone lentil (in Bedford shale).

Devonian or Mississippian: Northeastern Ohio.

C. S. Prosser, 1912 (Ohio Geol. Surv., 4th ser., Bull. 15, pp. 26, 86, 88). *Sagamore ss. lentil.*—Bluish fine-grained sss., with sh. partings; 23 ft. thick; forming lentil in upper part of Bedford sh. Separated from underlying Euclid ss. memb. of Bedford by 14 ft. of bluish shales; overlain by bluish-gray to bluish shales alternating with thin sss. forming topmost part of Bedford.

Named for Sagamore Creek, Bedford Twp.

Saganaga granite.

Pre-Cambrian (Laurentian): Northeastern Minnesota (Vermilion district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept.). *Saganaga granite* (Laurentian) occupies all shores and islands of ˊaganaga Lake except NW. shore.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 128). The *granite of Saganaga Lake*, locally known as "Saganaga Lake granite," is intrusive granite of Laurentian age, and same as granite of Basswood Lake.

Saganaga syenite.

Pre-Cambrian (Keewatin): Northeastern Minnesota.

A. Winchell, 1891 (Am. Jour. Sci., 3d, vol. 41, p. 386). Included in Keewatin.

†Saganaga Lake granite.

The Laurentian granite of Saganaga Lake, NE. Minn., is locally known as "Saganaga Lake granite."

Sagean series.

Term applied by C. [R.] Keyes to 300 ft. of undescribed Eo. beds in Mont., which probably correspond to Sage Creek fm. of Douglass and other geologists.

Sage Breaks shale member (of Niobrara formation).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Sage Breaks sh. memb.*—Gray noncalc. mudstone and sh. with many large light-gray calc. septarian concretions. Fossils scarce, but a few marine species found. Commonly forms scarps and buttes. Thickness 250 to 325 ft. Is lower memb. of Niobrara fm. Underlies Beaver Creek chalky memb. and overlies Turner sandy memb. of Carlile sh. In previous repts on NE. Wyo. and SE. Mont. included in Carlile sh. Named for exposures in the Sage Breaks, in T. 46 N., R. 63 W., Weston Co., Wyo.

Sage Creek formation.

Eocene (upper?): Southwestern Montana (Beaverhead County).

E. Douglass, 1903 (Carnegie Mus. Annals, vol. 2, pp. 145–146). *Sage Creek beds* (*Eocene?*).—A fm. that occurs N. of Sage Creek, about 7 mi. NE. of Lima, Beaverhead Co. [Fossils listed, but lithology and thickness not given.]

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 98). Deposits on Sage Creek, Mont., are probably *Eobasileus* zone (upper Eocene).

H. E. Wood, 2d, 1934 (Am. Mus. Nat. Hist. Bull., vol. 67, art. 5, pp. 253, 255, 277). *Sage Creek fm.* is Eocene and apparently of either Lower Uinta or Upper Bridger age, based on emended identifications of Douglass' fossils. Type loc. of Sage Creek fm. was finally located by F. D. and H. E. Wood, June 30–July 5, 1933, NW. of loc. No. 3 on map (fig. 51) about at bdy btw. secs. 29 and 30. This loc. (our No. 8) is 8 mi. N. by W. of Lima, instead of 7 mi. NE., but agrees perfectly otherwise with Douglass' description, and is the only loc. in region that does. The Sage Creek is a unit fm., and there is no reason to believe that it covers any large passage of time. It consists of regularly bedded fine-grained greenish-gray sss., with interspersed coarse cross-bedded channel sss., ranging into cgls. in places. The beds dip northeasterly and are separated from underlying Lower Eocene (?) salmon-colored beds by a marked erosional uncon. Upper surface of the beds is strongly eroded, and is overlain by the beds here named *Cook Ranch fm.*, which contain a Middle Olig. fauna that clearly has nothing to do with Douglass' Sage Creek, which term must be restricted to the Eocene beds.

Sage Creek white layer.

Eocene (middle): Southwestern Wyoming (Bridger Basin).

W. D. Matthew, 1909 (Am. Mus. Nat. Hist. Mem., vol. 9, pp. 295–297). Horizon C of Bridger fm. of Bridger Basin is defined inferiorly by a heavy and persistent calc. stratum, the *Sage Creek white layer*, shown at Sage Creek Spring.

Sage Hen limestone member (of Colorado shale).

Upper Cretaceous: Central northern Montana (Little Rocky Mountains region).

C. T. Lupton and Wallace Lee, 1921 (A. A. P. G. Bull., vol. 5, pp. 264, 266). *Sage Hen sandy ls.* (in Colorado sh. of Cat Creek field) lies 335 ft. above Mosby ss. memb. of the Colorado. Is named for conspicuous exposures in Sage Hen Creek. Is a fine-grained ss. cemented with the lime and when fresh shows no indication of its sandy character. When weathered becomes rotten and is easily crumbled with the fingers. Thickness 10 to 20 inches. Occurs at top of a zone of calc. concretions 130± ft. thick. At top of Sage Hen ls. there is distinct change in sedimentation. The beds overlying it are conspicuously argill., and ascending in the section become somewhat calc., though there are no limy beds in first 200 ft.

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Saginaw formation.

Pennsylvanian (late Pottsville): Michigan (Lower Peninsula).

A. C. Lane, 1901 (Mich. Miner, vol. 3, No. 1, p. 9). We are considering replacing *Jackson* (preoccupied) by *Saginaw*, a characteristic Michigan name, the Saginaw Valley occupying a large part of the coal basin and Saginaw Co. at present containing the most important coal mines.

A. C. Lane, 1902 (Mich. Geol. Surv., vol. 8, pt. 2, map at end). *Saginaw fm.*—Coal, paving brick clays and shales, ss., etc. Overlies Grand Rapids [group]. Is of Pottsville age. [In some early repts the Parma ss. was included in †Jackson or Saginaw fm. The generally accepted definition, however, treats Parma ss. as a distinct fm. lying btw. Saginaw fm. and Grand Rapids group.]

Saginaw sand.

Middle Devonian: Eastern Michigan (Saginaw region).

C. G. Carlson, 1927 (A. A. P. G. Bull., vol. 11, pp. 962+). *"Saginaw sand."*—A dolomitic lime near top of Traverse fm. Produces oil at Saginaw, near Bristol St. Bridge.

†Saginaw moraine.

A name used by F. B. Taylor in early repts for main moraine of Port Huron morainic system in Saginaw Valley, Mich. But he later (U. S. G. S. Mon. 53, 1915) discarded the name.

Saginaw.

Name applied to two glacial lakes, of Pleist. age, in Great Lakes region.

Saguenay formation.

Pre-Cambrian: Quebec.

J. A. Dresser, 1916 (Roy. Soc. Canada Trans., 3d ser., vol. 10, p. 126; Canada Geol. Surv. Mem. 92, p. 25).

Sailor Canyon formation.

Lower Jurassic: Northern California (Colfax region).

H. W. Turner, 1894 (Am. Geol., vol. 13, p. 232). *Sailor Canyon beds.*—At Sailor Canyon, which drains into American River about 6 mi. SE. of Cisco, are a series of beds from which Mr. Lindgren and Dr. Cooper Curtice have collected fossils regarded by Hyatt as of Liassic [Lower Jurassic] age. Considered older than Milton and younger than Cedar fm.

W. Lindgren, 1900 (U. S. G. S. Colfax folio, No. 66). *Sailor Canyon fm.*—Calc. clay slates with some ls. and a contact-metamorphic facies consisting chiefly of mica schist and hornfels. Younger than Calaveras fm. and older than Mariposa sl.

The Sailor Canyon fm. has an estimated thickness of 6,000 ft.

St. Alban formation.

Devonian: Quebec.

J. M. Clarke and C. Schuchert, 1900 (N. Y. State Mus. Mem. 3, vol. 3, p. 81).

St. Albans slate.

Middle Cambrian: Northwestern Vermont (Franklin County, St. Albans region).

J. Marcou, 1862 (Boston Soc. Nat. Hist. Proc., vol. 8, pp. 239–253). *St. Albans group.*—Green, brown, and reddish slates, containing lenticular masses of very hard whitish ls. Thickness 2,500 to 3,000 ft. Underlies Georgia slates [restricted to "gray and black sandy slates passing into true yellowish ss."] and overlies Lower Taconic system, which consists of 10,000 ft. of qtzite, cgls., talcose slates, clay slates, mica schist, and gneiss, with intercalated masses of crystalline ls.

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 176–178), recognized *St. Albans slates* as underlying *Georgia schists*.

C. D. Walcott, 1910 (Smithsonian Misc. Coll., vol. 53, No. 6, p. 254). A specimen of cephalon of *Paradoxides* was found by Mr. Geo. Edson (1907), of St. Albans, Vt., in the St. Albans shales just W. of city of St. Albans. The *St. Albans shales* are argillaceo-aren. and carry lentils of ls. that are more or less fossiliferous. The *Paradoxides* occurs in the sh. and in a ls. lentil.

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 112). Edson reported discovery of *Paradoxides* in shales in town of St. Albans, which indicates strongly that Middle Camb. is present there. He also reported finding *Agnostus* in same place, thus indicating Middle Camb. or later beds. It is thus possible some of sh. here named *Colchester* (Lower Camb.) is of Middle Camb. age, but it has not yet been practicable to distinguish such beds as a fm. If Middle Camb. shales are present, they can only extend a few mi. to N. and S., being cut out by Milton dol. This possibility is strengthened through the finding, by B. F. Howell, at same locality, in 1922, of apparent Middle Camb. fossils.

B. F. Howell, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 236). A small fossil, which appears to be possibly a fish plate, was found during past summer by Prof. C. Schuchert and writer in *St. Albans sh.*, a Camb. fm. containing *Paradoxides* and other marine fossils of a *Paradoxides* fauna just S. of town of St. Albans, Franklin Co., NW. Vt. The fossil will be of great interest if it can be proved to be a fish plate, as it will be the first evidence of existence of fish or fishlike creatures in the Camb. [On p. 242 Howell stated:] Paradoxidian fossils were reported from Franklin Co., Vt., by Edson, Perkins, and Walcott some 15 yrs ago, but not much was then known about the beds from which they came. During past 4 yrs the field work of Raymond, Prindle, Dunbar, Sayles, and especially Keith, Schuchert, and writer, has added much to our knowledge of the strat. and areal extent of these *Paradoxides* beds and character and relationships of fossils. The beds are dark shales, named *St. Albans fm.*, which, although they outcrop at only a few places and are known to be fossiliferous in only 4 of their outcrops, are believed to underlie mantle of glacial deposits in a continuous or nearly continuous band varying from a few yds. to ¼ mi. in width and extending from vicinity of West Georgia NE. for about 16 mi., to near Highgate.

B. F. Howell, 1929 (16th Rept. Vt. State Geol., pp. 255, 263, 265–269). In 1881 Marcou described and mapped the rocks in and about St. Albans. The area which he mapped as underlain by the rocks of his St. Albans group—a strip running N. from Georgia through St. Albans and Highgate Falls to and across Canadian bdy—is now known to contain beds of Paradoxidian age. Keith (1923) tentatively included the *Paradoxides* beds in the fm. which he called *Highgate sl.*, which he described as resting on Milton dol. The present writer in 1926 proposed that the old name *St. Albans* be restricted to the *Paradoxides* beds of Franklin Co. and used as a regular fm. name, with a definite meaning. It has been used before in a larger sense, but only a few times; and it is the most logical—almost the only appropriate—name available for those beds. It is used in that sense in this paper. The *St. Albans sh.* is, as its name implies, composed chiefly of mudstones. Many of its beds are, however, so limy as to deserve the name of *lss.*; and thin layers and lenses of ss. occur here and there throughout the fm. Some of beds are fine-grained black shales, but majority are dark-gray and coarser-grained, sometimes so micaceous as to be of golden-brown color, and sometimes sandy. The more limy strata tend to blue-gray color and vary from limy shales to impure lss., which are always mere lenses—never beds. Matrix of the ss. layers is also frequently limy. Whole fm. seems to have been thin-bedded and was at least in part banded, but cleavage has destroyed evidence of original bedding and banding. No evidence of cross-bedding on any considerable scale was seen in main body of fm. The St. Albans overlies Milton dol. [not true Milton and later renamed *Rugg Brook cgl.* by Schuchert], probably with discon., and underlies Mill River cgl., apparently with uncon. Thickness approx. 200 ft. The St. Albans closely resembles the younger Highgate sh. and also parts of the older Colchester fm., but is usually of a little lighter gray color, less distinctly banded, and coarser-grained and heavier-bedded than the Highgate, and is finer-grained and less heavy-bedded than the shales of Colchester fm. These distinctions do not always hold, however, and since the Milton, Mill River, and Swanton fms. are also frequently difficult to distinguish in the field, it is necessary for one to find fossils of a *Paradoxides* fauna in his shales if he is to feel certain that he has the St. Albans fm.

H. W. McGerrigle, 1931 (17th Rept. Vt. State Geol., pp. 179–191), compiled a table showing the superposition of the Camb. fms. beneath the Georgia sl. (Ord.) at Burlington, St. Albans, Highgate Springs, and Int. Bdy, in which he listed *St. Albans sh.*, 200 (?) ft. thick, uncon. underlying Mill River cgl. (Upper Camb.) and uncon. overlying Milton dol. [not true Milton and later renamed *Rugg Brook cgl.* by Schuchert].

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 374). After thorough search Middle Camb. fossils were found by Howell in *St. Albans sl.* at W. border of city of St. Albans and at several other localities. These beds have been traced by writer into W. part of Milton Twp. They are cut out a few mi. S. of Highgate Center btw. Milton dol. below and Highgate sl. above. There is fair prospect they can be identified in one of beds of sl. that is exposed only at low water below Highgate Falls. The St. Albans contains only sl., dark gray, locally banded, and, like the older Parker sl., micaceous.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 353–381). *St. Albans sl.* is 0 to 250 ft. thick; contains 20 sp. of Middle Camb. fossils; is uncon. overlain by Mill River ls. cgl. and rests on a nonfossiliferous basal cgl. (0 to 20 ft. thick and apparently of Middle Camb. age, as it rests uncon. on underlying Parker sl.), here named *Rugg Brook dol. cgl.* In previous repts the Rugg Brook cgl. has been called *Milton dol.*, but the typical Milton dol. lies higher in the section and is Upper Camb., hence the new name *Rugg Brook.*

†St. Albans group.

A name applied in Hitchcock's early repts to include rocks ranging in age from Lower Camb. to Lower Ord. and now divided into Georgia sl., Swanton cgl., and Highgate sl.

St. Albans limestones.

Lower Devonian: Quebec (Gaspe Peninsula).

J. M. Clarke, 1900 (N. Y. State Mus. Mem. 3, vol. 3, pp. 80–81). Mr. Charles Schuchert and writer have thought that beds 1 and 2 of Sir Wm. Logan's 1844 subdivisions, which carry Helderbergian fauna and are exposed at base of Mount St. *Alban* along shore of Cape Rosier cove on gulf of St. Lawrence, may be called *St. Albans lss.*

St. Anna moraine.

Pleistocene (Wisconsin stage): Southeastern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for development 1 mi. W. of St. Anna, Sheboygan Co.

St. Anthony sandstone.

Name applied by T. C. Hopkins (Ind. Dept. Geol. and Nat. Res. 20th Ann. Rept., 1895, p. 312, 1896) to ss. quarried at St. Anthony, Dubois Co., Ind.

St. Armand limestone.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6).

St. Bartholomew limestone.

Eocene: West Indies.

T. W. Vaughan, 1918 (Wash. Acad. Sci. Jour., vol. 8, p. 271) and 1924 (Geol. Soc. Am. Bull., vol. 35, p. 726).

St. Charles limestone.

Upper Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, p. 6). *St. Charles fm.*—Bluish-gray to gray aren. lss. with some cherty and concretionary layers, passing at base into thin-bedded gray to brown sss. Thickness 1,225 ft. in Blacksmith Fork Canyon, E. of Hyrum, Cache Co., Utah, the most accessible locality for study, and 1,197 ft. W. of Liberty, Bear Lake Co., Idaho. Type loc. is W. of St. Charles, Bear Lake Co., Idaho. The stream flowing through St. Charles passes over the fm. Contains Upper Camb. fossils, passing at top into Ord. [Garden City ls.]. Overlies Nounan fm.

St. Clair limestone.

Silurian: Northern Arkansas and central eastern Oklahoma.

R. A. F. Penrose, Jr., 1891 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 1, pp. 102–103, 112–114, 124–128, 166–174). *St. Clair ls.*—Highly crystalline granular fossiliferous ls., of light-gray, pink, chocolate-brown, or purplish-black color. Contains nodules and interbedded layers of oxides of manganese and is source of the manganese ores, as they are now found in a residual clay. Thickness 0 to more than 150 ft. In some places underlies Sylamore ss.; in other places is separated from overlying Boone chert by dark-brown or black earthy siliceous deposit, 1 to 40 ft. thick, underlain by residual clay, the product of decomposition in situ of St. Clair ls. Overlies Izard ls.

H. S. Williams, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 325–331). St. Clair ls. of Penrose includes beds ranging in age from Cincinnati to Niagara, and should be divided into three fms., here named (descending) Cason ls. (containing Clinton-Niagara fauna); Cason sh. (the manganese-bearing shales); and St. Clair ls. (containing Ord. fauna); the latter two fms. separated by erosion uncon.

H. S. Williams, 1900 (Ark. Geol. Surv. Ann. Rept. 1892, vol. 5, pp. 277–301). Cason ls. is abandoned and *St. Clair ls.* restricted to Sil. ls. overlying Cason sh., which outcrops at St. Clair Springs. For the Cincinnati memb. of Penrose's St. Clair ls., which does not outcrop in region of St. Clair Springs, Branner's suggested name *Polk Bayou ls.* is adopted.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28, pp. 421, 486, 558, 559), restricted *St. Clair ls.* to beds of pre-Rochester Clinton age, or to the ls. actually present at St. Clair Springs, the beds of Medina age being westward extension of Brassfield ls. of western Tenn., and therefore excluded.

H. D. Miser, 1920 (U. S. G. S. Bull. 715G, p. 98). In Batesville, Ark., dist. the true St. Clair ls. is locally overlain by a hitherto undiscovered fm. of late Sil. (probably late Niagaran) age named *Lafferty ls.*, and it is underlain by Brassfield ls. (in one place in Batesville dist.). The Brassfield ls. is not present at type loc. of St. Clair ls.

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ). Fauna collected by Taff from upper part of St. Clair near Marble [Sequoyah Co., Okla.] is of Niagaran age according to Ulrich. The typical St. Clair fauna is present in pink crinoidal bed [top memb.] of Chimneyhill ls. Base of St. Clair is not exposed in Okla.

Adopted for ls. uncon. overlying Brassfield ls. and in Ark. locally underlying Lafferty ls. (of Sil. age), or, in its absence, Sylamore ss. memb. of Chattanooga sh. Contains fossils of Rochester age, according to E. O. Ulrich. In Okla. it is locally overlain by a ls. of late Oriskany age.

Named for St. Clair Springs, 8 mi. NE. of Batesville, Independence Co., Ark.

†St. Clair shale.

Upper Devonian: Michigan (Lower Peninsula).

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. 1891 and 1892, p. 66). *St. Clair shales*, 150 to 300 ft. thick, underlie Richmondville or Berea ss. and overlie Traverse group.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, btw. pp. 1 and 31). *St. Clair black shales* are 145 to 300 ft. thick. Underlie Richmondville or Berea ss. and overlie Traverse group.

A. C. Lane, 1901 (Mich. Miner, vol. 3, No. 1, p. 9). We are considering replacing *St. Clair* (preoccupied) by Antrim.

Replaced by Antrim sh. in 1902.

Named for exposures along St. Clair River, St. Clair Co.

St. Cloud sandstone. (In Greene formation.)

Permian: Northern West Virginia.

R. V. Hennen and D. B. Reger, 1913 (W. Va. Geol. Surv. Rept. Marion, Monongalia, and Taylor Counties, p. 171). *St. Cloud ss.*—Massive micaceous medium-grained ss., 15 to 20 ft. thick in Monongalia and Marion Counties. Underlies Lower Proctor ss. and lies 4 to 5 ft. above Windy Gap coal, the Windy Gap ls. not being seen in area. Named for St. Cloud P. O., Monongalia Co.

St. Cloud granite.

Name applied by C. C. Wang (Geol. Soc. China Bull., vol. 11, No. 4, pp. 426–428, 1932) to a pre-Camb. intrusive granite in Wis. (area not stated).

†St. Croix formation.
†St. Croix sandstone.
†St. Croix series.
†St. Croix shales.

Upper Cambrian: Eastern Minnesota and western Wisconsin.

N. H. Winchell, 1873 (Minn. Geol. and Nat. Hist. Surv. 1st Ann. Rept., for 1872, pp. 68–80). *St. Croix ss.*—White or buff-colored heavy- or massive-bedded quartzose sss. with intercalated beds of sh. Thickness 600 ft. Underlies Lower Magnesian ls. [which included all beds btw. St. Peter ss. and his St. Croix ss.] and uncon. overlies [so-called] Potsdam ss. (hard vitreous red sss. with partings of red sh.). Named for occurrence in St. Croix Valley.

N. H. Winchell, 1874 (Minn. Geol. Nat. Hist. Surv. 2d Ann. Rept), designated basal fm. of †Lower Magnesian as *St. Lawrence ls.*, and applied "St. Croix ss." to the beds beneath the St. Lawrence and above his so-called Potsdam ss. This definition was followed by him in several succeeding repts.

N. H. Winchell, 1886 (Minn. Geol. Nat. Hist. Surv. 14th Ann. Rept., pp. 334–337), included Jordan ss. and St. Lawrence ls. in his St. Croix fm., and followed this definition of "St. Croix ss." in his 1888 rept.

C. W. Hall, 1889 (Minn. Acad. Nat. Sci. Bull., vol. 3, pp. 125–136), applied "St. Croix series" to the rocks beneath St. Lawrence fm. and above the red so-called Potsdam ss., and divided this "series" into Dresbach ss. or upper St. Croix, St. Croix shales or middle St. Croix, and St. Croix sss. or lower St. Croix.

N. H. Winchell, 1900 (Geol. map of Minn.). *St. Croix series.*—Includes Jordan, St. Lawrence, and Dresbach, and overlies Hinckley ss.

Some authors have applied "St. Croix shales" to the sh. underlying Dresbach ss. and "St. Croix sss." to the sss. underlying those shales.

St. Croix morainic system.

Pleistocene (Wisconsin stage): Northeastern Minnesota and northern Wisconsin.

C. P. Berkey, 1897 (Am. Geol., vol. 20, p. 360). Passes a short distance E. of village of St. Croix Falls, Wis., and follows almost parallel with and at certain points encroaches upon River St. Croix.

See also Jour. Geol., vol. 13, pp. 242–256, 1905, and F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 40–45). The members are unnamed.

St. Croix formation.

Miocene and Oligocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in Geol., No. 7, pp. 48–49).

St. Croixan epoch (or **series**).

Geographic name for Upper Cambrian. Proposed by C. D. Walcott (Smithsonian Misc. Coll., vol. 57, No. 10, pp. 306–307, 1912). Replaces †Saratogan. See U. S. G. S. Bull. 769, pp. 97–98.

St. David shale and limestone. (In Carbondale formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *St. David sh. and ls.* to that part of Carbondale fm. overlying Springfield (No. 5) coal and underlying his Canton sh. in Fulton Co. Derivation of name not stated, but probably is the town in Fulton Co.

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804), showed *St. David ls.*, 0 to 5± ft. thick, resting on coal No. 5.

St. David cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to an upper portion of Carbondale fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 5 and St. David ls. Derivation of name not stated.

St. Edmund dolomite lentille (of Cabot Head shale member).

Silurian (early): Ontario (Bruce Peninsula and Manitoulin Island).

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111, No. 91 geol. ser., p. 37 and chart opp. p. 18). *St. Edmund dol. lentille.*—Fine-grained light-buff weathering dol. and mag. calcilutite. Thickness 8+ ft. Occurs near top of Cabot Head sh. memb. on Bruce Peninsula and Manitoulin Island. Is younger than Dyer Bay dol. lentille of Cabot Head sh. memb. Type loc. along shore 3 mi. W. of Cabot Head, on lots 3 and 4, concession XIV, St. Edmund Twp, Bruce Peninsula.

St. Elias schist.

Age (?): Southeastern Alaska (St. Elias region).

I. C. Russell, 1891 (Nat. Geog. Mag., vol. 3, pp. 167–175). *St. Elias schist.*—The metamorphic rocks of main St. Elias Range are a schist in which bedding planes are preserved. Forms several thousand ft. of upper part of the range. Overthrust on Yakutat system.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, p. 212). *St. Elias schist of Russell* is a metamorphic terrane of unknown age. It may represent same horizon as Wales series.

†St. Elizabeth formation.

Lower Ordovician (Beekmantown): Central Missouri.

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., p. 50). *St. Elizabeth fm.*—A complex of ss., chert, qtzites, dol., and sh., 70 to 160 ft. thick, overlying Gasconade ls. and underlying Jefferson City fm. in Miller Co.

Same as Roubidoux fm., older name.

Named for St. Elizabeth, Miller Co.

St. Eugene silts.

St. Eugene interglacial epoch.

Pleistocene: British Columbia.

S. J. Schofield, 1915 (Canada Geol. Surv. Mem. 76, p. 85).

St. Francisville sand.

A subsurface sand in Chester group (Miss.) of Lawrence Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

†St. Francois limestone.

Upper Cambrian: Eastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv., vol. 6, pp. 331, 346, 349–354). *St. Francois ls.*—Great body of mag. ls., 600 ft. thick, lying btw. La Motte ss. below and Crystal City [St. Peter] ss. above in SE. Mo. Includes Potosi ls. and St. Joseph ls.

Named for St. Francois Co.

†Ste. Genevieve marble.

Mississippian: Central eastern Missouri.

G. C. Swallow, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pt. 1, p. 96). The well-known oolite found at Ste. Genevieve, called *Ste. Genevieve marble*, belongs to Archimedes ls.; it is a very superior building stone. [According to B. F. Shumard (St. Louis Acad. Sci. Trans., vol. 1, p. 407, 1857) the white, highly oolitic ls. extensively quarried near Ste. Genevieve is basal memb. of St. Louis ls. and older than fm. near Ste. Genevieve which he named *Ste. Genevieve ls.*]

Ste. Genevieve limestone. (In Meramec group.)

Mississippian: Eastern Missouri, southern Illinois and Indiana, Iowa, Kentucky, Tennessee, northern Alabama, and northeastern Mississippi.

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, p. 406, in a description of the rocks of Ste. Genevieve Co., Mo., read June 6, 1859). *Ste. Genevieve ls.*—A second Archimedes ls., very analogous in lithologic features to upper Archimedes ls. [described by Shumard as thin beds of gray ls. and bluish marl highly charged with fossils], occurring, however, in thick beds. Inferior part shades almost imperceptibly down into St. Louis ls. Underlies Ferruginous ss. [Aux Vases ss.] and overlies St. Louis ls.

In subsequent repts the use of *Ste. Genevieve ls.* was for many years confined to Mo., where the beds, usually not specifically named, were included in St. Louis ls., the †Ferruginous ss. (Aux Vases ss.) being treated as basal fm. of overlying Chester group. J. A. Gallaher, however, in 1898 (5th Bien. Rept. Mo. Bur. Geol. and Mines) and 1900 (Mo. Geol. Surv. vol. 13) deviated from this definition of St. Louis ls. by treating the Ste. Genevieve as a fm. distinct from the St. Louis and from the overlying rocks of Chester age, as did E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 41–42).

In early Ill. repts the beds later distinguished as *Ste. Genevieve ls.* were usually included, without a name, in St. Louis ls. According to Bain, however (U. S. G. S. Bull. 255, p. 22), the upper beds (later named *Rosiclare* and *Ohara* members of the Ste. Genevieve) were in some early Ill. repts included in Chester group.

In early repts on western Ky. the †Big Clifty ss. was treated as basal fm. of Chester group, and the beds now designated *Ste. Genevieve ls.* were included, without a name, in St. Louis ls. or "group." The typical Big Clifty is now generally considered to be same as true Cypress ss., the prior name, and "Big Clifty" has been discarded. In 1903 (U. S. G. S. Bull. 213, pp. 207–208) E. O. Ulrich separated, as a distinct fm., the upper 200 to 250 ft. of St. Louis ls. of western Ky. and named it "Princeton ls." He excluded his Princeton ls. from overlying Chester group.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., pp. 109–111, by E. R. Buckley and H. A. Buehler; U. S. G. S. Bull. 225, pp. 507–508, by H. F. Bain, relating to lead and zinc deposits of southern Ill. and western Ky.) and 1905 (U. S. G. S. Bull. 255, pp. 17–27, by H. F. Bain; and U. S. G. S. P. P. 36, by E. O. Ulrich and W. S. T. Smith; both relating to southern Ill. and western Ky.), included Ste. Genevieve ls. of western Ky. and southern Ill. in Chester group; divided the Ste. Genevieve into 3 members, named (descending) Ohara ls., Rosiclare ss., and Fredonia ls.; called the overlying ss. *Cypress ss.*, and correlated this ss. with Aux Vases ss. of Mo. and with Big Clifty ss. of Ky.

In 1907 (geol. map of Ill. and Ill. Geol. Surv. Bull. 6) S. Weller excluded Ste. Genevieve from the Chester; stated that it had not usually been distinguished from the St. Louis; that lithologically it closely resembles the St. Louis, although it contains oolitic beds, which the St. Louis does not; and that it is perhaps less cherty than the St. Louis; also that main distinction btw. Ste. Genevieve and St. Louis is faunal, the Ste. Genevieve containing recurrent Salem (Spergen) forms, which are older than St. Louis and which are absent from the St. Louis. He also reported an uncon. btw. the Ste. Genevieve and the overlying ss. (*Cypress*, as he then called it). In some subsequent Ill. Geol. Surv. repts Ste. Genevieve ls. and Cypress ss. were both excluded from Chester group, and also treated as distinct from Meramec group. The Ste. Genevieve was treated as distinct from both Chester group and Meramec group in Ill. repts until 1920, when S. Weller (Ill. Geol. Surv. Bull. 41) definitely included it in Meramec group.

In recent years a voluminous literature has appeared on the strat. subdivisions of Chester group in Miss. Valley region and their correlation, and on the subdivisions and proper classification of Ste. Genevieve ls. Detailed work has proved, to the satisfaction of most if not all geologists, that true Cypress ss. is not same as Aux Vases ss., but is a younger ss. in Chester group of Ill. and Ky., and that it is same as Big Clifty ss. of Ky., which is now discarded. But the limits of Ohara ls. and the classification of Ste. Genevieve ls. (i. e., whether it properly belongs in Chester group or in Meramec group) are matters about which there has long been considerable difference of opinion. It seems to be agreed that the typical Ste. Genevieve is uncon. overlain by Aux Vases ss. and uncon. underlain by St. Louis ls. In western Ky., however, the ss. overlying the Ste. Genevieve and formerly called "Cypress ss.," also "Big Clifty ss.," is now known to be older than true Cypress (=type Big Clifty) and is called *Bethel ss.* by Ulrich and Butts, who consider it is same as typical Aux Vases ss. of Mo., but which S. Weller contended is a younger ss. and=his Yankeetown chert of eastern Mo. and southern Ill. Weller also contended that upper part of Ohara ls. is=Renault fm. of Ste. Genevieve Co., Mo., which is much younger than typical Ste. Genevieve ls. The Ste. Genevieve ls. of S. Weller includes only lower part of Ohara ls. memb., and the Rosiclare ss. and Fredonia oolite members of Ulrich. The interpretation of Ulrich and Butts is that all of Ohara ls. memb. is present at its type loc. and that the upper part of type Ohara ls. memb. underlies a ss. (Bethel) that they consider to be=Aux Vases ss. of Mo., which overlies typical Ste. Genevieve ls. They also consider the Ste. Genevieve fauna to be more closely related to overlying Chester faunas than to underlying St. Louis fauna; and they consider the uncon. (present everywhere) at base of Ste. Genevieve to be of greater value than the uncon. (present in places only) at top of the Ste. Genevieve.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430–442), adhered to correlation of upper part of Ohara ls. memb. with Renault fm., and introduced *Levias* for the lower part of the Ohara, which they treated as top memb. of Ste. Genevieve ls.

The U. S. Geol. Survey formerly included Ste. Genevieve ls. in Chester group, but in May 1937 it transferred so-called "Upper Ohara" of repts to Renault fm. of Chester group and transferred the remainder of Ste. Genevieve ls. to Meramec group.

Named for outcrops in Miss. River bluffs 1 or 2 mi. below Ste. Genevieve, Ste. Genevieve Co., Mo.

†Ste. Genevieve sandstone. (In Chester group.)

Mississippian: Central eastern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 37) and 1900 (Mo. Geol. Surv. vol. 13, p. 168). *Ste. Genevieve ss.*—Massive yellow-brown ss., quarried 4 mi. below Ste. Genevieve and used in construction of Eads Bridge at St. Louis. Underlies Kaskaskia ls. and overlies St. Louis ls.

Same as Aux Vases ss., older name.

Named for exposures at Ste. Genevieve, Ste. Genevieve Co.

†Ste. Genevieve group.

Mississippian: Missouri, Illinois, western Kentucky.

C. R. Eastman, 1903 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 39, No. 7, p. 195), used *Ste. Genevieve group or stage* to include Chester, St. Louis, and Warsaw in Miss. Valley.

†Ste. Genevieve group.

Mississippian: Missouri, Illinois, and Iowa.

H. S. Williams, 1922 (Pan-Am. Geol., vol. 37, No. 1, pp. 39–40; posthumous paper; written for publication in Bull. 3 of Mo. Geol. Surv. (which was published in

1890), but withdrawn from page proof and suppressed). *Ste. Genevieve group.*—Name and classification proposed to include the fms. whose faunas have been described under the names *Warsaw* (in part), *St. Louis*, *Chester*, *Kaskaskia*, *upper Archimedes*, *Ferruginous ss.*, and their equivalents in Mo., Ill., and Iowa; and particularly defined, under the name "Archimedes group," by B. F. Shumard in his rept. on geol. of Ste. Genevieve Co., Mo.

Preoccupied by *Ste. Genevieve ls.* Replaced by Chester group and Meramec group.

Apparently named for Ste. Genevieve Co., Mo.

St. George formation.

Pliocene (?): Northwestern California (Del Norte County).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, p. 135 and map). *St. George fm.*—Northeasterly dipping marine fm. of sss. and shales carrying abundant invertebrate fauna. Thickness exposed near Point St. George, on W. coast of Del Norte Co., somewhat under 100 ft., but is presumably considerably thicker. Lies noncon. on Dothan fm. (Jurassic) and is noncon. overlain by Battery fm. (Pleist.).

St. George series.

Lower Ordovician: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, pp. 24, 46, 99).

St. Helena rhyolite.

Pliocene: Northern California (Sonoma County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 59–87). *St. Helena rhyolite.*—Of varying thickness up to 2,000 ft. Rests conformably on Sonoma tuff.

Apparently named for occurrence on Mount St. Helena, Sonoma Co.

St. James morainic system.

Pleistocene (Wisconsin stage): Southwestern Minnesota.

F. Leverett, 1932 (U. S. G. S. P. P. 161, pp. 94–99). Members not named. Village of St. James, Watonwan Co. stands on it.

St. Jean group.

Middle Cambrian: New Brunswick.

L. W. Bailey and G. F. Matthew, 1872 (Canada Geol. Surv. Rept. 1870–71, pp. 138–148). *St. Jean (John) group*, Lower Sil. Exact synonym of Acadian group [now classified as Middle Camb.].

St. Joe limestone member (of Boone limestone).

Mississippian (Fern Glen): Northern Arkansas, eastern Oklahoma, and southwestern Missouri.

T. C. Hopkins, 1893 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 4, pp. 10, 212, 253–349, pl. 10). *St. Joe ls.*—Prominent bed of fossiliferous red chertless ls., forming basal part of Boone chert and in places merging into overlying gray ls. of the Boone. Body of rock varies from light pink to dark chocolate color, interspersed with white, gray, or pea-green spots. Thickness 0 to 100 ft. Overlies Eureka [Chattanooga] sh., or, in its absence, the Sylamore ss. or still older (Lower Sil.) rocks.

Named for exposures at St. Joe, Searcy Co., Ark.

†St. Joe limestone. (In Shawnee formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., pp. 52–53). *St. Joe ls.*—Rough and many-bedded ls. resting on coal No. 7 and separated from overlying coal No. 8 by 3 in. to 100 ft. of clay sh.

Preoccupied. Probably same as Lecompton ls. memb.

Named for exposures near St. Joseph, Buchanan Co., and because it has contributed more building material to St. Joseph than any other native rock.

St. John group.

Middle Cambrian: New Brunswick.

J. M. Dawson, 1863 (Am. Jour. Sci., 2d, vol. 35, pp. 314-319). Includes St. John shales. Assigned to Dev.

G. F. Matthew, 1863 (Canadian Nat., vol. 8, pp. 241, 247-251). St. John group of New Brunswick is Camb.

Seems now to be classified as Middle Camb.

St. John formation.

Cretaceous: Alberta.

F. H. McLearn, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 16). [Assigned to Cret.; Williams and Bocock, 1932 (Roy. Soc. Canada Trans., 3d ser., vol. 26, sec. 4, p. 210) and Allan and Rutherford, 1934 (Alberta Research Coun. Rept. No. 30, p. 13), assigned this fm. to Lower Cret.

St. Johns slate.

Cambrian: Newfoundland.

J. B. Jukes, 1839 (Rept. on geol. Newfoundland, p. 3); 1840 (Edinburgh New Phil. Jour., vol. 29, p. 107). [No age given.]

J. B. Jukes, 1843 (Gen. rept. geol. Newfoundland, pp. 51+). St. Johns sl. is Camb. (?).

St. Johns shales.

Middle Cambrian: New Brunswick and Newfoundland.

J. W. Dawson, 1863 (Am. Jour. Sci., 2d, vol. 35, pp. 314-319). Included in St. John group [which is now classified as Middle Camb.].

St. Johns moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. (Not same as St. Johns moraine of Winchell (1872), who applied name to the moraine in Ind. and Ohio later named *Salamonie* by Leverett. See U. S. G. S. Mon. 41, p. 509.)

†St. Joseph limestone.

Upper Cambrian: Eastern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 347). *St. Joseph ls.*—Massive ls., 200 or more ft. thick, forming lower part of St. Francois ls. in SE. Mo. Underlies Potosi ls. and overlies La Motte ss.

Includes Elvins fm. and Bonneterre ls.

Named for mines of St. Joseph Lead Co. near Fredericktown.

†St. Joseph formation.

Mississippian: Southeastern Indiana.

P. B. Stockdale, 1929 (Ohio Jour. Sci., vol. 29, No. 4, p. 170). [See under *Borden group*.]

Probably named for St. Joseph, Clark Co.

Replaced by *Locust Point fm.*

St. Kitts gravels.

Age (?): West Indies.

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 537).

St. Landry marble.

Cretaceous (?): Southwestern Louisiana.

E. W. Hilgard, 1873 (Suppl. and Final Rept. Geol. Reconn. La., 1869, p. 12). Remarkably pure ls., of peculiar horizontally banded and fissured structure (whence it has received name of "St. Landry marble") and of fetid bituminous odor when struck. Weathered surfaces show horizontal structure and granular concretionary texture. Thickness of about 8 ft. is visible in pits about 1/4 mi. apart in bed of Nezpique and Boggy Bayou. No fossils found, but assigned to Cret.

Above is only known use of this name. On early maps Nezpique Bayou formed SW. bdy of St. Landry Co. and W. bdy of Acadia Co., but present maps show St. Landry Co. has been divided into Evangeline Co. to W. and St. Landry Co. to E.

St. Laurent limestone.

Middle Devonian (Hamilton): Eastern Missouri (Ste. Genevieve and Perry Counties).

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser., pp. 88, 175). *St. Lorenz*.—Ls. with a few thin ss. layers. Underlies Chattanooga sh. and overlies Beauvais ss.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser., p. 51). *St. Laurent ls.*—Named by [S.] Weller, in unpublished ms. of Mo. Bur. Geol. and Mines. Dominantly lss., but contains some highly aren. layers and some thin seams of pure ss. Overlies Beauvais ss. and is highest Middle Dev. in this area.

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., p. 151). *St. Laurent fm.*—Dominantly ls., but some notable aren. beds are included. Named for exposures along St. Laurent Creek, Perry Co., 3 mi. S. of St. Marys [in Ste. Genevieve Co.], where 275 ft. of these beds are exposed. Overlies Beauvais ss., possibly uncon. Is uncon. overlain by Lower Miss. (Burlington ls.). Carries Hamilton fauna.

St. Lawrence formation.

Upper Cambrian: Southern Minnesota, and Wisconsin, Iowa, and northern Illinois.

N. H. Winchell, 1874 (Minn. Geol. Nat. Hist. Surv. 2d Ann. Rept., pp. 86, 132, 138–157), divided the Paleozoic rocks of Minn. Valley into (descending): Trenton lss. and shales; St. Peter ss.; Lower Magnesian series (including Shakopee ls., Jordan ss., and *St. Lawrence ls.*); and St. Croix ss. The ss. underlying the Shakopee was in this rept miscorrelated with Jordan ss., and the rocks below the ss. were miscorrelated with the ls. at St. Lawrence, Minn., so that St. Lawrence ls. as here *defined* was applied to Oneota dol. of later repts. Winchell herein described the St. Lawrence as a heavy calc. fm. underlying the Jordan ss., and stated that only 14½ ft. of it was exposed at St. Lawrence, the type loc. He also, in another place in same rept, described it as "a great limestone formation which, while it differs considerably from the Shakopee stone, is still a magnesian limestone, and belongs to the same great series. It is harder than the Shakopee limestone, evenly bedded, quartzose, and specked with green. These green specks have somewhat the appearance of coming from metamorphism, yet they are caused by little rounded masses, which, if harder, would seem to have been water-worn and deposited with the sedimentation. They are, however, rather soft, cutting like talc. They exactly fill the cavities in which they lie. In some small portions they almost make up the bulk of the rock, which then has a green compact appearance, as if hornblendic. While the rock is evidently calcareous and magnesian in some parts, and almost destitute of these green specks, it is also siliceous and sharply crystalline." "The thickness of the next member [St. Lawrence ls.] of the Lower Magnesian has not yet been made out. It is visible at St. Lawrence, in Scott County, and at Judson, in Blue Earth County."

N. H. Winchell, 1876 (Minn. Acad. Nat. Sci. Bull. for 1875, pp. 153–155, and Minn. Geol. and Nat. Hist. Surv. 4th Ann. Rept., pp. 30–67), described *St. Lawrence ls.* as consisting of 200 ft. of dolomitic ls. with some distinctly aren. layers and stained with green sand, and as overlain by Jordan ss. and underlain by St. Croix ss., the latter 500 ft. thick. He also stated: "In Fillmore County [Minn.] the St. Lawrence limestone contains near its base a Trilobite bed as described in the Mendota limestone by Irving and which amounts to more than the total thickness of all the members at Madison."

N. H. Winchell, 1886 (Minn. Geol. and Nat. Hist. Surv. 14th Ann. Rept., pp. 334–337) and 1888 (Minn. Geol. and Nat. Hist. Surv. Final Rept., vol. 2, pp. xxi–xxii), from Winona, Minn., to Minnesota Valley, Minn., used the following classification:

Shakopee ls. 20–40.

White ss. 0–40. Has been erroneously described as Jordan ss. Is=New Richmond beds of Wooster.

Magnesian ls. 75–175.

Jordan ss. 75–100.

St. Lawrence ls. (shaly) 0–30. "If the shaly beds [see next item below] with which it is associated, and into which it seems to graduate, be included under this term, it will include beds to the amount of nearly 200 ft."

Sands and sandy shales at least 200.

Dresbach ss.

In several papers published in 1888 N. H. Winchell avoided the use of *St. Lawrence* as a fm. name, but applied it as a memb. under either St. Croix or Mendota. All other geologists down to 1924 applied the name to whole interval btw. Jordan ss. and the ss. variously called St. Croix, Dresbach, and Franconia.

E. O. Ulrich in 1924 (Wis. Acad. Sci., Arts and Lett., vol. 21, pp. 72–84) restricted the name *St. Lawrence* to 20 to 25 ft. of ls. or dol. that forms a part only of the St. Lawrence of previous usage, and treated this restricted St. Lawrence as a memb. of his Trempealeau fm., which had essentially the same limits as St. Lawrence fm. of most repts, but with the addition, at top, of Norwalk ss. memb., the fossiliferous part of the Jordan ss. as usually defined.

C. R. Stauffer, 1925 (Jour. Geol., vol. 33, pp. 699–713), followed the established definition of *St. Lawrence fm*, applying the name to the beds btw. Jordan ss. above and Franconia ss. below, and excluding from it Norwalk ss., which is all of Jordan ss. present at Jordan type loc.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 21–79). *St. Lawrence fm.* should continue to be used to include (descending) Lodi sh. memb., Black Earth dol. memb., and the thin unnamed sh. and ls. locally present at base. The Norwalk ss. is all of overlying Jordan ss. that is present at Jordan type loc. and should be included in Jordan ss. The Mazomanie ss. is same as Franconia ss., which underlies St. Lawrence fm. Trempealeau fm. should be discarded, as it includes all of St. Lawrence fm. and part of Jordan ss.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 6, 21–25). *Trempealeau fm.* includes (descending) Jordan ss. memb., Lodi sh. memb., *St. Lawrence* (Mendota or Black Earth) *dol.*, and a basal greensand and greensand cgl. memb. (0 to 15 ft. thick). It rests (probably with discon.) on Franconia fm. and is overlain by Madison fm. All evidence indicates that the Black Earth, Mendota, and St. Lawrence [restricted] are different expressions of same dol.

The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, adopted, for Ill., Iowa, Wis., and Minn., Trempealeau fm. (expanded to include at top Madison ss. and all of Jordan ss.), and *St. Lawrence memb.* (redefined to include basal unnamed memb. of previous repts) for beds beneath Lodi memb.

W. H. Twenhofel, G. O. Raasch, and F. T. Thwaites, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1687–1744). Trempealeau fm. divided into (descending) Madison memb., Jordan memb., Lodi memb., St. Lawrence memb., and Basal greensand and cgl. memb.

The U. S. Geol. Survey at present defines *St. Lawrence fm.* as underlying Jordan ss. (including Norwalk ss. memb. of Ulrich) and overlying Franconia ss., and divides it into (descending) Lodi sh. memb., Mendota dol. memb., and an unnamed basal memb. of sh. and cgl.

Named for exposures of part of fm. at St. Lawrence, Scott Co., Minn.

St. Lawrence stage.

Pleistocene.

W. Upham, 1895 (Am. Geol., vol. 16, p. 106). Included in Champlain epoch.

†St. Lawrence limestone or dolomite member.

Upper Cambrian: Southern Minnesota and southern Wisconsin.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, p. 547). *St. Lawrence or Black Earth dol.*—Almost exactly like the Mendota. Name proposed by E. O. Ulrich for a memb. of his Trempealeau fm., underlying Lodi dol. or sh. memb. Rests on sandy dolomitic shales of local distribution.

E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett. Trans., vol. 21, pp. 83, 84, 87–90). *St. Lawrence ls.* is proposed for a memb. of Trempealeau fm., 20 to 25 ft. thick, overlain by Lodi sh. memb. and underlain by either the local basal sh. memb. of Trempealeau fm., or, where that is absent, by Mazomanie ss. or Franconia ss. Is the rock exposed at St. Lawrence, Scott Co., Minn.

Same as Mendota dol. memb. of St. Lawrence fm. of U. S. Geol. Surv. classification.

A. C. Trowbridge, W. H. Twenhofel, F. T. Thwaites, and G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc.), expanded the definition of this St. Lawrence restricted memb. by including in it the basal unnamed memb. of Trempealeau fm. of previous repts. But Twenhofel, Raasch, and Thwaites 1935 (Geol. Soc. Am. Bull., vol. 46, No. 11, pp. 1687–1744) recognized a *basal greensand and cgl. memb.* btw. their St. Lawrence memb. and underlying Franconia fm., and stated that in places this basal memb. is separated from overlying St. Lawrence dol. memb. by as much as 15 ft. of glauconitic ss.

†St. Lawrencian terrane.

Pleistocene: New York, New England, and adjacent parts of Canada.

C. H. Hitchcock, 1890 (Am. Geol., vol. 5, pp. 197–200). In Jan. number of Am. Geol. Mr. Jos. F. James endeavors to persuade geologists to use *Laurentian* for the marine Quat. terrane for which Champlain is commonly employed. His reason is that Laurentian (in distinction from Lawrencian) was applied to this terrane by E. Desor "about beginning of year 1851" and before the same name had been suggested for the great fundamental crystalline system of rocks by W. E. Logan. Mr. Desor intended to name the terrane after the valley of St. Lawrence River. The English form is Lawrencian, while the French is Laurentian. Prof. Dana used Laurentian for the Quat. terrane in his presidential address before the A. A. A. S. in 1855, but later, in his Manual of Geol. and elsewhere, used the same word for the crystallines and Champlain for the clays. Now it was evidently intended to name this terrane after the St. Lawrence Valley. Should it not therefore be more correctly written the *St. Lawrencian terrane?* The river is not the Lawrence River, whether written in French or English, and therefore the *St.* should be prefixed. It need hardly be added that with such correct rendering there would never be any conflict with *Laurentian* as applied to the crystalline system. *The term Champlain has been in use for many years to embrace both the littoral and marine deposits now referred to the Columbia.*

St. Leon formation.

Silurian: Quebec (Matapedia Valley).

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 368–385). *St. Leon fm.*—Fine-grained, argill. sss. or siltstones of a gray or greenish gray color. About 1,000 ft. from base is a ls. cgl. at least 100 ft. thick, abundantly fossiliferous. Minimum thickness estimated at 2,500 ft. Basal part of fm. contains ls. lenses indicating transition from Sayabec fm. Underlies (conformably) Causapscal fm. Typically exposed in Amqui River Valley N. of village of St. Leon. Fossils (listed).

†St. Lorenz limestone.

Same as *St. Laurent ls.*, the approved spelling.

St. Louis limestone. (In Meramec group.)

Mississippian: Illinois, southern Indiana, Iowa, Missouri, Kentucky, Tennessee, northern Alabama, and southwestern Virginia.

G. Engelmann, 1847 (Am. Jour. Sci., 2d, vol. 3, pp. 119–120). *St. Louis ls.*—Hard light-yellowish or grayish rock, mostly pure carbonate of lime, in some strata mixed with sand, in others including irregular siliceous masses of a dark color, or light-colored thin siliceous strata; some strata compact and fine-grained; other strata coarser and even completely crystalline. Thickness 200 to 300 ft. Uppermost bed of carboniferous or mountain ls. in eastern Mo. and southern Ill. Overlain by coal-bearing strata. Rests on 50 to 100 ft. of soft, friable light-yellowish ss. with thin coal bed at top.

G. C. Swallow, 1855 (Mo. Geol. Surv. 2d Ann. Rept., pp. 93, 174). *St. Louis ls.*—Hard crystalline gray and bluish-gray cherty ls. with thin layers of argill. sh.: some strata are impure silico-mag. ls., earthy fracture, others compact silico-argill., drab or yellowish gray, conchoidal. Thickness 250 ft. Underlies Ferruginous ss. [Aux Vases] and overlies Archimedes ls. [Warsaw ls.].

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, p. 406). *St. Louis ls.* [restricted] is conformably overlain by Ste. Genevieve ls. [new name] and underlain by Third Archimedes ls. [Warsaw ls.] in Ste. Genevieve Co., Mo. It is 60 to 200 ft. thick. Upper 50 ft. cherty; middle 60 ft. light-gray sandy ls.; lower 20 ft. white, highly oolitic ls. [Spergen ls.].

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines, 2d ser., vol. 2) and 1905 (U. S. G. S. P. P. 36). *St. Louis ls.* [restricted] overlies Spergen ls. (heretofore included in St. Louis ls.) and underlies Ste. Genevieve ls. [This is present commonly accepted definition of St. Louis ls.]

Named for exposures at St. Louis, Mo.

†St. Louis group.

Mississippian: Illinois, Iowa, Missouri, and western Kentucky and Tennessee.

A. H. Worthen, 1866 (Ill. Geol. Surv. vol. 1, pp. 41–43, 83–89). *St. Louis group.*—Fossiliferous lss., 50 to 200 ft. thick, underlying Chester group and overlying Keokuk group (which includes geode bed at top). Includes even-bedded lss. of Alton and St. Louis; concretionary and brecciated lss. of Alton; oolitic ls. 3 mi. above Alton and equiv. beds at Bloomington and Spergen Hill, Ind.; also the faunally related blue calcareo-argill. shales and mag. and aren. lss. at Warsaw, Hancock Co., Ill. Overlain by Ferruginous ss.

Preoccupied by St. Louis ls. Replaced by *Meramec group.*

Named for St. Louis, Mo.

†St. Louis slate.

A name applied in some early repts (see R. D. Irving, U. S. G. S. 7th Ann. Rept., pp. 440–441, 1888) to St. Louis River sl. of NE. Minn. (later replaced by Virginia sl.), of upper Huronian age.

†St. Louis gabbro.

A name applied in some early repts to † St. Louis River gabbro (=Duluth gabbro) of NE. Minn.

†St. Louis conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 79, 83). *Bohemia cgl.*, of Keweenaw series, is same as St. Louis cgl.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 33, 371, 400, 932). St. Louis cgl. is same as Bohemia cgl., top fm. of Bohemian Range group. Occurs on the St. Louis property, Houghton Co.

†St. Louis marls.

A term applied by H. Hinds (Iowa Geol. Surv. vol. 19, p. 339, 1909) to upper part of Miss. rocks in Des Moines Co., Iowa, which he described as resting on St. Louis ls.

†St. Louis amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in lower part of Central Mine group. The mineralized part is the St. Louis lode.

†St. Louis flow.

Includes †St. Louis amygdaloid and underlying trap.

†St. Louis River slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (St. Louis and Carlton Counties).

R. D. Irving, 1883 (U. S. G. S. Mon. 5, p. 384). *St. Louis River slates* are plainly same as Thunder Bay slates, and both are Animikie slates.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pl. 14), mapped these slates as Virginia sl., the approved name.

Named for exposures on St. Louis River, St. Louis and Carlton Counties.

†St. Louis River gabbro.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 143–146; also U. S. G. S. Mon. 5). *St. Louis River gabbro*.—Chiefly coarse orthoclase gabbro, but including also orthoclase-free gabbros and very fine-grained diabase beds. Thickness of gabbro and associated granitic porphyry 6,000± ft. Underlies Duluth group. Included in Keweenawan series. Exposed along N. shore of St. Louis River to Duluth.

Same as Duluth gabbro.

St. Marc limestone.

Middle Ordovician (Trenton): Quebec (Deschambault region).

M. F. Goudge, 1933 (Dept. Mines Ottawa, Mines Branch Pub. 733, pp. 38–54).

A. J. W. Laverdiere, 1935 (Quebec Bur. Mines, Rept. Minister Mines 1934–35, pt. D, pp. 55–58).

Ste. Marie sandstone.

Upper Cambrian: Northern Michigan (Sault Ste. Marie region).

W. E. Logan, 1863 (Canada Geol. Surv. Rept. Prog. to 1863, p. 196), described the ss. at Sault Ste. Marie as *Ste. Marie ss.*

See also *Sault St. Mary sss.*

†St. Mary formation.

Tertiary? (Eocene?): Northwestern Montana and southwestern Alberta.

An abbreviated form of *St. Mary River fm.* that has been used by some geologists.

St. Mary River formation.

Upper Cretaceous: Northwestern Montana and southwestern Alberta, Canada.

G. M. Dawson, 1883 (Canada Geol. Surv. Rept. 1880–82, pp. 3B–6B). *St. Mary River series*.—Exposed for many mi. on St. Mary River [SW. Alberta]. Consists of sss., shales, and clays of general grayish or greenish colors. Underlies Willow Creek beds and overlies yellowish sss. and shaly beds with mingled fresh-water and brackish or marine mollusks.

E. Stebinger, 1914 (U. S. G. S. Bull. 540, pp. 330, 332). *St. Mary River fm.* was named by geologists of Canadian Geol. Surv., who first studied the fm. on banks of St. Mary River, Alberta, a few mi. N. of Blackfeet Indian Res. It consists essentially of an irregularly bedded mass of light-gray fresh- and brackish-water clays and sss., the clays making up two-thirds of bulk of fm.; the sss. are in places only partly indurated and not persistent, commonly thinning out and merging into clays within a short distance; some red and variegated clays are present in upper part. Thickness along Little Rocky Coulee, T. 35 N., R. 9 W., and T. 36 N., R. 10 W., is 990 ft. In Blackfeet Indian Res. it is separated from underlying Bearpaw sh. by 360 ft. of magnetite-bearing ss. [now known as *Horsethief ss.*], and is overlain by Willow Creek fm. [of dominantly red color].

St. Marys sandstone.

Upper Cambrian: Michigan (Upper Peninsula) and northeastern Wisconsin.

C. Rominger, R. Pumpelly, and T. B. Brooks, 1873 (Mich. Geol. Surv. Atlas, map of Upper Peninsula), showed *Potsdam or St. Marys* beneath *Calciferous*.

T. B. Brooks, 1880 (Geol. Wis., vol. 3, table opp. p. 450). *The Lower Sil. (St. Mary's) ss.* horizontally caps the highest hills, resting noncon. on Huronian and Laurentian in Menominee iron region, Mich. and Wis. [This ss. is shown in table as overlying Keweenawan copper series. On another page he called it *Potsdam ss.*]

Mich. Geol. Surv. 1916 geol. map of Mich. mapped this ss. as *Lake Superior ss.*

Named for exposures on St. Marys River, E. end of Upper Peninsula of Mich.

†St. Marys epidote.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, p. 25), used *"Epidote Lode," St. Mary's.* In detailed section (pp. 84–85) of St. Mary's mine (sec. 18, T. 55, R. 33, Houghton Co.) he used simply *"Epidote lode."*

According to A. C. Lane (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 431, 490, 1911) this rock is same as †Mesnard epidote, and belongs to Ashbed group.

St. Marys formation.

Miocene: Eastern Maryland and Virginia.

G. B. Shattuck, 1902 (Sci., n. s. vol. 15, p. 906). Chesapeake group is differentiated into 3 well-defined lithologic fms., named (ascending) Calvert, Choptank, and *St. Mary's* fms. An uncon. exists btw. the Calvert and the Choptank. These have been mapped in great detail throughout southern and eastern Md. Each has a clearly defined fauna.

W. B. Clark, 1903 (Md. Geol. Surv. St. Marys Co. Atlas). *St. Marys fm.*—Fossiliferous sandy clay, clay, and marl, 140 ft. thick. Top fm. of Chesapeake group. Overlies Choptank fm.

Named for development in St. Marys Co. and on St. Marys River, Md.

†St. Marys moraine.

Pleistocene (Wisconsin stage). Name applied by G. K. Gilbert to moraine later named *Fort Wayne*, from its relation to St. Marys River, Ohio, "whose course it governs for about 60 mi." But as town of St. Marys, Ohio, is on an earlier moraine, the name has led to some confusion, and is now replaced by *Fort Wayne.* (See U. S. G. S. Mon. 41, p. 566.)

St. Marys sands.

A. W. Grabau (Jour. Geol., vol. 17, p. 211, 1909) casually alluded, in one place, in parentheses, to the basal sands of the Beekmantown of Lake Ontario region as *St. Marys sands.* This is only record of this name.

St. Maurice sand.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 225).

†St. Maurice formation. (In Claiborne group.)

Eocene (middle): Northwestern Louisiana and southwestern Arkansas.

G. D. Harris, 1910 (Sci., n. s., vol. 31, p. 502). In preparing ms. for publication on lower Tertiaries of La., it has seemed desirable to have a formation name for that portion of the Eocene usually styled in our former publications "Lower Claiborne." The geographic name *St. Maurice fm.* is here proposed for these well-known Mississippi embayment marine beds.

The St. Maurice as defined in subsequent repts was treated as lower fm. of Claiborne group in NW. La. and SW. Ark., and was described as consisting of 200 to 550 ft. of argill. lss., calc. clays, calc. glauconite, with a large amount of ferruginous matter, and as underlying Yegua (†Cockfield) fm. (the upper fm. of Claiborne group) and overlying Wilcox group. More recent work resulted in dividing these deposits into 3 fms., in descending order, Cook Mtn fm., Sparta sand, and Cane River fm. The Cook Mtn fm. has also been called *St. Maurice fm.* (by Spooner), *Minden fm.* (by Campbell), and *Mount Lebanon fm.* (by Shearer): but the U. S. Geol. Survey has adopted the older name, *Cook Mtn fm.*, and discarded the more recent names that have been applied to these beds.

Named for exposures at St. Maurice, Winn Co., La.

†St. Maurice formation (restricted).

Eocene (middle): Northwestern Louisiana.

W. C. Spooner, 1926 (A. A. P. G. Bull., vol. 10, No. 1, p. 7, No. 3, pp. 234-237). St. Maurice fm. of Harris and later writers is here divided into three fms., named (descending) *St. Maurice beds* [restricted], Sparta sand [restricted], and Cane River beds. St. Maurice [restricted] includes the beds above Sparta sand and below Yegua fm., ranges in thickness from 100 to 150 ft., and consists of alternating beds of sands and clays, the sands predominating and ranging in color from light gray to red and brown. The sands are massive, cross-bedded, and laminated, and contain considerably more ferruginous ss. than is present in underlying Sparta sand. The clays are gray, green, red, and brown. The glauconitic beds are usually massive, but the sandier clays and lignitic clays are often laminated. Basal and upper beds are fossiliferous and at least one other fossiliferous horizon occurs btw. these two horizons.

These beds in La. have been called *Minden beds* by Campbell and Miller (1928), *Mount Lebanon fm.* by Shearer (1930), *Crockett* by Ellisor (1929), and *Cook Mtn fm.* They are same as Cook Mtn fm. of Tex., which has priority, and are now known by that name. For a short time the Sparta sand was treated as a memb. of Cook Mtn fm., but that usage is now discontinued, and the Sparta is treated as a distinct fm. by U. S. Geol. Survey.

St. Patrick limestone.

Miners' local name for an ore-bearing ls., 14 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 150 ft. below Hercules ls. of miners and 140 ft. above their North Ada ls. Exposed in St. Patrick claim. (See U. S. G. S. P. P. 173, 1932.)

St. Paul sand.

A subsurface sand, about 30 ft. thick, occurring toward top of Santa Margarita fm. in Coalinga dist., in "vicinity of California Oilfields property, sec. 27, No. 20, and extending down into N. part of sec. 34." Lies about 830 ft. above base of Big Blue serpentinous memb. and from 150 to 600 ft. beneath the surface.

St. Peter sandstone.

Lower Ordovician: Minnesota, Wisconsin, Michigan, Iowa, Illinois, Missouri, Indiana, Ohio, western Kentucky, Kansas, northern Arkansas, and Oklahoma.

D. D. Owen, 1847 (Prel. Rept. Prog. Geol. Surv. Wis. and Iowa, U. S. Gen. Land Office Rept. 1847, pp. 169, 170). Soft white ss. [called *St. Peters soft white ss.* on p. 170] near Lake St. Croix, capped with shell lss. such as form upper portions of hills on Wisconsin River near Prairie du Chien and constitute whole of escarpment of St. Peters Falls as well as bluffs on both sides of the Mississippi, from thence to Carvers Cave and St. Pauls, and therefore sometimes alluded to by us under the local name *St. Peters fm.*

In Upper Miss. Valley region the St. Peter ss. uncon. overlies Shakopee dol. and underlies Platteville ls. In northern Ark. the name *St. Peter ss.* has been misapplied to several sss., the upper of which (called "Upper St. Peter" by E. O. Ulrich) is now considered to be true St. Peter ss.

This upper ss. is overlain by Joachim ls. and is separated from the older Everton ls. (which includes 2 sss. formerly miscalled *St. Peter ss.*) by Jasper ls. The Lower St. Peter of Ulrich in Ark. has been named *Kings River ss. memb. of Everton ls.* (See E. T. McKnight, U. S. G. S. Bull. 853, 1935.) The beds in northern Ark. extending from top of upper or true St. Peter ss. down to top of Powell dol. were called *St. Peter group* by C. L. Dake in 1921.

C. R. Stauffer, 1934 (Jour. Geol., vol. 42, No. 4, p. 352). Minn. River was formerly called *St. Peter's*, and from outcrops near its mouth the St. Peter ss. was named. Type loc. is at Fort Snelling, and type section is that at bluff where Minn. River joins Miss. River. [On p. 354 is a detailed section of the St. Peter at Fort Snelling, footing 163 ft., resting on Shakopee dol. and overlain by 3 ft. of Glenwood beds, succeeded by 25 ft. of Platteville ls.]

F. C. Edson, 1935 (A. A. P. G. Bull., vol. 19, No. 8, pp. 1110, 1119, etc.). In Minn. and in Ozark region the beds overlying St. Peter series were formerly correlated with Stones River group, but are now known to be Black River in age. In both regions strata of Beekmantown age underlie the St. Peter series. In the east the Black River and Chazyan groups are present, but St. Peter series is absent. In these 3 type outcrop regions there is no evidence to support the generally accepted belief that the St. Peter-Buffalo River ss. series is pre-Chazyan in age. Work up to present indicates that when studies are completed the St. Peter series will be found in Okla. beneath beds of known Black River age, *and above beds of known Chazyan age*. Writer doubts presence of true St. Peter ss. in Ky. and Ohio.

Named for exposures on St. Peter River [see map in D. D. Owen's 1852 Rept.], now called *Minnesota River*, southern Minn.

†St. Peter group.

Lower Ordovician: Missouri.

C. L. Dake, 1918 (Mo. Bur. Geol. and Mines vol. 15, 2d ser.). Until recently *Everton* was included in St. Peter ss. North of Cedar Hill and S. of Brewerville, Perry Co., the dol. layers of Everton fm. disappear and underlying Everton and St. Peter ss. come together to form a single ss., 75 to 100 ft. thick. Where the lss. are absent it is nearly impossible to separate St. Peter and Everton.

C. L. Dake, 1921 (Univ. Mo. School Mines and Met. vol. 6, No. 1). *St. Peter group.*—In southern Mo. and Ark. the St. Peter fm. rests on Everton dol., except locally. Farther N., where the Everton thins out and disappears, the two sss. [St. Peter ss. and basal sandy beds of Everton ls.] come together and are wholly indistinguishable. In this area it is not practicable to attempt any separation, and while it is certain that the equivalents of both fms. are present, the term St. Peter is still used to refer to both, and includes all beds below Plattin ls. and above Powell dol., which are correlated with St. Peter ss. of Wis.

St. Peters sandstone.

Same as *St. Peter ss.*, the present approved spelling.

†St. Peter's shell limestone.

A name applied by D. D. Owen in 1848 (Rept. geol. reconn. Chippewa land dist. of Wis., etc.) and 1852 (Rept. Geol. Surv. Wis., Iowa, and Minn.) to the Platteville ls. of current nomenclature.

St. Piran sandstone.

Lower Cambrian: Alberta and British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 4). *St. Piran fm.*—Mainly gray qtzitic sss. with a few bands of siliceous sh. Thickness at Mount St. Piran 2,640 ft.; 300+ ft. at Mount Bosworth, B. C., and 500+ ft. at Castle Mtn. Alberta. Type loc. on SE. slope of Mount St. Piran. Lower Camb. fossils in upper part. Underlies Mount Whyte fm. and overlies Lake Louise fm.

St. Regis formation. (Of Ravalli group.)

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and northwestern Montana.

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277-285). *St. Regis fm.*—Shallow-water sss.; generally flaggy or shaly; usually fine-grained and much indurated;

mostly green and purple. Thickness 800± ft. Underlies Wallace fm. and overlies Burke fm. Description of general geology of region is based almost wholly on work of F. C. Calkins. Named for exposures in vicinity of St. Regis Pass, SE. part of Coeur d'Alene dist., Idaho.

†St. Stephens division.

†St. Stephens formation.

†St. Stephens group.

†St. Stephens limestone.

Oligocene and upper Eocene: Southern Alabama.

T. A. Conrad, 1856 (Phila. Acad. Nat. Sci. Proc., vol. 7, pp. 257–258). [This rept lists "groups of characteristic fossils" from "Newer Eocene" and "Older Eocene" of Miss. The upper two fossil groups (8 and 7) are designated *Vicksburg group*. Of fossil group No. 6 author says: "*Pecten poulsoni, Orbitolites mantelli.* Is probably synchronous with Orbitolite ls. of St. Stephens, Ala., as its two most prominent fossils are very abundant in this stratum at Vicksburg. Convenient to designate this *St. Stephens group*." Of fossil group No. 5, which he makes basal group of his "Newer Eocene," he says: "*Ostrea georgiana* (?). Lowest bed exposed in bank of Mississippi River at Vicksburg." The ls. is more fully described in Ala. Geol. Surv. Rept. on Coastal Plain, pp. 107–122, 1894.]

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala. with explanatory text), defined *St. Stephens (White ls.)* as including Vicksburg and Jackson, as consisting of 150 ft. of soft white ls. underlain by 50 ft. of argill. lss. containing *Zeuglodon* bones, and as overlying Claiborne group and underlying Grand Gulf fm. In subsequent repts (58th Cong., 1st sess., S. Ex. Doc. 19, 1903, pp. 12–20; U. S. G. S. Bull. 225, 1904, pp. 434–447; U. S. G. S. Bull. 243, 1905, pp. 71–81) he divided *St. Stephens ls. or white ls.* into (descending): (1) Upper or Salt Mtn div., (2) middle or *St. Stephens div.*, and (3) lower or Jackson div.

J. E. Brantly, 1920 (Ala. Geol. Surv. Bull. 22). *St. Stephens group*.—Consists of (descending): (1) Coral or Salt Mtn ls., hard white ls. 150 ft. thick, exposed at Salt Mtn, Clarke Co.; (2) Vicksburg fm., hard crystalline to soft white pulverulent ls., 140± ft. thick; and (3) Jackson fm., soft impure ls. with thin strata of harder ls. and thin beds of clay, 60 to 1,200 ft. thick. Overlies Gosport greensand and underlies Catahoula fm.

The rocks in SW. Ala. (the type region) to which *St. Stephens* has been applied are now divided into:

Vicksburg group	Byram marl 0 to 35 ft. Glendon fm. 0 to 100 ft. Marianna ls. 0 to 90± ft. Red Bluff clay 0 to 40 ft.
Jackson fm.	Yazoo clay memb. 16 to 65 ft. Cocoa sand memb. 6 to 70 ft. Calc. clay 30 to 50 ft. *Periarchus*-bearing bed 1 to 10 ft.

Named for exposures in bluff at St. Stephens, Washington Co.

†St. Thomas sandstone.

Lower Ordovician: Central Missouri (Cole County).

J. A. Gallaher, 1900 (Mo. Geol. Surv. vol. 13, p. 124). *St. Thomas ss.*—Generally massive qtzite, having in places oolitic structure. Underlies Second Calciferous [of Gallaher] and overlies First Calciferous [of Gallaher].

The 1922 geol. map of Mo. shows that rocks at and near St. Thomas are Roubidoux fm. and Jefferson City dol.

J. Bridge, 1930 (personal communication), states that St. Thomas ss. of Gallaher is Roubidoux fm.

Named for St. Thomas, Cole Co.

St. Wendell sandstone.

Pennsylvanian: Southwestern Indiana (Knox County) and adjacent parts of Illinois.

M. M. Fidlar, 1933 (Ind. Acad. Sci. Proc., vol. 42, p. 137). [See under *Parker fm., Fidlar, 1933.*]

M. A. Harrell, 1935 (Ind. Dept. Cons. Pub. No. 133), gave a table in which he showed (but did not define the units) the following subdivisions of the *Wabash* in Ind. (downward): New Haven fm., Buffkin fm., Grayville fm., McClearys Bluff fm., Friendsville fm., *St. Wendells fm.*, and Parker fm.; and also showed Wabash as resting on Merom ss.

†Sakonnet sandstone.

Pennsylvanian: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 357–365, and map, pl. 31). *Sakonnet ss.*—Shales with a predominating amount of dark-gray or blackish sss. and fine cgl. which form upper part of Aquidneck series on E. side of Sakonnet River and also across Portsmouth and Middletown Twps on W. side of Sakonnet River. They correspond to upper green shales of Aquidneck series of other parts of Narragansett Basin. Thickness 110 to 300 ft. East of river some of the sss. contain scattered pebbles, or even thin streaks of cgl. Overlie the dark-blue shales of Aquidneck series and underlie Purgatory cgl. [Mapped as a distinct fm.]

A part of Rhode Island fm.

Salada formation.

Pliocene: Mexico (Lower California).

A. Heim, 1922 (Geol. Mag., vol. 59, p. 544).

Salado halite.

Permian (upper): Delaware Basin and Pecos Valley of southeastern New Mexico and western Texas.

W. B. Lang, 1935 (A. A. P. G. Bull., vol. 19, No. 2, pp. 262–270). In 1923 writer recognized that the salt section of Delaware Basin is divisible into 2 major units, and orally introduced the terms "upper salt series" and "lower salt series," the basis for the separation at that time being that the upper series was shaly, pinkish, and by analysis showed more than 1 percent of K_2O, while the lower series has a dull-grayish appearance and on analysis yields less than 1 percent of K_2O. The upper salt series is dominantly rock salt with massive anhydrite beds, redbeds, shaly sands, and prominent beds and lenses of polyhalite that are characteristic of this fm. only. Although this upper salt series underlies an area of over 60,000 sq. mi. it has no known outcrop, the nearest approach to an outcrop being in eastern Culberson Co., where weathering has so deeply altered the anhydrite to gyp. that if the disrupted anhydrites of the upper series were present they would be difficult to recognize. The name *Salado halite* is given to this upper salt series, from Salado Wash, in northern Loving Co., Tex., *salado* being the Spanish word for "salted." The fm. has suffered pre-Rustler erosional truncation in Eddy Co., N. Mex., and in Reeves, Culberson, and western Loving Counties, Tex., and has also been affected in those areas where the more prominent reef masses accumulated. In Means well it extends from 920 ft. depth to 2,350 ft. The lower salt series outcrops in Eddy Co., N. Mex., and Culberson Co., Tex. It is the fm. to which Richardson gave name *Castile gyp.* as including all rocks btw. Delaware Mtn and Rustler fms. Richardson was not then aware of what took place in subsurface. As the outcropping gyp. is the lower salt series and but a surficial alteration by weathering of the main mass of anhydrite in subsurface, it seems fitting to apply to the lower salt series the name *Castile anhydrite*. The Castile anhydrite extends downward from 2,350 ft. depth to 4,990 ft., where it is uncon. on Delaware Mtn fm. The Castile in Delaware Basin consists of massive beds of gray anhydrite, clean white rock salt, dolomitic and crystalline lss. that are chemical precipitates, and some sss.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), discriminated *Salado halite* farther N. in Pecos Valley of N. Mex., where it is overlain by Rustler fm. and rests on Castile anhydrite.

Salamanca conglomerate member (of Cattaraugus fm., where Cattaraugus can be separated from Oswayo fm.; of Conewango fm. where Cattaraugus and Oswayo cannot be separated).

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_3). *Salamanca cgl. or Ellicottville rock*.—Physically similar to Panama cgl., but cannot be easily decided whether they occur at same horizon. [On p. 124 he stated Salamanca horizon is 200 to 300 ft. higher than Panama rock. The Panama cgl. is now believed to be older than Salamanca cgl. and to correspond to Wolf Creek cgl.] Assigned to Chemung. [Now considered to be younger than Chemung.]

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 967–989). *Salamanca cgl. lentil of Cattaraugus beds* occurs at about middle of that fm. and varies in thickness from 0 to 40 ft. In Olean quad. it is a hard gray ss. 10 to 15 ft. thick. In Salamanca quad. it is a massive cgl. Bulk of rock is coarse gritty sand. The ss. phase is well exposed in a number of small quarries on Mount Herman, just S. of Olean, where it is locally called *Mount Herman ss.* Is older than Kilbuck cgl. lentil and younger than Wolf Creek cgl. lentil. Separated from Kilbuck cgl. by 50 to 70 ft. of beds and from Wolf Creek cgl. by a considerable thickness of beds. Assigned to Dev. [In same bulletin (pp. 696–699) J. M. Clarke assigned Cattaraugus beds to Carbf.]

L. C. Glenn, 1904 (Geol. Soc. Am. Bull., vol. 14, pp. 522–531), stated that Salamanca, Pope Hollow, and Tuna are same cgl., and tentatively assigned it to Dev.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 425). In N. Y. Salamanca cgl. varies from hard gray ss. to quartz-pebble cgl., with pebbles distinctly flattened. It is not found outside of Cattaraugus Co., but it has extensive distribution in Pa. It has been called "Panama," "Pope Hollow," "Wrightsville," and "Tuna," but Panama cgl. is now believed to be older and=Wolf Creek cgl.

Whether Cattaraugus fm. is late Dev. or early Carbf. is still an open question.

Named for Salamanca "rock city," N. Y.

Salamanca formational suite.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 85–86). *Salamanca formational suite* is composed of 3 members, 2 cgls. and a separating sh. In Salamanca area the cgl. is a single memb., but traced to S. the lower beds of cgl. disappear and sh. replaces them; while still farther S., in Warren Co. and elsewhere in NW. Pa., a lower cgl. memb. which carries typical Salamanca fauna appears. It seems that this lower cgl., which is here named *Bimber Run cgl. memb.*, initiates a suite of cgl. deposition and therefore is justifiably linked with the better-known upper cgl. In this rept the upper cgl., which has heretofore been known as the only representative of the Salamanca, is being considered under the new category of *suite* as the top memb. of a trio of members which is being termed *Salamanca suite*. This grouping better shows genetic relationship and does not violate usage, as the casual worker can still speak of "Salamanca cgl." meaning the medial Venango cgls., which happen to be a unit which is a little more extensive vertically than was previously known. The upper memb. of the suite has figured largely in repts on Pa. geol., especially those discussing relationships of Venango oil sands. The Salamanca suite, or at least the predominant memb., has been widely traced through the region and variously correlated with locally named cgls. N. Y. State Mus. Bull. 69, 1903, pp. 974–977, gives description of typical development of the cgl. in Olean-Salamanca region. Assigned to Dev., and included in Venango stage. [In table opp. p. 60 of this book, the author shows *Salamanca formational suite* as including (descending) Pope Hollow cgl., North Warren sh. memb. (new name), and Bimber Run cgl. memb. (new name), and as underlying Saegerstown sh. memb. and overlying Amity sh.]

Salamanca moraine.

Name applied to a Pleist. moraine in N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, p. 635, 1932.)

Salamonie moraine.

Pleistocene (Wisconsin stage): Northern Ohio and northeastern Indiana. Shown in part on moraine map (fig. 8) in U. S. G. S. Columbus folio (No. 197), p. 12, and in part on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Salamonie River, Ind. Replaces Winchell's name St. Johns moraine, but not St. Johns moraine of Mich.

†Salem syenite.

E. Cornelius, 1821 (Am. Jour. Sci., vol. 3, p. 232), described specimens from *Salem sienite* at Salem, Mass. This syenite is now known as *Beverly syenite*. A. Hyatt, 1877 (Boston Soc. Nat. Hist. Proc., vol. 18, pp. 220–224), applied name *Salem syenites* to rocks now called *Salem gabbro-diorite*.

Named for occurrence in town of Salem, Mass.

†Salem breccia.

Lower Ordovician (early Chazy): Northern central Alabama (Bessemer quadrangle).

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. Cahaba coal field, p. 152). [For definition see †*Birmingham breccia*.]

Name preoccupied. Replaced by Attalla chert cgl. memb. of Chickamauga ls.

Named for exposures in Salem Hills, SW. of Bessemer, Jefferson Co.

†Salem limestone. (Of Meramec group.)

Mississippian: Southern Indiana.

E. R. Cumings, 1901 (Jour. Geol., vol. 9, p. 233; Am. Geol., vol. 27, p. 147). *Salem ls.*—Gray oolitic ls. formerly called *Bedford ls.* (preoccupied). Overlain by bastard ls., which forms basal part of Mitchell ls., and underlain by bryozoal ls. forming upper zone of Harrodsburg ls.

Same as *Spergen ls.*, the name employed by U. S. Geol. Survey. The Ind. and Ill. Geol. Surveys, however, use *Salem ls.* For further explanation see under *Spergen ls.*

Named for Salem, Washington Co.

Salem gabbro-diorite.

Early Paleozoic: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass., pp. 5, 7, 8, 11). *Salem gabbro diorite*, with olivine-bearing gabbro facies. [Gabbro at Nahant treated as distinct fm.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 178–181 and map). *Salem gabbro diorite.*—Includes several types of rock. Most characteristic and widely distributed rock contains quartz, labradorite, hornblende, augite, and biotite, and might be called a quartz-augite diorite, a quartz-hornblende gabbro, or an augite-hornblende tonalite, or, better still, a quartz gabbro-diorite. Grades into quartz diorite and granodiorite and into hornblende diorite and amphibolite. Named for occurrence at Salem. [Gabbro at Nahant treated as distinct fm.]

C. H. Clapp, 1921 (U. S. G. S. Bull. 704), treated gabbro at Nahant as distinct from *Salem gabbro-diorite*, which he stated is intruded by Quincy and Andover granites.

L. LaForge, 1932 (U. S. G. S. Bull. 839), treated the isolated area of *gabbro at Nahant* as part of Salem gabbro-diorite.

Salem limestone. (In Allegheny formation.)

Pennsylvanian: Northeastern Ohio.

W. Stout and R. E. Lamborn, 1924 (Ohio Geol. Surv., 4th ser., Bull. 28, pp. 146–150). *Salem ls.*—Bluish-gray, rather hard and dense ls., blocky in form, of fresh-water origin. Generally siliceous and ferruginous and in places changes into a calc. ss. and in other places into iron ore. Occurs in Allegheny fm., lying 4 in. to 10 ft. below Middle Kittanning coal, and lying on or only a few ft. above Oak Hill clay. Thickness varies from 5 in. to 1 foot 2 in. No fossils except small gastropods.

Named for exposures at Salem, Columbiana Co.

Salem Church granite.

Cambrian: Northwestern Georgia (Tate quadrangle).

W. S. Bayley, 1928 (Ga. Geol. Surv. Bull. 43, pp. 103-108, map). *Salem Church granite.*—White or light-gray gneissoid granite. Intrudes Hiwassee schist and Great Smoky fm., which is believed to be Camb. Occupies about 8 sq. mi., extending a little E. of Sharp Mtn Creek to W. margin of Tate quad. Best seen at Salem Church and to W. and SW.

Salem Point shale member.

Pennsylvanian: Southeastern Nebraska, Kansas, and Oklahoma.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1). *Salem Point sh. memb. of Grenola fm.*—The newly established Grenola fm. is divided into following members (descending): Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls. The Salem Point memb. consists of gray sh. with a thin sandy-limy layer at Roca, Nebr.; of gray argill. sh. with a thin nonfossiliferous sandy zone in southern Nebr. and northern and central Kans.; of gray calc. and sandy sh. thinning to past Hooser, Kans., and Burbank, Okla., becoming red sh. at Fairfax, Ralston, and Pawnee, Okla. It is less organic in origin and therefore less fossiliferous than Legion sh. and Sallyards ls. Thickness 3½ to 10 ft. Type loc., the road cuts at Salem Point, 1½ mi. NW. of Salem, Richardson Co., Nebr.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred this unit to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Salem School limestone member (of Graham formation).

Pennsylvanian: Central northern Texas (Young and Jack Counties).

Wallace Lee (rept completed and soon to be published by Tex. Geol. Surv.). *Salem School ls. memb.*—Yellowish earthy ls. crowded with marine fossils, lying near base of Graham fm. in Jack Co. Thickness 8 in. to 2 ft. Rests on both the channel deposits of Kisinger channel (which comprise basal part of Graham fm.) and on Home Creek ls. memb. of Caddo Creek fm. It is well exposed ½ mi. SE. of Salem School, in SE. part of Young Co., where it lies 5 ft. above Home Creek ls. A short distance S. of Ming Bend School it is 17 ft. above the Home Creek. During the interval represented by the 5 ft. of sh. a channel over 150 ft. deep was eroded and filled. Regional extension of this ls. is unknown, but it was recognized above the Home Creek ls. N. of Finis, at least 1 mi. from margin of the channel. Where Home Creek ls. is absent this ls. has previously been mapped as Home Creek.

Salesville shale member (of Mineral Wells formation).

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, p. 77 and charts). *Salesville sh. memb. of Mineral Wells fm.*—Sandy clays with few lentils of ss. and near base a thin layer of ls. Thickness 150± ft. Underlies Turkey Creek ss. and overlies Lake Pinto ss. Named for small town (in Palo Pinto Co.) N. of Mineral Wells. Well exposed in a number of smaller streams N. and W. of Mineral Wells.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534), followed above definition.

Salida schists.

Pre-Cambrian: Central Colorado (Chaffee County).

W. Cross, 1893 (Colo. Sci. Soc. Proc., vol. 4, in a paper entitled "On a series of peculiar schists near Salida, Colo.," pp. 286-293), casually referred to the schists in several places as *Salida schists*, but evidently did not intend to name them.

†Saliferous epoch.

Time term used by J. D. Dana (early editions of his Textbook of geology) and other writers to cover time during which the rocks of Cayuga group were deposited.

†Saliferous group.

A descriptive term applied in early N. Y. repts to the rocks now known as *Cayuga group*, which includes the salt deposits of the State.

Salina formation. (In Cayuga group.)

Silurian; New York, Michigan, and northern Ohio.

J. D. Dana, 1863 (Man. of geol., 1st ed., pp. 246–251). *Salina period.*—Includes epoch of Galt [Guelph] lss. and Saliferous epoch or that of Onondaga Salt group. Succeeds Niagara period and precedes Lower Helderberg period, which includes at base Tentaculite and Waterlime group. The rocks of the period consist of shales or marls and marly sss., with some impure lss., impregnated with salt and almost destitute of fossils. Thickness 700 to 1,000 ft. in Onondaga and Cayuga Counties [N. Y.], and only a few ft. on the Hudson. In Onondaga Co. the lower half consists of tender clayey deposits called marls and fragile clayey sss. of red, gray, greenish, yellowish, or mottled colors, and upper half consists of calc. marls and an impure drab-colored ls. containing beds of gyp. overlain by an hydraulic ls. [C. S. Prosser, 1890 (Am. Geol.) gave thickness of 1,418 ft. for the Salina.]

Many years ago the Guelph was transferred to Niagara group, in which it is now included.

In 1894 (N. Y. State Geol. 13th Ann. Rept., pp. 15–18) James Hall stated that upper memb. of *Salina "group"* is the waterlime extensively quarried at Rosendale, which is "of gray or drab color and varies greatly in development and thickness along its outcrop." In 1893 Hall called this ls. *Rosendale ls.* In some succeeding repts it was designated as "Salina waterlime." The Salina fm. as mapped by Hall in 1894 and by Merrill in 1901 included †Waterlime group and †Onondaga salt group.

In 1903 (Am. Geol., vol. 31, pp. 160–175) C. Schuchert defined *Bertie fm.* of N. Y. as underlying Cobleskill ls. and overlying *Salina proper*, but he stated: In southern half of Appalachian region Bertie fm. is not lithologically distinguishable from the Salina, and here the latter term is extended to embrace entire interval btw. the Niagara and Manlius, in latter of which Schuchert then included Cobleskill ls.

C. A. Hartnagel in 1903 (N. Y. State Mus. Bull. 69, pp. 1109–1175) divided *Salina beds* into (descending): (1) Salina waterlime 8+ ft. (Bertie fm. of Schuchert; Eurypterid fauna); (2) Wilbur ls., 8 in.; (3) gypseous shales with beds of rock salt in middle; (4) Pittsford sh. (Eurypterid fauna). Overlain by Cobleskill ls. and underlain by Guelph dol. (Niagaran). [The beds in eastern N. Y. that overlie the Wilbur are now called *Rosendale ls.*, and are believed to be = (in part at least) Bertie ls. memb. of Salina fm., which, according to C. A. Hartnagel, 1912 (Hdb. 19), is known to extend as far E. as Otsego Co., N. Y. From top of the Bertie (or Rosendale) to base of the Pittsford (or top of the Guelph) constitute present boundaries of Salina fm.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 337). All workable gyp. deposits of N. Y. are in Salina fm., and also the salt deposits. The Salina deposits of SE. N. Y. were laid down in a separate basin from those of central and western N. Y., and apparently under conditions not conducive to deposition of salt and gyp., but these SE. beds need further exploration.

Basal fm. of Cayuga group. Essentially same as †Onondaga salt group of early repts.

Type loc. Syracuse, N. Y. Named for the salt it contains. Supplies salt wells at Salina, N. Y.

†Salina period.

Time term used by J. D. Dana in early editions of his Textbook of geol. to include the time covered by deposition of beds btw. base of Helderberg and base of Guelph dol.

†Salina waterlime.

A term applied in some early N. Y. repts (N. H. Darton, N. Y. State Mus. 47th Ann. Rept., 1894; and H. Ries, N. Y. State Geol. 17th Ann. Rept., 1899) to "the attenuated eastern extension of the great Salina fm.," consisting of a few ft. of impure mag. ls. or cement rock, with some shaly intercalations, underlying †Tentaculite ls. and overlying Niagara group. Has also been applied to Rosendale and Bertie lss.

†Salina red shales.

A term applied in some early N. Y. repts to lower part of Salina fm., which consists predominantly of soft red sh. but also includes bluish-gray and green sh. and some thin lss.

Salinan.

A time term covering the epoch during which Salina fm. (Sil.) was deposited.

†Salinas shale.

Miocene (middle): Southern California (Salinas Valley region).

W. A. English, 1918 (U. S. G. S. Bull. 691, pp. 219–250). *Salinas sh.*—Probably best known of Calif. Tert. fms. is the marine diatomaceous sh. which extends from Monterey southward. This sh. was known as "bituminous sh." by early Calif. geologists, but is now commonly called "Monterey sh." The name *Monterey* has been adopted as a group name by U. S. Geol. Survey to include the so-called "Monterey sh." and the underlying Vaqueros ss. The name "Monterey sh." is therefore no longer applicable as a fm. name. The name *Maricopa sh.* was used in writer's rept. on Cuyama Valley (U. S. G. S. Bull. 621, 1916) on mistaken assumption that the sh. previously called "Monterey sh." was essentially contemp. with the sh. exposed in vicinity of Maricopa, but latter has since been found to include representatives not only of the sh. previously called "Monterey" in area under consideration, but also of overlying Santa Margarita fm. The name *Maricopa sh.* is therefore not appropriate as a substitute for "Monterey sh." The name *Salinas sh.* is here proposed for the diatomaceous sh. which is well developed on W. side of Salinas Valley within area mapped, and which is believed to extend as a single fm. northward along W. side of the valley to town of Monterey.

This name was abandoned by U. S. Geol. Survey in 1935, being replaced by *Monterey sh.* See W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, pp. 125–148).

Saline Bayou member. (In Claiborne group.)

Eocene: Eastern Texas (Angelina and Sabine Counties) and northwestern Louisiana.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Saline Bayou memb. of Claiborne fm.*—The series of beds that occur at type loc. of St. Maurice fm. on Saline Bayou, St. Maurice, La. As described by L. C. Johnson in 1888 this section is as follows (descending): (1) Detrital material resembling orange sand and consisting of rather stiff clay with pebbles, 1 to 3 ft.; (2) calc. gray clay, 10 ft.; (3) clay, more tenacious and calc., 15 ft.; (4) indurated glauconitic sand with a ferruginous seam at base, 10 ft.; (5) indurated, glauconitic fossiliferous sand, less sandy, and lighter in color than No. 4, 1½ ft.; (6) lignitic sand, 4 ft.; (7) glauconitic sand, 1 ft.; (8) dark lignitic sand, 4 ft.; (9) glauconitic sand, 1 ft.; (10) lignitic sand, 4 ft. Underlies Cockfield memb. and overlies Milams memb. Is top memb. of Harris' St. Maurice and Spooner's St. Maurice fm.

These beds are now treated as top memb. of Cook Mtn fm.

Saline Creek cave conglomerate.

Pennsylvanian: Central Missouri.

S. H. Ball and A. F. Smith, 1903 (Mo. Bur. Geol. and Mines vol. 1, 2d ser., pp. 92–95). *Saline Creek cave cgl.*—Coarse cgl. in matrix of aren. ls., calc. sh., or calc. ss. Thickness 0 to 60 ft. Irregular cave deposits of undet. age, but younger than Burlington ls. and older than or contemp. with Coal Measures. Rests uncon. on Upper Burlington ls. or on Cambro-Ord. fms.

E. N. Babcock and J. Minor, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 1, pp. 22–27). [See 1904 entry under *Graydon ss.*]

Is a channel filling.

Named for exposures on Saline Creek, Miller Co.

Salineno sandstone member (of Fayette formation).

Eocene (upper): Southern Texas (Starr County).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, pp. 1375, 1383, 1387). [See under *Los Guerras ss. memb.*, basal memb. of Fayette fm., which is said to be same ss. Crops out at Salineno, Starr Co., Tex.]

Saline River formation.

Cambrian: Canada (Mackenzie).

M. Y. Williams, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. B, p. 77).

†Salisbury schist.

Ordovician (?): Northwestern Connecticut (Salisbury-Canaan region).

A local name applied by J. D. Dana (Am. Ass. Adv. Sci. Proc., vol. 22, pp. 25–27, 1874) to the schist overlying Stockbridge ls. in Salisbury, NW. Conn., which was mapped as Berkshire schist by H. E. Gregory and H. H. Robinson (Conn. Geol. and Nat. Hist. Surv. Bull. 7, 1907).

W. M. Agar, 1932 (Am. Jour. Sci., 5th, vol. 23, pp. 31–48). *Salisbury schist.*—A schist with a variety of structural and petrographic types, that overlies Stockbridge ls. (probably of Ord. and Camb. age) in Salisbury-Canaan region. Has previously been called *Berkshire schist*, but since that is a comprehensive name which includes a number of rocks that may not be related, the name *Salisbury schist* will be applied to it in this loc. It includes the schist composing the ridges E. of Salisbury village and that in Taconic Range and its southern continuation, Indian Mtn. It includes 2 strikingly different types of rock, which, however, clearly grade one into the other. The schist of Canaan Mtn seems to be a different fm. [Long petrographic description of each type of schist. Mapped. Thickness not given.]

†Salkehatchie marl.

†Salkehatchie phase.

Miocene: Southern South Carolina (Colleton County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 18, 19). *Salkehatchie phase.*—During a phase of gradual land elevation, which probably immediately succeeded Edisto phase (but as yet with admitted possibilities of much later origin), the Salkehatchie phase, which comprised a deposit of phosphatic sediments, oozes and glauconites with numerous vertebrate remains, extended over the shoal areas of Edisto (Ecphora Miocene) marls, and contributed to their conversion into the great economic beds of phosphate rock. These deposits also extended over the Oligocene shales along Salkehatchie and Combahee Rivers, and over the Ashley-Cooper marls along upper drainage area of Ashley and Cooper Rivers. [Sloan also called the deposit *Salkehatchie marl.*]

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). The †Salkehatchie marl or "phase" of Sloan is included in Hawthorn fm., and name is abandoned.

Named for exposures along Salkehatchie River.

Sallisaw marble.

Silurian: Central eastern Oklahoma (Sequoyah County).

C. Schuchert, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 670). [In a section of the rocks near Marble City, Sequoyah Co., Okla., he describes a white ls. of upper Oriskanian age, 5 to 8 ft. thick, containing a large fauna, and resting uncon. on middle Sil. *St. Clair marble or Sallisaw marble of Taff*. The compiler has been unable to find that Taff ever published the name Sallisaw.]

Sallisaw sandstone.

Middle Devonian: Eastern Oklahoma (Cherokee County).

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ, pp. 24+ and map). *Sallisaw ss.*—A calc. ss. of earliest Middle Dev. age which occurs in vicinity of Marble [Sequoyah Co.?], where it has been mapped with Sylamore ss. Inasmuch as true Sylamore is herein considered to be of Miss. age, the beds containing the Middle Dev. fossils are separated from the Sylamore, and given the name *Sallisaw ss.*, from exposures along Sallisaw Creek. Distribution unknown. The fossils were found in one place only. The ss. is probably present only as remnants beneath true Sylamore ss. Further collecting may prove the entire calc. basal Sylamore to be Sallisaw ss. Overlies Frisco ls. uncon. and uncon. underlies Sylamore ss.

Sallyards limestone member.

Pennsylvanian: Southeastern Nebraska, Kansas, and northern Oklahoma.

G. E. Condra and C. E. Busby, 1933 (Nebr. Geol. Surv. Paper No. 1). *Sallyards ls. memb. of Grenola fm.*—The newly established Grenola fm. is divided into following members (descending): Neva ls., Salem Point sh., Burr ls., Legion sh., and Sallyards ls. The Sallyards memb. is fossiliferous massive earthy ls. at Roca, Nebr.; in southern Nebr. and northern Kans. it is shaly, fossiliferous, and limy; in Okla. it is impure ls. grading into ss. Its numerous pelecypods at most points indicate that it is a near-shore marine deposit. Where there is a comprehensive fauna (as at Sallyards, Grenola, and Hooser, Kans.) it is more typically marine. Thickness 6 in. to 3 ft. 6 in. It rests on Roca sh. Type loc., S. bank of ravine 1 mi. NE. of Sallyards, Greenwood Co., Kans.

G. E. Condra, 1935 [see under *Roca sh.*]. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), assigned Grenola fm. to Perm. This change in Perm.-Penn. bdy has not been considered by U. S. Geol. Survey for its publications.

Sallyards sand.

Subsurface unit. The main producing sand of Sallyards oil field, Greenwood and Butler Counties, Kans., which lies in Cherokee sh., about 300 ft. below Fort Scott ls. Also called *Blankenship sand.*

Salmon hornblende schist.

Pre-Cambrian (?): Northern California (Trinity and Shasta Counties).

O. H. Hershey, 1901 (Am. Geol., vol. 27, pp. 225–245). *Salmon hornblende schist.*—Of remarkable uniformity throughout its thickness of probably not less than 2,500 ft. Largest area of this schist is traversed by south fork of Salmon River btw. its head and vicinity of village of Cecilville.

According to J. S. Diller (unpublished report on Weaverville quad.), also H. G. Ferguson, is probably intrusive into Abrams mica schist.

N. E. A. Hinds, 1932 (Univ. Calif. Pub., Bull. Dept. Geol. Sci., vol. 20, No. 11, pp. 375–410), introduced *Siskiyou terrane* to include Abrams and Salmon fms.

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1, 2, p. 82). *Salmon schist* is of eruptive igneous origin except for a few sed. interbeds. Thickness probably 5,000+ ft. In Weaverville quad. it includes notable volumes of chlorite schist.

Salmon series.

A term employed by C. [R.] Keyes to cover pre-Camb. rocks in Cordilleran region interpreted as having been formed during earlier part of Keewatin epoch, called "Coutchiching" by some geologists. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Salmon Arm schist.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 124).

R. A. Daly, 1913 (Canada Geol. Surv. Summ. Rept. 1912, p. 157). *Salmon Arm schist* is pre-Beltian.

†Salmon River sandstone.

Upper Ordovician: Northern New York (Lewis County).

T. A. Conrad, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 58, 62–63). *Salmon River ss.*—Olive-colored ss. characterized by *Pterinea carinata*. Underlies Niagara ss. Separated from older Trenton ls. and sl. by green sl. containing *Agnostis pisiformis*. [Includes Oswego ss. and Pulaski sh., according to A. F. Foerste (Canada Dept. Mines, Geol. Surv. Mem. 83, pp. 4–13, 1916).]

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Ann. Rept., p. 374). *Salmon River ss.*—Gray and greenish (latter prevailing in lower part and former in upper part) sss.; frequently a thin coating of green sh. on lower layers, with and without markings or configurations like fucoids. Forms falls of Salmon River in town of Orwell and above Redfield village. Underlies Medina ss. and overlies Pulaski shales. [Same as Oswego ss.]

†Salmon River sandstones and shales.

Upper Ordovician: New York.

T. A. Conrad, 1840 (N. Y. Geol. Surv. 4th Rept., p. 201). By the name *Salmon River sandstones and shales* I have indicated a fm. which overlies and immediately succeeds the Trenton ls. series and was the first to show that it possessed a distinct group of fossils very different from those above or below it.

Includes Oswego ss. and Pulaski sh.

Salmon River monzonite.

Tertiary (Miocene ?): Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 7, 117° to 117°30'). *Salmon River monzonite* (*stock*), Tert. (?). [Lies short distance to E. of Salmon River, B. C., not far N. of Int. Bdy.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 304). *Salmon River monzonite*, Mio. (?).

Salmon River conglomerate.

Jurassic: Northwestern British Columbia (Salmon River district).

S. J. Schofield and G. Hanson, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, p. 8). *Salmon River fm.*—Cgl., 300+ ft. thick, conformably underlying Nass fm. and conformably overlying Bear River fm.

Salmontrout limestone.

Middle Devonian: Northeastern Alaska (Porcupine River region).

E. M. Kindle, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 262, 325–327). Lowest div. of Dev. in Porcupine Valley is fossiliferous ls., 325± ft. thick, massive, light gray to blue, weathering buff, and much broken by joints. Rests apparently uncon. on black Sil. graptolite shales and is overlain by brown sh., probably several hundred ft. thick and believed to be Upper Dev. The ls. outcrops on both banks of Porcupine River immediately above Salmontrout River, and hence is named *Salmontrout ls.* It contains Middle Dev. fauna [listed].

Salona formation.

Middle Ordovician: Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 404, 420). *Salona fm.*—Basal fm. of Trenton group. Consists of 240 ft. of black argill. lss., very different from underlying lss. of Stones River group and lithologically and faunally different from overlying Coburn fm. of Trenton group. Appears to attain max. thickness at Salona [Clinton Co.].

R. R. Rosenkrans, 1933 (Wash. Acad. Sci. Jour., vol. 23, No. 9, pp. 414–415), gives detailed section of *Salona fm.* in central Pa., where he shows it resting on Rodman ls.

Salt sand.

Drillers' term. Has been applied in SW. Pa. to Homewood ss. memb., to Connoquenessing ss. memb., to Homewood and Connoquenessing sss. combined, of Pottsville fm.; to Clarion and other ss. members of Allegheny fm.; to Mahoning ss. memb. of Conemaugh fm.; to Burgoon and other ss. members of Pocono fm.; to Maxton sand of Ky.; and to Murrysville sand of Pocono fm. Also to a sand of Penn. age in Okla.

†Salt Creek gravel beds.

Pleistocene: North-central Kansas.

W. N. Logan, 1897 (Kans. Univ. Geol. Surv. vol. 2, p. 218). *Salt Creek gravel beds.*—Gravel bed or cgl. gravel stones derived from disintegration of shales and lss. of upper group of Benton. Lie about 15 ft. above saliferous shales of Upper Dakota, which form bottom of creek bed. Probably later than Tert.

Is lower gravel bed on Saline River. The name has not had further usage.

Named for Salt Creek, Russell Co.

Salt Creek member (of Moenkopi formation).

Lower Triassic: Northeastern Arizona (Holbrook region).

D. Hager, 1921 (Oil possibilities of Holbrook area, NE. Ariz., private publication). *Salt Creek memb. of Moenkopie fm.*—Basal memb. of Moenkopie fm. Consists of 3 to 4 ft. of red sh. (below) and 12 ft. of massive cream to light-brown ss. (above), the latter locally stained pink to red and even dark red in places, but never for any great distance. A good place to study this memb. is at mouth of Salt Creek, mouth of Clear Creek, and at SE. corner of Winslow (where it trends in NE.-SW. direction), and also just S. of Holbrook. Overlies Kaibab ls., where that fm. is present.

Salt Creek marble. (In Blaine formation.)

Permian: Northwestern Oklahoma (Blaine County).

G. G. Suffel, 1930 (Okla. Geol. Surv. Bull. 49, p. 69). A phase of Medicine Lodge gyp. in vicinity of Salt and Bitter Creeks [Blaine Co.] is known as *Salt Creek marble.* It appears to be largely anhydrite.

Salt Creek fanglomerate.

Pleistocene (?): Eastern Utah (southern Wasatch Mountains).

A. J. Eardley, 1933 (Mich. Acad. Sci., Arts, and Lett., vol. 18, pp. 310, 336). *Salt Creek fangl.*—A thin fm. uncon. overlying the volcanic water-laid deposits and the Jurassic shales in Salt Creek Canyon, southern Wasatch Mtns. From main highway it can be seen as a red capping on W. side of mouth of Toots Canyon and over the castellated volcanic ash at junction of North Fork and main canyon. Is composed of a mixture of large and small angular rock fragments, rudely sorted, with matrix of red earthy material. Cementation usually poor. Stratification rough and channeled. In most places the fm. is a fangl. No fossils. Separation from Eocene Wasatch cgl. by 2 unconformities suggests late Tert. or Pleist. age for the fangl.

Salt Creek Bend shale. (In Cisco group.)

Pennsylvanian: Central Texas (McCulloch County, Colorado River region).

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 245, 249). *Salt Creek Bend sh.* is here proposed for the strata of Pueblo fm. btw. Stockwether ls. below and Camp Colorado ls. above. Drake called this interval "Bed No. 13." At type loc. (a sharp bend on Colorado River 0.1 mi. E. of mouth of Salt Creek) it is 128 ft. thick and consists of chiefly maroon-colored shales with 2 thin lss. near middle. The lower ls. lies 17 ft. below the upper ls., 90± ft. above Stockwether ls. memb., and consists of 2 ft. of nodular aren. gray ls. weathering greenish. The upper ls. lies 22 ft. below top of Salt Creek Bend memb. and consists of 6 in. of yellow massive ls. that breaks into large rectangular slabs.

Salt Fork division. (In Cimarron group.)

Permian: Central southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 18). *Salt Fork div.*—Lower 900 to 1,000 ft. of Cimarron series. Divided into (descending) Cave Creek gypsums or fm., Flower-pot shales, Cedar Hills sss., Salt Plain measures, and Harper sss. Overlies, probably uncon., Big Blue series, and underlies Dog Creek shales of Kiger div. [In 1897 (Am. Geol., vol. 19, pp. 351–363) Cragin included Dog Creek shales in his Salt Fork div. In 1897 C. S. Prosser excluded Dog Creek shales and Cave Creek gyp.]

C. S. Prosser, 1897 (Univ. Geol. Surv. Kans., vol. 2, pp. 92–94). *Salt Fork fm.* includes beds below Medicine Lodge gyp. down to base of Harper ss.

E. Haworth and J. Bennett, 1908 (Univ. Geol. Surv. Kans., vol. 9, p. 77). *Salt Fork stage* includes (descending) Dog Creek fm., Cave Creek gyp., Glass Mtn fm., and Kingfisher fm. or Harper ss. Underlies Kiger stage and overlies Sumner stage.

This name has not been used in subsequent repts.

Named for Salt Fork, Comanche and Barber Counties, Kans.

Salt Grass shale member (of Pierre shale).

Upper Cretaceous: Northwestern Kansas (Wallace County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7). *Salt Grass sh. memb. of Pierre sh.*—Gray clayey sh., with few thin bentonite beds, medium-sized ls. concretions, many with cone-in-cone structure, and limonite concretionary streaks in abundance.

Thickness 60 ft. Lowest zone in many places contains several layers of light-gray to nearly white ls. concretions and in places irregular bodies of ls. in which *Lucina occidentalis* is very abundant. Overlies Lake Creek sh. memb. of Pierre and lies 600 to 700 ft. below top of Pierre sh. in Wallace Co. Named for Salt Grass Canyon, the southern tributary of Goose Creek in secs. 1 and 12, T. 12 S., R. 42 W.

†Saltillo limestone.

Middle Ordovician: Western Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 33–35, 44). *Saltillo ls.*—Fine-grained gray or bluish-gray ls. layers, 2 to 5 in. thick, interbedded with equal thicknesses of shaly clay. Thickness more than 70 ft. Utica fossils. Underlies Lorraine ls. in Tenn. River Valley. Oldest fm. of Cincinnati group. Typical section at Clifton, Wayne Co.

Same as Hermitage fm., better-established name.

Named for Saltillo, Hardin Co.

Salt Lake formation.

Tertiary (probably Pliocene): Northern Utah and southeastern Idaho.

F. V. Hayden, 1869 (U. S. Geol. and Geog. Surv. Terr. Rept. on Colo. and N. Mex., 3d Ann. Rept., p. 92). In valley of Weber River from Morgan City to Devil's Gate there is 1,200 ft. of sands, sss., and marls, of light color for most part, which I regard as of upper tertiary age. These beds must have not only occupied this expansion of Weber Valley, but also all of Salt Lake Valley, for remnants of it are seen all along margins of mtns enclosing Salt Lake Valley. I found this series of beds so widely extended and so largely developed in Weber Valley and Salt Lake Valley that I have named it *Salt Lake group.*

G. R. Mansfield, 1920 (Am. Jour. Sci., vol. 49, pp. 402–406). *Salt Lake fm.*—[Quoted Hayden's definition, and stated:] This term was introduced into SE. Idaho by A. C. Peale (U. S. G. S. Terr. 11th Ann. Rept., pp. 588, 640, 1879). In above citation the name appears to be used in a strictly geographical sense, with neither a definite implication of lacustrine origin of the beds nor implication of connection with Great Salt Lake. It is true, however, that members of Hayden Surveys did regard these beds as lacustrine. The long usage of the name in this region and fact that it was directly applied by Peale to the beds under consideration make its retention desirable. It has been shown by Gilbert, however (U. S. G. S. Mon. 1, p. 214, 1890), that these deposits long antedate origin of present Great Salt Lake, and it is now believed that the beds, though probably partly lacustrine, are largely of fluviatile origin. They most commonly consist of light-gray or buff-colored cgls. in which matrix is white, relatively soft, loose-textured, and calc. The pebbles (of variable size) are generally of local materials and rather angular, though many are subangular or even rounded. There are also beds of white marls, calc. clays, sss., and grits. Thickness, few in. to 1,000+ ft. Fossils [listed] are few and poor but are regarded as probably Plio. Strat. position indicates later age than Wasatch fm. The fm. is therefore classified as Tert. (Plio.?).

Salt Lake conglomerate.

Quaternary (?): Western Wyoming (Lincoln County).

A. C. Peale, 1879 (U. S. Geog. and Geol. Surv. Terr. 11th Ann. Rept., pp. 552, 612, 641). *Salt Lake cgl.*—At various points in lower valley of Salt River, especially on E. side, there are fragments of a ls. cgl. which is horizontal in position. I have included it with the Quat., although no facts were observed bearing on its age. It abuts against Carbf. lss. The Salt River receives greater portion of drainage of Salt River Range [Wyo.]. [In table on p. 612 he called it *Salt River cgl.*]

Salt Lake tuff.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, p. 64). In Salt Lake region the oldest fm. is Koolau basalt, which is followed by the older parts of the reef ls. Next younger is Fort Shafter gravel. The oldest tuff is next in age and appears to be contemp. with parts of the gravel. The youngest distinct fm. of region is the younger tuff. The 2 tuff fms. are so nearly coextensive in area that they will be called *Lower Salt Lake tuff* and *Upper Salt Lake tuff*. The older tuff is believed to be the product of combined action of Salt Lake, Aliamanu, and Makalapa.

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Salt Lake tuff*.—Subaerial tuff, 300± ft. thick, deposited on dissected Kaena (+95-ft.) terraces on Salt Lake Crater. Is younger than Aliamanu tuff and contemp. with Makalapa tuff. Included in middle part of Honolulu volcanic series [q. v.]. Assigned to late Pleist. [This is Upper Salt Lake tuff of Wentworth.]

Saltlick beds.

Pennsylvanian: Eastern Kentucky (Magoffin, Floyd, and Knott Counties).

W. C. Morse, 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 296, 303). *Saltlick beds*.—Just S. of gap btw. Grassy Creek and Raccoon Branch (Prestonburg quad.) and just NE. of the one btw. Saltlick Creek and Quicksand Creek (Hindman quad.) are impure lss. that might easily be mistaken for Magoffin beds, because of their strat. position so near the Magoffin beds, and also because of their structure at Saltlick-Quicksand gap, where the beds consist of 2 thin layers of ls. separated by a thin interval of sh. Careful study at this gap showed beds lie 35 ft. above Magoffin beds and that they are lithologically different. They lie 127 ft. below Lost Creek ls. Best exposed at head of Saltlick Creek, where they consist of (descending): (1) ls., blue, impure, shaly at top, fossiliferous, 1.3 ft.; (2) shales, blue, carbonaceous, sandy, fossiliferous, 5½ ft.; (3) ls., impure, sandy, blue, ½ ft. Fossils listed. Doubtfully identified also at gap btw. Mare Creek and Buffalo Creek. Extent of Saltlick beds unknown. They have not been recognized outside of 3 gaps mentioned above.

Salt Mountain limestone. (In Wilcox group.)

Eocene (lower): Southwestern Alabama.

D. W. Langdon, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 589–605. See also Ala. Geol. Surv. Rept. Coastal Plain, pp. 107–122, 1894). The uppermost or *Salt Mtn div.* of this group [White Orbitoidal ls.] is seen nowhere E. of typical locality and so does not enter into geol. features of this section of Ala. [E. of Alabama River]. As a matter of fact the character of *Salt Mtn ls.*, composed as it is of corals and species of echini, and the occurrence of this isolated elevation point rather to Salt Mtn being an atoll or coral island built up in Tert. seas, rather than any extensive deposit justifying the constitution of a group. Is top div. of White Orbitoidal ls. and of Eocene. [Later repts. by Langdon and others, gave thickness of *Salt Mtn fm.* as 100 to 150 ft., and defined it as overlying the white orbitoidal Vicksburg ls. (Marianna ls. of modern nomenclature), and assigned it to the †Coral ls.]

C. W. Cooke, 1923 (U. S. G. S. P. P. 133, pp. 1–9), replaced the descriptive name "Coral ls." with *Glendon ls.* and replaced the paleontologic name "Orbitoidal ls." with *Marianna ls.* Both of these lss. are exposed near Salt Mtn, "which is now considered to be a tilted block brought up by the Jackson fault."

B. W. Blanpied, 1932 (9th Ann. Field Trip of Shreveport Geol. Soc., correlation chart at end of book), assigned *Salt Mtn ls.* to a position in lower Eocene Wilcox group btw. Tuscahoma sand and Nanafalia fm. This is now generally accepted as true position of that ls. Its identification at this strat. horizon was ascertained through the study of well logs, and does not involve a redefinition of either *Tuscahoma sand* or *Nanafalia fm.*, because it is not present at type localities of either of those fms., its only known outcrops being at Salt Mtn and at 2 places within a mile of that mtn. (See C. W. Cooke, A. A. P. G. Bull., vol. 19, No. 8, 1935, pp. 1162+, where Salt Mtn ls. is assigned to Wilcox group, lower Eo.)

Named for exposures at Salt Mtn, Clarke Co.

Salt Plain shale. (In Cimarron group.)

Permian: Central southern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 20–24). *Salt Plain measures*.—Red clay shales, probably with some sss., 155 ft. thick, impregnated with salt and constituting what may be regarded as upper or secondary salt measures of Kans. Perm. Overlain by Cedar Hills sss. and underlain by Harper sss. Included in Salt Fork div.

In later Kans. repts (R. C. Moore, 1917 and 1920) this sh. was treated as a memb. of Enid fm.

Named for Great Salt Plain of Cimarron River, Kans.

Salt River cgl.

See under *Salt Lake cgl.*

Saltsburg sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3, p. 22). *Saltsburg ss.*—Named for fine exposures along Conemaugh and Loyalhanna Rivers near Saltsburg [Indiana Co., Pa.]. Thickness 25 to 40 ft. Underlies Berlin(?) [Maynardier?] coal in Fayette and Westmoreland Counties, and overlies Platt (?) [Upper Bakerstown?] coal. Lies 165 ft. above Mahoning ss. and 100 ft. below Morgantown ss.

According to U. S. G. S. folios, also G. H. Ashley, 1908 (Topog. and Geol. Surveys Pa.), the Saltsburg ss. underlies Pittsburgh Reds and lies higher than Cambridge ls. memb.

Saltsburg (Lower) sandstone. (In Conemaugh formation.)

See Reger, 1924, under *Thomas ss.*

Saltsburg formation. (In Conemaugh formation.)

Pennsylvanian: Southwestern Pennsylvania (Punxsutawney quadrangle).

G. H. Ashley, 1926 (Pa. Topog. and Geol. Atlas, No. 65, Punxsutawney quad., pl. 4, pp. 23–24). *Saltsburg fm.* includes beds from base of Ames ls. to base of Bakerstown coal (which is made top of Buffalo fm.).

Saltsburg member. (In Conemaugh formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include (descending) Pittsburgh Reds, Saltsburg ss., Upper Bakerstown coal, Woods Run ls., and Bakerstown coal.

Saltsville chert.

See *Saltville chert*, the correct spelling.

Saltville chert. (In Helderberg group.)

Lower Devonian: Southwestern Virginia.

F. M. Swartz, 1929 (Pa. Acad. Sci. Proc., vol. 3, p. 80), applied name *Saltsville* [Saltville] *chert* to 5 to 60± ft. of beds in SW. Va., which he showed (in section) as overlying Rocky Gap ss. (correlated with Shriver chert and underlying New Scotland ls.), and as doubtfully correlated with basal part of Ridgeley ss. of northern W. Va. and western Md. He applied the name from Tumbling Creek, Va., near Saltsvil'e [Saltville], to Gala, Va., and showed the beds as consisting of chert and ss., with some thin lss., their greatest thickness being in Tumbling Creek section.

Salt Wash sandstone member (of Morrison formation).

Upper Jurassic: Central eastern Utah (San Rafael Swell to northern San Juan County) and central western Colorado.

C. T. Lupton, 1914 (U. S. G. S. Bull. 541, p. 127). *Salt Wash ss. memb. of McElmo fm.*—Gray conglomeratic ss. that crops out in cliffs. In places is lenticular, soft, and friable. Thickness 150 to 175 ft. Top lies 325 to 350 ft. below Dakota ss. [Dakota? now], and base lies 700± ft. above the very cross-bedded coarse gray La Plata ss., the 700 ft. of intervening beds consisting of red ss., thin-bedded above and massive below. [Named for Salt Wash, Grand Co., Utah.]

As a result of detailed work in eastern Utah and western Colo. by several geologists (especially J. B. Reeside, Jr., W. T. Thom, Jr., W. T. Lee, H. D. Miser, A. A. Baker, and J. Gilluly) the so-called "McElmo fm." of some Utah repts is now divided into Morrison fm. above and Summerville fm. below, and the so-called "McElmo fm." of other Utah repts is now divided into Morrison, Summerville, Entrada, and Carmel fms. The so-called "La Plata ss." is also now divided into several fms., and

"McElmo fm." and "La Plata ss." have both been discarded. The base of Morrison fm. is drawn at base of Salt Wash ss. memb. (See U. S. G. S. Press Bull. 6064, Mar. 30, 1926; A. A. P. G. Bull., vol. 11, No. 8, pp. 785–808, 1927; and U. S. G. S. P. P. 150D, Feb. 15, 1928.)

Salt Water Pond series.

Cambrian or pre-Cambrian: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, p. 32).

†Salt Wells group.

Upper Cretaceous (early Montana and late Colorado): Southwestern Wyoming, northwestern Colorado, and northeastern Utah (Uinta Mountains).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 49, 154). *Salt Wells group.*—Sss. or aren. shales, often very friable, producing badlands, with carbonaceous shales and lignitic coal. Thickness 1,800 ft. Underlies Golden Wall ss. (basal memb. of Point of Rocks group) and overlies Sulphur Creek group. [Mapped at and around Salt Wells Station, Sweetwater Co., Wyo.]

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Salt Wells group of Powell as in places=Baxter sh. and in places=Blair fm. and Baxter sh., and of early Montana and late Colorado age. This reconnaissance term has been discontinued.

Saluda limestone. (In Richmond group.)

Upper Ordovician: Southeastern Indiana, north-central Kentucky, and southwestern Ohio (?).

A. F. Foerste, 1902 (Am. Geol., vol. 30, p. 369). *Saluda bed.*—Replaces Madison bed (preoccupied). Includes all material in Richmond group overlying the coral beds, which form its base. These beds usually consist of large numbers of *Columnaria alveolata, Columnaria halli,* and *Calapoecia cribiformis.* Named for Saluda Creek, 6 mi. S. of Hanover, Ind. Although the coral bed is practically absent along Saluda Creek, the section nevertheless is sufficiently distinct to enable anyone to draw line btw. the nearly unfossiliferous base of Saluda bed and the richly fossiliferous beds of the Richmond immediately beneath. The typical exposures must ever remain those at Madison.

A. F. Foerste, 1909 (Denison Univ. Sci. Lab. Bull. 14, pp. 289–324). *Saluda* wedges in btw. Liberty and Whitewater. Includes Madison coral reef at base.

A. F. Foerste, 1910 (Denison Univ. Sci. Lab. Bull. 16, pp. 77–100). *Saluda* includes Hitz layer at top.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17). Hitz layer occurs immediately above the Saluda.

W. H. Shideler, 1914 (Ohio Nat., vol. 14, pp. 229–235). There are two *Columnaria alveolata* reefs at base of Saluda beds, the upper one being 2 ft. thick and lying 6 ft. above the lower one, which is 1 ft. thick. Cumings includes both reefs in his Saluda and identifies the lower one with the reef at base of the Saluda farther N. But, as will be presently shown, it is the upper reef, not the lower, that extends toward the N. and NE. Hence it seems best here to consider the top reef as the base of the Saluda. Even should we base the Saluda with the lower *Columnaria* reef at Madison the result would be but little change, and nowhere could the Saluda be said to be beneath the Whitewater. The Saluda is in part=Whitewater.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21). Hitz ls. belongs to Whitewater, and not to *Saluda.* It contains a typical Whitewater fauna. The Saluda wedge forms a conspicuous bdy in Ind. btw. the Whitewater and the Liberty. In some places the Whitewater is=Whitewater and nearly all of Saluda. The Saluda fails entirely in Ohio. Aside from the Hitz bed the fauna of the Saluda is meager [listed].

A. F. Foerste, 1924 (Canada Geol. Surv. Mem. 138, pp. 7–8). *Saluda* is an aren. phase which during Whitewater time entered SE. Ind. from the SW. It carries a fauna sufficiently distinct from that of typical Whitewater as seen farther N. in Ind. to make it possible to speak of a Saluda fauna and of a Whitewater fauna, though in point of time the Saluda must be included in the Whitewater. The typical Saluda forms an horizon entering as a wedge into the typical Whitewater from the S.

Saluda zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 8, 12). *Saluda zone (partly Archean)* comprises an irregularly shaped area bordered on NW. by Oconee Creek zone, from Tugaloo River to N. C. line; this State line constitutes northerly limit of this zone to head of Gap Creek (near Saluda Gap). It is separated from Tyger zone on SE. by a line extending from Gap Creek southwesterly near Pendleton, and thence to Tugaloo River near long. 83° (above Hattons Ford), whence Tugaloo River completes westerly bdy to initial point. Consists of granite, granite gneisses (some porphyritic), granulite, gneissoid slates and schists, hornblende slates and schists (very prominent), peridotite, dikes of granite, diorite (occasional), pegmatite.

Named for exposures in Saluda Mtn range [S. C. ?].

Salvation sand.

A subsurface sand in Mauch Chunk fm. (Miss.) of SW. Pa.

Salvisa limestone member (of Perryville formation).

Middle Ordovician: North-central Kentucky.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 329). *Salvisa memb.*—Fine-grained fossiliferous ls., usually exhibiting conchoidal fracture; dove-colored to white where typically developed in Mercer and Boyle Counties, but northward does not always possess these characteristics. Thickness 0 to 20 ft. Middle memb. of Perryville div. of Lexington ls. Overlies Faulconer memb. of Perryville and underlies Cornishville memb. of Perryville.

A. F. Foerste, 1914 (Cincinnati Soc. Nat. Hist. Jour., vol. 21, btw. pp. 109 and 145). *Salvisa ls. memb. of Lexington ls.* consists of very fine-grained hard ls. of whitish or light dove color, containing abundant ostracodes. Underlies Cornishville ls. and overlies Faulconer ls.

A. M. Miller, 1914 (Ky. Geol. Surv., 4th ser., vol. 2, pt. 3, btw. pp. 18 and 36). *Salvisa bed* of Perryville memb. is 0 to 20 ft. thick, and generally consists of light-colored fine-grained compact "birdseye" ls. Is the "Upper Birdseye" of Linney. [Miller, 1919 (Dept. Geol. and Forestry of Ky., ser. 5, Bull. 6) and 1925 (Ky. Geol. Surv., ser. 6, vol. 21, pp. 126–142) continued to recognize *Salvisa memb.* as distinct from Cornishville above and Faulconer below, but Foerste, 1924 (Canada Dept. Mines Geol. Surv. Mem. 138, No. 121 geol. ser., chart opp. p. 58), divided Perryville into Cornishville above and Faulconer below. See also under *Perryville fm.*]

Subsequent repts, by other geologists, continue to apply *Salvisa* to the beds below Cornishville memb. and above Faulconer memb.

Named for Salvisa, Mercer Co.

Sam Creek limestone member (of Savanna sandstone).

Pennsylvanian: Eastern Oklahoma (Muskogee County).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Sam Creek ls. memb. of Savanna ss.*—Consists of (descending): (1) Gray ls. containing so many *Marginifera muricata* that it is almost a coquina, 6 in.; (2) gray sh., 3½ ft.; (3) alternating gray ls. and fossiliferous gray sh., the ls. containing *Campophyllum torquium*, 11 ft.; (4) gray ls. with layers of gray sh., 3 ft. 8 in. Total thickness 0 to 18± ft. Named by S. W. Lowman, in ms. in preparation, from exposure in center of W½E½ sec. 15, T. 14 N., R. 18 E., along S. bank of Sam Creek. Occurs as far S. as T. 13 N., R. 18 E. Lies very close below Spiro ss. memb. of Savanna ss. and 40 to 50 ft. above Spaniard ls. memb.

Sample sandstone member (of Gasper oolite).

Mississippian: Western Kentucky.

C. Butts, 1917 (Ky. Geol. Surv., Mississippian fms. of western Ky., pp. 67, 70). *Sample ss. memb.*—Typically exposed 1 mi. E. of Sample, Breckinridge Co., where it consists of 40 ft. of massively bedded ss. It varies greatly in character and thickness in short distances. In highway N. of Sample it consists of 5 ft. of ss. overlain by 15 ft. of coarse sandy, mealy sh. with a few fossils. On a low knob ¼ mi. S. of Sample it is coarse thick-bedded ss. occupying upper 25 ft. of the knob, and its full thickness is unknown. Near East View, Hardin Co., it has

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degenerated to about 20 ft. of sh. and flaggy ss. It lies near middle of Gasper oolite, and is known to be present in Breckinridge, Meade, Hardin, Grayson, and perhaps Hart Counties.

A. H. Sutton and J. M. Weller, 1932 (Jour. Geol., vol. 40, No. 5, pp. 430–442). *Sample ss.* is same as Bethel ss.

Sampson Rock sandstone. (In Pottsville formation.)

Pennsylvanian: Western Maryland (Allegany and Garrett Counties).

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 571). *Sampson Rock ss.* (*Homewood ss.*).—Thick and massive ss., locally conglomeratic. Well exposed at Sampson Rock, W. of Frostburg. Overlies Upper Mercer sh. and fauna. Top memb. of Pottsville fm.

San Andreas limestone.

See *San Andres ls.*, the approved spelling of the geographic feature for which it was named.

San Andres limestone member (of Chupadera formation).

Permian: Central and southeastern New Mexico.

W. T. Lee, 1909 (U. S. G. S. Bull. 389). *San Andreas ls.*—Essentially massive ls., often cherty and poorly fossiliferous, although at several localities fossils were abundant. Thickness 500 ft. This ls. was not included by Herrick in Manzano group, but he refers to it, in his description of region E. of Socorro, as an unfossiliferous ls. overlying Manzano red beds, and includes it in the illustration of his section. The writer, however, found in it fossils which are said to be unquestionably of Penn. [Perm. now] age, and which prove that San Andreas ls. should be included in Manzano group. So far as known at present the San Andreas ls. is uppermost memb. of Manzano group. Typically developed at N. end of San Andreas Mtns. Until further information is available the San Andreas ls. cannot be definitely separated from Yeso fm., except in its type loc. in San Andreas Mtns, where it is 500 ft. or more thick and clearly separable from underlying beds. In Caballos and Fra Cristobal Mtns, to W., and at Carthage, to N., the uppermost ls. of the sections is correlated with some confidence on lithologic evidence with San Andreas ls.; but since the San Andreas fauna is apparently not sufficiently characteristic for purposes of correlation, it is not known whether the capping ls. shown in the sections from other localities is the San Andreas or one of the lss. within Yeso fm. The large coiled shells of the genus *Euomphalus*, the long pencil-shaped scaphopods *Plagioglypta canna* and *Dentalium mexicanum*, and the genus *Aviculipinna* are conspicuous in uppermost lss. provisionally correlated with the San Andreas, but are not entirely absent from the lower ones. The San Andreas ls. differs from the older fms. of Manzano group in having a more restricted geographic range. The beds provisionally correlated with it are well developed in southern part, but become less prominent northward and are not represented in northern part of region described.

N. H. Darton, 1922. [See under *Chupadera fm.*]

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). *San Andres ls. memb. of Chupadera fm.* is here applied to the rocks in Pecos Valley of N. Mex. that were named *Picacho ls.* in 1933; and *Hondo ss. memb. of Chupadera fm.* (above) and *Yeso memb. of Chupadera fm.* (below) are here applied to the rocks designated as *Nogal fm.* in 1933. *Picacho ls.* and *Nogal fm.* are both abandoned. [The recognition of Hondo ss. involves a slight redefinition of both Yeso and San Andres.]

San Angelo sandstone.

Permian: Central northern Texas (Stonewall and adjoining counties).

W. F. Cummins and O. Lerch, 1891 (Am. Geol., vol. 7, pp. 73–77, 321–325). *San Angelo beds.*—Consist of (descending): (1) Lighter-buff and whitish thin beds of loose friable ss. and clays, 50± ft.; (2) series of red and yellow clays and sss., 100± ft.; (3) quartz cgl., 12 ft. Rests uncon. on Red Beds and is uncon. overlain by Trinity sands. Well exposed a few mi. W. of San Angelo, near center of that section of Tex. Lithologically very different from fms. above and below.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, pp. 7–8). *San Angelo beds* are=Blowout Mtn ss. of Wrather, and will replace latter name.

J. W. Beede, 1919 (A. A. P. G. Bull., vol. 3, pp. 117–123). *San Angelo fm.* as exposed in SE. corner of Coke Co. is 125 to 150 ft. thick, and is 400 to 500 ft. thick 4 mi. W. of Robert Lee. Is largely coarse cgl., intercalated with beds of ss. and sh. To NW. the coarse cgl. gives way to finer cgls. and sss. of buffish hue. Farther up Colorado River these beds are of finer texture, and wedges of sh. come in and thicken up btw. the sss. and cgls. Is basal fm. of Double Mtn stage.

J. W. Beede, 1920 (Univ. Tex. Bull. 1847, pp. 3–7). *San Angelo fm.*, basal part of Double Mtn stage in Coke Co., consists of 400 ft. of cgl., sh., and sss., with locally some sheets of gyp. and dol. Rests uncon. on Choza fm. of Clear Fork stage.

J. W. Beede and W. P. Bentley, 1921 (Univ. Tex. Bull. 1850). *San Angelo fm.* uncon. overlies Choza fm. The uncon. may be of very great extent. Is sharply but probably conformably separated from overlying Eskota or Greer beds. Assigned to Perm.

J. W. Beede and D. D. Christner, 1926 (Univ. Tex. Bull. 2607). *San Angelo fm.*, named for its occurrence in central Tex., has been traced from San Angelo, Tom Green Co., to Foard Co., where it is 100 to 160 ft. thick, uncon. overlies Clear Fork stage, and conformably underlies Blaine gyp. Is basal fm. of Double Mtn series. Has also been traced from San Angelo, Tom Green Co., N. to its crossing on Red River, in Wilbarger Co., and thence to Duncan, Okla., where it is continuous with Duncan ss. Is same as Blowout Mtn ss. In central Tex., Okla., and Kans. it is separated from the Blaine by Chickasha fm.

G. G. Henderson, 1928 (Univ. Tex. Bull. 2807). *San Angelo fm.* is 126 ft. thick in Tom Green Co. [type loc.], uncon. underlies Blaine fm., and uncon. overlies Choza fm., top fm. of Clear Fork stage.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13). As described in this paper the Blaine fm. contains considerably more than in Okla. section. The terms "Chickasha fm." and "Dog Creek shales" are not used because the equivalents of these members in Tex., although recognizable in most places, are not especially outstanding. Those beds btw. San Angelo fm. and Whitehorse ss. have been included in the Blaine, as all are similar and obviously belong together. The SW. Okla. section of the Blaine commences approx. 200 ft. above Duncan ss.

The San Angelo being largely ss., the U. S. Geol. Survey has adopted the name *San Angelo ss.*, and recognizes the overlying fm. as the Chickasha. See also *Duncan ss.*, to which it is equivalent.

San Antonio formation.

Pleistocene: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *San Antonio fm.*—A great series of alluvial fans at foot of steep face of Berkeley Hills btw. East Oakland and Berkeley, built up by streams that emerge from the hills. Is divisible into an older gravel, which consists of rock fragments derived from the front of the hills and does not contain any chert, and a later or upper part, here called *chert-gravel memb.*, because it contains abundant fragments of chert. The fm. has been thoroughly dissected and terraced. [Fossils listed.] Uncon. underlies Merritt sand and uncon. overlies Alameda fm. Named for development in San Antonio Twp, Alameda Co.

Sanatoga member. (In Brunswick formation.)

Upper Triassic (Newark group): Southeastern Pennsylvania (Montgomery County).

D. G. McLaughlin, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 179). *Sanatoga sh.*, 200 ft. of dark sh. in Brunswick fm. Exposed at Sanatoga, Schwenksville, and Lederachsville [all in Montgomery Co.], Pa.

D. B. McLaughlin, 1933 (Mich. Acad. Sci., Arts, and Lett., vol. 18, pp. 430, 433). *Sanatoga memb.*—The highest black-sh. memb. of Brunswick fm. studied by writer. (Term *black sh.* as here used covers all gray, green, or black shales in Brunswick and Lockatong fms.) Consists of 200± ft. of dark-gray and green sh. Along Perkiomen Creek lies 2,000± ft. above Graters members of Brunswick, but in Schuylkill section it is probably only 1,100 ft. above the Graters. Forms part of Perkasie shales of Lyman. Wherry has pointed out (Proc. Acad. Nat. Sci. Phila., vol. 64, p. 376, 1912) that the Perkasie should not be regarded as a definite fm., since a large part of it is merely red sh. which has been altered by the diabase intrusion. The Sanatoga memb., however, although slightly altered in places, does not owe its dark color nor most of its hardness to baking. Named for excellent exposures in a large quarry and in the railroad cut at Sanatoga Station on Schuylkill River.

San Augustine group. (In Claiborne group.)

Eocene: Eastern Texas.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, No. 4, p. 428). *San Augustine group.*—Brown ferruginous marine sands interbedded with clays and sandy clays, underlying Nacogdoches beds and overlying Carrizo sands. Abundant Lower Claiborne fauna. Is the "Marine" of Kennedy. Includes Cook Mtn and Mount Selman fms., which are not constant subdivisions but depend entirely on local conditions. At any rate they are practically a unit paleontologically, and a group name is desirable. As "Marine" is not a suitable name, after consultation with Kennedy the name San Augustine is suggested as a substitute, since the town of that name [in San Augustine Co.] is located near center of an excellent section including both subdivisions.

B. C. Renick, 1928 (A. A. P. G. Bull., vol. 12, pp. 531, 534). *San Augustine memb.*—Basal memb. of Cook Mtn fm. Consists of 15 to 75 ft. of fossiliferous glauconitic and glauconitic calc. marl, brown sand, and some brown clay, green and greenish blue where fresh and brownish red at outcrops. Underlies Nacogdoches memb. and overlies Queen City memb. of Mount Selman fm. [As thus applied—to the beds beneath Nacogdoches and above Queen City sand (=Carrizo ss.)—San Augustine memb. appears to correspond to San Augustine group of Dumble.]

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, p. 1342). *San Augustine* abandoned for Weches memb. of Claiborne fm. (See under *Weches memb.*)

San Benito gravels.

Pleistocene: Western California (San Benito County).

A. C. Lawson, 1893 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 1, pp. 151–153). [Correlated Merced "series" (Plio.) with "the delta gravels on the San Benito." On p. 153 he casually used the term *San Benito gravels*, but apparently not as a geologic name.]

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 468–469, 470, 477, and map). Yellow, loosely consolidated sss., blue sh., blue, red, and gray bedded gravel, indurated ss. in places, strata often brilliantly colored. Thickness 1,000± ft. The gravel was called Plio. by Whitney and accepted by Lawson, but carries characteristic Pleist. vertebrate fossils. These Pleist. gravels were named "San Benito gravels" by Lawson (1893), who thought they were Plio. Uncon. overlie Plio. Paicines fm. [The fm. is mapped along San Benito River.]

Sanborn formation.

Pleistocene: Western Kansas.

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, pp. 163+). The name *Sanborn fm.* is proposed for the Pleist. loess, with some gravel and sand at base, which is widely distributed on divides in western Kans. Major part of fm. is loess. It seems to writer that only the loess that covers the divides can be considered to be Pleist., the loess of the valley slopes and bottoms being largely if not wholly redeposited from the divides, the redeposition having taken place probably for the most part in late Pleist. and Recent times. The name *Sanborn fm.* is intended as a substitute for the old terms "Tertiary marl" or "Plains marl," introduced for this fm. by Robt. Hay. The new name is derived from Sanborn, Nebr., which is nearest town to a locality of the fm. in NW. corner of Cheyenne Co., Kans., where the loess is 180 ft. thick, is exposed in steep bluffs of numerous canyons on S. side of Arikaree River, and is underlain by a few ft. of Ogallala and by Pierre sh. In other parts of the county the loess on the divides is 20 to 60 ft. thick. Basal part of fm. is always sandy, and in many places coarse gravel was seen at its base.

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, p. 355). *"Sanborn fm."* (Elias, 1931) of western Kans. is a composite of sand, gravel, and loess, ranging in age from early Pleist. (Kansan or perhaps older) to Peorian or younger (the "yellow dirt"). The separate parts of "Sanborn fm.," especially the loess, are differentiated in Nebr. and should not have been grouped together as a fm.; at least a new fm. name should not have been assigned.

San Bruno sandstone. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

R. Crandall, 1907 (Am. Phil. Soc. Proc., vol. 46, pp. 3–58). *San Bruno ss.*—Chiefly hard blue-gray ss. interbedded with shales and some coarse cgls.; several hundred ft. of ss. at top. Thickness great. Is a subdivision of Franciscan series. Overlain by lower jasper bed of the Franciscan and rests on crystalline lss. of the Franciscan. Named for fact it forms San Bruno Mtns.

A. C. Lawson (U. S. G. S. San Francisco folio, No. 193, 1914) mapped above-described rocks as *Cahil ss.*, toward the middle of which occurs Calera ls. memb. Since Crandall's San Bruno ss. rests on the ls. it is=upper part of Cahil ss. of Lawson.

San Carlos formation.

Upper Cretaceous (Gulf series): Western Texas.

T. W. Vaughan, 1900 (U. S. G. S. Bull. 164, pp. 81–82). *San Carlos fm.*—Fossiliferous sss. and clays containing coal, underlying Vieja series and extending to base of San Carlos section. [Thickness not stated but appears to be at least 1,400 ft.] Upper Cret. fossils.

J. A. Udden, C. L. Baker, E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 78–79, table opp. p. 59), correlated *San Carlos fm.* with Taylor marl and lower part of Navarro fm.

According to T. W. Stanton (personal communication, 1919) these beds are=to, in part at least, Taylor marl, which is of Pierre age.

Named for San Carlos, Presidio Co.

San Carlos formation.

Pleistocene: Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 259).

San Cayetano formation.

Jurassic: Cuba.

R. E. Dickerson and W. H. Butt, 1935 (A. A. P. G. Bull., vol. 19, No. 1, pp. 116–118).

Same as *Cayetano fm.*, De Golyer, 1918.

Sanchez sandstone member (of Fayette formation).

Eocene (upper): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, p. 1387). *Sanchez ss. memb. of Fayette fm.*—Soft gray ridge-making ss. with hard dark-brown calc. concretionary masses. Two fossil horizons containing gastropods and bivalves and, at base, several beds of ss. with plentiful *Ostrea georgiana*. Thickness 139 ft. Lies 280 ft. below top of Fayette fm. in section measured on both sides of Rio Grande btw. Roma and Rio Grande City [Starr Co.], Tex. [Derivation of name not stated.]

San Cristobal limestone.

Cretaceous: Guatemala and Chiapas, Mexico.

See under *Cristobal fm.*

†Sand Brook trap.

Name applied by H. B. Kümmel, 1898 (N. J. Geol. Surv. Ann. Rept. State Geol. 1897), to 425 ft. of extrusive basalt interbedded in upper half or third of Brunswick sh., of Newark group (Upper Triassic), near Sand Brook village, Hunterdon Co., N. J. "In a way contemporaneous with Watchung basalt." In U. S. G. S. Trenton folio, No. 167, 1909, this name was not considered necessary, and the rock near Sand Brook village was mapped as basalt, without a name.

†Sand Coulee beds.

Eocene (lower): Western Wyoming (Bighorn Basin).

W. Granger, 1914 (Am. Mus. Nat. Hist. Bull., vol. 33, pp. 202–205). *Sand Coulee beds.*—Red-banded shales, 0 to 200 ft. thick, underlying, apparently conformably, Gray Bull beds (*Systemodon*-bearing shales) and overlying, perhaps with angular uncon., the gray Clark Fork beds near head of Big Sand Coulee in Clark Fork Basin, Bighorn Basin, Wyo. Fossiliferous, but do not contain *Systemodon*, and fauna is radically different from Clark Fork fauna.

According to H. F. Osborn (U. S. G. S. Mon. 55, 1929) these beds belong to his *Eohippus-Coryphodon* zone in lower part of Wasatch fm., and are older than Gray Bull beds of Granger.

G. L. Jepsen, 1930 (Am. Phil. Soc. Proc., vol. 69, No. 7, pp. 474, 494), included these beds in Gray Bull, as explained under *Gray Bull memb.*

Sand Creek formation.

Pennsylvanian: Central northern Oklahoma (Osage County).

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 79). *Sand Creek fm.*—Named by K. C. Heald, in unpublished ms. Consists of (1) Foraker ls. memb., 60 to 110 ft. thick, at top; (2) shales and thin sss.; (3) Grayhorse ls. memb., 4 ft. thick, at base. Thickness 200 ft. Overlies Buck Creek fm. and underlies Elmdale fm. Is of late Penn. (Monongahela) age. Named for Sand Creek, N. part of Osage Co. Outcrops also in western Osage, eastern Pawnee, and Payne Counties, where it merges with undiff. red beds.

Sanders Bridge limestone. (In Palo Pinto formation.)

Pennsylvanian: North-central Texas.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 24). *Sanders Bridge ls.*, in Palo Pinto fm., lies 7 to 10 ft. below Balsora ls. and 12± ft. above Boone Creek ls. Thickness 16± ft. Consists of a single hard ls. ledge. Has characteristic Palo Pinto cleavage and thin-bedded stratification. Thins to E. and NE. Well exposed at Sanders Bridge over Boone Creek, on Booneville-Willowpoint road.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 105). Type loc. of Sanders Bridge ls. is on Boone Creek, 3¼ mi. NW. of Booneville, Wise Co.

Sandgrass andesite.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1915 (Econ. Geol., vol. 10, p. 729). *Sandgrass andesite.*—Intrusive; 500 ft. thick. Is the "calcite andesite" of earlier repts.

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, pp. 13–15). *Sandgrass andesite.*—In Spurr's earliest examination of dist., rocks belonging to Sandgrass andesite were considered to be an altered phase of Mizpah trachyte and were called by him "calcitic phase of earlier andesite." When the fm. was recognized as distinct from Mizpah trachyte, the name was shortened by those working in the dist. to "calcite andesite." In his final publication (Econ. Geol., vol. 10, 1915) Spurr proposed name *Sandgrass andesite* for this fm., and this name is here retained, although microscopic study has shown the fm. contains relatively little andesite, most of the rock being keratophyric. Exposed in all the mines examined including 1,000-ft. and 1,140-ft. levels of Sand Grass mine. Spurr considered the fm. to be intrusive; J. A. Burgess implied that it is a flow, a view accepted by Locke. So far as present examination went the bulk of the fm. as exposed underground is definitely extrusive. The fm. is dominantly gray green to dark green, although locally bands of nearly black basalt are interlaid with it. Bulk of rock is porphyritic. Some probable flow breccias are also included. Total thickness of fm. not definitely known. On 1,540-ft. level of Tonopah Extension mine 500± ft. are exposed and lower limit concealed by faulting. Is interbedded with Tonopah fm. and therefore of same age.

Sand Hills.

Cretaceous: New Jersey.

W. B. Clark and G. B. Shattuck, 1897 (Johns Hopkins Univ. Circ. 128, pp. 13–16, in a description of the Sand Hills of N. J.), casually alluded in one place to *Sand Hills series* and in two places to the *Sand Hills deposits*, but evidently did not intend to name the deposits, although the name is listed in U. S. G. S. Bull. 191.

†Sand Hills formation.

Pleistocene (Peorian): Western and central northern Nebraska (Sand Hills region).

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, pp. 321, 322, 326, 331, 350). *Sand Hills fm.*—Eolian dune sand, believed to have been derived by wind action from the older Tert. fms. and pre-Peorian Pleist. materials. It is the material left behind after the loess had been sifted out by wind action and carried eastward to become the yellow loess. In some parts of Sand Hills area it can be seen to grade into Peorian loess and is believed to be exact equiv. of this loess. The Sand Hills occupy 20,000± sq. mi. of central and northern Nebr., or half the area of the State.

Sandia clay.

Quaternary: Central northern New Mexico (Sandia Mountains).

E. D. Cope, 1875 (Ann. Rept. Chief Eng. U. S. A., Rept. Secy War to 44th Cong., vol. 2, pt. 2, p. 997). *Zandia clay.*—Indurated clay; lacustrine deposit; 40 ft. thick; post-Plio. Overlies Tert. gravel and cobblestones in Zandia [Sandia is approved spelling] Mtns, N. Mex.

Sandia formation. (Of Magdalena group.)

Pennsylvanian: Central northern New Mexico.

C. L. Herrick, 1900 (Jour. Geol., vol. 8, pp. 112–126; Am. Geol., vol. 25, pp. 234–237; N. Mex. Univ. Bull., vol. 2, pt. 3, pp. 1–14). *Sandia series.*—Series of shales, sss., and cgls., with occasional bands of sandy ls. Thickness 150 ft. Separated from overlying Coyote ss. by thick series of dark conchoidal lss. and shales. Rests on qtzite of unknown age. Present in Sandia, Manzano, and San Andreas Mtns.

C. R. Keyes, 1904 (Am. Jour. Sci., 4th, vol. 18, pp. 360–362). *Sandia fm.* consists of 800 ft. of lss. underlying Madera ls. and overlying Lake Valley ls.

C. H. Gordon, 1907 (Jour. Geol., vol. 15, pp. 810–816). *Sandia fm.*—Alternating beds of blue and black clay sh., compact earthy ls. and cgl., vitreous ss. or qtzite; sh. and ls. predominate. Includes Incarnacion fire clay of Herrick at base. Thickness 500 to 700 ft. Underlies Madera ls. Is lower fm. of Magdalena group. In Magdalena Mtns rests on Kelly ls. (Miss.).

†Sandia series.

A term used by C. R. Keyes (Rept. Gov. N. Mex. to U. S. Secy Interior, 1903) to cover what appears to be Manzano and Magdalena groups of present nomenclature.

Sandia quartzites.

A name applied by C. R. Keyes (Ores and Metals, vol. 12, p. 48, July 1903) to the "basal cgl. and associated sss." of his Middle Carbf., in Sandia Mtns, N. Mex., "which probably corresponds to the coal measures of Miss. Valley."

Probably refers to Sandia fm. of other geologists.

San Diego formation.

Pliocene (middle): Southern California (San Diego region).

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 337). *San Diego beds.*—Plio. sandy marls exhibited in well explored by Hemphill in city park; below Pleist. at Pacific Beach, San Diego, on shores of False Bay near by; and on Coronado Peninsula, opposite San Diego. Same horizon crops out in various places northward, especially at Dead Mans Island and Harbor Hill, San Pedro, and on coast of Todos Santos Bay, Lower California.

A. J. Ellis, 1919 (U. S. G. S. W. S. P. 446). *San Diego fm.*—An extension of Dall's use of the name. Consists of lenticular deposits of cgl., sandy marls, sand, and clay, with rare lenses of ls. The sandy marls which are exposed around Mission Bay and in Mission Valley and underlying the cgls. E. of San Diego have been referred to in the literature as *San Diego beds.* Fossil collections obtained from them have been classified as Plio. Orcutt has assembled data in regard to fossil collections obtained from these deposits in a well boring in city of San Diego. The beds described by Orcutt are near base of later Tert. section. They are best developed in immediate environs of city of San Diego, but have been recognized by their lithologic character as far S. as Otay, and in N. part of the area in vicinity of Oceanside. They seem to be integral parts of a simple fm. and chronologically inseparable from the other lenticular strata with which they are interbedded. On this ground it is proposed to include all of the later Tert. marine deposits in this area under the name *San Diego fm.* It is essentially a shallow-water deposit. Rests on Eocene beds and is overlain by San Pedro fm. Thickness 500 ft.

To N. the *San Diego* becomes a memb. of Pico fm. (See W. P. Woodring 1932 (16th Int. Geol. Cong. Guidebook 15, pl. 2, etc.)

San Diego formation.

Cretaceous: Puerto Rico.

H. A. Meyerhoff, 1931 (Sci. surv. Porto Rico and Virgin Islands, vol. 2, pt. 3, p. 289, N. Y. Acad. Sci.), and 1933 (Geol. of Puerto Rico, p. 44).

San Dimas formation.

Pleistocene (upper): Southern California (southwestern part of San Bernardino County).

R. Eckis, 1928 (Jour. Geol., vol. 36, pp. 228, 235–236). [*San Dimas fm.* on map, *San Dimas alluvium* in heading.] Dissected alluvium with decomposed gravels and red, brown, or yellow color commonly occurring as high fan-head remnants and as isolated or nearly isolated midfan mesas. Called "earlier alluvium" by W. C. Mendenhall in U. S. G. S. W. S. P. 219, pp. 10–12, 1908. Type loc. is at San Dimas, 5 mi. W. of Claremont. Overlain by Recent alluvium, from which it is sometimes difficult to distinguish it. Is generally undeformed.

R. Eckis, 1934 (Calif. Dept. Pub. Works, Div. Water Res. Bull. 45, p. 38), assigned this fm. to upper Pleist.

†Sand Mountain conglomerate.

Pennsylvanian: Northern central Alabama (Jefferson and Blount Counties).

J. L. Campbell and W. H. Ruffner, 1883 (Phys. surv. from Atlanta, Ga., across Ala. and Miss., pp. 54–57). *Sand Mtn cgl. or Cliff Rock.*—Whitish ss., unusually coarse though not always so; usually about 100 ft. thick. Divides Carbf. rocks of Ala. into two groups. Is bottom memb. of Great Conglomerate or Millstone Grit. Rests on Lower or so-called Sub-Carbf. group.

The ss. of Sand Mtn is Boyles ss. memb. of Pottsville fm. (a later but better-defined name), and is so mapped in U. S. G. S. Birmingham folio, No. 175, 1910, by C. Butts.

Sandoval granite.

Pre-Cambrian: Central northern New Mexico (Magdalena and Sandia Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 11). *Sandoval granites.*—Red granites penetrating all pre-Cambric rocks of Sandia, Magdalena, and other ranges. [Derivation of name not given. On p. 4 they are assigned to pre-Camb.]

Sandpoint conglomerate.

Late Carboniferous (?): Northern Idaho (Pend Oreille region).

A. L. Anderson, 1930 (Idaho Bur. Mines and Geol. Bull. 12). *Sandpoint cgl.*—Cemented pebbles and boulders from sill rocks and Belt terrane. Very variable texture. Dominantly boulders from gravel size to 3 or 4 ft. diam., embedded in fine siliceous or sandy matrix. Thickness 4,000 to 5,000 ft. at least. Lies in Purcell trench, N. of Sandpoint, Bonner Co. Rests uncon. on Algonkian rocks. Deposited under torrential conditions in great valley carved in Belt terrane. Top removed by erosion. Much disturbed by faulting. Probably late Carbf.

†Sand Pond gneiss.

Pre-Cambrian: Northern New Jersey.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 439). *Sand Pond gneiss.*—Coarse foliated syenitic gneiss.

In U. S. G. S. Franklin Furnace folio, No. 161, 1908, this name was discarded, the rock being an inseparable part of Byram gneiss.

Sandro shale.

Upper Cretaceous: Alberta.

R. L. Rutherford, 1935 (Alberta Research Council 11th Ann. Rept., No. 28, 1932, pp. 33–38). Included in Belly River series of Smith and Cold Lake dist.

Sand Springs basalt.

Pleistocene: Southern Idaho (Gooding and Jerome Counties).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Sand Springs* *basalt.*—A massive pahoehoe flow, 500± ft. thick. Exposed for 14 mi. up Snake River, or to point where Sand Springs cascade into Snake River, in Gooding Co. Older than Burley lake beds and younger than McKinney basalt. The Bliss basalt may possibly be a subaqueous facies.

Sandstorm rhyolite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 43, etc.). *Sandstorm rhyolite.*—Thin, originally glassy rhyolite flows overlying the latite and most of the Kendall tuff. Usually nearly white, shows conspicuous flow lamination, and weathers in thin, shelly flakes. It is the rock of Sandstorm mine and of hills lying W. of road from the mine to Columbia. Thickness 100 to 400± ft. Upper part of Kendall tuff is intermingled with the rhyolite. Is much older than Siebert [Esmeralda] fm. [which is upper Mio.].

Sandsuck shale.

Lower Cambrian: Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 3). *Sandsuck sh.*—Bluish-gray shales with lighter-gray bands. Shales weather dull yellow. Thickness at least 1,000 ft. Lowest fm. in Chilhowee Mtn. Underlies Cochran cgl.

Named for exposures on Sandsuck Branch of Walden Creek, Sevier Co., Tenn.

Sandusky limestone.

Middle Devonian: Northern and central Ohio.

J. S. Newberry, 1873 (Ohio Geol. Surv. vol. 1, table opp. p. 89, pp. 143–144). *Sandusky ls.*—Blue thin-bedded ls., 15 to 20 ft. thick, present in northern and middle Ohio; quarried at Sandusky and Delaware. Composes upper fm. of Corniferous ls. Lies above Columbus ls., lower fm. of Corniferous ls., and is overlain by Hamilton group (ls. and marl).

E. Orton, 1878 (Ohio Geol. Surv. vol. 3), and 1888 (Ohio Geol. Surv. vol. 6), 1890, 1893; also J. A. Bownocker, 1898 (Denison Univ. Sci. Lab. Bull., vol. 11). *Sandusky ls.* is=Delaware ls.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, btw. pp. 519 and 546). *Sandusky ls.*, 30 ft. thick, is="Delaware ls." and has 5 yrs. priority.

C. S. Prosser, 1905 (Jour. Geol., vol. 13, pp. 413–443). Since it is proved that nearly all of the rock to which Dr. Newberry gave name "Sandusky ls." belongs in *lower* instead of *upper* division of what he called "Corniferous ls.," it appears to writer that name "*Sandusky ls.*" ought to be dropped. If it were now applied to lower fm. it would cause serious confusion, since that was named, at same time, Columbus ls., under which designation it is well known.

C. K. Swartz, 1907 (Johns Hopkins Univ. Circ. 7, pp. 56–65). Sandusky and Delaware are not equivalent. Sandusky is in part of Delaware age and in part of Columbus age, and name should be dropped.

Sandy Creek beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 85, 137, 141, 149, 154, etc.). *Sandy Creek beds* overlie Worthville beds and underlie Bennett Bridge beds. Next to top div. of Pulaski fm. Divided into two paleontologic zones. Exposed along upper Sandy Creek, Jefferson Co.

Sandy Huff shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 193). *Sandy Huff sh.*—Dark gray laminated, argill., 5 to 70 ft. thick. Underlies Harvey cgl. and overlies Castle coal. Exposed just below mouth of Sandy Huff Branch, McDowell Co.

San Emedio series.

Pre-Cambrian (?): Southern California (Kern County).

O. H. Hershey, April 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pl. 1, map). [*San Emidio schists* on legend of map lie btw. Camb. above and Archean gneiss below.]

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 273-290). *San Emedio series*.—A series of thoroughly crystalline schists and ls. Tentatively assigned to pre-Camb. (?). Relations to Pelona schist series unknown and can not be conjectured.

Probably named for Range or Mtn in Kern Co., which U. S. Geog. Bd. states should be spelled *Emigdio*.

See *San Emigdio fm.*

†San Emigdio formation.

Oligocene: Southern California (Kern County).

G. C. Gester, 1917 (Calif. Acad. Sci. Proc., 4th ser., vol. 7, pl. opp. p. 220). [Gives section of Midway and Tejon districts, in which the name *San Emigdio* is applied to shales and sands underlying the lower Mio. and apparently referred to Olig.]

C. M. Wagner and K. H. Schilling, 1923 (Calif. Univ. Pub. Dept. Geol. Bull., vol. 14, pp. 235-252). *San Emigdio fm.*—Basal fm. of San Lorenzo group [expanded definition]. Discon. underlies Pleito fm., upper fm. of San Lorenzo group, and uncon. overlies Tejon fm. East of San Emigdio Canyon it consists of 700 ft. of alternating yellowish and grayish sss. and sandy shales containing very fossiliferous dark-red bands and lenses; underlain by 150 ft. of bluish-black sh. carrying fossils in calc. concretions; with, at base, 150 ft. of light-gray and tan unfossiliferous ss., in places conglomeratic and gritty. Mapped along E. side of San Emigdio Creek, SW. part of Kern Co. Carries *Molopophorus lincolnensis* zone. Correlated with Butano ss., which is older than typical San Lorenzo fm.

Is a faunal zone in San Lorenzo fm.

San Felipe formation.

Upper Cretaceous: Mexico.

I. C. White, 1913 (Geol. Soc. Am. Bull., vol. 24, p. 255).

San Fernando formation.

Eocene: Trinidad.

R. J. L. Guppy, 1866 (London Geol. Soc. Quart. Jour., vol. 22, p. 572). Assigned to Mio.

T. W. Vaughan, 1924 (Geol. Soc. Am. Bull., vol. 35, p. 726), and G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol. No. 7, p. 41), assigned this fm. to Eo.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 700), assigned these deposits to Olig.

San Fernando formation.

Oligocene: Mexico.

E. T. Dumble, 1908 (Sci., n. s., vol. 27, p. 273), and 1911 (Sci., n. s., vol. 33, p. 233).

Sanford formation. (In Newark group.)

Triassic (Upper): Central North Carolina.

M. R. Campbell and K. K. Kimball, 1923 (N. C. Geol. and Econ. Surv. Bull. 33, pp. 20, 43-45). *Sanford fm.*—Almost universally red rocks, largely cgl., ss., and sh., in a monotonous succession. So far as known contains no coal beds. Includes all rocks of Triassic age above Cumnock fm. Is top fm. of Newark group. Thickness probably 4,000 or 5,000 ft. Overlies Cumnock fm.

Named for development under and around town of Sanford, Lee Co.

†San Francisco sandstone.

Jurassic (?) and late Tertiary: Western California (San Francisco Bay region).

W. P. Blake, 1856 (Expl. and Surv. for R. R. route Mississippi River to Pacific Ocean, vol. 5, 33d Cong., 2d sess., S. Ex. Doc. 78, pp. 145-156). Fine-grained compact sss. associated with thin shales. Thickness 1,000 to 3,000 ft. Tertiary in part at least, but Upper Cret. may also be represented. Forms greater part of hills and mtns around the [San Francisco] bay and, so far as explored, a considerable part of mass of Coast Mtns. Believed to be most extensive and highly developed sed. fm. of Calif. coast, and may appropriately be known as *San Francisco or California ss.* [Includes sss. of Franciscan group and rocks belonging to Merced fm.]

A. C. Lawson, 1895 (Am. Geol., vol. 15, p. 347, and U. S. G. S. 15th Ann. Rept., p. 417). *San Francisco ss.*, the dominant sed. fm. of Franciscan series, consists of moderately fine-grained ss. with subordinate beds of sh. and cgl. Is interbedded with foraminiferal lss., radiolarian cherts, and volcanic rocks, including basaltic lavas, diabases, pyroclastic accumulations, etc.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193), divided Franciscan rocks into five named fms., three of which are ss.

The term "San Francisco ss." is no longer used by geologists.

†San Francisco group.

Late Tertiary and Franciscan (Jurassic?): Western California (San Francisco region).

J. S. Newberry, 1857 (Pacific R. R. Repts., vol. 6, pt. 2, pp. 10–12). Upon the serpentine lies a deposit of sss. and shales, several hundred ft. thick. They are somewhat interstratified, their strata conformable, and apparently belong to same geological epoch, being members of a group widely spread over Pacific coast, and to which, under the name *San Francisco group*, I shall frequently have occasion to refer. The ss. where long exposed is light gray, soft, and easily worked. It forms the slopes of the axis lying btw. Bay of San Francisco and the ocean and the rocky basis upon which the city of San Francisco rests. The shales are greenish or yellowish brown. No fossils found in either the ss. or sh. in vicinity of San Francisco, but on San Pablo Bay this group is highly fossiliferous. Assigned to Mio.

Apparently includes Franciscan and late Tert. rocks.

San Gabriel formation.

Pre-Cretaceous (pre-Cambrian?): Southern California (San Gabriel Mountains).

W. J. Miller, 1934 (Univ. Calif. at Los Angeles Pub. in Math. and Phys. Sci., vol. 1, No. 1, pp. 12, 25–65, map). *San Gabriel fm.*—A metamorphic complex, consisting chiefly of Rubio metadiorite and Placerita meta-sediments intimately injected by Echo granite. Usually exhibits banded structure. Some of schist may be of sed. origin; a porphyritic gneiss is also present. The fm. is cut by Wilson diorite, Lowe granodiorite, and Echo granite. Named because extensively developed in San Gabriel Mtns. Assigned to pre-Cret. (pre-Camb.?). Presumably younger than Placerita fm. (probably pre-Camb.), but the two are intimately associated and relations are not clear.

Sangamon stage of deglaciation (Pleistocene).

Sangamon stage is name applied to the interglacial stage during which the *Sangamon soil and gumbotil, vegetal and other deposits* were formed. The name was proposed by F. Leverett (Jour. Geol., vol. 6, pp. 171–181, 1898), from exposures of the soil in Sangamon Co., Ill. The soil overlies the Illinoian glacial till and underlies the main loess deposit, and has generally been considered to be older than Iowan drift. See under *Iowan*.

San German limestone.

Cretaceous; Puerto Rico.

G. J. Mitchell, 1922 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 3, p. 253).

Sangre de Cristo formation.

Pennsylvanian and Permian: Central southern Colorado (Sangre de Cristo Range).

R. C. Hills, 1899 (U. S. G. S. Elmoro folio, No. 58, p. 1). The exposures in neighboring mtns to W. indicate that it was not until near end of Carbf., when *Sangre de Cristo cgl.* was formed, that any considerable accumulation of sediments took place.

R. C. Hills, 1900 (U. S. G. S. Walsenburg folio, No. 68). In Sangre de Cristo Range the strat. section corresponds very nearly with that at S. extremity of Greenhorn Mtns [in this quad.] except in respect to thickness of the cgl. Below

Morrison fm. there is in each case about same thickness of capping red ss., but the coarse cgl. and ss. on which it rests attain in the Sangre de Cristo a thickness of several thousand ft. In that locality the beds have yielded an upper Carbf. fauna and flora. Evidence of similar character from Fountain fm. on E. slope of Rocky Mtns is meager and contradictory, and it is still a question whether it should be classed as Perm. or Triassic. As Fountain and *Sangre de Cristo* fms. have not sufficient geologic importance to warrant separation on areal geol. sheet, they are grouped together under name *Badito fm.* and referred to upper Carbf. The upper part of the Badito consists of 100 ft. of massive or thick-bedded brick-red ss., sometimes shaly on weathered surface, and apparently corresponds to some part of Fountain fm. The lower part consists of coarse brownish red cgl. [In chart in back of folio Fountain fm. is shown as overlying *Sangre de Cristo fm.* and both as=Badito fm.]

R. C. Hills, 1901 (U. S. G. S. Spanish Peaks folio, No. 71, p. 2). A few mi. W. of the dist. [Spanish Peaks quad.] there are extensive exposures of reddish-brown coarse cgl. (*Sangre de Cristo fm.*) which attains an enormous thickness and is regarded as of upper Carbf. age. It was the erosion of this cgl. that furnished bulk of material composing Huerfano beds of Spanish Peaks area.

F. A. Melton, 1925 (Jour. Geol., vol. 33, pp. 807–815). *Sangre de Cristo cgl.*—Cgls., arkoses, and shales, noteworthy for red color throughout nearly entire fm. Most characteristic development and greatest thickness is in central part of Sangre de Cristo Range near village of Crestone [Saguache Co.], where it is probably at least 13,000 ft. thick and where it forms backbone of the range. From this place it thins irregularly in both directions until it is 6,000 ft. at Culebra Range, near S. border of State. To N. of Crestone it thins to 4,300 ft. in valley of Arkansas River SE. of Salida. Near Crestone it is divisible into 2 groups of strata: *Upper Sangre de Cristo cgl.* (Perm.), consisting of 5,500± ft. of very coarse red cgls.; and *Lower Sangre de Cristo cgl.* (Penn.), consisting of 7,500± ft. of finer cgls. and arkoses, of darker color than Upper Sangre de Cristo cgl., and containing at base the Veta Pass ls. memb. Rests on Leadville ls. (Miss.). Though an angular uncon. was not seen btw. the Upper and Lower Sangre de Cristo cgls., it is believed that further search in this area may reveal such a break. The coarse conglomeratic beds in Upper Sangre de Cristo cgl. are "here named *Crestone cgl. phase of the Upper Sangre de Cristo cgl.*" [See under *Crestone*.]

J. H. Johnson, 1929 (Colo. Sci. Soc. Proc., vol. 12, pp. 3–18). There is distinct uncon. btw. *Upper Sangre de Cristo fm.* and *Lower Sangre de Cristo* at some localities.

Sangre de Cristo granite.

R. D. George, 1913 (Colo. Geol. Surv. geol. map of Colo.), mapped the pre-Camb. granite of Sangre de Cristo Range as *Sangre de Cristo granite*.

San Jacinto series.

Pleistocene and Pliocene: Southern California (Riverside County).

P. H. Dudley, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 223). *San Jacinto series*, Pliocene-Pleistocene, sedimentary. [Appears to be named for town, as the paper is on an area btw. towns of Riverside and San Jacinto.]

San Joaquin formation.

Pliocene: Southern California (San Joaquin Valley).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 178–192). *San Joaquin clays* applied to upper third of Etchegoin fm. [See description under *Etchegoin fm.*]

W. P. Woodring, 1934 (U. S. G. S. geol. map and structure sections of Kettleman Hills), restricted *Etchegoin ss.* to lower two-thirds of Etchegoin fm. of previous publications, and applied *San Joaquin fm.* to upper part (previously called *San Joaquin clays*), which he assigned to Plio.

San Juan tuff.

Tertiary (Miocene?): Southwestern Colorado.

W. Cross, 1896 (Colo. Sci. Soc. Proc., vol. 5, pp. 225–228). *San Juan fm.*—Stratified and water-laid andesitic tuffs and breccias, forming lower memb. of volcanic complex of Telluride dist., SW. Colo. Plays important part in composition of large part of San Juan Mtns. Texture varies from thin-bedded fine-grained tuff containing no large fragments to a tuff breccia consisting of large subangular blocks embedded in a finer-grained matrix. Upper limit not always clearly definable, but in mtns about Marshall Basin it is very sharply defined by appearance of first massive lava flow of augite andesite. Thickness 1,000 to 2,500+ ft. Rests conformably [uncon. reported in some areas] on San Miguel cgl. [preoccupied, and later replaced by Telluride cgl.].

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120) and 1907 (Ouray folio, No. 153). *San Juan tuff* uncon. underlies Silverton volcanic series and uncon. overlies Telluride cgl. Thickness 100 to 3,000 ft.

San Juan series.

In some early repts the *San Juan tuff* of SW. Colo. was called *San Juan series*. The name has also been applied to Paleozoic rocks in Wash. (See beyond.)

†San Juan glacial epoch.

A name applied by W. W. Atwood and K. F. Mather (Sci., n. s., vol. 35, p. 315, 1912; Jour. Geol., vol. 20, p. 388, 1912; and G. S. A. Bull., vol. 23, p. 732, 1912) to the time during which the oldest till sheet of San Juan Mtns, SW. Colo., was laid down. They later replaced the name with *Cerro glacial stage*.

†San Juan moraine.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1912 (Jour. Geol., vol. 20, pp. 392–409), mapped and described "San Juan moraine" in San Juan Mtns of SW. Colo. Later (U. S. G. S. P. P. 95, pl. 1, 1915, and P. P. 166, 1932) they replaced term "San Juan" by unpreoccupied name *Cerro till*, the present accepted name.

San Juan formation.

Upper Cretaceous: Northeastern Mexico.

E. T. Dumble, 1915 (Am. Inst. Min. Engrs. Bull. 104, p. 1626, Aug. 1915, and Calif. Acad. Sci. Proc., 4th ser., vol. 5, p. 170, Dec. 1915).

E. A. Trager, 1926 (A. A. P. G. Bull., vol. 10, No. 7, pp. 672, 675–681), stated that this name is replaced by *San Felipe fm.*

San Juan formation.

Pleistocene: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 10, 11).

San Juan series.

Carboniferous and Devonian: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 217). The majority of fms. exposed in San Juan Islands of State of Wash. belong to one more or less conformable series, here called *San Juan series*, which is composed of highly metamorphosed sed. and volcanic rocks of Paleozoic age. Divided into Orcas group (Miss. and Dev.) below and Leech River group (Penn., "which no doubt includes Clapp's Leech River 'formation' ") above.

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2). On Vancouver Island is a series of rocks known as *Sicker series*, which is apparently unfossiliferous. It is suspected by writer that Sicker series and San Juan series are identical, even though former has been provisionally assigned to Jurassic.

San Juan Bautista formation.

Oligocene: Southern California (San Benito County).

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 470, 471, 472, 493 and map). *San Juan Bautista fm.*—Blue indurated calc ss., also fine-grained argill. buff-colored ss., carbonaceous grit, and clay sh. Thickness about 1,500 ft. Base not exposed. Contains numerous fossils, which establish its Olig. age and marine origin. Lower fm. of San Lorenzo series. Named for exposures in vicinity of San Juan Bautista.

San Juan Raya formation.

Cretaceous: Mexico.

W. A. Ver Wiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 282).

Sankaty sand.

Pleistocene: Southeastern Massachusetts (Nantucket Island and Cape Cod).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 975–988). *Sankaty beds (first interglacial epoch)*.—Compound gravels and sands with local clay deposits. Of marine origin. Named for Sankaty Head, on Nantucket, but also occur on Gardners Island, Marthas Vineyard, and Block Island. Overlie basal boulder bed (of first glacial stage) and precede Gay Head interval of erosion and folding, which intervened btw. Sankaty beds and Tisbury beds.

J. B. Woodworth, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 197–212). *Sankaty group*.—Gravels and sands of granitic character, 25 ft. thick, uncon. underlying Tisbury beds on Marthas Vineyard. The uppermost beds involved in the principal folding over island of Marthas Vineyard. For reason that beds occupying a similar position with reference to the folding on island of Marthas Vineyard carry the well-known marine fauna at Sankaty Head, the name *Sankaty group* has been proposed for this horizon. Overlies boulder bed.

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). *Sankaty beds (interglacial)* of Long Island consist of 50–150 ft. of blue clay, considerable lignite, and occasional fragments of shells, and occupy strat. position of these beds on Marthas Vineyard and Nantucket. Preceded Gayhead interval and overlie Jameco gravel. Correlated with Yarmouth interglacial stage of Mississippi Valley.

M. L. Fuller, 1905 (Geol. Soc. Am. Bull., vol. 16, pp. 367–390). Sankaty beds of Woodworth = Herod gravel and Jacob sand. If term is to be retained, as it possibly will be, because of well-known fauna of Sankaty Head, it should, in writer's opinion, be limited to a single class of deposits, namely, the interglacial deposits here separately described under headings *Gardiner clay* and *Jacob sands*. The glacially derived Herod gravels should be excluded.

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). *Sankaty fm.* on Long Island varies in thickness from 0 to 150 ft. and varies in character from truly swampy deposits to relatively fine sands and clays which show no trace of swamp origin and which contain shallow-water mollusks. On N. shore occurs merely as erosion remnants. Overlies Jameco gravel and precedes Gay Head period of folding.

M. L. Fuller, 1906 (Sci., n. s., vol. 24, pp. 467–469). Jacob sand is equiv. in part to Sankaty beds of Nantucket.

F. G. Clapp, 1908 (Geol. Soc. Am. Bull., vol. 18, table opp. p. 512). Sankaty of Woodworth and Veatch = Jacob sand and Gardiner clay.

M. L. Fuller, 1914 (U. S. G. S. P. P. 82, p. 92). Sankaty beds of Woodworth are = Herod gravel memb. of Manhasset fm. and Jacob sand. Sankaty beds of Veatch are = Gardiners clay.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll., Mus. Comp. Zool. Mem., vol. 52). Pleistocene of Nantucket Island divided (descending): (1) Nantucket moraine, of Wisconsin age; (2) Vineyard interglacial stage of erosion; (3) Manhasset fm. (glacial), consisting of Hempstead (?) gravel memb. and Montauk till memb., the basal Herod gravel memb. being absent; (4) Jacob sand; (5) Gardiners clay; (6) Jameco gravel and associated till deposits of Marthas Vineyard not recognized above sea level; (7) stony blue clay passing laterally into stratified gravel, and locally contorted drift of probable Mannetto age; rests uncon. on (8). *Sankaty sand*, fossiliferous marine sands on horizon of glacial Weyquosque fm. of Marthas Vineyard and Block Island; (9) the ferruginous gravel of Desor and the uncon. underlying light-brown sandy clay of Desor not now exposed. Tertiary absent, but Upper Cret. believed to be present below sea level. The *Sankaty sand* as here defined occurs only on Nantucket Island and Cape Cod. Is older than glacial Mannetto fm. and is correlated with part of Nebraskan stage of Mississippi Valley.

The 1934 definition of Sankaty by Woodworth, which separated the fossiliferous marine sands from the contemp. glacial gravels and sands (Weyquosque fm.), and restricted *Sankaty* to the old marine sands at Sankaty Head and Cape Cod, is the U. S. Geol. Survey's present accepted definition.

Sankaty beds.

Sankaty group.

See under *Sankaty sand*.

†Sankaty Head beds.

Pleistocene: Massachusetts (Nantucket Island and Cape Cod).

J. H. Wilson, 1905 (Jour. Geol., vol. 13, pp. 713–734) and 1906 (Glacial history of Nantucket and Cape Cod, pp. 13–30). *Sankaty Head beds.*—Fossiliferous interglacial beds underlying Wisconsin drift and resting, apparently uncon., on an unfossiliferous old clay at Sankaty Head. Consist of sands and gravels, including 2 beds of ferruginous gravel in lower part.

J. H. Wilson, 1907 (Geol. Soc. Am. Bull., vol. 17, pp. 710–711). *Sankaty Head deposits* underlie late Wisconsin ice sheet and overlie interglacial fms. Included in Pleist.

Same as *Sankaty sand.*

San Lorenzo formation.

Oligocene: Southern California (Santa Cruz Mountains region).

R. Arnold, 1906 (U. S. G. S. P. P. 47, p. 16). *San Lorenzo fm.*—Essentially a series of grayish "muddy" shales and fine sss., typically exposed along bed of San Lorenzo River about 2 mi. above Boulder Creek, Santa Cruz Co. Extends W. from type loc. into Big Basin, on N. side of which it rests conformably against the older yellowish sss. of Butano Ridge [later named Butano ss.]; possibly Olig. in age. Conformably [uncon.] underlies Vaqueros ss. [Fossils listed.] Thickness about 2,300 ft. in vicinity of type loc.

E. R. Atwill, 1935 (A. A. P. G. Bull., vol. 19, No. 8, p. 1204). Recent work points to conclusion type San Lorenzo may range from Olig. (or even Eo.) to Mio.

†San Lorenzo series.

Oligocene: Southern California.

B. L. Clark, 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, pp. 54–111), used *San Lorenzo series* to include "all known marine beds in Calif., Oreg., Wash., and British Columbia that have generally been referred to the Olig." In Sobrante anticline, in Concord quad., he divided his San Lorenzo series into (descending) Concord fm. (=lower part of Lawson's Sobrante ss.), Kirker tuff, and San Ramon fm., and stated that it represents *Agasoma gravidum* zone. In this expanded San Lorenzo Clark later included lower part of Sobrante ss. of Lawson; the San Lorenzo fm. and underlying Butano ss. of Santa Cruz Mtns and their equivalent; and the Kreyenhagen sh.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). After reviewing the paleontological data pertaining to type section of San Lorenzo fm. it seems best, in view of poor preservation and small number of species in the fauna, to discard that name as a general one for Olig. series, and to use only the local formational names, correlating them with the general established faunal horizons.

San Lorenzo quartz diorite.

Age (?): Puerto Rico.

C. R. Fettke, 1924 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 2, p. 153).

†San Luis formation.

Jurassic (?): Southern California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *San Luis fm.*—Usually earthy ss., but in places there is a great thickness of dark sh. very similar to Toro fm. Contains many lentils of radiolarian jasper and some contact-metamorphic schist. Local representative of Franciscan. Represents all of Franciscan present in the area. Uncon. underlies Toro fm. (Knoxville) and uncon. overlies serpentine and other basic igneous rocks. Named for development in San Luis Valley, San Luis Obispo Co.

Replaced by Franciscan fm.

San Luis formation.

Eocene (late): Cuba.

C. Schuchert, 1935 (Hist. Geol. Antillean-Caribbean region, p. 492).

San Mateo formation.

Pliocene (?): Southern California (San Diego and Orange Counties).

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, pp. 169, 217–219). *Post-Capistrano fm.*—The younger [than Capistrano fm.] rocks are of slight significance in present study. They are very patchy in distribution and lie uncon. on the older rocks. There is the tilted *San Mateo fm.*, doubtful correlative of San Diego Plio., consisting of arkosic sands and gravels with a little admixture of blue schists and containing an occasional marine fossil; and topping all the very slightly deformed or untilted Terrace gravels and Alluvium. Thickness several hundred ft. Classified as Plio. (?). [Mapped.]

Named for occurrence along San Mateo Creek, in NW. corner of San Diego Co.

San Miguel formation.

Upper Cretaceous (Gulf series): Southern Texas.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 224–230). *San Miguel beds.*—Thin- to heavy-bedded sss. separated by bands of clay and containing seams of glauconitic material with many fossils and occasional heavy beds of clay, especially toward top. Thickness 800 ft. Included in Eagle Pass div. Underlies Coal series (Olmos fm.) of Eagle Pass div. and overlies Upson clays. Named for locality at which it was first observed by Dr. Comstock and myself. In Rio Grande section it first occurs in hills N. of Carter's ranch, where the hills show exposures of it 75 to 100 ft. in height. The exposures are excellent for several mi. S. of this point.

E. Böse and O. A. Cavins, 1927 (Univ. Tex. Bull. 2748, p. 44). A good locality for observing *San Miguel beds* is near Arroyo de las Navajas, on road from Piedras Negras to El Moral.

L. W. Stephenson, 1931 (personal communication): The name *San Miguel* was proposed by Dumble and was derived from the abandoned village of San Miguel. In a letter to L. W. Stephenson dated Mar. 1, 1937, F. M. Getzendaner, of Uvalde, Tex., says: "Mr. Ed Smidt, who was born and reared at Eagle Pass, once told me that San Miguel was a ranch headquarters at the old rock house on Elm Creek, now within the boundaries of the J. K. Burr ranch, and about 13 miles N-NE. of Eagle Pass. I know definitely that the old rock house was built and occupied for many years by one San Miguel, a pioneer ranchman in Maverick County. * * * As you know, the old rock house is within the outcrop of the San Miguel formation."

†San Miguel conglomerate.

Eocene: Southwestern Colorado.

W. Cross, 1896 (Colo. Sci. Soc. Proc., vol. 5, pp. 235–241). *San Miguel cgl.*—Characteristically a coarse cgl., in which pebbles of many kinds are recognizable at a glance—granite, schists of various kinds, hard bluish qtzites, lss., red sss., and some dense porphyritic eruptive rocks. Thickness 200 to 1,000 ft. in Telluride dist. Great uncon. at base. Rests on rocks of Colorado Cret. age. Conformably overlain by San Juan fm. Typically exposed on N. side of San Miguel River, from Marshall Creek westward for several miles.

Later replaced by Telluride cgl., because of prior use of San Miguel for a Cret. fm. in Tex.

†San Miguel cherts.

Jurassic (?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, p. 416). *San Miguel cherts*, radiolarian, 530 ft. thick. Underlie Bonita ss. and overlie Marin ss. A fm. in the Franciscan.

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, pp. 544–545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). [The rocks of San Miguel Hills, San Francisco Co., which appears to be type loc., are mapped as Ingleside chert, Marin ss., and Sausalito chert. The name *San Miguel* is preoccupied.]

San Miguel limestone.

Late Cretaceous or early Tertiary: Costa Rica.

J. Romanes, 1912 (Geol. Soc. London Quart. Jour., vol. 69, p. 106).

San Onofre breccia.

Miocene (middle): Southern California (San Diego County).

A. J. Ellis, 1919 (U. S. G. S. W. S. P. 446). *San Onofre breccia.*—Very coarse breccias or aggls., made up almost entirely of angular boulders and slabs of garnetiferous glaucophane schists and other schistose rock fragments. Forms San Onofre Hills, in San Diego Co. Older than Poway cgl. and San Diego fm. Assigned to lower Mio. [M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7), stated Poway fauna is Eo.]

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7). [Described above fm. as *San Onofre facies of Temblor fm.* or *Turritella ocoyana* zone; gave thickness as 2,610 ft., and stated that the Temblor beds underlying the San Onofre facies consists of 300 or more ft. of gray or white ss. and sh. Doubtful correlatives of San Onofre are described under headings *San Pedro schist breccia and ss., Catalina schist breccia,* and *Bouquet Canyon breccia.*]

San Pablo group.

San Pablo formation (where undivided).

Miocene (upper): Western California coast region.

J. C. Merriam, 1898 (Calif. Univ. Pub., Dept. Geol. Bull. vol. 2, pp. 109–118). *San Pablo fm.*—Marine sss., tuffs, and ashes, 1,500 ft. thick, characterized by *Astrodapsis* and *Scutella (Clypeaster) gabbi.* A considerable thickness of tuffs and ashes, most prominent in upper part of fm., and peculiar weathering of the sss. are constant and striking characters of greatest value in identifying the fm. where fossil remains are rare or absent. Overlies Contra Costa County Mio., without distinct uncon., although a break is indicated at several localities.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). [Described *San Pablo fm.* as resting uncon. on Briones ss. and as uncon. overlain by Plio. rocks (Pinole tuff in some areas and the younger Orinda fm. in other areas). According to B. L. Clark (Jour. Geol., vol. 29, pp. 586–614, 1921) the San Pablo fm. (renamed by him *Cierbo group*) occurs only in general region of San Francisco Bay, lies discon. below Santa Margarita fm., and rests discon. on Briones ss.]

B. L. Clark and R. Arnold, 1918 (Geol. Soc. Am. Bull., vol. 29, p. 298), applied *San Pablo group* to all upper Mio. deposits of western Calif., including Briones ss. at base and Santa Margarita fm. at top.

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 586–614), used *San Pablo series* to cover all upper Mio. fms. of western Calif., including Santa Margarita fm., Mint Canyon fm., and Maricopa sh. In Mount Diablo region he divided it into (descending): (1) Santa Margarita fm. (300 to 3,000 ft. thick), resting discon. on (2) Cierbo group (600 to 1,300 ft. thick and the fm. heretofore called *San Pablo fm.*), which in turn is discon. on (3) Briones ss. (2,300 ft. thick and formerly included in Monterey group). As thus applied *San Pablo series* is described as resting on Rodeo sh. in Mount Diablo region, on Salinas sh. in Salinas Valley, and on rocks designated *Temblor* by B. L. Clark; and it is described as uncon. overlain, in different areas, by Pinole tuff, Jacalitos fm., and Fernando group. (See also under *Cierbo fm.*)

P. D. Trask, 1922 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 13, No. 5, pp. 133–147). Briones ss. was transferred from Monterey group to San Pablo group by Bruce Clark in 1921. It should probably be classified with San Pablo group (upper Mio.) instead of with Monterey group (lower and middle Mio.).

B. L. Clark and A. O. Woodford, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, No. 2, pp. 65–81), divided *San Pablo group* into *Nerola fm.* above and *Cierbo fm.* below, but did not define the fms.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). *San Pablo group* (upper Mio.) is several thousand ft. thick in San Francisco Bay region. Includes (descending) Neroly fm. (*Astrodapsis tumidus* zone), Cierbo fm. (*Scutella gabbi* zone), and *Briones fm.* (locally known as *Astrodapsis brewerianus* zone). The Briones was formerly included in Monterey group, but Parker Trask (1922) showed that stratigraphically and faunally it is more closely related to overlying San Pablo group. [This is present approved definition of U. S. Geol. Survey.]

Named for occurrence on San Pablo Bay, Contra Costa Co., near town of Rodeo.

San Pablo series.

See under *San Pablo group.*

San Pedran epoch.

Pleistocene: Southern California.

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pp. 1–29). *San Pedran epoch (deposition)*.—Arnold's Upper San Pedro series seems to include the deposits of the three lower [of the 10] terraces of San Pedro Hill, and perhaps it might be convenient to extend the name, in the form of *San Pedran*, to the epoch as well. May be approx. = Iowan. [He applied *Los Angelan epoch* to the erosion epoch preceding the upper San Pedro and correlated Arnold's lower San Pedro with what he called the *Red Bluff epoch (deposition)*. See under *Sierran*.]

San Pedro sand.

Pleistocene (lower): Southern California (San Diego, Los Angeles, and Ventura Counties).

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, 1898—first published in 1897 as House Doc. 5, 55th Cong., 2d sess.—p. 335). *San Pedro beds*.—Extensive beds of unconsolidated Pleist. sand replete with molluscan shells in very perfect condition, best exhibited at Harbor Hill, at head of San Pedro Harbor, Los Angeles Co. Assigned to Pleist. Same horizon is recognizable above the Plio. of Pacific Beach, San Diego; at various points on Coronado Beach peninsula opposite San Diego, especially at a cove called Spanish Bight; and also at Santa Barbara and elsewhere. Uncon. overlies Merced group.

W. S. W. Kew, 1923 (A. A. P. G. Bull., vol. 7, p. 420). *San Pedro fm. (Pleist.)*.—This series of beds, which is typically developed in vicinity of San Pedro, has been described in detail by Ralph Arnold (Calif. Acad. Sci. Mem., vol. 3, 1903), who has divided it into two members, separated by an uncon. The San Pedro occurs at many places in Los Angeles Basin, resting uncon. on Saugus fm. or upon beds of San Diego age.

A. J. Tieje, 1926 (A. A. P. G. Bull., vol. 10, pp. 502–512), applied *Palos Verdes sands* to upper memb. of typical San Pedro, and restricted *San Pedro* to lower memb. of Arnold's San Pedro. He stated these changes were made upon suggestion of W. S. W. Kew. *This is present approved definition of U. S. Geol. Survey.*

J. E. Eaton, 1928 (A. A. P. G. Bull., vol. 12, No. 2, pp. 123–125), restricted *San Pedro fm.* to lower part of San Pedro and named the uncon. upper part in Ventura Basin, *Hall Canyon fm.*, which he stated is older than Palos Verdes fm. (See 1928 entry under *Hall Canyon fm.*).

U. S. Grant, IV, and H. R. Gale, 1931 (San Diego Soc. Nat. Hist. Mem., vol. 1, p. 37). In the Pleist. *San Pedro fm.* (or *group*) there can be recognized the lower or Las Posas zone, the middle Deadman Island "Plio.," or Timms Point zone, as it might be called, and the upper or typical San Pedro zone.

W. P. Woodring, 1932 (16th Int. Geol. Cong. Guidebook 15, pl. 2), showed typical *San Pedro sand* (restricted) of San Pedro Hills as younger than Saugus fm. and uncon. overlain by older terrace deposits, which in turn underlie Palos Verdes sand.

T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 490–492). *San Pedro fm.* consists of 3,000 to 3,500 ft. of poorly consolidated light-gray to buff fine to coarse sands and gravels, buff-weathering sandy silts, and greenish-gray, drab-gray, and, locally, grayish-maroon clays and silty clays; over 75 percent of it is sands and pebble to cobble gravels. It has been called *Saugus* by Kew, Cartright, Waterfall, and Driver, and most of it has been called *Las Posas* by Pressler, Grant, and Gale. Eaton (1928) [rept cited above] has arbitrarily divided it into 3 so-called fms.—Hall Canyon, San Pedro, and Saugus—which cannot be consistently separated or recognized for any distance, either paleontologically or lithologically. Because of large number of confusing local names for the southern Calif. Pleist., writer prefers to use Arnold's original name *San Pedro*, even though type San Pedro probably comprises only a meager remnant of the Ventura San Pedro. Overlies Santa Barbara fm.

U. S. Grant, IV, 1935 (Pan.-Am. Geol., vol. 64, No. 1, pp. 73–74), gave following as succession of marine Pleist. fms. at San Pedro: Palos Verdes fm., San Pedro fm., Timm Point fm., and Lomita fm., and listed fossils from each fm.

†San Pedro shales.

Eocene(?): Western California (San Francisco region).

R. Crandall, 1907 (Am. Phil. Soc. Proc., vol. 46, pp. 3–58). *San Pedro shales*.—Thin-bedded black coarse-grained hard shales, 4,000 ft. thick, exposed in cliffs N. and S. of San Pedro Point. Included in Franciscan series. Rest on coarse basal cgl. of the Franciscan and are overlain by crystalline ls. of Calera Valley [Calera ls. memb.], which is also included in the Franciscan.

The name is preoccupied in southern Calif. The rocks of the San Pedro Point SW. of San Francisco and in San Mateo Co., and of adjacent areas are mapped by A. C. Lawson (U. S. G. S. San Francisco folio, No. 193, 1914) as *Martinez (?) fm.*

San Pedro andesite.

Age (?): Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 323).

San Pedro schist breccia and sandstone.

Miocene or Pliocene: Southern California (San Pedro and San Pedro Hill).

A. O. Woodford, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 7, pp. 210–211). *San Pedro schist breccia and ss.*—Point Fermin at San Pedro is composed of blue schist ss., with a little breccia of various sorts, interfingering with more or less purely diatomaceous sh. One may trace in the sea cliffs the gradual change from a section that is chiefly blue ss. to one exclusively made up of thin beds of white sh. At very tip of Point Fermin there are 100 ft. of tar-saturated blue schist ss. intercalated in the sh. series. In this ss. are included several 1- to 3-foot beds of breccia and, near top and bottom, thin beds of sh. The San Pedro-Point Fermin Oil & Gas Co. well at Point Fermin passed through the following materials (oral communication from officers of the company, supplemented by inspection of samples):

0–600 ft. below sea level. Chiefly fine ss. and sh.
600 ft.–1,200 ft. Blue ss., schist breccia, some sh.
1,200 ft.–1,800 ft.? Soft sh., with blue schist flakes.
1,800 ft.?–2,500 ft. Bedrock, chiefly blue-green quartzose schist.

In San Pedro Hill, 5 mi. NW. of Point Fermin, the schists in place are separated from overlying sh. by a few ft. of fine schist breccia, which along eastern edge of the schists becomes much thicker and probably grades out into sh. as at the Point. The overlying sh. contains blue ss. beds and pockets, as well as numerous pumice fragments. The fossil evidence is inadequate for certain correlation of the San Pedro occurrences. Fossils [listed] suggest Lower Mio. age for at least part of the section. However, W. S. W. Kew, of U. S. Geol. Survey, who has studied San Pedro region in detail, considers the beds below the Point Fermin breccia to be Upper Mio. and those above Plio., on basis of resemblance of the shales to those of the Upper Mio. and Plio., respectively, of Santa Monica Mtns. Below the breccia chert predominates, and Kew has never been able to find diatoms; above, soft diatomaceous sh. predominates. [Described under center heading "Doubtful correlatives of the San Onofre facies."]

San Rafael formation.

Oligocene: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, pp. 144, 147). Assigned to Tert.

W. A. Ver Wiebe (Am. Jour. Sci., 5th, vol. 8, p. 492, 1924), T. W. Vaughan (Geol. Soc. Am. Bull., vol. 35, 1924, p. 732), and R. H. Palmer (A. A. P. G. Bull., vol. 11, p. 1196, 1927) assigned this fm. to Olig.

San Rafael group.

Upper Jurassic: Southern and eastern Utah and western Colorado.

Name adopted at joint conference of J. Gilluly, J. B. Reeside, Jr., H. E. Gregory, and R. C. Moore, from area specially studied by Gilluly and Reeside. Name first appeared in print in A. A. P. G. Bull., vol. 11, p. 787, 1927, in paper by Reeside, C. E. Dobbin, A. A. Baker, and E. T. McKnight. Name was proposed for the marine Upper Jurassic succession of rocks in SE. Utah. Includes (descending) Summerville, Curtis, Entrada, and Carmel fms., which are fully described by Gilluly and Reeside in U. S. G. S. P. P. 150, pp. 73–80, 1928. Uncon. underlies Morrison fm. and overlies, probably uncon., Navajo ss. Named for splendid exposures of the fms. in San Rafael Swell of SE. Utah. (See also U. S. G. S. P. P. 183, 1936, p. 6.)

San Ramon sandstone.

Oligocene: Western California (San Francisco Bay region).

B. L. Clark, 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, pp. 54–111). On Sobrante anticline, in Concord quad., the *San Ramon fm.* consists for most part of medium-fine gray sss., which at base are massive, rather coarse, and somewhat calc., but toward top are not so massive; thin beds of micaceous gray, medium-fine ss. alternating with thinner layers of sandy sh. and clay sh., well exposed on side of road just S. of divide btw. Bear and Pinole Creeks, on N. side of the anticline. The fm. is basal div. of San Lorenzo series in this region, where it is overlain by Kirker tuff and rests uncon. on Tejon fm. The San Lorenzo series of San Ramon syncline, Mount Diablo region, is considerably different from that of Sobrante anticline. Only one distinct fm. was recognized in Ramon syncline, and this is called *San Ramon fm.*, the name already applied to basal memb. of the San Lorenzo of Sobrante anticline. It seems very probable San Ramon fm. of this section represents a longer period of deposition than the San Ramon of Sobrante anticline, but whether the time of the deposition of Kirker tuffs and Concord fm. [the two upper fms. of his San Lorenzo series in Sobrante anticline] is represented in this record may be open to doubt. It rests uncon. on Tejon fm.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). San Ramon horizon (Olig.) is locally known as *Agasoma gravidum* zone. [On a later page Clark assigned it to upper Olig.]

W. P. Woodring, 1931 (Carnegie Inst. Wash. Pub. 418, p. 17). *San Ramon fm.* of B. L. Clark, with its modernized fauna, looks suspiciously like Mio. The modernization of the marine Mio. fauna is clearly brought out by A. M. Davies (Proc. Geol. Assoc., vol. 40 (1929), pp. 307–327, 1930). The Mio. affinities of San Ramon fauna have been discussed by R. B. Stewart in rept (Acad. Nat. Sci. Phila. Spec. Pub. No. 3, pp. 19–20, 1930) issued after this paper was written.

San Saba series.

Lower Ordovician and Upper Cambrian(?): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxii, 301–306). *San Saba series.*—Dolomites and chert, without evidence of dynamic uncon., divided into Deep Creek div. (above) and Hinton div. (below). Overlies Leon series. Upper beds of Sil. [Ord.] of central mineral dist. of Tex.

Is a part of Ellenburger ls.

Named for San Saba Co. and San Saba River Valley.

San Sebastian shale.

Tertiary: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 10, 17). [Assigned to Tert. in this and other repts. by other geologists, up to 1933, when H. A. Meyerhoff (Geol. of Puerto Rico, p. 65) assigned it to Olig.]

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region). San Sebastian sh. is upper Olig.

San Simon limestone.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 52). *San Simon lss.*, 300 ft. thick, underlie Truxton ls. and compose basal fm. of Mississippian in Nev.

Derivation of name not stated. May be same as Simon terrane of Keyes.

Santa Ana limestone.

Triassic: Southern California (Orange County).

J. P. Smith, 1898 (Jour. Geol., vol. 6, pp. 779–780). *Santa Ana ls.*—Hard black siliceous ls. on W. slope of Santa Ana Range, Orange Co.

Santa Ana.

Triassic: Southern California.

F. J. H. Merrill, 1914 (Geology and mineral resources of San Diego and Imperial Counties, Calif. State Min. Bur., p. 9). [Name is used in table as "local" name for Triassic. Statement on page 10 indicates it is intended to be applied to same metamorphic rocks in Orange Co. (in which are Santa Ana Mtns) as those to which *Julian group* is applied in adjoining San Diego Co.]

Santa Ana sandstone.

Probably upper Pliocene or lower Quaternary (mapped as Pliocene): Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull. vol. 13, No. 9, pp. 344, 378–379, and map). *Santa Ana ss.*—Ss. and sh., for most part of medium-gray color, although brown and reddish streaks are present. Also includes strata of coarse granitic detritus up to 5 and 6 ft. thick, btw. which are finely laminated shales and occasional calc. seams. Cannot be correlated with much certainty with any other fm. in dist. May possibly have been formed at same time as Hathaway fm. of S. side of range. Is uncon. overlain by Cabezon fangl. Present position of the evenly bedded ss. and sh. in bottom of a deep canyon can only be explained by faulting.

Named for Santa Ana River, San Bernardino Co., along which it is exposed.

Santa Anna shale member (of Moran formation).

Permian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 419). *Santa Anna bed.*—Bluish and reddish sandy clay, 25 to 75 ft. thick. Memb. of Cisco div., near top. Overlies Horse Creek bed and underlies bed No. 18 (15 to 25 ft. of ls. interstratified with clay).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 177–183 and charts). *Santa Anna sh. memb. of Moran fm.*—Underlies Sedwick ls. memb. of Moran and overlies Horse Creek ls. memb. of Moran in Colorado River Valley. Thickness 25 to 75 ft.

Named for exposures in buttes at Santa Anna, Coleman Co., and at various points to N. of that town.

Moran fm. was transferred to Wichita group (Perm.) in 1933.

Santa Anna Branch shale member (of Putnam formation).

Permian: Central and central northern Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 420). *Santa Anna Branch bed.*—Bluish clay, gray shaly sandy clay, a little coal in places, and some thin ls. and ss. strata. Thickness 100 to 150 ft. Top memb. of Cisco div.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 184–188). Putnam fm. (top fm. of Cisco group), as here defined, consists of Coleman Junction ls. memb. above and Santa Anna Branch sh. memb. below. The Santa Anna clay bed as described by Drake at his type loc. along Santa Anna Branch [Coleman Co.] corresponds almost exactly to the section of Putnam fm. below Coleman Junction ls. as measured by Applin S. of Santa Anna. Therefore, although it is possible that in some of Drake's other sections he has included in bottom of his Santa Anna Branch beds yellow lss. that are = lentils in top of Moran fm., the Santa Anna Branch beds are regarded as essentially = the strata btw. Coleman Junction ls. and the yellow ls. strata at top of Moran fm., and the name has been retained. [Sections given show thickness of Santa Anna Branch memb. as 119 to 174 ft.]

Putnam fm. was transferred to Wichita group (Perm.) in 1933.

Santa Barbara beds (also marls).

Pliocene (upper): Southern California (Santa Barbara County).

J. P. Smith, 1912 (Calif. Acad. Sci. Proc., 4th ser., vol. 3, pp. 161–182). The upper Plio. is recorded under name *Santa Barbara*, because it is by no means certain that the name *Merced*, which has been used for the upper Plio., is applicable in southern Calif.

J. P. Smith, 1915 (Nature and science on Pacific coast, p. 51, San Francisco, Elder & Co.). [*Santa Barbara beds* is used in chart for uppermost Plio. beds in Coast Ranges, which are shown as younger than San Diego and Merced.]

C. M. Carson, 1925 (Pan-Am. Geol., vol. 43, pp. 265–270). *Santa Barbara marls.*—Composed of evenly bedded soft brownish-yellow sandy bryozoan marls giving place above to fine soft sands. Thickness 1,000 ft. Probably rests uncon. on Mio. shales. Younger than Ventura sands and San Diego clays. The Santa Barbara fm. represents coldest part of Plio. epoch, immediately preceding the very cold early Pleist. It occurs at Santa Barbara and San Pedro.

U. S. Grant, IV, and H. R. Gale, 1931 (San Diego Soc. Nat. Hist. Mem., vol. 1, p. 35). Type loc. of *Santa Barbara fm.* is at Packard's Hill, Santa Barbara.

T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 3, pp. 492–494). Pressler's Kalorama memb. of Las Posas fm. contains typical Santa Barbara fauna and is here included in *Santa Barbara fm.* Upper half of the Santa Barbara is here tentatively placed in Lower Pleist., instead of Upper Plio., on basis of a mastodon tooth found at Santa Barbara and stated by Stock to be too large for Plio. mastodon. From evidence available the Plio.-Pleist. div. line appears to be near middle of Santa Barbara fm. At type loc. on Santa Barbara "mesa," at Rincon Point near Santa Barbara-Ventura Co. line, and at other places near edge of the basin, where it has a shallow-water facies, the Santa Barbara can be divided into 2 faunal zones on basis of its mega-fauna—(1) an upper *Pecten caurinus* zone, and (2) a lower *Pecten bellus* zone.

Santa Catalina gneiss.

Pre-Cambrian: Southern and central Arizona.

W. P. Blake, 1908 (Sci., n. s., vol. 28, pp. 379–380). *Santa Catalina gneiss.*—The extensively developed pre-Camb. gneiss on S. side of Santa Catalina Mtns near Tucson. Remarkable for its tabular form, regular stratification, altitude at low angles, broad, flat surfaces, and, in places, extreme foliation, passing from coarse-grained tabular granitic gneiss into micaceous sericitic and hornblende schists. These gneissic and schistose rocks are members of the series of pre-Camb. schists for which I proposed the name *Arizonian*. They are widely distributed in middle and southern Ariz.

Santa Catalina formation.

Middle Cambrian: Southeastern Arizona (Santa Catalina Mountains).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 476, 477, 480, 482). *Santa Catalina fm.*—Alternating thin-bedded red to black and ocherous qtzites, red to yellow sss., and light-colored, often pinkish and greenish micaceous shales, having, in type loc. (in Peppersauce Canyon, on N. side of Santa Catalina Mtns), thickness of 415 ft. Is a unit characterized by a trilobite that persists through entire thickness of fm. and that does not occur in underlying Troy qtzite nor in the younger Abrigo fm. [here restricted to middle part of Abrigo ls. of previous repts]. Is overlain by Southern Bell qtzite [new]. Is Middle Camb.

Santa Clara formation.

Pliocene and Pleistocene: Western California (Santa Clara County).

J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 171). *The Santa Clara lake beds.*—Fossil fresh-water shells have been found at several points on both sides of this valley, and at different heights above it, but sufficient specimens have not yet been collected to determine the ages, elevations, disturbances, etc., of the various beds. The oldest known is that at San José Mission, where a ridge apparently of Plio. date remains as a remnant of a thick bed of gravel and alluvium once filling greater part of valley to depth of probably 300 ft. above tides. The same deposit is seen at intervals from East Oakland along the foothills southward on E. side of valley, and less abundantly on W. side to near Redwood City, but does not everywhere contain fossils. It is considerably disturbed in some places, usually by elevation of the mtns since its deposit. Fossils from San José Mission listed.

J. C. Branner, J. F. Newsom, and R. Arnold, 1909 (U. S. G. S. Santa Cruz folio, No. 163). *Santa Clara fm.*—Coarse gravel, sand, and sandy clay, locally lignitic, containing a fresh-water fauna. Thickness at least 500 ft. Greater part is contemp. with Paso Robles fm. Rests, probably conformably, on Purisima fm. Overlain by Quat. deposits. Recent alluvium rests uncon. on it in at least one place. Considered contemp. with Merced fm.

Appears to have been named for its considerable development in Santa Clara Co.

Santa Claran epoch.

Pleistocene: California.

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pp. 1–29). *Santa Claran epoch (erosion).*—The epoch of erosion that initiated Sierran period of Le Conte precedes Red Bluff epoch of deposition. There is no portion of State in which this epoch is so clearly defined as on Upper Plio. area of Santa Clara River Valley of the South. Therefore I suggest for it the name *Santa Claran* as being eminently appropriate. (See under *Sierran.*)

Santa Cruz Island formation.

Pleistocene: Southern California (Santa Cruz Island).

R. W. Chaney and H. L. Mason, 1934 (Carnegie Inst. Wash. Pub. 415, pp. 4–6, 48; preprint 1930). Resting on truncated edges of Tert. deposits (of Mio. or Eo. age) exposed in valley of Willow Creek, on Santa Cruz Island, is a nearly horizontal alluvial deposit with max. thickness of 30 to 35 ft., which is here designated *Santa Cruz Island fm.* The fm. consists of clay, yellow to gray sands, and gravel, with numerous seams and pockets of carbonaceous material, and appears to have been largely derived from underlying Tert. Flora is closely related to that of Pleist. deposits of Carpinteria [Santa Barbara Co.], which have been named *Carpinteria fm.*

Santa Fe formation.

Miocene (upper) and Pliocene: Northern New Mexico and central southern Colorado.

F. V. Hayden, 1869 (U. S. Geol. and Geog. Surv. Terr. 3d Ann. Rept., pp. 66, 90). From Santa Fe to banks of Gallisteo Creek, 18 mi., we pass over the recent marls and sands which seem to occupy greater part of valley of Rio Grande above and below Santa Fe, which I have named *Santa Fe marls.* They are mostly of light cream color, sometimes rusty yellow, sometimes yellowish white, with layers of ss. varying in texture from a very fine aggregate of quartz to a moderately coarse puddingstone. These marls and sands weather into unique forms N. of Santa Fe like the "badlands" of Dakota. Are much younger than Gallisteo sand group. In Taos Valley they rest on metamorphic rocks. They are doubtless of Upper Tert. age. Thickness 1,200 to 1,500 ft. N. of Santa Fe, in Rio Grande Valley. [According to C. B. Hunt the thickness of this fm. in wells reaches 5,000 ft.]

Santa Fe schist.

Age (?): Cuba.

C. W. Hayes, T. W. Vaughan, and A. C. Spencer, 1901 (Rept. geol. reconn. Cuba, p. 114).

Santa Fe granite.

Pre-Cambrian (?): Central northern Colorado (Clear Creek, Summit, and Park Counties).

H. B. Patton, 1909 (Colo. Geol. Surv. 1st Rept., pp. 126–128, map). *Santa Fe granite.*—Gray medium-grained biotite-muscovite granite. Forms highest point of Santa Fe Peak. On this peak it occurs in well-defined dikes. This method of occurrence is a striking peculiarity as compared with Montezuma granite. Always in contact with Idaho Springs fm. [pre-Camb.]. Is younger than that fm., and believed to be older than Montezuma granite.

Santa Francisca rhyolite.

Age (?): Mexico.

G. E. Anderson, 1926 (Am. Inst. Min. and Met. Engrs. Trans. [preprint], No. 1551, p. 5).

Santa Isabel series.

Recent: Puerto Rico.

E. T. Hodge, 1920 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, pt. 2, p. 166).

Santa Lucia granite.

Santa Lucia quartz diorite.

Pre-Cretaceous: Southern California.

A. C. Lawson, 1893 (Calif. Univ. Pub. Dept. Geol. Bull., vol. 1, pp. 1–89). *Santa Lucia granite*, pre-Cret., forms main ridge of Santa Lucia Range.

P. D. Trask, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 6). *Santa Lucia quartz diorite.*—The term *Santa Lucia* was first applied by Lawson (1893) to the porphyritic granite in vicinity of Carmel Bay, but the porphyritic variety that he describes is only of local extent in Point Sur quad. As it apparently grades into the main quartz diorite mass of the region, and hence is probably a differentiate of the quartz diorite, the name *Santa Lucia* is retained for the entire plutonic mass. Intrudes Sur series.

F. A. Nickell, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 313–314). Evidence is that *Santa Lucia quartz diorite* has intruded and is later than *Santa Lucia granite* of Gavilan Range, and presumably both intrusives cut Sur series.

Santa Lucia series.

Pre-Franciscan (possibly pre-Cambrian): Southern California (Monterey, San Benito, and San Luis Obispo Counties).

B. Willis, 1900 (Sci., n. s., vol. 11, p. 221). *Santa Lucia series* is pre-Franciscan. Separated from Franciscan by erosion interval. [All there is about it.]

J. P. Smith, 1916 (Calif. State Min. Bur. Bull. 72, pp. 9, 25–26). *Santa Lucia fm.*—Schists, gneisses, and crystalline ls. of Santa Lucia Range in Monterey and San Luis Obispo Counties, and Fremont's Peak of Gavilan Range in San Benito Co., have been named by Bailey Willis [above citation] the *Santa Lucia series*. The rocks have never been fully described, but a partial description is given by H. W. Fairbanks (Calif. State Min. Bur. Rept. 12, pp. 493–526) without naming the series. No definite fossils known, but round crinoid stems are said to have been found in the Gavilan lss. of Fremont's Peak. They are certainly pre-granitic, and the granite of Santa Lucia Range is older than Franciscan. The rocks are thoroughly metamorphosed and look as old as the pre-Camb. rocks of southern Calif. Thickness and structural relations unknown, but Franciscan rocks lie uncon. upon them in the few places where contacts have been observed.

Same as Coast complex of Willis and Sur series of Trask.

Santa Margarita sandstone.

Miocene (upper): Southern California (Santa Cruz Mountains and southward).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Santa Margarita fm.*—Alternating beds of cgl. and soft ss., with several strata of diatomaceous earth and pumice. Thickness about 1,500 ft. Occurs in N. part of area, and considered to be contemp. with Pismo fm. of S. part of area, though the two fms. are not known to have been connected. Uncon. underlies Paso Robles fm. and uncon. overlies Monterey sh.

Named for exposures at Santa Margarita, San Luis Obispo Co.

†Santa Maria formation.

Pliocene and Pleistocene: Southern California (Santa Barbara County).

C. M. Carson, 1925 (Pan-Am. Geol., vol. 43, pp. 265–270). In Santa Maria dist. the Fernando fm. is sometimes called *Santa Maria fm.* It consists of a succession of shaly cgls., fine white and yellow sss., coarse gray sands, and thick beds of incoherent cgls. having aggregate thickness of not less than 3,000 ft., according to Arnold and Anderson.

San Tamaulipas formation.

Lower Cretaceous (Comanche series): Northeastern Mexico.

E. T. Dumble and E. R. Applin, 1924 (Pan-Am. Geol., vol. 41, p. 336). *San Tamaulipas fm.*—A very highly bituminous and calc. sh., which very closely resembles basal portion of Eagle Ford fm. of central Tex. and which occupies strat. interval btw. 4,554 and 4,666 ft. in well log of Idolo or Idol Island, Mexico, btw. Tampico and Tuxpam. Underlies San Juan fm. and overlies Tamasopa fm. [On p. 343 is called *Tamaulipas fm.*, as explained under *Tamasopo series*.]

Santa Monica slate.

Triassic (?): Southern California (Santa Monica Mountains).

H. W. Hoots, 1931 (U. S. G. S. P. P. 165C). *Santa Monica sl.*—Dark-gray and bluish gray to black sl. and phyllite, much of which has undergone contact and regional metamorphism and is locally altered to mica schist. Thickness 5,000 to 7,000± ft. Is of pre-Chico age. Assigned to Triassic (?); may be Jurassic or Paleozoic. Is intruded by Jurassic (?) granite and granodiorite. Named for occurrence in Santa Monica Mtns.

Santa Paula formation.

Lower Pliocene and Miocene (?): Southern California (Ventura Basin).

J. E. Eaton, 1926 (Oil and Gas Jour., Nov. 11, 1926, p. 72, also Oil Age, Nov. 1926, p. 16). *Santa Paula fm.*—Previously unrecognized. Well-bedded sss., blue sandy and brown sticky shales and cgls., locally present in Los Angeles Basin. 10,000 ft. exposed NW. of Santa Paula; absent S. of Ventura Basin (on upthrown side of Santa Clara River fault) from South Mtn to and including type loc. of Pico fm. Best exposed on great monocline NW. of Santa Paula. The exposed Santa Paula sediments in Ventura Basin are Lower Plio., but base is not there exposed and is elsewhere indicated to be of Santa Margarita (Upper Mio.) age. Basal fm. of Fernando group. Underlies Pico fm. and uncon. overlies Modelo fm.

J. E. Eaton, 1929 (A. A. P. G. Bull., vol. 13, No. 7, p. 755). *Santa Paula fm.*—Consists of (1) heavy-bedded gray to blue arkosic ss., with lesser members of thin- and medium-bedded ss. and brown and blue clay; locally conglomeratic; 7,500 ft.; (2) calc. ss. and brown and blue sandy clay, locally conglomeratic; 1,750 ft. Of Middle and Lower Plio. age. Underlies Pico fm. and overlies Santa Margarita fm.

W. P. Woodring, 1932 (16th Int. Geol. Cong. Guidebook 15, correlation chart). Santa Paula fm. of Eaton as originally defined included deposits of late Repetto (lower Plio.) and early Pico age. [The Pico is middle and upper Plio.]

Santa Rita limestone.

Silurian: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. No. 19, pp. 7–21). *Santa Rita ls.*—Dark-drab compact lss., 0 to 10 ft. thick, containing Sil. fossils. Type loc. Santa Rita, Grant Co. Underlies, uncon., Silver sh. (Dev.) and overlies El Pasan series (Ord.).

Santa Rita limestone.

Middle (?) Devonian: Southeastern Arizona (Santa Rita Mountains region).

C. R. Stauffer, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 133). Lower third of Dev. in Santa Rita Mtns, Ariz., contains fauna very different from that of Martin ls. and at once marked as much older. This fauna somewhat resembles that found by Kindle in Jefferson ls. of Mont., although it has a greater variety of Mollusca and fewer Brachiopoda. The fm. carrying this older fauna in Ariz. may be called *Santa Rita ls.* Its age is probably Middle Dev.

C. R. Stauffer, 1928 (Geol. Soc. Am. Bull., vol. 39, No. 2, pp. 430–433). *Santa Rita ls.*—Fairly massive dark-bluish to black ls. and calc. sh. Has not been recognized outside of Santa Rita Mtns. Is cut by many veins of white calcite and metamorphosed, with consequent destruction of fossils, but fossils obtained indicate Dev., at least as early as Middle Dev., and hence much older than Upper Dev. Martin ls. [The Martin ls. has long been classified as Upper and Middle Dev.]

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, p. 495). Writer considers it unwise to include Santa Rita ls. in Paleozoic strat. column of Ariz., until description of Middle Dev. fossils cited from Santa Rita Mtns has been given by Stauffer.

Santa Ritan series.

A term employed by C. R. Keyes to cover Santa Rita ls.

Santa Rosa beds.

A term applied by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, pp. 122–152, 1900) to sandy cgls. and red slates in Sonora, Mexico, assigned by him to Carbf. or Dev.

Santa Rosa sandstone. (In Dockum group.)

Triassic (Upper ?): Northeastern New Mexico (Guadalupe County).

D. Hager and A. E. Robitaille, 1919 (Geol. rept. on oil possibilities in eastern N. Mex., correlation table). *Santa Rosa ss.* in Las Vegas area and to E. is 500 to 600 ft. thick. Lies below 800 ft. of Triassic red and white beds, and lies above San Andres ls.

J. L. Rich, 1921 (Am. Jour. Sci., 5th, vol. 2, pp. 295–298). *Santa Rosa ss.*—Coarse gray ss., conglomeratic at base. Thickness 50 to 100 ft. Is a very definite unit exposed at Santa Rosa and Puerto de Luna and along canyon of Pecos for many mi. both above and below those places. From Santa Rosa it can be traced up valley of Pecos as a continuous unbroken escarpment to Estaritos Dome, E. of Anton Chico, where it forms the rim rock surrounding the dome. In center of dome, 200± ft. below base of Santa Rosa ss., the San Andreas ls., 10 to 25 ft. thick, is exposed. Beneath the San Andreas on the dome is the Permian Glorieta ss. The Santa Rosa ss. is Upper Triassic.

N. H. Darton, 1922 (U. S. G. S. Bull. 726E, p. 183, Mar. 31, 1922). [The name *Santa Rosa ss.* was adopted by U. S. Geol. Survey, for Mr. Darton's rept, in July 1919, but the rept was not published until Mar. 1922.] East of Glorieta Mesa and Hills of Pedernal the strata overlying Chupadera fm. consist of 800 ft. or more of red shales and sss. representing Dockum group, including near bottom a resistant massive ss. which is prominent in mesas of Guadalupe Co. and along Pecos River at Santa Rosa. This ss. appears to occur at about horizon of Shinarump cgl., but no definite correlation is possible, and I here propose for it, tentatively at least, the name *Santa Rita ss.* Case has found in it and above it Triassic bones. It rests on sh. that may be either Triassic or Perm.

Santa Rosa littoral marine formation.

Permian (middle and lower): Mexico and Guatemala.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 330).

Santa Rosa conglomerate.

Permian (lower): Guatemala.

C. Schuchert, 1935 (p. 341 of book cited above). Basal bed of Santa Rosa fm.

Santa Rosa beds.

Miocene (middle): Isthmus of Tehuantepec.

C. Schuchert, 1935 (p. 376 of book cited above).

Santa Susana formation.

Eocene (middle): Southern California (Ventura County).

B. L. Clark, 1924 (Pan-Pacific Sci. Cong. Proc., Australia, 1923, pp. 874-879). *Santa Susana fm.*—A fm. only recently recognized and as yet differentiated only in region of Simi Valley, Ventura Co. Richard Nelson, who has completed a mon. on Martinez of Simi Valley, proposes to call it *Santa Susana fm.* The beds referable to it had previously been mapped as part of the Martinez. Consists very largely of sh. and shaly sss. with heavy cgls. at base. Thickness 1,000 to 1,500 ft. Fauna entirely different from that of underlying Martinez and has very little in common with that of uncon. overlying Meganos group, although it is more closely related to Meganos fauna than to Martinez fauna.

R. N. Nelson, 1925 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 11, p. 401 and map). *Santa Susana sh.*—Predominately light-gray sh. with some fine-grained ss. and a lens of cgl. at base toward its E. end. Sporadic boulders of qtzite up to 6 in. diam. have been found in both ss. and sh. [Thickness not stated.] Grades into upper sh. of underlying Martinez group and into overlying Domengine fm. Is middle Eo. Occurs E. of main fault S. of Simi Valley. Fauna includes several distinctive genera, such as *Corbis* and *Velates*, which are new to Eo. of Calif. Other forms are closely related to those in the Meganos but distinct from any known in the Martinez. Named for its occurrence in proximity to town of Santa Susana.

†Santee beds.

Eocene (Jackson and Claiborne): Eastern and central South Carolina.

M. Tuomey, 1848 (Geol. of S. C., pp. 156, 190, 211). *Santee beds*, which I consider the lowest of the calc. portion of the Eocene [the lower part of the Eocene being called *Buhrstone fm.*]. Fossils [listed on pp. 160-162]. Consist of thick beds of white ls., marl, and greensand, best seen on the Santee, where, interstratified with the greensand, they dip gently to S. The coralline marl of Eutaw is found near upper edge of these beds. Overlie Buhrstone fm. and underlie Coralline marl, which is in turn overlain by Ashley and Cooper beds [Cooper marl of present nomenclature]. Are basal part of Ruffin's Carolinian bed. [As interpreted by C. W. Cooke (U. S. G. S. Bull. 867, 1936) the Santee beds of Tuomey included Cooper marl, Santee ls., and part of McBean fm.]

W. H. Dall, 1897 (U. S. G. S. 18th Ann. Rept., pt. 2, published in 1897 as House Doc. 5, 55th Cong., 2d sess., p. 342). *Santee beds.*—Upper Eocene of Santee River, S. C. See Tuomey, Geol. S. C., 1848, p. 156. Tuomey included Claibornian as well as Jacksonian marls in his series. The term as adopted here refers to upper green marls from which *Zeuglodon* has been obtained. The series when undisturbed would probably be divisible into several horizons corresponding to the different members of the Upper Eocene. Included in Jacksonian stage. [As interpreted by C. W. Cooke (U. S. G. S. Bull. 867, 1936) Santee beds of Dall is a larger unit than Santee ls. of present nomenclature, and includes Santee ls. and overlying Cooper marl.]

Santee limestone.

Eocene (Jackson): Eastern and central South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 17). *Santee marl*, also *Santee phase*.—The upper limit extends along a line from Shell Bluff by Kennedy's scarp (Tinkers Creek), by Hollomans Bridge (South Edisto Fork), by Jenkins Hill, by Warley Hill (Stout Creek), by Weeks Landing (Santee River), by Creston, by Cave Hill, by Whaley's Mill (Poplar Creek), by Pinckney Landing (Santee River), by Potato Creek, by Vances Ferry, by Wittee Lake (Williamsburg County), and thence toward ocean along ridge E. of Lenuds Ferry. The lower limit of exposures extends from mouth of Lower Three Runs to Utseys Bluff (eastern scarp of Edisto River SW. of St. Georges), whence it passes along Four Hole Ridge and thence to Wambaw Creek, in SE. part of Berkeley Co.; it probably approx. follows the edge of Cooper marls, under which it passes, with the Barnwell sands intervening in a thick series W. of St. Georges anticline, but in a very thin layer, if at all, along southerly contact of St. Georges anticline. The Mount Hope marl should also be found intervening. The materials of Santee phase consist of high-grade marls of a yellow-white color and compact texture.

In 1911 the U. S. Geol. Survey adopted *Santee marl memb. of McBean fm.* for essentially the same fm. as Santee marl of Sloan. In 1929 (Fla. Geol. Surv. 20th Ann. Rept.) C. W. Cooke and S. Mossom removed the Santee from McBean fm., because the Santee fauna was of Jackson age, while the rest of the deposits heretofore included in the McBean are of Claiborne age and probably uncon. with the Santee. They defined *Santee ls.*, as they called it, as consisting of the light-colored ls. exposed along Santee River, and as in some places overlain by Barnwell sand and in other places by Cooper marl.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Barnwell sand of western S. C. includes at base a ls. that appears to be=Santee ls. of Santee drainage.

Santee River beds.

A term applied by F. S. Holmes (Phosphate rock of S. C., 1870, pl. 1) to the Eocene marl along Santee River, S. C., which he in text called *Santee marl*.

Santiago formation.

Age (?): Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 241).

†Santiago chert.

Devonian(?): Southwestern Texas (Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, p. 41). *Santiago chert*.—A chert fm. of Marathon region is thought by Ulrich to be possibly lower Miss. (Kinderhook) in age. This is named by Baker the Santiago chert. It overlies Caballos novaculite uncon. Is thin-bedded, banded or ribboned, of dull shades of practically every color, but mostly green. Observed thickness 20 to 450 ft. [The 1919 edition of Bulletin 44 discarded Santiago chert and used Caballos novaculite to include it.]

C. L. Baker and W. F. Bowman, 1917 (Univ. Tex. Bull. 1753, p. 93). [See under *Caballos novaculite*.] Named for a locality at E. base of Santiago Range, E. of range's summit, where it was first seen.

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, p. 1078). [See 1931 entry under *Caballos novaculite*.]

San Timoteo beds.

Pliocene (upper): Southern California (San Jacinto quadrangle, Riverside County).

C. Frick, 1921 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 12, pp. 283–288). *San Timoteo beds.*—Great thickness of beds of late Plio. age, coarser than Eden beds, the upper div. of lower Plio. in this region, and containing vertebrate fossils which correlate in general way with the Blanco of Tex. Occur in San Timoteo Canyon area.

R. Eckis, 1934 (Calif. Dept. Pub. Works, Div. Water Res. Bull. 45, p. 51). It seems possible that upper beds of San Timoteo of Frick may well be lower Pleist.

Santo limestone. (In Millsap Lake formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). *Santo ls.* lies 60± ft. below Goen ls., and higher than Barton Creek ls., all members of Mineral Wells fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 106). *Santo ls.* is memb. of Garner fm., the name *Mineral Wells fm.* being restricted to upper part of original Mineral Wells fm.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 15–24). *Santo ls.*—Blue ls., weathering lemon yellow. Contains a few crinoid fragments. Thickness 1¾ ft. Lies 75+ ft. above base of Grindstone Creek memb. of Millsap Lake fm., and 50 ft. below Goen ls. bed in Grindstone Creek memb. Is typically exposed along the creek 0.4 mi. by road S. of railroad crossing in Santo, Palo Pinto Co. [This bull. describes Santo ls. as a single bed. The columnar section on the map (of Palo Pinto Co.) accompanying this bull. shows 2 lss. near together in this part of Millsap Lake fm., but the name *Santo ls.* is placed opp. the upper of these lss.]

Santo Domingo rhyolite.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], p. 16).

Santo Domingo flood plain deposits.

Quaternary: Mexico (Santo Domingo River, Sonora).

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], pp. 11, 12).

Santos shale.

Miocene (lower): Central California (San Joaquin Valley).

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169), divided Temblor fm. in McKittrick-Midway-San Emigdio region into (descending) Gould sh., Button bed ss., Media sh., Carneros ss., *Santos sh.*, and *Phacoides* reef.

L. M. Clark and A. Clark, 1935 (A. A. P. G. Bull., vol. 19, No. 1, p. 137). Vaqueros fossils have recently been found at several localities in Agua ss. (a memb. in upper part of Santos sh.), which prove Vaqueros age of at least lower two-thirds of Santos sh. and necessitate its removal from the Temblor [middle Mio.].

San Vicente formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 334).

Sapello quartzite.

Pre-Cambrian: Central northern New Mexico (Las Vegas region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 11). *Sapello qtzites.*—Main body of Archeozoic qtzites below the thick ls. section in Solitario Peak region, NW. of Las Vegas. Thickness 300 ft. [Derivation of name not given.]

†Sapulpa group.

Pennsylvanian: Central northern and central Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 6, 11). *Sapulpa group.*—Includes all beds btw. base of Lenapah ls. below and base of Pawhuska fm. of J. P. Smith above.

Named for Sapulpa, Creek Co.

Sapulpa sand.

A subsurface sand, 10 to 40 ft. thick, of early Penn. (Cherokee) age in central Okla., said to be same as Mounds sand, to correlate with Dutcher sand, and to lie lower than Taneha sand in Sapulpa dist. In that dist. the sand below Taneha sand is called *Dutcher* in Okla. Geol. Surv. Bull. 40Q, 1928, p. 141.

Saracachi formation.

Age (?): Mexico.

R. T. Hill, 1904 (Greene Consolidated Gold Co. [Prospectus], p. 16).

Saragossa quartzite.

Probably Carboniferous: Southern California (San Bernardino Mountains).

F. E. Vaughan, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 9, pp. 344, 352–363, and map). *Saragossa qtzite.*—At least 3,500 ft. of rocks (upper limit unknown) consisting of (descending):

1. Very heavy-bedded saccharoidal qtzites containing occasional strata of schist.
2. Series of soft biotite and muscovite schists.
3. Saccharoidal qtzite, cross-bedded.
4. Schists, 200 ft. thick, rather thin-bedded and varying from fine biotite schist to coarse gritty quartz-biotite schist; toward top free from dark constituents.
5. Quartzite-pebble cgl. Several ft.
6. White and pink qtzite, so recrystallized as to have lost all semblance of original clastic structure, 120 ft.
7. Soft decomposed biotite schist, 50 ft.

Is intruded by granites. Grades downward into Furnace ls. Is probably Sil. or Dev. Named for Saragossa Spring, San Bernardino Co., around which it is well developed.

A. O. Woodford and T. F. Harriss (1928) collected Miss. fossils from upper part of underlying Furnace ls., so that Saragossa qtzite is probably Carbf.

Saranac formation.

Pre-Cambrian: Northeastern New York (Clinton and Franklin Counties).

See under †*Dannemora fm.*

Saratoga sand.

Pleistocene: Eastern New York.

A. Fitch, 1850 (Historical, topographical, and agricultural survey of county of Washington, [N. Y.], pt. 3, p. 878). The *Saratoga sand fm.*, for which no name more definite and appropriate can probably be given, and which will be readily understood without explanation, reaches into Washington Co. in SW. part of Kingsbury, and occupies all that part of this town and of Fort Edward which is S. and W. of Fort Edward Creek, being a tract of nearly 5,000 acres. It also extends a half mile S. of mouth of Fort Edward Creek, forming the flats along the river here, and occurs in Saratoga and the counties S. of it. Overlies Albany clay. Is composed chiefly of grains of white and of hyaline quartz, more or less rounded and worn, scattered with minute fragments of hornblende and other minerals. Along the Hudson and Wood Creek occur tracts of sand similar to and which seem to be cotemporary with the Saratoga sands, though some of them may be more recent deposits.

Saratoga chalk.

Upper Cretaceous: Southwestern Arkansas.

J. C. Branner, 1898 (Am. Inst. Min. Engrs. Trans., vol. 27, pp. 52–59). *Saratoga chalk.*—Light-gray chalk, outcropping E. of Saratoga, W. of Columbus, N. of Washington, and thence E. to near Arkadelphia. Overlies upper White Cliffs [Annona] chalk, and underlies calc. ss. or marl [Nacatoch sand]. Thickness 20 to 40 [60] ft.

According to 1925 and 1926 work of L. W. Stephenson and C. H. Dane, the Saratoga chalk is a distinct fm., uncon. underlying Nacatoch sand

and uncon. overlying Marlbrook marl (restricted). In some previous repts it has been treated as a memb. of Marlbrook marl. It is younger than Annona chalk. (See C. H. Dane, U. S. G. S. Press Bull. 8823, Sept. 10, 1926; L. W. Stephenson, A. A. P. G. Bull., vol. 11, No. 1, Jan. 1927; and C. H. Dane, Ark. Geol. Surv. Bull. 1, 1929.)

Named for typical outcrops just N., also E., of Saratoga, Hempstead Co.

†Saratoga formation.

†Saratoga series.

†Saratogan group.

Terms that have been applied by some geologists to rocks in Saratoga region, N. Y., that are divided into Little Falls dol., Hoyt ls., Theresa fm., and Potsdam ss. See also †*Sarceen series.*

†Saratogan epoch (or series).

Discarded name for Upper Cambrian or St. Croixan series. See U. S. G. S. Bull. 769, pp. 96–97. Originally spelled "Saratogian."

Sarbach formation.

Lower Ordovician: Alberta.

C. D. Walcott, 1920 (Smithsonian Misc. Coll., vol. 72, No. 1, p. 15). *Sarbach fm.*, Ord., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll., vol. 67, No. 8, p. 459, Mar. 5, 1923. Uncon. overlies Mons fm. Thickness 1,120 ft.]

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 302–307), assigned this fm. to upper Beekmantown and Mons fm. to lower Beekmantown.

†Sarceen series.

C. D. Walcott, 1923 (Smithsonian Misc. Coll., vol. 67, No. 8, pp. 466–476). *Sarceen series* (*Lower Ozarkian*).—To replace Saratogan as used by E. O. Ulrich in Geol. Soc. Am. Bull., vol. 22, 1911 [which included Little Falls, Hoyt, Theresa, and Potsdam fms.]. Named for Sarcee Indian tribe, which ranged in western Alberta N. of Blackfeet (Siksika) tribe and hunted up the river valleys to Continental Divide. Type fm. is Mons fm. Fauna of lower Mons is "predominantly Upper Camb.," but "trilobites midway of the Mons fm. strongly foreshadow the change to Ord. fauna."

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 301), assigned *Mons fm.* to Lower Ord. (Beekmantown).

J. A. Allan and R. L. Rutherford, 1934 (Alberta Research Council Rept. No. 30, p. 31). *Sarceen series* is Ord.

Sarten sandstone.

Lower Cretaceous (Comanche): Southwestern New Mexico (Deming region).

N. H. Darton, 1916 (U. S. G. S. Bull. 618, pp. 19, 43). *Sarten ss.*—Almost entirely light-gray massive ss., most of it qtzitic or very hard. Some beds are slabby, and a few contain a little calcium carbonate. At base more or less cgl., part of it containing angular and subangular fragments. Thickness in Sarten Ridge (type loc.), Goat Ridge, and ridges E. of Cooks post office, Deming quad., 300 ft., but in many areas top has been removed by erosion or covered by later deposits. Comanche (Washita) fossils from limy beds not far below middle. Overlain by Colorado sh. Rests uncon. on Lobo fm. (Triassic ?).

Sasakwa limestone member (of Holdenville shale).

Pennsylvanian: Central southern Oklahoma (Pontotoc and Seminole Counties).

G. D. Morgan, 1923 (Okla. Geol. Surv. Circ. 12, pp. 9, 10) and 1924 (Bureau Geol. [Okla.] Bull. 2, pp. 103–105). *Sasakwa ls. memb.*—Fossiliferous ls. occurring about 35 ft. below top of Holdenville fm. in Stonewall quad., Okla. Its outcrop passes through town of Sasakwa. Thickness 1 to 15 ft. Lies 17 to 70 ft. above top of Homer ls. memb. of Holdenville fm.

Named for exposures in Sasakwa, Seminole Co. Also especially well exposed in railroad cut and quarry about ¼ mi. S. of Sasakwa.

†Saskatchewan gravels.

Pleistocene: Saskatchewan and Alberta.

R. G. McConnell, 1886 (Canada Geol. Surv., n. s., vol. 1, pp. 70C–71C).

†Sassafras River greensand.

Upper Cretaceous: Northeastern Maryland.

W J McGee, 1888 (U. S. G. S. 7th Ann. Rept., p. 612). *Sassafras River greensand.*—A nearly homogeneous massive bed of richly glauconitic sand, with glauconite diminishing somewhat near base. More or less ferruginous, but destitute of distinctive bedding. Thickness probably more than 100 ft. No fossils found, but it is doubtless Cret. Rests with erosion uncon. on Potomac fm. and is uncon. overlain by Columbia fm. Was noted only along Sassafras River for short distance above its mouth to Back Creek Neck and on Mauldens Mtn and a few neighboring eminences.

According to L. W. Stephenson (personal communication) the beds at locality described on Sassafras River include Magothy, Matawan, and Monmouth fms., all of Upper Cret. age. See U. S. G. S. Tolchester folio, No. 204, and Dover folio, No. 137. Is same as Severn fm. of Darton.

Satan tongue (of Mancos shale).

Upper Cretaceous: Northwestern New Mexico (Gallup region).

J. D. Sears, 1934 (U. S. G. S. Bull. 860A). The upper tongue of Mancos sh. (marine) that grades laterally into Hosta ss. memb. of Mesaverde fm. in part of area from Gallup eastward toward Mount Taylor is here named *Satan tongue of Mancos sh.*, because its beginning and growth are well shown in Satan Pass. Is of Colorado age.

Satanka shale.

Permian: Southeastern Wyoming and northeastern Colorado.

N. H. Darton, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 430, etc.). *Satanka sh.*—Red sh. with 10-ft. bed of gyp. a short distance below top and a 15-ft. bed of gyp. 25 ft. lower in fm. Thickness 200 to 232 ft. Underlies Forelle ls. and overlies Casper fm. Named for R. R. station a few mi. S. of Laramie, Wyo. [Albany Co.].

See under *Chugwater fm.*

†Satilla formation. (Of Columbia group.)

Pleistocene: Georgia Coastal Plain.

J. O. Veatch and L. W. Stephenson, 1911 (Ga. Geol. Surv. Bull. 26, pp. 60, 424, 434–445). *Satilla fm.*—Latest Pleist. deposits in Ga., consisting of coastal-terrace deposits and fluviatile or river-terrace deposits. The *coastal deposits* lie upon a wave-cut terrace which extends 20 to 30 mi. back from present ocean at elevations of 15 to 40 ft. above sea level. The western limit of this terrace or plain is marked by the high sand ridge E. of Folkston, Charlton Co., and by the escarpment at Waynesville and Mount Pleasant, Wayne Co., and at Walthoursville, Liberty Co. Is first marine terrace. The deposits on Satilla plain rest uncon. on Plio. or Mio. strata. They consist of greenish and bluish marine clays; gray, white, and yellow sands; and thin layers of gravel; all unconsolidated. Thickness 15 to 50 ft. The relative age of fm. with respect to the older Okefenokee fm. is determined by its topographic position and not by strat. sequence or paleontologic evidence. The Satilla fm. is fossiliferous; the topographically higher Okefenokee fm. is not fossiliferous. The *fluviatile deposits* form low terraces along larger rivers of Coastal Plain, and consist of unconsolidated sands, clays, and gravels which merge coastward into marine or fluviomarine deposits. The river terraces are comparatively flat plains from 10 or 15 to 40 or 50 ft. above the rivers, and vary in width from 300 or 400 yards to an original width of 8 or 10 mi. Thickness 10 to 40 ft. Included in Columbia group.

Named for development along both sides of Satilla River, in Camden and Charlton Counties.

The Pleist. terrace deposits of Atlantic Coastal Plain from Del. to Fla. are now divided into the 7 fms. enumerated under *Columbia group*, and Satilla and Okefenokee fms. have been abandoned.

Satsop formation.

Pleistocene: Western Washington.

J. H. Bretz, 1914 (Geol. Soc. Am. Cordilleran sect., abstract of meeting in May 1914) and 1915 (Geol. Soc. Am. Bull., vol. 26, p. 131). *Satsop fm.*—Grand deposit widely distributed along Wash. coast and in Chehalis Valley, but not found in Puget Sound region.

J. H. Bretz, 1917 (Geol. Soc. Am. Bull., vol. 28, No. 1, p. 170). *Satsop fm.* is a widespread fluviatile deposit in river valleys of SW. Wash., in Columbia River Valley for at least 200 mi. above mouth, and in lower Willamette Valley of NW. Oreg., and is a coastal deposit exposed at intervals along almost entire Pacific coast of Wash. and Oreg. Extends inland as far as Yakima Valley, on E. flank of Cascade Mtns of Wash. From strat. relations and fossils the coastal phase is known to be Quat.

J. H. Bretz, 1917 (Jour. Geol., vol. 25, pp. 446–458). *Satsop fm.* is here extended to cover that Quat. fm. of Pacific coast whose minimum limits reach from Strait Juan de Fuca N. of Wash. to Coquille Valley, within 80 mi. of Oreg.-Calif. line. Type section is Satsop Valley, a tributary of Chehalis Valley. Thickness 300 ft. in Chehalis Valley, 200 ft. S. of Grays Harbor, 75 ft. in Willapa Bay region, 150 ft. at least in Cowlitz Valley, 500 at least along Sandy River, 500 at Angels Rest, 700 in Benson Plateau, Cascade Range. At The Dalles what is regarded as a local phase of Satsop fm. is 1,000 ft. thick. The Satsop rests uncon. on Tert. and older rocks. It was mapped by Ralph Arnold as Pleist. gravel, sand, and clay. In Columbia Valley it rests on eroded Columbia River lava.

Satsop fm. continued to be assigned to Pleist. until 1921, when Bretz (Geol. Soc. Am. Bull., vol. 32, pp. 36–37) assigned it to Plio. or Pleist. In 1927 (Sci., n. s., vol. 66, p. 236) and 1929 (Geol. Soc. Am. Bull., vol. 40, p. 177) J. P. Buwalda and B. N. Moore assigned the beds that had been called *Satsop fm.* by Bretz in Columbia River gorge to late Tert. (Neocene). In 1930 (Carnegie Inst. Wash. Pub. 404, pp. 11–26) Buwalda and Moore assigned to middle Neocene the beds in Columbia River gorge that had been called "Satsop fm.," and applied to them the name *Hood River cgl.*, stating that they are now known to be older than type Satsop of Chehalis Valley, Wash., 100 mi. distant, and that they rest on Columbia River lava and underlie the Dalles beds. They stated: "It is the *Portland delta gravel* and related deposits to the north and south which constitute the Quaternary valley fill." This appears to make Satsop fm. (restricted to Pleist. deposits) same as their Portland delta gravel.

Saturday Mountain formation.

Upper Ordovician: Southern central Idaho (Custer County).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Saturday Mtn fm.*—Dark massive dol. interbedded with argillite and shaly dol., in part carbonaceous. Thickness 3,000 (?) ft. Contains same fauna as Fish Haven dol. of SE. Idaho, but lithology is different. Underlies Laketown dol. and overlies Kinnikinic qtzite. Named for Saturday Mtn, on W. side of lower course of Squaw Creek, on W. border of Bayhorse quad.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 952, etc.). *Saturday Mtn fm.*—Named for ridge that lies W. of lower Squaw Creek, near middle of W. bdy of Bayhorse quad., where it consists dominantly of more or less shaly dol. and mag. ls., mostly black on fresh fracture. Usually surficially bleached to dirty buff and locally stained brown. Thickness 300 (T. 12 N., R. 19 E.) to 3,000± ft. in W. part of quad. Younger than Kinnikinic qtzite and older than Trail Creek fm. (Sil.). Fossils.

Saucesian stage.

Tertiary: California.

See under *Zemorrian stage*, R. M. Kleinpell, 1934.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224, etc.). *Saucesian stage* includes middle and upper members of Rincon sh., middle Temblor, etc.

Saucito sandstone member (of Cook Mountain formation).

Eocene (middle): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, p. 1384). *Saucito ss.*, top memb. of Cook Mtn fm. in section along Rio Grande from San Pedro de Roma on Mexican side from Roma [Starr Co.], Tex. Consists of 94 ft. of medium coarse-grained poorly bedded gray ss. [Derivation of name not stated.]

Sauer Dough sand.

A local sand bed, about 10 ft. thick, in Vaqueros ss. of Coalinga dist., Calif. It is uppermost sand in some wells along W. edge of sec. 22, T. 19 S., R. 15 E., and lies about 40 ft. above Pulaski sand.

Saugeen clay.

Pleistocene: Ontario.

W. E. Logan, 1863 (Canada Geol. Surv. Repts. 1843-63, pp. 887, 896-907, 909). *Saugeen clay*, the upper of the two divisions of stratified clays which overlie the boulder fm. or glacial drift of western Canada [Ontario], is a fresh-water deposit, well exposed along Saugeen River. With exception of a yellow band sometimes found at top, it consists of a thinly bedded brown calc. clay, in layers seldom more than an in. thick, separated by thin partings of drab or olive color; in places this clay div. is underlain by beds of sand, and in certain parts of its distribution it is also interstratified with sands and gravels. In two or three instances fresh-water shells have been found in beds apparently belonging to this div. Rests uncon. on the blue Erie clay. On shore of Lake Erie the Erie and Saugeen clays are well exposed. They apparently belong to a distinct basin, so that their relations to lower and upper divisions of the stratified drift of eastern Canada and Vt. cannot yet be determined. The Saugeen clay is considered to be older than Artemisia gravel.

J. W. Spencer, 1888 (Am. Geol., vol. 2, pp. 294-297). Upon the Erie clay rests the more sandy yellow and brown *Saugen* [*Saugeen*] *clays*, a name including a group of clays. These stratified deposits of interior of continent are probably the equivalents in part of the more eastern marine Champlain beds, but their exact relationship has not been made out. Some of the included beds are doubtless the deeper lacustrine equivalents of some beaches of the next series.

J. W. Spencer, 1892 (Phil. Soc. Wash. Bull., vol. 11, p. 506). Amongst the deposits of the later Pleist. period there is a well-stratified, hardened brown clay charged with pebbles which are more or less glaciated, resting upon the typical blue boulder clay N. of Toronto. In Canadian classification of the Pleist. deposits there is no place for this deposit. Indeed, all stratified deposits of this region need revision, in light of progress that has been made in surface geology during last 20 years. Thus, the *Saugeen clay* is resolvable into three series. The relation of all the clays to the older beaches requires special study, as some of them may represent deep-water deposits of the Beach epoch, while some of the later beaches rest upon such clays.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 222). In Ontario the boulder clays are superimposed by the Erie clay, which in turn is overlain by the *Saugeen clay and sands*.

Saugus formation. (In Fernando group.)

Pleistocene (lower): Southern California (Los Angeles County).

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349-372). *Saugus div.*—Great series, 2,000 ft. thick, of unlithified sand, gravel, and clay, stratified, water-worn, and water-deposited. Is an alluvial deposit, a river delta progressively sinking. Splendidly exposed in railway cuts in Soledad Canyon near Saugus, Los Angeles Co. Conformably overlies Soledad div.

W. S. W. Kew, 1923 (A. A. P. G. Bull., vol. 7, pp. 411-420) and 1924 (U. S. G. S. Bull. 753, p. 81). *Saugus fm.* was first recognized by Hershey as "Saugus division of the upper Pliocene series." In previous repts the Saugus deposits have been included in Fernando fm., of which they constitute the upper uncon. part. In this rept the Saugus deposits are treated as a distinct fm. and the Fernando is made a group. In most places the Saugus fm. rests uncon. on the Pico, the lower fm. of Fernando group, and is uncon. overlain by Pleist. terrace deposits. Is of upper Plio. and lower Pleist. age. Fauna is younger than Pico fauna.

J. E. Eaton, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 123), stated that *Saugus fm.* grades up into San Pedro fm. (restricted) in deeper parts of Ventura and Los Angeles Basins.

J. E. Eaton, 1931 (A. A. P. G. Bull., vol. 15, No. 4, p. 381). *Saugus* of U. S. G. S. Bull. 753 is an undiff. succession of pre-San Pedro, San Pedro, and Hall Canyon age. A characteristic fauna was listed, however, from basal (pre-San Pedro) part on W. The name *Saugus* has priority, regional significance, and utility only when restricted to basal unit of pre-San Pedro age, which carries type fauna. Writer uses the name in this restricted sense. As restricted the fm. is dominantly a poorly bedded, somewhat coarse-grained clastic succession, which commonly contains more clay than does overlying San Pedro. Rests on Pico with very sharp contact.

U. S. Grant and H. R. Gale, 1931. (See under *Ventura sands.*)

W. P. Woodring, 1932 (16th Int. Geol. Cong. Guidebook 15, pl. 2, p. 35), showed Saugus fm. (restricted to marine and nonmarine deposits of lower Pleist. age) of Los Angeles Basin as older than San Pedro sand [restricted], and the Saugus of Santa Ynez Range, Santa Clara Valley, and Simi Valley as including, in upper part, the equiv. of the San Pedro restricted. The deposits of upper Plio. age that had previously been included in the Saugus were here transferred to underlying Pico fm. On p. 49 W. S. W. Kew stated: *Saugus fm.* was deposited in a shallow basin and embraces both marine and nonmarine deposits; at type section it is mainly nonmarine, but in Ventura Co. the lower part contains several marine faunal zones of Pleist. age. [This is present approved definition of U. S. Geol. Survey.]

†Saugus granodiorite.

†Saugus quartz diorite.

Early Paleozoic: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass.), applied *Saugus* to a quartz diorite and to a granodiorite. B. K. Emerson (U. S. G. S. Bull. 597, 1917) renamed the quartz diorite *Newburyport quartz diorite* and showed the granodiorite to be same as Dedham granodiorite.

Sault St. Mary sandstones.

A name applied by A. R. C. Selwyn (Sci., vol. 1, 1883, p. 11) to the Upper Camb. ss. (Lake Superior ss.) of Sault Ste. Marie region, Mich.-Ont.

Saunders formation.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Iron River district).

R. C. Allen, 1910 (Mich. Geol. and Biol. Surv. Pub. 3, pp. 33, 36). *Saunders fm.*—Cherty dol.; massive white and pink dol.; quartzose dol.; impure carbonate slates; qtzites and talcose slates. Thickness 3,750± ft. Underlies, with possible uncon., Michigamme sl. and uncon. overlies Archean. Named for [exposures E. of] village of Saunders, in Iron Co., Mich.

Sauquoit beds.

Silurian: East-central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 333, 341). *Sauquoit beds.*—"This name is temporarily extended over all the sh. and ss. beds between Oneida cgl. and the oolitic ore bed in Oriskany and Sauquoit Valleys, where it is about 100 ft. thick, with type section on Swift Creek, north of Sauquoit village and in its vicinity. It may be desirable later to restrict the term to some definite unit within this series, in which are probably present true Sodus, Martville, and perhaps Maplewood and other horizons." Fossils listed.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 338). "The matter of a geographic name for the Middle Clinton of N. Y. is in doubt." "Chadwick's name Sauquoit may then be the one that will finally be adopted." [See further explanation under *Clinton fm.*]

Sausalito chert. (In Franciscan group.)

Jurassic (?): Western California (San Francisco region).

R. Arnold, March 1902 (Sci., n. s., vol. 15, table on p. 416). *Sausalito cherts*, radiolarian, 900 ft. thick. [Shown in table as underlying Marin ss., overlying Bolinas ss., and as a subdivision of the Franciscan.]

A. C. Lawson, February 1903 (Geol. Soc. Am. Bull., vol. 13, table on pp. 544-545). [Same as above.]

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Sausalito chert.*—Radiolarian chert, prevailingly dull brownish red, especially in thicker and more evenly bedded parts, but includes some rock of yellow, green, and other colors, interbedded with thousands of thin layers of sh. Underlies Marin ss. and overlies Cahil ss. Included in Franciscan group.

Named for exposures W. of town of Sausalito, on Marin Peninsula, Marin Co.

Savage formation.

Pennsylvanian: Northeastern West Virginia and western Maryland.

N. H. Darton and J. A. Taff, 1896 (U. S. G. S. Piedmont folio, No. 28). *Savage fm.*—Nearly equally divided btw. ss. and sh.; contains 4 coals of economic importance, and 2 thin beds of ls., the upper of which is 5 ft. thick and lies 53 ft. below top of fm. Thickness 130 to 160 ft. The roof of the coal bed commonly known as 6-foot bed or Davis seam is top of fm., and base rests on upper ss. and cgl. of Blackwater fm. Is overlain by Bayard fm. Savage River has cut through Savage fm.

Savage fire clay.

See *Mount Savage fire clay.*

Savanna sandstone.

Pennsylvanian (Allegheny): Eastern and central southern Oklahoma and western Arkansas.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 437). *Savanna ss.*—Shales, with 5 heavy ridge-making sss., 50 to 200 ft. thick, the ss. at top and base being usually thicker than the other sss., the distinctive feature of the fm. being the sss. Thickness 1,150 ft. Overlies McAlester sh. and underlies Boggy sh.

This name was later misapplied in Ark., as explained under *McAlester fm.*

Named for Savanna, Pittsburg Co., Okla., which is located on the fm.

Savant group.

Pre-Cambrian: Ontario.

E. S. Moore, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 551) and 1930 (Ont. Dept. Mines 37th Ann. Rept., vol. 37, pt. 4, p. 56). Occurs in Lake Savant area, 140 mi. NW. of Lake Superior.

Saverton shale. (In Kinderhook group.)

Mississippian: Northeastern Missouri, southeastern Iowa, and western Illinois.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 149, 151, 153-156). *Saverton sh.*—Blue shales, 2 to 75 ft. thick, underlying Louisiana ls. and overlying Grassy (black) sh. Usually included in Grassy sh. [Grassy Creek sh.].

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 282, etc.), stated that Saverton sh. (Miss.) is well developed in Pike and Calhoun Counties, western Ill. A. H. Bell, 1932 (Ill. Geol. Surv. Press Bull. 24), gave 47 to 83 ft. of Saverton sh. in wells in Warsaw area, Hancock Co., Ill., and included it in Kinderhook group, as did R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245).

J. M. Weller (1935) proposed to redefine this fm., as explained under *Grassy Creek sh.*

Some writers have included this sh. in Dev.; others have included it in Miss. The U. S. Geol. Survey has recently (June 1937) assigned it to Kinderhook group.

Named for exposures in vicinity of Saverton, Ralls Co., Mo.

Savoy schist.

Ordovician: Western Massachusetts and southeastern Vermont.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form.

although cited in U. S. G. S. Bull. 191, 1902). *Savoy schist,* sericite schist, with beds of amphibolite. Underlies Hawley schist and overlies Chester amphibolite.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 156–163, 220–221 and pl. 34). *Savoy schist.*—Sericite schist with garnet and chlorite locally developed. Underlies Hawley schist and overlies Chester amphibolite. Thickness 5,000 ft. (?). [See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 42).]

Named for development in E. part of Savoy Twp, Mass.

Sawatch quartzite.

Upper Cambrian: Western and central Colorado.

G. H. Eldridge, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *Sawatch qtzite.*—Lowest sedimentary series in region. *Lower div.* consists of 50 to 200 ft. of white qtzite with a persistent cgl. of pure white quartz at base. *Upper div.* consists of 130 to 160 ft. of red ferruginous and somewhat calc. ss. composed chiefly of quartz and feldspar with small amount of mica. A green glauconitic mineral occurs in both divisions but more abundantly in upper div., which also contains a few fossils of Potsdam type. The upper div. is absent at head of Taylor Creek. The Sawatch rests on Archean granite and gneiss and is overlain by Yule ls. Named for persistent occurrence around flanks of Sawatch Range.

The upper red sandy and shaly beds of Sawatch qtzite are in some areas known as "transition shales" and "red cast beds." In Leadville region they have been named *Peerless sh. memb.*

Sawatch schist.

Pre-Cambrian: Central Colorado (Sawatch Range).

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, pp. 466–479, map). [See description under *Holy Cross schist.*]

†Sawatchan series.

Upper Cambrian: Colorado.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 281, 286). The upper series of Cambric period in Colo. Divided (descending) into three unnamed fms.: Sss., 150 ft.; qtzites, 400 ft.; and cgls., 50 ft. "An adaptation of Eldridge's title" [Sawatch qtzite]. These rocks encircle Sawatch uplift in central part of Colo.

Sawback formation.

Lower Ordovician (?) and Cambrian: British Columbia and Alberta.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 120); also J. A. Allan, p. 182 of same book; also J. A. Allan, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 172). [In all these repts *Sawback fm.* was assigned to *Dev.*]

L. D. Burling and J. A. Allan, 1916 (Canada Geol. Surv. Summ. Rept. 1915, pp. 99, 101), assigned this fm. to Camb., which is where it is now placed by all workers.

E. M. Kindle, 1924 (Pan-Am. Geol., vol. 42, p. 117). The *Sawback fm.* of Banff, Alberta, embraces Mons, Lyell, and Sullivan fms. [Walcott in 1920 assigned these 3 fms. to Camb., but later he assigned Mons fm. to lower Ozarkian of Ulrich. In 1930 (Am. Jour. Sci., 5th, vol. 20, p. 301) P. E. Raymond assigned Mons fm. to Lower Ord. (Beekmantown), but, so far as records show, the Lyell and Sullivan fms. are still assigned to Upper Camb.]

Sawbackian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, pp. 285, 288, 289). Dol., 1,700 ft. thick, of Late Cambric age, lying uncon. below Sherbrookian series and uncon. above Paget fm., of Late Cambric age. "For present the Sawback fm. is best treated as having serial rank."

Sawridge formation.

Upper Cretaceous: Alberta.

J. A. Allan, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. C, p. 11), and 1934 (Alberta Research Council Rept. No. 30, p. 20).

Sawyer limestone member (of Waxahatchee slate).

Paleozoic or pre-Cambrian: Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 51). *Sawyer ls. memb. of Talladega sl.*—Thick-bedded fine-grained bluish-gray ls. in places a highly variegated marble, 100 to 500 ft. thick, occurring in lower part of Talladega sl. No fossils. Lies about 4,500 ft. above base of Talladega sl. [In Montevallo-Columbiana quads. this ls. is a memb. of Waxahatchee sl.]

Named from fact it underlies Sawyer Cove, Shelby Co., in Columbiana quad.

Sawyer quartz syenite.

Devonian or Carboniferous: New Hampshire (Belknap Mountains). See 1936 entry (D. Modell) under *White Mtn magma series*. Named for farm at W. base of Gunstock Mtn.

Sawyer Hill moraine.

Pleistocene (Wisconsin stage): Northeastern New York (Essex County). Named for Sawyer Hill. See N. Y. State Mus. Bull. 187, 1916.

Saxet sand.

A subsurface sand in Frio clay of Driscoll pool, Duval Co., Tex.

Saxian series.

Upper Cretaceous: Northwestern Iowa.

C. [R.] Keyes, 1925 (Pan-Am. Geol., vol. 43, p. 300). The chalk beds represented by Crill and Niobrara fms., which doubtless come together at no very great distance E. of Missouri River, and where they should unquestionably be distinctly recognized by special title, under some such name as *Saxian series*, from locality of easternmost known outcrops of the terranes in Iowa.

†Saxicava sand.

A paleontologic term applied in early repts on New England region to beds of Pleist. marine sand containing the fossil *Saxicava rugosa* and said to underlie †Leda clay (also paleontologic) and to form part of †Champlain epoch.

Saxton conglomerate member (of Chemung formation).

Upper Devonian: Central Pennsylvania (Blair and Huntingdon Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 523, 535). *Saxton cgl. memb. (of Chemung fm.)*.—Introduced to replace [I. C.] White's name Lackawaxen cgl. in Blair and Huntingdon Counties, as it seems very uncertain whether this cgl. is same as typical Lackawaxen. Exposed in and about Saxton, Huntingdon Co.

Saxton shale. (In Catskill formation.)

Upper Devonian: Central southern Pennsylvania (Bedford County) and eastern West Virginia.

D. B. Reger, 1927 (Geol. Soc. Am. Bull., vol. 38, pp. 157, 397–410). *Saxton sh.*—Green sh., carrying fossil plants, located in upper part of Catskill series at Riddlesburg, Bedford Co., Pa., where its visible thickness is 5 ft. and where it lies 330 ft. below base of Berea ss. or top of Catskill. Well exposed on N. side of deep cut. Has been recognized by writer at localities [mentioned] in Dauphin, Monroe, Westmoreland, Indiana, and Cambria (near Johnstown) Counties, Pa., also in Morgan and Randolph Counties, W. Va. Distance below base of Pocono varies from 100 to 800 ft. May correlate with Montrose red sh. or with Paupack ss.

Sayabec formation.

Silurian: Quebec (Matapedia Valley).

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 368–385). *Sayabec fm.*—Gray, dove-colored ls., typically exposed at a quarry on shore of Lake Matapedia 3 mi. E. of Sayabec, where it consists of a lower part made up of nearly unfossiliferous aren. ls. and dol., and an upper part of fossiliferous dense argill. ls. Thickness exposed 290 ft., but may be 500 ft. thick. Conformably overlies Val Brilliant fm. and conformably underlies St. Leon fm. Fossils (listed).

Saypo limestone member.

Mississippian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 46+). *Saypo ls. memb.*—In lower part of Madison ls. Thickness 72 to 141 ft. Lower 91 ft. is shaly fine-grained argill. lss. interbedded with white smooth and thicker-bedded argill. lss.; weathers bright buff. Overlying 20 ft. is massive thick-bedded gray crinoidal lss. that weather gray. Upper 30 ft. is massive chocolate-colored crinoidal lss., thick-bedded in upper part and thinner-bedded in lower part. In Pentagon Mtn area the very top of the Saypo is a thin zone of shaly thin-bedded tan ls. crowded with poorly preserved fenestellid Bryozoa. Underlies Dean Lake chert memb. and overlies Silvertip cgl., basal memb. of Madison. Named for Saypo quad., over much of which it is well exposed. Type loc. on S. side of upper part of Pentagon Mtn, SW ¼ sec. 14, T. 25 N., R. 12 W., where it forms a buff-colored, relatively gentle slope beneath the harder Dean Lake chert.

Scajaquada limy shale.

Silurian: Western New York.

G. H. Chadwick, 1917. (See 1917 entry under *Bertie ls. memb.*)

Derivation of name not stated.

†Scalent series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 106, 134–136+, and vol. 2, p. 754). Divided into (descending): (1) *Scalent ls. (Water Lime group of N. Y.)*, 250 ft. thick on the Juniata; (2) *Scalent grey marls*, 800 ft. thick on the Juniata; and (3) *Scalent variegated marls*, about 400 ft. thick on the Juniata. Nos. 2 and 3 stated to "probably represent Onondaga salt group of N. Y."

†Scalent limestone.

†Scalent marls.

See under *†Scalent series.*

Scanlan conglomerate. (Of Apache group.)

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Scanlan cgl.*—Imperfectly rounded pebbles of glassy vein quartz with an occasional small flake of schist, held together by an abundant pink matrix consisting of cleavage particles of orthoclase or microcline and quartz. The material appears to have been of local derivation and to represent the surficial detritus of the ancient granitic plain, slightly reworked by waves of an encroaching sea. Named for Scanlan Pass, Globe quad., through which the trail passes just E. of Barnes Peak. Basal fm. of Apache group. Overlies, uncon., Pinal schist.

Scarboro beds.

Pleistocene: Ontario.

A. P. Coleman, 1907 (10th Int. Geol. Cong., Mexico, 1906, p. 1249), and 1909 (Ont. Bur. Mines Ann. Rept., vol. 18, pt. 1, p. 297). Included in Toronto fm.

Scarboro phyllite. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). *Scarboro phyllite.*—A carbonaceous sericite phyllite. Included in Casco Bay group.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 171). *Scarboro phyllite.*—Uniformly fine-grained sericite phyllite, chiefly dark bluish gray to black from presence of biotite and carbonaceous matter, but locally light gray and white in upper half of fm. Typically not siliceous. In places somewhat garnetiferous, and dark-colored parts are in general heavily impregnated with pyrite. Vein quartz in chunky lenticles and irregularly contorted seams is characteristic, as are knobby and undulatory cleavage surfaces. Estimated thickness 200 to 600 ft. Belongs to Casco Bay group. Overlies Diamond Island sl. and, in places, Cape Elizabeth fm. Conformably underlies Spurwink ls. Assigned to Penn. (?). Named for exposures in Scarboro, Cumberland Co.

Scarboro moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), 1913, p. 17.

Schaghticoke shale.

Lower Ordovician (Beekmantown): Eastern New York (Rensselaer County).

R. Ruedemann, 1903 (N. Y. State Mus. Bull. 69, pp. 934–966), described the slates outcropping at Schaghticoke, and in places called them *Schaghticoke slates, Schaghticoke beds,* and *Dictyonema beds.* Consist of very fine-bedded black and prevailing dull-greenish to olive siliceous and argill. slates with intercalations of thin beds of hard gray, very fine-grained ls. Assigned to "highest Upper Cambric."

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, chart), showed *Schaghticoke sh.* as topmost Camb. fm. in eastern N. Y.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 32 and chart). *Schaghticoke sh.* (*1903 Ruedemann*).—Typically exposed along Hoosic River at and in vicinity of Schaghticoke, Rensselaer Co. Fauna characterized by *Dictyonema flabelliforme,* which is considered by some European geologists as marking closing stage of Cambric time, but by others as belonging to early Ordovicic. Is here included in Ordovicic. Lowest Ordovicic fm. in eastern N. Y.

R. Ruedemann and H. P. Cushing, 1914 (N. Y. State Mus. Bull. 169, p. 73). *Schaghticoke sh.* assigned to Beekmantown. Consists of light greenish-gray glazed argill. sh., that weathers light drab or whitish, with intercalations of light bluish-gray sandy sh. and streaks of black sh. containing graptolites. Older than Deepkill sh. [In 1921 (N. Y. State Mus. Bull. 227, 228, p. 130) Ruedemann classified this sh. as lowest Beekmantown.]

R. Ruedemann, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 311). *Schaghticoke sh.* is basal fm. of Ord.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 414), showed this sh. as basal Beekmantown, as beneath Deepkill sh., and as uncon. above Nassau (Lower Camb.).

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 269–270). *Schaghticoke sh.* contains 2 graptolite zones, one of which occurs in Canada and Europe, where it is considered by some as early Ord. and by others as latest Camb. Total thickness unknown; only about 50 ft. exposed, but thickness is probably considerably more. [In tables on pp. 194 and 268 she placed *Schaghticoke sh.* below Tribes Hill ls. and included it in "Canadian system," but excluded it from Beekmantown.]

Schell shale.

Lower Ordovician: Eastern Nevada (Ely region).

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, p. 78). *Schell shales,* 100 ft. thick, underlie Egan lss. and overlie Pogonipan series in Nev. [On p. 78 of 1924 definition the shales are stated to be basal memb. of Mid-Ordovicic section.] Named for outcrops in full thickness in a fault block near middle of Schell Creek Range E. of Ely.

A part of Pogonip ls.

Schenectady formation.

Middle Ordovician (Trenton): East-central New York.

R. Ruedemann, 1912 (N. Y. State Mus. Bull. 162). *Schenectady fm.*—Olive-gray shales more argill. than underlying Canajoharie sh. and contain more ss. beds than the other sh. fms. of N. Y. Thickness 1,700 to 2,000 ft. Fossils of Trenton age, probably middle and upper Trenton. Formerly called Frankfort sh., but older than true Frankfort and older than true Utica sh. Type exposures at Dettbarn quarries, at Schenectady, and at Aqueduct and Rexford Flats, near Schenectady. Does not extend far W. and ends abruptly eastward against the folded region. At Indian Ladder, near Meadowdale, Albany Co., it is uncon. overlain by Indian Ladder beds, of post-Utica age. Between Central Bridge and Howes Cave [Schoharie Co.] overlain by Brayman sh., largely if not wholly of Upper Ordovicic age.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 40). *Schenectady beds (1912 Ruedemann).*—These beds of shales and sss., typically exposed in vicinity of Schenectady, were formerly included with the Hudson River and usually correlated with the Lorraine or the Frankfort. They overlie Canajoharie sh. and are of upper Trenton age. In Albany Co. these beds have at top the Indian Ladder beds, while in Schoharie Co. the Brayman sh. is above them. West of Schenectady Co. the upper limits and exact relation to higher beds of Utica and Frankfort shales have not been established.

H. P. Cushing and R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, p. 51). *Schenectady fm.*—Grits and sss. with interbedded black and gray argill. shales, 2,000 ft. thick in Saratoga Springs region. Carries a middle and upper Trenton fauna. Uncon. underlies Indian Ladder beds and overlies Canajoharie sh.

P. E. Raymond, 1916 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, pp. 247–251), suggested that *Schenectady fm.* is probably to be correlated with the Utica and the Frankfort.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258), correlated *Schenectady beds* with upper Trenton and lower Utica; but in 1929 (Geol. Soc. Am. Bull., vol. 40, p. 414) he assigned *Schenectady sh.* wholly to Trenton and showed Utica as absent.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 268, 287). *Schenectady beds* overlie Canajoharie sh. and are older than Indian Ladder beds, of Frankfort age. They are now known to be of upper Trenton age.

Schenley red beds. (In Conemaugh formation.)

Pennsylvanian: Southwest Pennsylvania.

M. E. Johnson, 1925 (Pa. Geol. Surv., 4th ser., Topog. and Geol. Atlas of Pa., No. 37, Greensburg quad., pp. 54, 121). Name applied to the red shales and clays, of variable extent and thickness, occupying interval in Conemaugh group btw. Wellersburg clay and Birmingham sh. So called because of their excellent exposure in Schenley dist., Pittsburgh. Just N. of Blackburn, on Turtle Creek branch of Pa. R. R., the Schenley red beds are quarried, and consist of 17 ft. of structureless clay underlain by 6 ft. of clay sh.

†Schloenbachi beds.

A paleontologic name applied by R. T. Hill (Geol. Soc. Am. Bull., vol. 2, 1891, p. 515) to Kiamichi fm.

Schodack formation.

Lower Cambrian: Eastern New York (Washington and Rensselaer Counties) and southwestern Vermont (Rutland County).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 67–70 and map). *Schodack shales and lss.*—Black shales and lss. overlying Eddy Hill grit—all Lower Camb. Named for exposures 2 mi. S. of Schodack Landing, N. Y.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, No. 2, p. 414), placed *Schodack beds* beneath Nassau beds.

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, pp. 25, 73, 79, and map), gave following downward succession: *Schodack shales and lss.*, Troy shales and lss., Diamond Rock qtzite, Bomoseen grit, and Nassau beds. On p. 27 he gave following downward succession: Troy shales and lss., Diamond Rock qtzite, Nassau beds, *Schodack sh. and ls.*, and Bomoseen grit.

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, p. 277). *Schodack fm.*—Thinly bedded black sh. containing thin beds of impure blue ls. that carries fragments of Lower Camb. trilobites in N. part of Hoosick quad., which establish age of fm. as Lower Camb. The black sh. itself has so far yielded only sponge spicules found by Dale. The fm. is=Schodack sh. and ls. of Ruedemann in Capital dist., N. Y. Rests, with apparent conformity, on Mettawee sl. and is conformably overlain by Eagle Bridge qtzite.

Schoharie grit.

Middle Devonian: Eastern New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 378). *Schoharie layers.*—These are the layers so abundant in fossils and have furnished such numbers to the collectors of Schoharie. Underlie Onondaga ls. and overlie the "argillaceous mass" called *Fucoides Cauda-Galli* [Esopus grit].

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, p. 131). *Schoharie grit.*—Calc. fine-grained ss., from which, when long exposed, the carbonate of lime disappears without altering the form of the rock. Readily recognized by peculiar mineral characters and fossils. Underlies Onondaga ls. and overlies Cauda-galli grit [Esopus grit]. [This is present commonly accepted definition of Schoharie grit.]

E. Emmons, 1846 (N. Y. Nat. Hist. Agric., vol. 1), gave thickness of Schoharie grit as 2 to 4 ft.

N. H. Darton, 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 393–422). *Schoharie grit.*—A very aren. ls., which weathers to dark-buff or brown porous massive, rather tough sandrock. Is a thin memb. Merges into Onondaga ls. above but is more sharply separated from underlying fm. [Esopus sl.]. Is a local deposit, developed in vicinity of Schoharie and extending through Schoharie and Albany Counties and along eastern outcrop to Ulster Co. Appears to be a local phase of earlier Onondaga deposits. Is about 6 ft. thick ¾ mi. S. of Callahan's Corners.

F. J. H. Merrill, 1898 (N. Y. State Mus. Bull. 4, No. 19). *Schoharie grit* is a hard calc. ss.; when freshly quarried looks like a gray ls.; weathers to gritty yellow ss. Found only from Cherry Valley eastward. Thickness 4 or 5 ft.

C. S. Prosser, 1899 (N. Y. State Mus. 17th Ann. Rept.), assigned thickness of 12 ft. to Schoharie grit in Schoharie Co. and 3 ft. in Albany Co. A. W. Grabau, 1903 (N. Y. State Mus. Bull. 69), reported 200 ft. of Schoharie grit in Becraft Mtn, Columbia Co., N. Y.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 63). *Schoharie grit* is found in Schoharie, Albany, and Otsego Counties and in Hudson River Valley, but does not appear to be everywhere continuous. Has extensive fauna.

The present N. Y. State Survey treats Schoharie grit as a fm. younger than its Oriskanian and as underlying Onondaga ls. and overlying Esopus grit. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 370.) This is present definition of U. S. Geol. Survey.

†Schoharie stage.

Term used by A. W. Grabau (Buffalo Soc. Nat. Hist., vol. 6, p. xviii, 1898) to include Schoharie grit and Esopus sh.

Schoolcraft member.

Silurian (Niagaran): Northern Michigan.

See under *Cordell memb.*

Schooler Creek formation.

Triassic (Upper): British Columbia.

F. H. McLearn, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. B, p. 2). Assigned to Triassic. [All subsequent repts. by other geologists, assign this fm. to Upper Tr.]

School Land sandstone. (Buried.)

Ordovician: Northeastern Oklahoma (Oklahoma City field).

D. A. McGee and W. W. Clawson, Jr., 1930 (A. A. P. G. Bull., vol. 16, No. 10, pp. 967, 973+). *School Land ss.*—An Ord. oil and gas horizon, 85 ft. thick, lying about 220 ft. below "Wilcox" sand in Oklahoma City oil field, and 0 to 20 ft. above Hammer-Haindl ss. Basal 30 ft. of School Land ss. is often called *Mollman sand.* [Derivation of names not stated.]

Schooner Head series.

Cambrian or pre-Cambrian(?): Southeastern Maine (Mount Desert Island).

N. S. Shaler, 1889 (U. S. G. S. 8th Ann. Rept., pt. 2, pp. 1037, 1041, 1060, and map). *Schooner Head series.*—Micaceous, contorted argill. schists and aren. shales or slates, with associated injected rocks, on E. face of Mount Desert Island, extending from near Schooner Head to Rodick's Cove. Probably of same age as Bartlett's Island series of W. side of island, but of less distinctly schistose character and thicker-bedded; appears to have originally been more like flags than shales. Assigned to Camb. or pre-Camb. Named for exposures at Schooner Head, E. coast of Mount Desert Island.

On 1933 geol. map of Maine, by A. Keith, these rocks appear to be included in igneous block labeled "mainly Sil., but some Dev."

Schooner Hill facies.

Name applied by **P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 137, etc., 1931)** to a lithologic development of his Locust Point fm. in a part of southern Ind.

Schott sand.

A subsurface lenticular sand in Eocene Yegua fm. (of Claiborne group) of southern Tex. Lies 300 ft. below Mirando sand.

Schramm sand.

A subsurface sand in Pottsville fm. (Penn.) of SE. Ohio.

Schreyfogel's limestone.

Mississippian: Northeastern Pennsylvania (Sullivan County).

F. Platt, 1880 (2d Pa. Geol. Surv. Rept. G_2, pp. 187, 199). *Schreyfogel's ls.*—Thin greenish siliceous ls., poor and sandy, exposed on hillside S. of Schreyfogel's Hotel and 170 ft. above level of Loyalsock Creek. Is clearly in Pocono ss. and must lie 300± ft. beneath Pottsville cgl.

Schroeppel shale.

See *Phoenix or Schroeppel shale.*

Schroyer limestone. (In Wreford limestone.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 33). *Schroyer ls.*—Top memb. of Wreford ls. Chert-bearing ls., 8 or 9 ft. thick in vicinity of Cambridge, Cowley Co., Kans., and about 20 ft. thick in Big Blue Valley, in vicinity of Randolph. In Nebr. its max. exposed thickness is about 10 ft., in a small creek valley 3 mi. SE. of Wymore. Type loc. on E. side of Big Blue Valley, about 1¼ mi. below Schroyer, Marshall Co., Kans. Overlies Havensville sh. and underlies Wymore sh. memb. of Matfield fm.

Schubert Creek limestone.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). As described elsewhere in this Guidebook by Jewett, the lowermost fm. of Bronson group includes 3 ls. lentils which are named (ascending order) *Schubert Creek, Critzer,* and *Sniabar.* The Schubert Creek ls. was apparently studied by Hinds and Greene in vicinity of Uniontown as a supposedly authentic representative of "Hertha" ls. in Kans., and this rock was correlated by them with the prominent ls. that appears next below Bethany Falls ls. in Kansas City and NW. Mo. dist. Latter bed is now called Sniabar. [See also under *Swope fm.*]

J. M. Jewett, 1932 (pp. 100, 103 of book cited above). *Schubert Creek ls.*—Ls., rather light in color, crystalline, and generally brecciated. Lowest memb. of Swope fm. Type loc. on Schubert Creek, btw. Bronson and Uniontown, Kans., on U. S. Highway 54. Thickness, few in. to 15 ft. Present along line of outcrop of Bronson group from T. 22 S. to T. 28 S.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 80), discarded *Schubert Creek ls.* (See under *Critzer ls.*) He appears to include it in his Bourbon fm.

Schultze granite.

Probably Tertiary: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Schultze granite.*—Granitite or biotite granite. Intrudes Pinal schist in Globe quad. Forms the light-colored hills about Schultze's ranch.

F. L. Ransome, 1919 (U. S. G. S. P. P. 115), assigned this fm. to early Tertiary (?).

Schumann formation.

Pleistocene and Pliocene (?): Southern California (Santa Maria district).

R. D. Reed, 1933 (Geol. of Calif., p. 232). *Schumann fm.*—Fresh-water beds with thin marine intercalation; contains vertebrate fossils suggesting Pleist. Lower part may be Upper Plio. Thickness 2,000± ft. Overlies *Dendraster* cgl. (Upper Plio.).

R. D. Reed, 1936 (letter dated May 18). "Schumann fm." is a name in local use for some of the strata exposed near N. end of Schumann cut, where the railroad enters the Casmalia Hills S. of Guadalupe (Guadalupe quad.). It has been discussed at several meetings here, but so far as I know has not been described in print.

H. W. Hoots and S. C. Herold, 1935 (Geol. of nat. gas, A. A. P. G., p. 156). *Schumann fm.*—Fresh-water gravels, sands, clays, and ls., with sand-dollar bed at base. Of Plio. age. Thickness 2,000 ft. Uncon. underlies Orcutt fm. and overlies, with local uncon., Upper Foxen sand, top fm. of Etchegoin group.

Schunemunk conglomerate.

Schunnemunk conglomerate.

Variant spellings of *Skunnemunk cgl.* used by E. C. Eckel in N. Y. State Geol. 20th Ann. Rept., 1902.

Schuyler soapstone.

Pre-Cambrian: Central Virginia.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. edition of geol. map of Va.). *Schuyler soapstone.*—Intrusive into Lynchburg gneiss. Mapped at and around Schuyler, Nelson Co.

Schwatka andesites.

Tertiary (?): Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 42).

Scio sand.

A subsurface sand, of probable Dev. age, in western N. Y., lying higher than Bradford and Richburg sands.

Scioto freestone. (In Allegheny formation.)

Pennsylvanian: Central southern Ohio.

D. D. Owen, 1859 (Rept. Geol. Reconn. State of Ind. in 1838, pt. 2, p. 50). *Scioto freestone* rests on cgl. or millstone grit [Pottsville] in Ohio and underlies coal measures. Equiv. to Knob freestone of Ind.

Probably named for Scioto Valley, Ohio.

†Scioto slates and shales.

Upper Devonian: Southern Ohio.

D. D. Owen, 1859 (Rept. geol. reconn. State of Ind. in 1838, pt. 2, p. 59). The black sl. in base of these knobs [in Indiana] is equiv. of *Scioto slates and shales.*

Replaced by Ohio sh., better defined and established.

Probably named for Scioto Valley, Ohio.

Scioto Valley shale facies.

Mississippian: Southern Ohio (Scioto Valley).

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 757–758). *Scioto Valley sh. facies of Cuyahoga fm.*—Argill. shales with thin ss. beds tongued into them from either side. Includes (descending): Portsmouth memb., 253 ft.; Buena Vista ss. memb.; Henley sh. memb., 200+ ft. Underlies Logan fm. and overlies Sunbury sh.

Includes Cuyahoga fm. and lower part of Black Hand fm.

Sciotoville fire clay. (In Pottsville formation.)

Pennsylvanian: Southern Ohio.

E. B. Andrews, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, p. 166, pl. opp. p. 242). *Sciotoville fire clay.*—Fire clay extensively worked at Sciotoville. Immediately overlies Logan or Upper Waverly ss.

Well-known economic memb. of Pottsville fm. According to C. S. Prosser and W. C. Morse (Outlines of field trips in geology for central Ohio, 1915) the Sciotoville fire clay lies above Sharon coal No. 1 and below Connoquenessing ss. memb. of Pottsville fm.

Scossa slates.

Jurassic: Northwestern Nevada (Pershing County).

J. C. Jones, A. M. Smith, C. Stoddard, 1931 (Univ. Nev. Bull., vol. 25, No. 4, pp. 6, 7, 8). Jurassic slates, schists, sss., etc., that cover greater part of Scossa dist. are, for brevity, here called *Scossa slates*. Ribs or bands of harder rock fms. intersect the veins and cut obliquely across all members of Scossa fm.

Scotia ore bed.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geology of Newfoundland, No. 4). *Scotia ore bed.*—Oolitic hematite, fossiliferous; discon. (?) overlain by chamosite sl. and underlain by gray sh. Included in Wabana series.

Scotland beds.

Eocene: West Indies (Barbados).

J. W. W. Spencer, 1902 (London Geol. Soc. Quart. Jour., vol. 58, p. 356). [No age assigned. R. J. L. Guppy, 1911 (London Geol. Soc. Quart. Jour., vol. 67, p. 693) assigned *Scotland beds* of Barbados to Cret.; E. H. C. Craig, 1913 (Rept. on oil fields of Barbados, p. 2), assigned them to Tert. (?); C. T. Trechmann, 1925 (Geol. Mag., vol. 62, p. 481), and C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 715), assigned them to Eo.]

Scotland schist.

Late Carboniferous or post-Carboniferous (?): Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 132, 141, and map). *Scotland schist.*—Coarse muscovite schist squeezed into minute folds as result of metamorphism. Is practically a mass of muscovite with some biotite and occasionally garnet and quartz. Covers town of Scotland. Of sedimentary origin. Believed to be older than Willimantic gneiss. Evidence indicates that Putnam gneiss underlies Scotland schist. The two fms. are conformable and pass into each other without noticeable change. Hebron gneiss grades into Scotland schist.

W. G. Foye and A. C. Lane, 1934 (Am. Jour. Sci., 5th, vol. 28, p. 128). *Scotland schist* is same as Brimfield schist, which is pre-Carbf.

Scots Bay formation.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

Scott shale. (In Pottsville group.)

Pennsylvanian: Eastern Tennessee.

A. Keith, 1896 (U. S. G. S. Briceville folio, No. 33). *Scott sh.*—Mainly argill. and sandy shales, but includes many beds of shaly ss., a few massive sss., and five or six coal seams, all very similar in composition to those of Wartburg ss. Contains more sh. than ss., and the sss. are thinner than in the Wartburg. Thickness 450 to 600 ft. Overlies Wartburg ss. and underlies Anderson ss. Named for its frequent occurrence in Scott Co.

Scott limestone.

An abbreviation of *Fort Scott ls.* that is employed by C. [R.] Keyes.

Scott sand.

A subsurface sand, of early Penn. (Cherokee) age, in central and central northern Okla., lying lower than Taneha sand and correlated with Dutcher sand. In type region (Scott field, Creek Co.) it lies at 2,510 ft. depth. The name has also been applied to an oil sand in Strawn fm. (Penn.) of Young Co., Tex., lying about 830 ft. below Palo Pinto ls. (basal memb. of Canyon group) on the Scott lease.

†Scotts Bluff formation.

A term loosely applied by H. Engelmann (Eng. Dept. U. S. Army, J. H. Simpson's expl. of Great Basin of Terr. of Utah, 1876, pp. 247, 282–284) to Tert. deposits on North Fork of Platte River in SW. Nebr., which he assigned to Mio. and stated that they are apparently coeval with the Mio. strata of badlands of White River and overlie another series of Tert. strata, which in turn overlies his Platte River or Lignite fm., of Eo. or Upper Cret. age. In U. S. G. S. Scotts Bluff folio, No. 88, 1903, the Tert. deposits of Scotts Bluff quad., Nebr., are divided into (descending) Ogallala fm., Arikaree fm., Gering fm., Brule clay, and Chadron fm. The present age designations of these fms. are as follows: Ogallala fm., Plio. and upper Mio.; Arikaree and Gering fms., Mio.; and Brule clay and Chadron fm. (which compose White River group), Olig.

Scotts Creek flint.

Mississippian: Eastern Ohio.

E. Orton, 1880 (Review of strat. of Ohio, p. 22). *Scotts Creek flint*, found on all tributaries of Scott's Creek, is base of Maxville ls. and is=Logan flint of my Hanging Rock rept in vol. 3, p. 900.

Scottsmore quartzite.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Scottsville sand.

A subsurface sand, of Sil. age, in western Ky.

Scotty Wash quartzite.

Mississippian (upper): Eastern Nevada (Pioche district).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171, pp. 7, 21, map, etc.). *Scotty Wash qtzite.*—A red-brown thin- and thick-bedded qtzitic ss. with some shaly ss., which apparently conformably overlies Peers Spring fm. (Miss.) and is provisionally correlated with Diamond Spring qtzite of Eureka dist. Base not shown, as it is separated from lower Miss. fms. by fault contacts. Overlain, apparently conformably, by Bailey Spring ls. (Miss. and Penn.). Thickness 700 to 1,000± ft. No fossils. Named for fact Scotty Wash passes through the fm. E. of Silverhorn.

Scrag granite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Ammonoosuc River region, Franconia, Moosilauke, and Littleton quadrangles).

C. R. Williams, 1934 (Appalachia, vol. 20, No. 4, pp. 69–78). *Scrag granite.*—Pink, largely quartz and feldspar, with few dark minerals. Carbf. (?). Found only on Scrag Hill [Franconia quad.].

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., p. 11, and map). *Scrag granite* is younger than Bethlehem gneiss and is late Dev. or late Carbf. Assigned to New Hampshire magma series.

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H.), mapped and described this granite in Moosilauke and Littleton quads.

Scranton sandstone. (In Pottsville formation.)

Pennsylvanian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 45, 46, 48+). *Scranton ss.*—Current-bedded pebbly ss.; dark gray, in portions almost black; contains numerous small white quartz pebbles. Thickness 60 to 75 feet. Is upper div. of Pottsville cgl. and first great pebbly ss. mass above lowest workable coal of Scranton region and easily recognized by its extraordinary oblique lamination. Well exposed along railroad, about ½ mi. S. of depot, and at many other places around Scranton. It looks very much as if the Scranton current-bedded ss., the *McIntire Upper cgl.*, the *Blossburg Monkey ledge*, the *Johnson Run rock* of McKean, and Homewood ss. of Beaver River country were all the same.

Scranton shale. (In Shawnee group, Kansas.)

Scranton shale member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci., vol. 21, pt. 1, pp. 71–85). *Scranton shales of Bennett.*—Previously called Burlingame shales, but that name is retained for the ls., both being named at same time. Is top fm. of Shawnee stage. Underlies Burlingame ls. and overlies Howard ls.

Scranton sh. is still applied by Nebr. Geol. Survey and U. S. Geol. Survey to the beds underlying Burlingame ls. and overlying Howard ls., but R. C. Moore in 1936 (Kans. Geol. Surv. Bull. 22) discarded the name from the Kans. classification, treating the named subdivisions into which Condra had in 1930 divided it as fms. in Wabaunsee group. Moore stated (p. 210) that Rock Lake sh., South Bend ls., Plattford sh., and Cass ls. of Condra do not belong to Scranton sh. Condra in 1930 transferred his Rock Lake sh. and South Bend ls. to Stanton ls., and in 1935 stated (Nebr. Geol. Surv. Paper No. 8) his Plattford sh. is same as Weston sh., but did not explain what replaces his Cass ls., although he abandoned that name in 1930.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Scrubgrass fire clay. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Scrubgrass fire clay,* 10 ft. thick in Lawrence Co., Pa., underlies Scrubgrass coal and is probably nearly a rider to or top bench of Clarion coal.

E. Orton, 1884 (Ohio Geol. Surv. vol. 5, p. 660). *Scrub Grass clay,* 4 ft. thick, underlies Upper Clarion or Scrub-Grass coal and lies higher in section than Lower Clarion coal.

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31). *Scrubgrass coal* lies 4 ft. 9 in. above Clarion coal in Vinton Co., and 2 ft. 2 in. below Vanport ls.

†Scutella limestone.

Lower Devonian: Eastern New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 377). *Scutella ls.*—Underlies Oriskany ss. and overlies Delthyris shaly ls. [New Scotland ls.]. Named for peculiar fossil which it contains.

Replaced by Becraft ls. in 1893. Has also been called "Upper Pentamerus ls."

Seaforth limestone.

Tertiary (Oligocene?): West Indies (Antigua).

J. W. W. Spencer, 1901 (London Geol. Soc. Quart. Jour., vol. 57, p. 494).

Seahorne limestone.

Name applied by H. R. Wanless (Geol. Soc. Am. Bull., vol. 42, 1931, pp. 801–812, and Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a ls., 0 to 10± ft. thick, in upper part of Pottsville fm. (Penn.) of central western Ill. Shown as lying 30± ft. higher than his Bernadotte ss. and 100± ft. higher than coal No. 1, and to contain a distinctive fauna. Derivation of name not stated.

Seahorne cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a portion of upper part of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated.

†Sea Island sands.

†Sea Island loams.

Pleistocene: Southern South Carolina (Charleston and Beaufort Counties).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908 publication cited below); 1907 (Summary of mineral resources of S. C., table on p. 12); 1908 (S. C. Geol. Surv. ser. 4, Bull. 2, p. 485, definition). [*Sea Island sands* in first two publications cited. *Sea Island loams* in last publication cited.] The Sea Island loams extend from point near McClellanville to mouth of Broad River along a curved zone which approx. conforms to inland waterway. They feather out on Ten Mile Ridge in a progressively impoverished state. On seaboard side they are delimited by a barrier of sands, which are probably senior to the Sea Island loams; the extreme seaward border consists of recent sea sands largely accumulated through eolian forces. It appears that the fine-grained Sea Island loams were derived from Bohicket marl sands by accentuated action of waters, which partly reworked the latter and deposited them over the Wando sands in form of a fine glauconitic silt mixed with fine sands. Is a marine Pleist. fm.

C. W. Cooke (personal communication, 1935). The beds described are a facies of Pamlico fm.

Named for development on islands off coast of Charleston and Beaufort Counties.

Seaman Ranch shale member (of Brad formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 111+). *Seaman Ranch beds*.—Chiefly sh., with thin lss. and some sss. Average thickness 150 to 200 ft. Upper part usually consists of 50 to 110 ft. of dark-gray soft sandy sh. containing 1 or 2 lentils of reddish-brown ss. and a thin layer or two of dark-brown ls.; lower part consists of 60 to 100 ft. of sh. Usually nonfossiliferous. Is lower memb. of Brad fm. in Brazos River Valley. Underlies Ranger ls. memb. of Brad and overlies Adams Branch ls. memb. of Graford fm. Occupies position of Placid sh., Clear Creek ls., and Cedarton sh. of Colorado River Valley section of the Brad. Named for Seaman ranch, in W. part of Palo Pinto Co., where typically exposed along Caddo Creek.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 111), extended Graford fm. up to top of Merriman ls., and restricted Brad fm. of Colorado River Valley to Placid sh. memb. and overlying Ranger ls. memb. He stated that in Brazos River Valley the fm. consists of Ranger ls. memb. and underlying Seaman Ranch beds.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 55). Brad fm. of Palo Pinto Co. divided into Ranger ls. (above), 45 ft. thick, and Seaman Ranch beds (below), 135 ft. thick. Rests on Merriman ls. (top memb. of Graford fm.), which in previous repts was miscorrelated with Adams Branch ls. of Colorado River region. Fossils listed.

Seattle formation.

Oligocene: Northwestern Washington and Puget Sound region.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 579, 582, 604). *Seattle fm*.—Ashy shales with ls. nodules, sandy and massive sh., shaly ss., and ss. Thickness 3,000 to 4,000 ft. Is older than Twin River fm., younger than San Lorenzo fm., and=middle part of Astoria series. Includes Aturia bed at Astoria. [Probably named for Seattle, Wash.]

B. L. Clark and R. Arnold, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 303–308). C. E. Weaver has apparently shown (Calif. Acad. Sci. Proc., 4th, vol. 6, No. 3, 1916, pp. 41–52) that the beds forming Twin Creek fm. are part of Arnold and Hannibal's Seattle fm. (*Acila gettysburgensis* zone), and they are here included in *Seattle group*.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 245, 261–264). [See 1925 entry under *Blakeley fm.*]

†Sebastian stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Sebastian stage*.—Includes (descending): Greenwood ss. (100 ft. thick); Tomlinson sh. (500 to 600 ft. thick); Hartwell ss. (0 to 100 ft. thick); Belva sh. (0 to 500 ft. thick); and

Ozark ss. (0 to 500 ft. thick). Underlies Poteau stage, and in Ark. overlies Spadra stage, which is absent [?] in Okla., as are Hartwell ss., Belva sh., and Ozark ss.

Includes McAlester sh. and Savanna ss.

Probably named for Sabastian Co., Ark.

Seboomook slate.

Silurian: Western Maine (Moosehead Lake region).

E. H. Perkins, 1925 (Am. Jour. Sci., 5th, vol. 10, pp. 374–375). *Seboomook sl.*—Apparently underlies Moose River ss. (of Oriskany age) on NW. side of that fm., and contains *Monograptus*, which fixes its age as Sil. Outcrops limited to lake shore, rapids of streams, and a few cuts along roads of Great Northern Paper Co. In most outcrops the rock is a dark-bluish sl., often with well-developed cleavage. Fresh pyrite cubes are common on unweathered surfaces, while weathered surfaces are iron-stained from decomposed pyrite. Some localities show interbedded ss. layers which often contain clay balls closely resembling the sl. in composition. Best exposure of fm. is at Seboomook Dam, on West Branch of Penobscot River [in extreme E. part of Somerset Co.].

Seboruco formation.

Pleistocene: Jamaica and Cuba.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, pp. 419, 499).

Sebree sandstone. (In Carbondale formation.)

Pennsylvanian: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 27). *Sebree scarp-making ss.*—Coarse massive ss., 10 to 50 ft. thick, forming basal memb. of De Koven fm. in Webster Co. Rests uncon. on Tradewater fm.

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 97). *Sebree ss.*—Caps Sebree Hills. Forms ridge that extends from Sebree E. to Green River. Named for prominent development btw. Sebree and Steamport Ferry, where it caps the hills and in places forms prominent cliffs. Is basal memb. of Carbondale fm.

Seco formation.

Eocene: Central Texas (Medina County).

R. A. Liddle, 1921 (Univ. Tex. Bull. 1860, p. 85, map, columnar section). *Seco fm.*—Variegated aren. shales, predominantly deep red; a few lenses of brown-red to deep-red aren. lss. Thickness 100± ft. Top fm. of Wilcox group in Medina Co. Overlies Buttsgin fm. and underlies Carrizo ss. of Claiborne group. Exposed in Seco Creek, 3 mi. S. of W. of Yancey, Medina Co.

†Secondary.

See explanation under †*Primitive*.

†Second Bottoms.

A descriptive term applied in early repts on geol. of Miss. to most widely developed and best-preserved Pleist. terrace in State. Thickness of deposit 0 to 100± ft. "Underlies loess and overlies loess." Probably same as Port Hudson fm.

†Second Pentamerus limestone.

Lower Devonian: New York.

T. A. Conrad, 1840 (Am. Jour. Sci., 1st, vol. 38, pp. 89–90). Second Pentamerus ls. underlies the shaly ls. of Catskill Creek [New Scotland ls.] and overlies the Water ls. (characterized by *Tentaculites annulatus*, *Delthyris*, *Orthis*, unnamed univalves, and *Cytherina*).

†Second Pentamerus limestone.

Silurian (Cayugan): New York.

T. A. Conrad, 1839 (N. Y. Geol. Surv. 2d Rept., pp. 62–63). *Second Pentamerus ls.* underlies Helderberg lss. and overlies gypseous shales that contain *Eurypterus remipes* and succeed the Rochester shales. Carries *Pentamerus Knightii* and *Euomphalus profundus*. [Applies to a ls. or lss. of Cayuga group.]

†Secretan series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, p. 78), to Secret Canyon sh. of Nev.

Secret Canyon shale.

Middle Cambrian: Eastern Nevada (Eureka region).

Arnold Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 255–259). *Secret Canyon sh.*—Yellow and gray or brown argill. shales, passing [upward] into transition beds of shaly ls., 25 to 200 ft. thick; near top interstratified layers of sh. and thinly bedded lss. Grades into underlying Prospect Mtn qtzite and is overlain by Hamburg ls. Thickness 1,600 ft. Named for exposures in Secret Canyon, Eureka dist.

Sedalia limestone.

Name casually used by A. W. Vogdes (St. Louis Acad. Sci. Trans., vol. 5, p. 615, 1892), as follows: "From Sedalia [Mo.] we have the new species [of trilobites] described in this paper. The fossil Crustacea of the Sedalia limestones have a strong Devonian facies." This name is listed in Bull. 191 of U. S. G. S. but was not defined by Vogdes.

Sedalia limestone. (Of Osage group.)

Mississippian: Central and northeastern Missouri and western Illinois (Jersey, Calhoun, and Pike Counties).

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 61, 78, 84, 86, 90, 91, 144, 146, 149–154, 166, 254). *Sedalia ls.* here proposed for the gray to light-buff "silico-mag." ls. which was termed Upper Chouteau by Swallow and other geologists. Occurs in thick beds, which contain disseminated masses of white or limpid calc. spar. It is really a siliceous dol. throughout region of its typical development; is massively bedded, individual layers being in many places 10 to 20 ft. thick. At different horizons it contains layers of grayish of bluish-black, very dense, hard chert nodules, and locally thin chert bands. Thickness of fm. 0–40 ft. in central Mo.; 10 to 15 ft. in NE. Mo. Rests (uncon. in places) on Chouteau ls. restricted (=Lower Chouteau of previous repts), or uncon. on older rocks, and is overlain by Lower Burlington ls. Is 30 ft. thick at Chouteau Springs, Cooper Co., Mo., type loc. of Chouteau ls., where it rests on 20 ft. of "Lower Chouteau" (=Chouteau ls. as here restricted). Appears to correspond to Fern Glen ls.; carries related fauna but is lithologically different. Where Sedalia is present no Fern Glen beds are found, and where Fern Glen appears no Sedalia is recognized. The Sedalia appears to grade laterally into the Fern Glen, but it is not certain whether it is=all of Fern Glen, or, as seems probable, only lower part. It probably corresponds to Pierson ls. of SW. Mo., but is lithologically different. Is believed to correspond to bed 7 of the Kinderhook at Burlington, Iowa. [The Fern Glen ls. is now included in Osage group. In table opp. p. 282 Moore lists Sedalia ls. in Jersey, Calhoun, and Pike Counties, Ill.]

Named for exposures in vicinity of Sedalia, Pettis Co., Mo.

Sedwick limestone member (of Moran formation).

Permian: Central and central northern Texas (Shackelford County region).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 40). *Sedwick ls. memb. of Moran fm.*—Persistent yellowish lss., commonly 3 in number, closely associated and characterized by widely distributed and abundant small silicified fossil casts, mainly gastropods. Forms top memb. of Moran fm.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 176, 179–183). The persistent and prominent ls. at top of Moran fm. was designated Sedwick in course of field work, but it appears desirable to apply a geographic term to entire ls. division in the [Moran] fm. above Santa Anna bed. The *Sedwick memb.* may then be defined to include the series of thin yellow lss. with interbedded shales which lie at summit of Moran fm. The upper bed of Sedwick is 1 to 2 ft. thick, of rather dirty yellow color, contains numerous small stringers of calcite and, locally, numerous fossils, and is more or less cherty. The next lower bed in Sedwick memb., designated in field work *Hart School bed*, occurs 3 to 12 ft. below top of the ls. It is of yellow color, 2 to 6 ft. thick, and characterized by abundance of small silicified gastropods and other fossils. [Several detailed sections of Moran fm. show Sedwick memb. as consisting of 2 to 6 ls. beds, chiefly yellow, but in some places blue in lower part, varying in thickness from 1 to 6 ft., separated by sh. beds varying in thickness from 1 to 19 ft., the total thickness of Sedwick memb. varying from 15 to 42 ft.] Named for outcrops W. of Sedwick, Shackelford Co.

Moran fm. was transferred to Permian Wichita group in 1933.

Seekonk beds.

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 173–176). *Seekonk beds.*—A series of ss. and cgl. beds, somewhat less than 2,000 ft. thick. While sss. form dominant exposures and leading topographical feature, shales enter about equally into thickness of the series, which lies about 1,000 ft. higher stratigraphically than Tenmile River beds and is included in upper part of Rhode Island Coal Measures. The Seekonk cgl., although here tentatively included in Dighton group, may belong to Seekonk beds.

Named for occurrence in Seekonk Twp, Bristol Co., Mass.

Seekonk conglomerate.

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 174, 176). [In table on p. 134 *Seekonk cgl.* is included in Dighton group. On p. 174 it is described, with a subheading, under major heading *Seekonk beds* (which are included in Rhode Island Coal Measures) and is said to be very massive, 50 to 60 ft. thick, and because of its striking resemblance to the cgls. of Dighton group it is tentatively considered=the coarse cgl. at base of that group and is so represented on map. On p. 176 author "raises the question whether the Seekônk cgl. is the coarse cgl. elsewhere found at the base of the Dighton group or a lower cgl. comprised within the Seekonk beds proper."]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks of Seekonk Twp and along Seekonk River as Rhode Island fm., and showed no areas of Dighton cgl. in that vicinity.

Named for occurrence in Seekonk, Bristol Co., Mass.

Seekonk sandstone.

See under *Westville shale.*

Seeley slate.

Pre-Cambrian (middle? Huronian): Central southern Wisconsin (Sauk County).

S. Weidman, 1904 (Wis. Geol. Nat. Hist. Surv. Bull. 13, p. 46). *Seeley sl.*—Gray clay sl., 500 to 1,000± ft. thick. Appears to grade into overlying Freedom fm. and to rest on Baraboo qtzite without evidence of uncon. Does not outcrop, but is found only by exploration. Named for occurrence near Seeley Creek.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 720), indicated *Seeley sl.* may be middle Huronian.

Sego sandstone member (of Price River formation).

Upper Cretaceous: Central eastern Utah (Book Cliffs) and central western Colorado.

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). *Sego ss. memb. of Price River fm.*—An eastward-pointing tongue of Price River fm., dominantly ss., buff-weathering in the main, massive and cliff-forming to thin-bedded and shaly. Thickness 140 to 210 ft. Carries marine fauna of Lewis age. Not recognized NW. of Beckwith Plateau. Underlies Neslen coal-bearing memb. of Price River fm. and overlies Castlegate ss. memb. of the Price River. In part of area the Buck tongue of Mancos sh. wedges in btw. the Sego and Castlegate sss. Named for settlement in T. 20 S., R. 20 E., Utah.

This name first appeared in print in U. S. G. S. Bull. 851, 1934, by C. E. Erdmann, in a rept. on E. part of Book Cliffs coal field, where he treated it as a fm. (40 to 300 ft. thick) in Mesaverde group, underlying Mount Garfield fm. and overlying Buck tongue of Mancos sh. Erdmann credited the name to Fisher. (See also 1932 correlation chart of Utah, compiled by M. G. Wilmarth.)

Seguin formation. (In Wilcox group.)

Eocene: Eastern Texas (Trinity River to Rio Grande).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 558, 574, 634). *Seguin fm.* here proposed to designate all marine strata btw. the compact silty clays of Midway group and base of nonmarine Rockdale fm. of Wilcox group. In most places base is marked by contact of thinly laminated carbonaceous and fossiliferous sands with silty clays. Top is limited by a thin concretionary layer made up largely of shells of *Ostrea multilirata* Conrad. Type loc. is the section exposed along the banks of Moss Branch 10 mi. NW. of Bastrop, in NW. part of Bastrop Co., about 1 mi. N. of old Caldwell village. Another equally good locality is the exposure along Solomon's Creek, 6 mi. S. and 1 mi. W. of Elgin, Bastrop Co. The fm. at Seguin is obscured largely by alluvium along Guadalupe River. It can be seen in Geronimo Creek 1½ mi. E. of town, and along the highway 2 mi. S-SW. of town, S. of Guadalupe River. Can be mapped most of distance from Trinity River to Rio Grande. Thickness throughout central Tex. 50 to 75 ft.; in Rio Grande Valley may be 190 ft.; in wells S. of its outcrop its thickness ranges from 100 to 160 ft. Rests conformably on upper (Kerens) memb. of Wills Point fm. in NE. Tex., discon. on middle Wills Point in places in south-central Tex., and discon. on Kincaid fm. in SW. Tex. It underlies Rockdale fm., probably conformably.

Seignelay till.

A term applied by C. [R.] Keyes to an old till sheet (pre-Nebraskan, he stated) in Ill. or Iowa. (See Pan-Am. Geol., vol. 58, pp. 203, 217, 1932.)

Seine series.

Pre-Cambrian: Ontario.

A. C. Lawson, 1912 (Canada Geol. Surv. Mem. 28, p. 10).

Seine conglomerate.

Pre-Cambrian (lower Huronian): Western Ontario.

A. C. Lawson, 1913 (Canada Geol. Surv. Mem. 40, p. 59).

F. F. Grout, 1926 (Minn. Geol. Surv. Bull. 21). Ogishke cgl. is same as "Seine" cgl. of Lawson.

Seine River series.

Pre-Cambrian: Western Ontario.

F. D. Adams, 1915 (Problems of American geology, p. 56).

Selenurus limestone.

A paleontologic name applied in early N. Y. repts to Onondaga ls.

Seligman limestone.

Permian: Northwestern Arizona (Aubrey Cliffs).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 338). *Seligman lss.* is suggested for the calc. strata in lower part of Supaian series as exposed best perhaps in Aubrey Cliffs, near Seligman. Thickness 500 ft.

†Selinsgrove upper sandstone.

Middle Devonian: Central Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81). *Selinsgrove upper ss.*, a bed, 202 ft. thick, in Hamilton group. Lies 125 ft. [325 ft., J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2)] above Selinsgrove lower ss.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81). *Selinsgrove upper ss.* is 202 ft. thick below Selinsgrove, Snyder Co., and to S. thickens to 300 ft. Finely exposed where N. C. R. R. cuts through just opposite town of Selinsgrove and 1 mi. below Selinsgrove Junction, Northumberland Co. Lies 950 ft. below top of Hamilton group and 125 ft. [325 ft., J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2)] above Selinsgrove lower ss.

†Selinsgrove lower sandstone.

Middle Devonian: Central Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81). *Selinsgrove lower ss.*: Hard gray ss. in 3 layers separated by thin shales. Below Selinsgrove, Snyder

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Co., it is 5 ft. thick, but to S. it thickens to 100 ft. Lies 125 ft. [325 ft., J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2)] below Selinsgrove upper ss. and 800 ft. above Selinsgrove upper ls., all of which are included in Hamilton group.

†Selinsgrove upper limestone.

Middle Devonian: Central Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81). *Selinsgrove upper ls.*—Below Selinsgrove, Snyder Co., is divided (descending): Light-gray impure ls. with dull fracture, 10 ft.; drab limy shales, 20 ft.; shaly impure ls., 10 ft. Overlies Marcellus sl. and lies 800 ft. below Selinsgrove lower ss.

†Selinsgrove lower limestone.

Middle Devonian: Central Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81). *Selinsgrove lower ls.*—Hard light-gray rock, somewhat impure, in layers 1 to 3 in. thick, interstratified with thin gray shales. Thickness 65 ft. below Selinsgrove, Snyder Co.; 100 ft. near S. line of Northumberland Co. Rests on Selinsgrove sh., and is overlain by Marcellus sl.

Same as Onondaga ls., the older name.

†Selinsgrove shale.

Lower Devonian: Central Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 78–81, 363). *Selinsgrove sh.*—Light-gray sh. weathering into splintery-shaped pieces and containing at top a few thin layers of impure ls. Underlies Selinsgrove lower ls. Thickness 140 ft. Exposed about ¼ mi. below Selinsgrove Junction, Northumberland Co.

Same as Esopus sh., older name.

Selkirk series.

Pre-Cambrian: British Columbia.

G. M. Dawson, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 165, 171). *Selkirk series*, Cambro-Sil., British Columbia.

More recent Canada Geol. Surv. Repts (by Daly, Schofield, and others) assign these rocks to pre-Camb. They are included in Belt series by U. S. Geol. Survey.

Selkirk limestone.

Ordovician: Manitoba.

A. F. Foerste, 1929 (Denison Univ. Bull., vol. 29, No. 2, Sci. Lab. Jour., vol. 24, pp. 35, 37; and vol. 29, No. 7, p. 130). *Selkirk ls.*, Ord., Manitoba.

A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 211). *Selkirk ls.* of Manitoba correlates with middle part of Bighorn fm., of Richmond age.

Selkirk volcanics.

Pleistocene and Recent: Yukon Territory.

H. S. Bostock, 1934 (Canada Geol. Surv. Summ. Rept. 1933, pt. A, p. 7).

Selkirkian period.

Selkirkic period.

Terms introduced by C. [R.] Keyes to cover the time of Selkirk series of Canadian geologists, and later expanded to include more than that series. (See Iowa Acad. Sci. Proc., vol. 21, p. 23, 1914; Pan-Am. Geol., vol. 44, p. 218, 1925.)

Sellersburg limestone.

Middle Devonian: Southern Indiana and north-central Kentucky.

E. M. Kindle, 1899 (Bull. Am. Pal., vol. 3, No. 12, pp. 8, 20, 110). *Sellersburg beds.*—Fine-grained calc. ss., with thin bed of ls. at top; 6 to 20 ft. thick. Overlain by black New Albany sh. and underlain by Jeffersonville ls.

Adopted by U. S. Geol. Survey as originally defined. Some writers have restricted name to upper part of fm. Includes Beechwood ls. memb.

[library stamp]

above (Sellersburg ls. restricted of Siebenthal) and Silver Creek ls. memb. below. Contains Hamilton fossils.

Named for Sellersburg, Clark Co., Ind.

Selma chalk.

Upper Cretaceous: Alabama, northeastern Mississippi, and western Tennessee.

E. A. Smith, L. C. Johnson, and D. W. Langdon, 1894 (Ala. Geol. Surv. Rept. Geol. Coastal Plain of Ala., pp. 15, 22, 27, 255, 276–286). *Selma chalk or Rotten ls.*—Of comparatively uniform composition. Gray to bluish argill. fossiliferous ls., traversed at intervals by beds of purer ls., harder in texture. In some places consists of dark-bluish clay marl. Thickness 0 to 1,200 ft. Underlies Ripley group and overlies Coffee (or Eutaw) group.

In western Tenn. and parts of northern Miss. overlies Coffee sand and underlies Ripley fm. In east-central Miss. and western Ala. overlies Tombigbee sand memb. of Eutaw fm. and for many years included all deposits up to the Eocene. In central Ala. overlies Tombigbee sand memb. of Eutaw fm. and underlies Ripley fm. To E. is replaced by Ripley fm. In NE. Miss. a tongue of the chalk (named Oktibbeha tongue) was described by Stephenson as overlying Ripley fm. (See L. W. Stephenson, U. S. G. S. P. P. 81, 1914, Ga. Geol. Surv. Bull. 26, 1911, and Wash. Acad. Sci. Jour., vol. 7, pp. 243–250, 1917, for explanation of relations to adjacent fms.) In April 1937 Stephenson proposed (and the U. S. Geol. Survey adopted) that the beds for many years called *Prairie Bluff tongue of Selma chalk* be raised to rank of a fm., called *Prairie Bluff chalk*, and redefined so as to include the beds previously called *Oktibbeha tongue of Selma chalk*, the latter name being discarded. This is a restriction of *Selma chalk* as defined by U. S. Geol. Survey since 1917. The Prairie Bluff chalk is uncon. on the Selma restricted. (See L. W. Stephenson and W. H. Monroe, A. A. P. G. Bull., 1937.)

Named for Selma, Dallas Co., Ala.

†Selma division (of Selma chalk).

Upper Cretaceous: Alabama.

E. A. Smith, 1903 (58th Cong., 1st sess., S. Ex. Doc. 19, pp. 12–20 and map). *Lower or Selma div. (of Selma chalk)*.—Clayey ls., in many parts a calc. clay instead of ls.; of dark-gray to bluish color, usually striped with lighter-colored purer ls. Underlies middle or Demopolis div. of Selma chalk and overlies Eutaw fm. Along Alabama River is seen in bluffs from Kings Landing to Selma and beyond.

Conflicts with use of Selma in broad sense. Later workers did not find it feasible to make the 3 subdivisions of the Selma indicated in above-cited rept. and the 3 names (*Selma div.*, *Demopolis div.*, and *Portland div.*) have been discarded. (See Ala. Geol. Surv. Spec. Rept. No. 14, 1926, p. 239.)

Named for exposures at Selma, Dallas Co.

Seminoe formation (iron bearing).

Pre-Cambrian: Southern Wyoming (Carbon County).

T. S. Lovering, 1930 (U. S. G. S. Bull. 811D). *Seminoe fm. (iron bearing)*.—A banded jaspery iron-bearing qtzite, a few ft. to 350± ft. thick, which lies uncon. on the early greenstone schists and is overlain by the late greenstone schists of Seminoe Mtns. Contains some interbedded schist. Probably of Archean age and sed. origin.

Seminole conglomerate.

Pennsylvanian: Central southern and central Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Seminole cgl.*—Lower 50 ft. cgl. of white chert in brown-sand matrix; upper 100 ft. brown ss. Overlies Holdenville sh. Is youngest Carbf. fm. in area.

R. W. Clark and C. M. Bauer, 1921 (A. A. P. G. Bull., vol. 5, pp. 282–292). Overlying Holdenville sh. in Ocmulgee dist. is a cgl. which in writers' opinion is to be correlated with Seminole cgl. as mapped by Taff in Coalgate folio. Its thickness is 15 to 355 ft. In some places the cgl. is at base, in other places at top, and in still other places it forms lenses in ss. It is overlain by 100 to 120 ft. of sh. that belongs to Tulsa group. [Tulsa group is older than Seminole cgl.]

G. D. Morgan, 1923 (Okla. Geol. Surv. Circ. 12). In Stonewall quad. [Pontotoc Co.] the *Seminole fm.* is 150± ft. thick and consists of (descending): (1) Almost unbroken greenish-blue sh., 15 to 30 ft.; (2) cgls. and sss. become thinner and percentage of sh. increases over No. 3, 70 to 85 ft.; (3) chert cgls. or coarse brown sss., "the 50-foot conglomeratic phase of type area," 30 to 50 feet. Overlies Holdenville fm. with local uncon. Is overlain by the newly discriminated Francis fm., to be described in forthcoming paper, the basal memb. of which is here named De Nay ls. memb. This ls. is included in Francis fm., instead of Seminole fm., because Taff did not mention any ls. memb. in the Seminole. It lies 150± ft. above base of Seminole fm., which is thickness of Seminole as given by Taff.

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 48). *Seminole cgl.* consists of 20 to 150 ft. of cgl. of white chert in brown matrix succeeded by brown ss. It extends NE. from central Pontotoc Co., crossing Seminole, Okfuskee, and Creek Counties.

Named for Seminole Nation, Okla., the typical area being in NW. corner of Coalgate quad., near edge of Seminole Nation.

Seminole sand member (of Simpson formation).

Ordovician: Central Oklahoma (Seminole County).

A. I. Levorsen, 1928 (Okla. Geol. Surv. Bull. 40BB). *Seminole sand memb.* (subsurface), 0 to 80 ft. thick, lies 20 to 175 ft. below top of Simpson fm. in Seminole Co. and 10 to 100± ft. above Wilcox sand memb. ("Second Wilcox" sand of oil fields). It is the "Wilcox" or "First Wilcox" sand of oil fields and is separated from underlying Wilcox sand memb. by dol. Is probably a lens, grading into dol. toward S. part of Co. and thinning out to N. and NE. parts of State. Distinguished from the older Wilcox sand by its dol. content and the uniformity and slightly smaller size of its sand grains.

T. E. Weirich, 1930 (A. A. P. G. Bull., vol. 14, No. 12, p. 1510). In Lovell pool, Logan Co., the "Seminole sand" is composed of green shales and sands; in Seminole dist. of sand; and in Maud and Ada dists. of dol.

Seneca limestone.

Middle Devonian: New York.

L. Vanuxem, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 275–278). *Seneca ls.*—So dark from carbonaceous matter as to be almost black. First met with in Seneca Co., where it is separate from all other masses of ls.; hence its name. Rests on 15 to 20 ft. of black brittle ls. terminated by one or two layers containing nodules of flint; "the layers below the flint I understand are the true 'cornitiferous rock' of Prof. Eaton." Is overlain by pyritiferous sl., slaty sh., and ss.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 292–295, 310). *Seneca ls.*—Fine-grained, compact, often brittle; contains thin layers and nodules of hornstone and a shaly stratum. Succeeds the gray crinoidal Onondaga ls. and in some instances alternates with it. Is recognized by its darker-blue color, fine texture, and homogeneous structure, generally very brittle. Uncon. underlies Marcellus shales.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept). *Seneca ls.* underlies Marcellus shales and overlies "Corniferous limerock" of Prof. Eaton, which rests on Onondaga ls.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 139–144). *Seneca ls.* underlies Marcellus shales and rests on Corniferous ls. Is terminal part of Corniferous ls., which rests on Onondaga ls. Reason for considering it a distinct rock was finding it in Seneca Co., the first year of the Survey, unconnected with any other rock, and subsequently in the third dist., containing in both districts *Strophomena lineata* in great abundance, none of which had then been discovered in any part of dist. below that rock.

In 1843 James Hall included this ls. in his "Corniferous ls.," which he treated as distinct from Onondaga ls. In 1846 E. Emmons included it, along with "Corniferous ls.," in Onondaga ls., as now universally recognized. Since then the name has practically fallen into disuse, although P. F. Schneider in 1894 called these lss. the *Seneca group.*

Seneca group.

See under *Seneca ls.*

Seneca quartz porphyry.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Green Lake County).

R. D. Irving, 1877 (Geol. Wis., vol. 2, p. 520). *Seneca (Pine Bluff) quartz porphyry.*—Occurs in sec. 2, T. 17, R. 11 E.

†Seneca chert. (In Boone limestone?)

Mississippian: Southwestern Missouri.

W. P. Jenney, 1894 (Am. Inst. Min. Engrs. Trans., vol. 22, p. 178). "Ore occurs in upper beds [of "Subcarboniferous" of SW. Mo.], designated as Cherokee ls. and *Seneca chert.*"

C. E. Siebenthal, 1907 (U. S. G. S. Joplin folio, No. 148, p. 4). Jenney in applying name "Seneca chert" presumably meant the chert herein called Grand Falls chert memb. of Boone ls., but his reference is too indefinite to satisfy demands of geologic terminology. The chert at Seneca [Newton Co.] is *not* to be correlated with the Grand Falls, and Seneca is preoccupied.

Seneca sandstone.

Seneca Red sandstone.

Seneca Creek sandstone.

Commercial terms applied to a ss. in Newark group of Md. (See E. B. Mathews, Md. Geol. Surv. vol. 2, pp. 199-208, 1898.)

Seneca Falls moraine.

Name applied to Pleist. moraine in central N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627+, 1932.)

Senecan group.

Upper Devonian: New York.

J. M. Clarke and C. Schuchert, 1899 (Sci., n. s., vol. 10, pp. 874-878). *Senecan period or group* includes Portage beds, Genesee sh., and Tully ls., which are excellently exposed along shores of Seneca Lake, in Seneca Co.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), followed above definition.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), also 1924 (N. Y. State Mus. Bull. 251), excluded from top of Senecan (and from the Portage group) certain beds (Dunkirk sh., Gowanda sh., Laona ss., etc.) that had previously been included in Senecan (and in the Portage), and apparently also restricted Senecan at base, drawing its base at base of the Middlesex sh.

The present N. Y. State Survey draws top of *Senecan* at base of Dunkirk sh. to W., at base of Longbeards Riffs ss. in west-central part of State, and at base of Cayuta sh. memb. of Chemung fm. in central N. Y. (See W. Goldring, N. Y. State Mus. Hdb. 10, 1931, p. 369.)

Senora formation.

Pennsylvanian: Eastern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Senora ss.*—Brown ss., generally thick-bedded in N. part of Coalgate quad. and thin and shaly in SW. part of quad. Thickness 140 to 500 ft. Overlies Stuart sh. and underlies Calvin ss.

Named for old post village of Senora, which was located in S. part of Okmulgee Co.

Senorito sandstone lentil (in Chinle? formation).

Triassic (Upper): Central northern New Mexico (Sandoval County).

B. C. Renick, 1931 (U. S. G. S. W. S. P. 620). *Senorito ss. lentil.*—Consists of (descending): (1) Massive cross-bedded ss., with streaks of cgl. at several intervals, of tan color, with greenish tint, 33 ft.; (2) cgl. and ss., 4 ft.; (3) massive cross-bedded ss., tan, yellow, white, and greenish, 55 ft.; (4) at most places 10 ft. of ls. cgl. at base. Total thickness 13 to 92 ft. Well exposed in Senorito Canyon, western Sandoval Co. Lies 10 to 50 ft. above base of Chinle (?) fm.

Sensori agglomerate and limestone.

Oligocene: Panama and Costa Rica.

D. F. MacDonald et al., 1919 (A. A. P. G. Bull., vol. 3, p. 364).

Sentinel granodiorite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 125, map). Is less uniform in composition than most other intrusive bodies. In W. part of the zone crossed by Yosemite Valley the rock is relatively light-colored and homogeneous, but in E. part of valley it is darker and more streaky and contains many dark inclusions. Constitutes greater part of both walls of Yosemite Valley from Three Brothers nearly to Royal Arches and from the Fissures eastward to Glacier Point. Oldest known fm. of Tuolumne intrusive series. Next older than Half Dome quartz monzonite, and generally contains more biotite and hornblende than the Half Dome.

Named for fact that it composes Sentinel Rock.

Sentinel dolomite.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Derivation of name not stated.]

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct., 1932, pp. 329–356). *Sentinel dol.*—White, slightly aren. dol., characterized by irregular patches or segregations of coarsely crystalline carbonates or, more rarely, chert. Thickness 100 ft. Conformably underlies Radcliff fm. and conformably overlies Wildrose fm.—all included in Telescope group (lower Paleozoic?). [Derivation of name not stated, but map shows the dol. on Sentinel Peak, southern part of Panamint Range.]

Sentinel Butte shale member (of Fort Union? formation).

Eocene: Southwestern North Dakota and northeastern Montana.

A. G. Leonard, 1908 (N. Dak. Geol. Surv. 5th Bien. Rept.). *Sentinel Butte coal group* of SW. N. Dak. is in upper part of Fort Union fm. and includes coals Q, R, S, T, and V. The underlying Beaver Creek coal group includes coals N, O, P.

W. T. Thom, Jr., and C. E. Dobbin, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 484, 495–497). *Sentinel Butte sh. memb. of Fort Union (?) fm.*—Is classed as Fort Union (?) by U. S. Geol. Surv., though regarded as Wasatch by [C. J.] Hares and the writers. Typically developed at Sentinel Butte [Billings Co.], N. Dak. Consists of dark clay shales resembling those of Hell Creek memb. of Lance fm. and Lebo sh. memb. of Fort Union fm. Overlies Tongue River memb. of Fort Union fm. and underlies Ulm coal group of Wasatch fm. Is essentially=Intermediate coal group of northern Wyo. plus Roland coal bed and to lower part of Kingsbury cgl., which overlaps on granite core of Big Horn Mtns. This uncon. overlap C. H. Wegemann (personal communication) regards as marking base of Wasatch. In northern Wyo. and southern Mont., and perhaps in Dakota areas as well, the base of Sentinel Butte sh. is marked by Roland coal beds.

C. J. Hares, 1928 (U. S. G. S. Bull. 775). *Sentinel Butte sh. memb. of Fort Union (?) fm.* is 325± ft. thick in Marmarth field, SW. N. Dak., and consists of dark, somber sandy sh., gray ss., and lignite interbedded. Overlies Tongue River memb. of Fort Union fm. and uncon. underlies White River (?) fm. The Bullion Creek lignite bed lies near top and HT lignite bed at base.

Sequatchie formation.

Upper Ordovician (Richmond): Eastern Tennessee, southwestern Virginia, and northeastern Alabama.

E. O. Ulrich, 1912 (12th Int. Geol. Cong., Canada, pp. 614, 646, 647, 648, 649, 651, 665, and plate). *Sequatchie fm.*—Local designation for all deposits of Richmond age in southern Appalachian Valley. Consists of red shales and argill. lss., heavier-bedded in upper part. Uncon. overlies Fairview fm. and uncon. underlies Clinch ss. Eastern border of the Sequatchie is usually confined to Clinton trough. Is equiv. to Arnheim, Waynesville, Liberty, Whitewater, and Elkhorn stages of Ind. and Ohio. The Juniata attains its greatest development in central Pa. and thins southwardly. Nearing the border of Tenn. it seems to pass into the more calc. Sequatchie fm., in which facies the deposits of this age extend into NE. Ala.

The present accepted definition of Sequatchie fm. limits it to marine limy beds W. of Powell's Valley, in eastern Tenn., SW. Va., and northern Ala., which are the time equiv. of Juniata ss. of Clinch Mtn and northward. In SW. Va. and NE. Tenn. it is overlain by Clinch ss. and underlain by Reedsville sh.

Sequoyah formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Sequoyah fm.*—Sss. and shales overlying Dotson ss. and extending up to top of a heavy ss. 450 ft. above base of fm. Includes some coal seams. Underlies Tellowa fm. [Type loc. not stated and unknown.]

†Seral series.

Pennsylvanian: Appalachian region.

H. D. Rogers, 1844 (Am. Jour. Sci., 1st, vol. 47, p. 156). *Seral series* embraces one vast and multiform body of coal strata, 3,000 ft. thick in western Pa. and Va. and probably still thicker in the anthracite basins. Consists of (1) the *true coal fm.* (divided into following 4 distinct members, i. e., new shales, new coal measures, older shales, and older coal measures); and (2) the *Seral cgl.* [Pottsville fm.], the great cgl. under the coal measures. Overlies Vespertine series. [Nongeographic name for all of Penn. rocks of Pa. and Va.]

H. D. Rogers, 1858 (Geol. Pa., vol. 1, pp. 109, 146–148+; vol. 2, p. 758), introduced "Umbral series or Middle Carboniferous," for 3,000± ft. of fossiliferous soft red shales and red sss. previously included in his Vespertine series, and described the siliceous cgl. or millstone grit forming basal memb. of his Seral series as resting on Umbral series [Mauch Chunk sh.].

Named to indicate "twilight period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

†Seral conglomerate.

See under *†Seral series.* As used in some early repts "Seral cgl." applied to all of Pottsville fm., and in other repts to only the upper (Homewood) ss. memb. of the Pottsville.

Sergeant shale.

Upper Cretaceous: Northwestern Iowa.

C. [R.] Keyes, 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 148, 150). *Sergeant shales.*, 75 ft. thick, underlie Ponca ss. and overlie Nishnabotna ss. All included in Dakotan series.

Named for Sergeant Bluff, Woodbury Co.

Serge Island marble.

Upper Cretaceous: Jamaica.

C. T. Trechman, 1936 (Geol. Mag., No. 864, vol. 73, No. 6, p. 258).

Serna schist.

Pre-Cambrian: Central northern New Mexico (Santa Fe region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 11). *Serna schists.*—Basal part of Archeozoic section near Picuris, N. of Santa Fe, on W. flank of Rocky Mtns. Thickness 1,500 ft. [Derivation of name not given.]

Serpent quartzite.

Pre-Cambrian (Huronian): Western Ontario.

W. H. Collins, 1916 (Canada Geol. Surv. Mus. Bull. 22, p. 4). Included in Bruce series.

Sespe formation.

Oligocene and upper Eocene: Southern California (Ventura County).

W. L. Watts, 1897 (Calif. State Min. Bur. Bull. 11, pp. 22–38). *Sespe brownstone fm.*—Ss., shales, and cgl., all more or less brown. Widely exposed in Sespe dist. Underlain, with apparent conformity, by white ss., and overlain, also with apparent conformity, by drab ss. Is of Tert. age, and younger than rocks containing Eo. fossils and older than beds containing Mio. fossils.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753). *Sespe fm.*—Nonmarine red, brown, and yellow cgl. and ss. with interbedded sh. Corresponds to Sespe brownstone fm. of Watts. Thickness 3,500 ft. at type loc. on Sespe Creek, in NW. part of Camulos quad. Ranges up to 4,000 or more ft. Conformably underlies marine Vaqueros fm. (with true Vaqueros—*Turritella inezana*—fauna), and uncon. overlies marine Tejon fm. Top 500 ft. of Tejon consists of light-gray ss. with some sh. and corresponds to "white ss." of Watts. The Vaqueros corresponds to "drab ss." of Watts. Typical Sespe corresponds to middle memb. only of Sespe fm. of G. H. Eldridge and R. Arnold, as mapped and described in U. S. G. S. Bull. 309, 1907.

The Sespe fm. and overlying and underlying fms. are exposed in gorge of Sespe Creek near entrance of Tar Creek and in region that extends E. btw. waters of Tar and Little Sespe Creeks.

Seth limestone. (In Kanawha formation.)

Pennsylvanian: Southwestern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 168). *Seth ls. of Krebs* (C. E. Krebs, Boone Co. Rept. W. Va. Geol. Surv., 1914 [1915]), belonging, at its type loc. near Seth, in Boone Co., 15 to 20 [25 in later repts] ft. below Williamson coal, 35 to 50 ft. below Dingess ls., and 180 ft. above base of lower bench of Campbell Creek (No. 2 Gas) coal, was not observed in territory covered by this rept. where it is evidently replaced by Upper Cedar Grove ss. [Later repts state that in some areas the Seth ls. occurs in sh. underlying the Upper Cedar Grove ss.]

Setters formation.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania, Maryland, Virginia.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Rept., vol. 1, pp. 130–132). *Setters Ridge quartz schist or qtzite*, extensively quarried N. of Baltimore, and affording at many other places a definite geological horizon. Always perfectly foliated by parallel muscovite-mica layers, at variable distances from each other, with plenty of stretched and broken tourmaline crystals in the foliation planes.

G. H. Williams and N. H. Darton, 1892 (U. S. G. S. map of Baltimore and vicinity, to accompany "Guide to Baltimore" prepared for Baltimore meeting Am. Inst. Min. Engrs., Feb. 1892). *Setters quartz schist.*—A peculiar schist composed mostly of quartz and divided into beds of varying thickness by parallel layers of muscovite. Underlies Cockeysville marble and overlies Baltimore hornblende gneiss. Most characteristic occurrence is in Setter's Ridge.

W. B. Clark, 1904 (Md. Geol. Surv. map of Harford Co., Md.) gave thickness of *Setters qtzite* as 750 ft.

The Glenarm series was formerly classified by U. S. Geol. Survey as belonging to "Algonkian system," but that term having been discarded it is now classified as pre-Camb.

Setters Ridge quartzite.

Same as *Setters fm.*

Seven Devils volcanics.

Permian: Central Idaho (Seven Devils region).

W. Lindgren, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, pp. 193–198, pl. 8). *Seven Devils series.*—Strongly compressed slates and crystalline ls. accompanied by large masses of Mesozoic or Paleozoic effusive rocks and schists derived from these. Poor in fossils. Probably Carbf. [Mapped over large area at and around Seven Devils. According to C. P. Ross (personal communication, April 1933) the "effusive rocks and schists" correspond to Seven Devils volcanics of Anderson.]

A. L. Anderson, 1930 (Idaho Bur. Mines and Geol. Pam. 34). *Seven Devils volcanics* [in text], *Seven Devils series* [on map].—The Perm. rocks of Orofino region are a continuation of those in Seven Devils region and Snake River Canyon, where they are dominantly of volcanic origin, mainly andesitic flows and pyroclastics with some fossiliferous calc. tuffs bearing a Phosphoria fauna. This lava group is herein designated *Seven Devils volcanics*, from type loc. in Seven Devils Mtns. Thickness probably more than a mile. They outcrop in 3 places in SW.

part of Orofino dist. As a whole the rocks are greatly altered and in most places resemble greenstones; apparently the series includes both surface lava flows, mainly of andesitic composition, and intrusive dikes and stocks of dioritic and gabbroic composition; the dikes and stocks cut the flows in a bewildering fashion; some of intrusives are probably much later than the flows and probably related to Triassic or Jurassic activity. Overlain, discon., by Triassic (?) rocks in Snake River Canyon.

†seven-foot tier.

A term applied in early N. Y. repts to post-Lowville part of Black River group. See under *Watertown ls.*

Seven Rivers gypsiferous member (of Chalk Bluff formation).

Permian: Southeastern New Mexico (Pecos Valley).

O. E. Meinzer, B. C. Renick, and Kirk Bryan, 1926 (U. S. G. S. W. S. P. 580–A, pp. 6–7, 13–15, and map). *Seven Rivers gypsiferous memb. of Chupadera fm.*—The upper 60 ft. or more consists of interbedded greenish limy sh. and ls., which in places changes laterally into ls. breccia; W. of Atchison, Topeka & Santa Fe Railway tracks the breccia becomes a persistent bed. Lower part of Seven Rivers memb. consists of an undet. thickness, but at least 100 ft., of thick beds of gyp. and associated red sand and sh. The Seven Rivers is basal memb. of Chupadera fm. as exposed in Carlsbad region, where it underlies Carlsbad ls. memb. of the Chupadera.

A. G. Fiedler and S. S. Nye, 1933 (U. S. G. S. W. S. P. 639). *Seven Rivers tongue of Pecos fm.*—Underlies Carlsbad ls. tongue of Capitan ls. and is underlain by basal deposits of Pecos fm.; in places it rests on Picacho ls.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), made following changes: (1) Divided the rocks formerly called *Pecos fm.* into several fms. (see under *Pecos fm.*); (2) abandoned *Pecos;* (3) introduced *Chalk Bluff fm.* for the beds overlying San Andres ls. memb. of Chupadera fm. and underlying Castile anhydrite in Pecos Valley, where the Castile is only the upper attenuated part of the Castile of Delaware Basin; (4) redefined *Seven Rivers gypsiferous memb.* by removing its upper part, which he named *Three Twins memb.* of Chalk Bluff fm.; (5) showed Seven Rivers and Three Twins members as composing upper part of Chalk Bluff fm., the Seven Rivers resting on Queen ss. memb. of Chalk Bluff fm.; (6) introduced *Azotea tongue of Carlsbad ls.* for the tongue of ls. that separates the Seven Rivers and Three Twins members. This is present approved classification of U. S. Geol. Survey.

†Seven Sisters sandstone.

Pennsylvanian: Eastern Kentucky (Middlesboro coal field).

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, p. 119), inadvertently failed, in one place, to change "Seven Sisters ss.," which in ms. they had originally used but later discarded for *Naese ss. memb.*, the present approved name for the ss., which is also exposed at a well-known geographic feature on Cumberland River that is known as Seven Sisters.

Severn formation.

Upper Cretaceous and Eocene: Eastern Maryland.

N. H. Darton, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 431, 438). *Severn fm.*—The continuous southern extension of the N. J. Cret. green sand series, but whether it represents all or part of these members is not yet determined. In Md. it is a strat. unit, distinctly separable from the N. J. series as a whole by its homogeneity of constitution, and it is with this restriction that the term Severn is applied. Consists almost entirely of fine black sand, more or less flecked with scales of mica, very sparingly but irregularly glauconitic, and usually containing considerable carbonaceous materials. Thickness 10 to 100 ft. Exposed in high cliffs at Round Bay on Severn River. Uncon. underlies Pamunkey fm. and uncon. overlies Potomac fm. [group].

N. H. Darton, 1893 (Am. Jour. Sci., 3d, vol. 45, pp. 407–419). *Severn fm.* (mapped) is separated from underlying Magothy fm. by an erosion uncon.

N. H. Darton, 1896 (U. S. G. S. Bull. 138, pp. 124–126). *Severn fm.*—Black argill. and carbonaceous sands, 3 to 150 ft. thick. Underlies Pamunkey fm. and overlies Magothy fm.

Discarded by U. S. Geol. Survey. Includes Rancocas fm. (Eo.) and Monmouth and Matawan fms. (Upper Cret.), which have been separated.

Severn limestone.

Silurian: Ontario (Hudson Bay region).

A. F. Foerste and T. E. Savage, 1927 (Denison Univ. Bull., Sci. Lab. Jour., vol. 22, pp. 6, 14).

Severn River limestone.

Silurian: Canada.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 341, 359, 367).

Severy shale. (In Shawnee group, Kansas.)

Severy shale member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

E. Haworth, 1898 (Kans. Univ. Geol. Surv., vol. 3, p. 66). *Severy shales* proposed by G. I. Adams in field notes, for shales, 50 to 75 ft. thick, overlying Elk Falls ls. and underlying Howard ls. in Chautauqua, Elk, and Greenwood Counties, Kans. With Howard ls. it forms light escarpment traceable from Eureka to Cedar Valley.

Was for many years treated as a memb. of Shawnee fm. In Kans. the Shawnee is treated as a group and the Severy as a fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 203, 206). Shunganunga sh. of Beede is unnecessary name. The few ft. of beds to which it was applied are included, without differentiation, in Severy sh. where Bachelor Creek ls. memb. of Howard ls. is absent. Where Coal Creek memb. of Topeka ls. is recognized, the Severy rests on it. Where Hartford is only memb. of Topeka represented, the lower bdy of Severy is top of Hartford ls. Severy is here treated as basal fm. of Wabaunsee group.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for Severy, Greenwood Co., Kans., which is built on this sh.

Sevier shale. (In Blount group.)

Lower Ordovician (late Chazy): Eastern Tennessee, western North Carolina, and southwestern Virginia.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 4). *Sevier sh.*—Shales overlying Tellico ss. and underlying Bays ss. in Knoxville quad., Tenn. As a whole is a thick series of calc. yellow shales, weathered from light-blue shaly ls. Is similar to Athens sh. With it occur occasional beds of gray ls. or variegated marble and beds of sandy sh. and calc. ss. SE. of Knoxville it consists of 200 to 300 ft. of gray argill. ls., gray and variegated marble, and shaly ls. overlain by 1,000 to 1,200 ft. of calc. yellow shales with occasional thin ls. beds and sandy shales. North of Montvale Springs there are two heavy beds of sandy sh. and calc. ss. interbedded with light-blue shaly ls. The shales are precisely like Athens sh. and the sss. very similar to Tellico ss. Passing NE. the sss. diminish in thickness and are more interbedded with shales. Fossils similar to those of Chickamauga ls. are common in the lss. and marbles of this fm.

Foregoing is original definition in type area. The name, however, first appeared in print in 1894, in a paper on SW. Va. by M. R. Campbell (Geol. Soc. Am. Bull., vol. 5, p. 176, pl. 4), who accepted Keith's name and correlated the rocks of SW. Va. with those of Knoxville quad., Tenn. As described by Campbell, the fm. in SW. Va. underlies Bays ss. and overlies Shenandoah ls. The name was also used by Campbell in U. S. G. S. Estillville folio (No. 12), published in 1894, where the fm. is described as 440 to 4,000 ft. thick; consisting of yellow or blue calc. sh., becoming quite sandy in upper part to SE.; basal part N. of Clinch River consisting of few ft. to 800 ft. of black sh.; underlies Bays ss. and overlies Chickamauga ls. N. of Clinch River and Moccasin ls. S. of Clinch River.

The Ottosee sh. of Ulrich is basal calc. memb. of typical Sevier sh. In early repts and folios of SW. Va. the younger Martinsburg sh. was erroneously mapped as Sevier sh.

Named for exposures in Sevier Co., Tenn.

Seville limestone. (In Pottsville formation.)

Pennsylvanian: Central western Illinois (Fulton County).

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 3, p. 805), showed *Seville ls.* above coal No. 1, in basal part of Penn. [Pottsville] of western Ill.

J. E. Lamar and H. B. Willman, 1934 (Ill. Geol. Surv. Bull. 61, p. 135). *Seville ls.* of Fulton Co., which lies above Rock Island (No. 1) coal, locally reaches thickness of 5 to 20 ft., but is absent in places.

Probably named for Seville, Fulton Co.

Seville cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a portion of middle part of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 1. Derivation of name not stated.

Sevy dolomite.

Middle Devonian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Sevy dol.*—Remarkably homogeneous throughout. Typical rock a well-bedded light mouse-gray dol. in layers 6 to 12 in. thick, which weathers very light gray; extremely dense; breaks with conchoidal fracture; most beds show faint lamination parallel to bedding. The fm. contains a few beds of darker dol. near top and locally beds containing tiny nodules of light-colored chert. Basal bed is conglomeratic. Thickness 450± ft. No diagnostic fossils. Grades into overlying Simonson dol., which contains Middle Dev. fossils. Overlies, uncon., Laketown dol., of Sil. age. Named for exposures in Sevy Canyon, on W. side of Deep Creek Range, Gold Hill region.

See also U. S. G. S. P. P. 177, 1934.

Sewanee conglomerate. (In Lee group.)

Pennsylvanian (lower Pottsville): Southern Tennessee.

J. M. Safford, 1893 (Tenn. State Bd. Health Bull., vol. 8, No. 6, pp. 89–98). *Sewanee cgl.*—As studied at Sewanee the cgl. is a heavy-bedded ss., abounding in white quartz pebbles of various shapes, from size of buckshot to that of pigeon's eggs and larger, which are scattered through it like plums in a pudding, the pebbles being in places so numerous that the rock is quarried for pebble gravel. Very generally a thickness of 3 to 24 in. of very base of the cgl. is a hard iron rock, a ferruginous cgl. The Sewanee cgl. caps Sewanee Plateau and rests on shales, with occasionally a bed of clay and a few in. of coal at some points on the mtn. Thickness 25 to 100 ft.; average about 60 ft.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., p. 150). *Sewanee cgl.*—The great cgl. on which Sewanee, the site of the University of the South, is located. Forms topmost stratum of Bon Air Measures. [Later work by C. Butts showed that the cgl. forming topmost stratum of Bon Air Measures of Safford in type loc. is not Sewanee cgl. but the much younger Bonair ss., and that all of †Bon Air Measures are above true Sewanee cgl.]

Overlies Gizzard fm. and underlies Whitwell sh. Thickness 200 ft. Is= upper part of Lookout ss.

Sewell formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell and W. C. Mendenhall, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, pp. 487, 494). *Sewell fm.*—Shales and sss. overlying Raleigh ss. and underlying

Fayette [Nuttall] ss. along New and Kanawha Rivers, W. Va. Includes Sewell coal, about 70 ft above base. Thickness of fm. 280 to 650 ft.

Comprises all of middle Pottsville in region described. Later definitions include at top the Nuttall ss. memb., which is same as Fayette ss. (preoccupied) of Messrs. Campbell and Mendenhall.

Named for Sewell, Fayette Co., W. Va.

†Sewell formation. (In Rancocas group.)

Eocene: New Jersey.

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 316–338). *Sewell marls*.—Dark greensand marls, with glauconite thickly disseminated. Thickness 20 to 30 ft. Basal div. of Rancocas fm. Overlies Monmouth fm. and underlies Vincentown limesands, the top div. of Rancocas fm. Named for Sewell, Gloucester Co.

This name being preoccupied, it was replaced by *Hornerstown marl*, which is now classified as a fm. of Rancocas *group*.

†Sewickley limestone. (In Monongahela formation.)

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_5, pp. 55–104, 286). *Sewickley ls.*, 8 to 10 ft. thick, is middle memb. of Pittsburg ls. group, and lies 90 ft. above Pittsburg coal. It is lower than Sewickley coal and higher than Redstone coal.

J. J. Stevenson, 1877 (2d Pa. Geol. Surv. Rept. K_2). *Fish-pot or Sewickley ls.*, 25 ft. thick, lies 30 ft. below Sewickley coal and 20 ft. above Redstone coal.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 61–62). I have deemed it preferable to apply the name *Sewickley ls.* to the whole ls. group which lies btw. the Sewickley and Redstone coal beds.

The Sewickley ls. of Platt and Stevenson is same as Fishpot ls. memb. of Monongahela fm., the older name.

Sewickley sandstone member (of Monongahela formation).

Pennsylvanian: Southwestern Pennsylvania, western Maryland, and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 60). *Sewickley ss.*—Flaggy, also massive and even pebbly ss., 0 to 60 ft. thick. Overlies Sewickley coal and underlies "Great" [Benwood] ls., 160± ft. thick. Its massive character is well shown along Monongahela River btw. Morgantown and Fairmont [W. Va.], in vicinity of Big Falls.

Sewickley member. (In Monongahela formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa., No. 27, Pittsburgh quad., p. 31, 1929) to include Benwood ls. and Sewickley coal [btw. which occurs Sewickley ss.].

Sextant formation.

Devonian: Ontario.

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 341, 374, 375).

†Sexton terrane (also †Sexton limestone).

An abbreviated form of *Sexton Creek ls.* employed by C. [R.] Keyes.

Sexton Creek limestone.

Silurian (early): Southwestern Illinois and eastern Missouri.

T. E. Savage, 1909 (Am. Jour. Sci., 4th, vol. 28, p. 518). *Sexton Creek ls.*—Lss. of Niagaran (Clinton) age, 16 to 70 ft. thick, in Alexander Co., Ill. Lower part thin layers of hard gray ls. and chert interbedded; upper part thicker layers of pink or reddish, mottled subcrystalline ls. Separated from underlying Edgewood ls. of Alexandrian series by 2-in. band of red residual clay. Uncon. underlies Dev. Helderbergian series. Named for exposures on Sexton Creek, Alexander Co., Ill.

T. E. Savage, 1910 (Ill. Geol. Surv. Bull. 16, pp. 304–341). *Sexton Creek ls.* was proposed to include all strata in this part of Miss. Valley [SW. Ill.] that belong to Clinton group. Fossils correlate it with Clinton of Ohio and Ind., which is probably as low as any Clinton previously described.

T. E. Savage, 1913 (Ill. Geol. Surv. Bull. 23). *Sexton Creek ls.* of Ill. and Mo. is=Brassfield ls. of Ohio, formerly included in Clinton but now known, by fossils, to be pre-Clinton. Sexton Creek and Brassfield are both now considered top fm. of Alexandrian series. The Sexton Creek overlies Essex ls. with a possible break in deposition.

T. E. Savage, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 111–112), divided his Alexandrian series into (descending) *Sexton Creek (Brassfield) ls.*, Essex ls., Edgewood ls., and Girardeau ls., and stated "the several fms. are uncon. among themselves." [On later pp. (353+) he used *Sexton Creek ls.* in NE. Ill.]

T. E. Savage, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 305–324). *Sexton Creek ls.* is restricted to rocks in southern basin, and *Kankakee ls.* (new name) introduced for contemp. deposits in NE. Ill., western Ill., and eastern Mo. N. of St. Louis.

T. E. Savage and M. L. Nebel, 1923 (Ill. Geol. Surv. Bull. 43). *Sexton Creek ls.*, 50 to 70 ft. thick, was deposited in sea that advanced from S. as far N. as Jackson Co. The sea that deposited *Kankakee ls.* at about same time invaded from E. or NE. and extended as far as Calhoun and Jersey Counties, Ill.

T. E. Savage, 1926 (Ill. Acad. Sci. Trans., vol. 19, pp. 286–287). *Sexton Creek (Brassfield) ls.* extends as far N. as Belvidere, near N. border of State [in McHenry Co.].

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 526+). Writer now believes that all Alexandrian strata in Ill. and Iowa were deposited in a sea that advanced from S., and thus belong to same province as Alexandrian strata in SW. Ill. [But he used *Kankakee (Brassfield) ls.* in NW. Ill. and *Sexton Creek (Brassfield) ls.* in SW. Ill., and discarded his Waucoma ls. for Kankakee and discarded his Winston ls. for Edgewood. A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 270–274), also used *Kankakee ls.* in NE. and NW. Ill.]

Seymour formation.

Pleistocene: Central northern Texas.

W. F. Cummins, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 181–190). *Seymour beds.*—Unstratified beds of sandy clay, few ft. to 50 ft. thick, in Baylor and Knox Counties. Overlies Permian red beds. Often at base beds of sandy pebbles cemented into solid masses by lime.

Named for Seymour, Baylor Co.

Shabu series.

Pre-Cambrian: Ontario.

G. D. Furse, 1934 (Ont. Dept. Mines 42d Ann. Rept., pt. 6, p. 24).

Shades sandstone member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1910 (U. S. G. S. Birmingham folio, No. 175, pp. 10, 11). *Shades ss. memb.*—Thick-bedded, rather coarse ss., generally somewhat conglomeratic in lower part. Thickness 200 ft. Basal ss. memb. of Pottsville fm. in Cahaba and Coosa coal fields. Either rests on Brock coal or is separated from that coal by 50 ft. of shale.

Named for presence on Shades Mtn, Jeffersonville Co.

Shadrick Mill sandstone. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 376). *Shadrick Mill ss.*—Ss., usually massive but with some flaggy beds and a thin cgl. Thickness 150 feet. Memb. of Strawn div. Overlies Elliott Creek bed and underlies bed No. 8 (250 to 300 ft. of clay interstratified with ss. at base).

Named for Shadrick Mill, Lampasas Co.

Shady dolomite.

Lower Cambrian: Eastern Tennessee, northern Alabama, northwestern Georgia, western North Carolina, and southwestern Virginia (as far north as Roanoke).

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 5). *Shady ls.*—Thick and massive beds of gray, bluish-gray, and mottled-gray ls., with nodules and masses of black chert, and a few beds of almost white ls. or marble. Thin seams of blue and gray sh. occur in many parts of fm., and in upper layers a few beds of red sh. make transition to overlying Watauga sh. Thickness 750 to 800 ft. Overlies Erwin qtzite.

In most areas the Shady is almost wholly dol. In Ala. it rests on Weisner qtzite.

Named for Shady, Johnson Co., Tenn.

†Shafer limestone.

A name applied locally, in Moab region, central eastern Utah, to a marine ls. 0 to 25 ft. thick, in places lying at top of Rico fm. (Permian) and in other places 10 ft. below top of Rico. Named for Shafer dome, but impossible to identify the ls. in other nearby domes of the region, according to J. B. Reeside, Jr. (personal communication). (See also A. A. Baker, U. S. G. S. Bull. 841, 1933.)

Shaffer shale.

Middle Devonian: West-central New York (Ontario County).

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, table and p. 22). In Ontario Co. the succession of Hamilton beds is (ascending) *Shaffer sh.* (=Skaneateles sh.), Centerfield ls., Canandaigua sh. (=Ludlowville sh.), Encrinal (Tichenor) ls., and Moscow sh.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). The Skaneateles sh. is evidently continuous into Canandaigua area, and hence that name is employed for it rather than *Shaffer sh.*

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 217–219), replaced *Shaffer sh.* with *Levanna sh.*, because latter type loc. afforded better exposures. See under *Levanna sh.*

These are the only records of *Shaffer sh.* or *Levanna sh.*

Shafter limestone. (Of Trinity group.)

Lower Cretaceous (Comanche series): Western Texas (Presidio County).

J. A. Udden, 1904 (Univ. Tex. Min. Surv. Bull. 8, pp. 10, 11, 25, 30–39). *Shafter beds.*—Alternating lss., stony marls, clays, and fine-grained straight-bedded lenticular masses of yellow and brown sss. Thickness 700 ft. Lower Cret. fossils. Underlie Edwards ls. and overlie Presidio beds. Lower 400 or 500 ft. are=Glen Rose; upper part believed to belong to horizon of Walnut clays.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745). All but uppermost part of *Shafter beds* are=Finlay ls.

C. P. Ross and W. E. Cartwright, 1935 (Univ. Tex. Bull. 3401, pp. 577, 586). *Shafter ls. (restricted)*.—Chiefly ls., 1,075± ft. thick. A restriction of Udden's *Shafter beds*, by excluding Walnut fm., here for first time mapped separately. Rests uncon. on Presidio fm. Is all of Trinity age and appears to be identical with Glen Rose ls. If detailed study of fossils confirms Glen Rose age, the local name Shafter ls. may be dropped.

Named for Shafter, Presidio Co. Exposed in and around the town.

Shaggy Peak rhyolite.

Tertiary (Eocene?): Central northern Utah.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, pp. 59–60). Shaggy Peak, Fairfield quad., is entirely composed of the intrusive rock here named *Shaggy Peak rhyolite*.

Shakopee dolomite. (In Prairie du Chien group.)

Lower Ordovician: Southern Minnesota and Wisconsin, Iowa, and northern Illinois.

N. H. Winchell, 1874 (Minn. Geol. and Nat. Hist. Surv. 2d Ann. Rept., pp. 138–147). *Shakopee ls.*—Mag. ls. alternating with calc. ss. Thickness in Minn. Valley 70 ft. Is uppermost memb. of Lower Magnesian [later named *Prairie du Chien group*]. Outcrops at Shakopee [Scott Co., Minn.]. Rests on ss. seen at Jordan—the Jordan ss.

The ss. upon which this uppermost memb. of †Lower Mag. rests was in foregoing rept mistaken for the older Jordan ss. In 1882 Wooster, in describing the †Lower Mag. rocks of St. Croix Valley, Wis., applied *Willow River beds* to uppermost memb. and *New Richmond ss.* to underlying ss. In 1886 (Minn. Geol. and Nat. Hist. Surv. 14th Ann. Rept., pp. 334–337) Winchell corrected his miscorrelation of the white ss. underlying his Shakopee ls. with Jordan ss., and adopted for it Wooster's name *New Richmond ss.* Winchell's name *Shakopee* continued to be used (usually for the beds above New Richmond ss., but in some early repts for all of the †Lower Mag.) in Minn., Wis., and Iowa repts, and *Willow River* was not again used until revived by Powers in 1935. (See under †*Willow River ls.*)

In 1889 (Minn. Acad. Nat. Sci. Bull., vol. 3, pp. 125–136) C. W. Hall applied †*Shakopee A* to the dol. beds in Minn. now known as Shakopee dol., †*Elevator B* to a ss. at their base, and †*Shakopee B* to the dol. now known as Oneota dol. In 1891 (U. S. G. S. 11th Ann. Rept., pt. 1) W J McGee applied *Oneota ls.* to the beds underlying New Richmond ss. of Wis. and Minn. repts and overlying the Jordan ss. (or the beds which had been called "Shakopee B" by C. W. Hall), and applied *Shakopee ls.* to the beds underlying the St. Peter ss. and overlying the New Richmond ss.

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 65–73). If the beds exposed at Shakopee are not in reality Oneota, evidence to contrary is paleontological. If Shakopee is to be retained for uppermost part of the Prairie du Chien, it should be recognized that the outcrops at Shakopee may not be included in it. If it should prove true that the beds at Shakopee belong in lower part of the dol. rather than in upper part, Shakopee could not properly be applied to upper part of the Prairie du Chien. In that case it might be advisable to discard *Shakopee* and return to Wooster's name *Willow River beds*. However, Wooster's name for these beds has not come into general use, and the Oneota is much thicker and more conspicuous in the section along Willow River than are these younger [Shakopee] beds. On the whole it seems best to continue to use *Shakopee* for these younger dolomites and sss., at least until the age of the beds at Shakopee is conclusively determined.

E. H. Powers, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 171), gave detailed section of the rocks exposed at Shakopee, Minn., in which he identified: Willow River dol. [Shakopee], 61 ft.; New Richmond ss., 2 ft.; Oneota dol., 126 ft.

In Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, *Willow River* is used in Iowa and Wis., by Powers and Trowbridge, but does not appear to have been adopted by the Ill., Minn., and Wis. Geological Surveys. (See fig. 2, pp. 83, 172–174.) G. M. Kay, however, adopts it (p. 283), although he stated (p. 282) that Stauffer (Jour. Geol., vol. 42, 1934, pp. 347–352) has rechecked the section at Shakopee "and concludes that Winchell was correct in classifying the outcropping beds as younger than the New Richmond and calling them Shakopee." Kay also says (p. 283) the type section of Shakopee "may be of Oneota age."

†Shakopee A limestone.

A term applied by C. W. Hall (Minn. Acad. Nat. Sci. Bull., vol. 3, pp. 125–136, 1889) to the beds now known as *Shakopee dol.*

†Shakopee B limestone.

A term applied by C. W. Hall (Minn. Acad. Nat. Sci. Bull., vol. 3, pp. 125–136, 1889) to the beds now known as *Oneota dol.*

†Shakopee group.

A term employed by F. W. Sardeson (Pan-Am. Geol., vol. 41, btw. pp. 107 and 122, 1924) to include Shakopee dol. and Oneota dol., instead of *Prairie du Chien group*, which he considered objectionable.

Shaktolik group.

Upper Cretaceous: Southwestern Alaska (Lower Yukon and Norton Bay-Nulato region).

P. S. Smith and H. M. Eakin, 1911 (U. S. G. S. Bull. 449, p. 57). *Shaktolik group* (so called after river of that name, which affords good section of the beds) includes thick series of sss., shales, and grits, lying btw. Ungalik cgl. below and top of sed. series in Norton Bay-Nulato region. Divided into a lower sandy div. and an upper shaly div. Includes Nulato sss. of Dall, but further work is needed to determine whether Nulato can be used for one of fms. of the group.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, p. 398, chart opp. p. 474), divided the Upper Cret. rocks of Lower Yukon and Norton Bay dists. into (descending) Kaltag, Nulato, and Melozi fms. and Ungalik cgl., and stated that the first 3 are contemp. with Shaktolik group.

P. S. Smith (U. S. G. S. P. P. 192). The beds above Ungalik cgl. have been described as *Shaktolik group*, but later, without much additional field evidence and mainly on theoretical grounds, this group was subdivided by G. C. Martin [U. S. G. S. Bull. 776, 1926] into 3 fms., named (ascending) *Melozi*, *Nulato*, and *Kaltag*. These subdivisions have not yet been given a tryout in field practice.

†Shaly limestone.

A descriptive term applied in a titular sense in early N. Y. repts to New Scotland ls., which was also called "Lower Shaly ls.," in contradistinction to "Upper Shaly ls." (Port Ewen ls.).

Shamattawa limestone.

Ordovician: Manitoba.

See *Shammattawa ls.*

Shammattawa limestone.

Ordovician: Manitoba (Hudson Bay region).

T. E. Savage and F. M. Van Tuyl, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 342, 345).

Shamokin black shale member.

Middle Devonian (Marcellus): Central Pennsylvania (Northumberland County).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, Proc. Pal. Soc. Feb. 28, pp. 202–203). *Shamokin black sh. memb.*—Basal memb. of Marcellus fm. in central Pa. Mostly fissile black sh., but in part finely aren. Fossils. Thickness 250± ft. at Selinsgrove Junction. Named for Shamokin Creek, in W. part of Northumberland Co., where exposed in N. limb of northern Selinsgrove Junction anticline. Underlies Turkey Ridge ss. memb.

†Shandon quartzite.

Upper Cambrian: Southwestern New Mexico.

C. H. Gordon, 1907 (Jour. Geol., vol. 15, pp. 91–92). *Shandon qtzite.*—Qtzites, sss., and shales with occasional ls. bed. Thickness 50 to 1,100 ft. Of Upper Camb. age. Underlies Mimbres ls.

Same as Bliss ss., and this local name is no longer used.

Named for Shandon, eastern part of Sierra Co.

Shandro shale.

Upper Cretaceous: Alberta.

J. A. Allan, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 12). Included in Belly River series.

Shannon sandstone member (of Steele shale).

Upper Cretaceous: Central Wyoming.

C. H. Wegemann, 1911 (U. S. G. S. Bull. 452, pp. 43, 47). About 1,025 ft. above base of Pierre fm. in this [Salt Creek] oil field lies the ss. here named *Shannon ss. lentil of Pierre fm.* It forms the rim rock of Salt Creek dome, and S. of Shannon is 170 ft. thick. It is somewhat variable in character, but usually contains 2 resistant beds separated by 100± ft. of softer ss. Lies 1,100 ft. below Parkman ss. memb.

Later work resulted in differentiating (in 1915) the deposits of Pierre age in this part of Wyo. into Mesaverde fm. (above) and Steele sh. (below), and the Shannon ss. has for many years been treated by U. S. Geol. Survey as a *memb.* of Steele sh., since it is of considerable geographic extent.

Shannon Run limestone. (In Washington formation.)

Permian: Northern West Virginia (Monongalia County).

E. L. Core, 1929 (W. Va. Acad. Sci. Proc., vol. 3, p. 205). Immediately beneath Waynesburg "B" coal in this region (near Core, Monongalia Co.) there occurs a local ls. which present author for convenience has designated *Shannon Run ls.*, from its exposure on Shannon Run, 2 mi. W. of Mount Morris. It is here a foot thick and has eroded to greater extent than overlying coal. It lies 30 to 35 ft. above Colvin Run ls.

Shannopin sand.

Drillers' term for a sand in SW. Pa., of Upper Dev. or early Carbf. age, which is considered=Hundred-foot sand, in part at least.

Shark River marl.

Eocene (middle): Northeastern New Jersey.

T. A. Conrad, 1865 (Acad. Nat. Sci. Phila. Proc., vol. 17, pp. 70–73). *Shark River marl*, the bed of the oldest Eo. ocean. Consists of fossiliferous indurated clay with disseminated grains of greensand. Thickness unknown.

W. B. Clark, 1893 (N. J. Geol. Surv. Ann. Rept. 1892, pp. 208–210). *Shark River marl.*—A marked greensand with slight admixture of argill. materials, with usually a hardened stony layer at top. Thickness 12 ft. Eo. fossils. Typically developed in valley of Shark River. Overlain uncon. by Miocene [Kirkwood fm.]. Rests conformably on Manasquan marl. [Later repts give thicknesses up to 19 ft.]

Sharon shale member (of Pottsville formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477, 489+). The Seral ss. and cgl., 50 to 100 ft. thick, embraces locally the *Sharon coal group* as a member.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 8–9). Hodge [J. T.] in 1839 named and described *Sharon series* as underneath Cgl. No. XII, from his explorations W. of Allegheny River. Lesley in 1841 [where?] named and described the *Tionesta series* as overlying Cgl. No. XII as he approached Allegheny River from Potter Co. The Tionesta ss. is Cgl. XII, and therefore *Tionesta series* of coal beds is same as *Sharon series*. It is therefore necessary to expunge the whole Tionesta group, sandrock and coal beds, from Mr. Rogers' column.

J. P. Lesley, 1877 (2d Pa. Geol. Surv. Rept. H_5, p. xxiii). *Sharon and Quinnimont coal group* included in Pottsville cgl.

J. J. Stevenson, 1877 (2d Pa. Geol. Surv. Rept. K_2). *Sharon coal group* included in Upper Umbral [Mauch Chunk sh.].

W. G. Platt, 1878 (2d Pa. Geol. Surv. Rept. H_4). [*Sharon and Quinnimont coal group* placed btw. Pottsville cgl. and Mauch Chunk sh.]

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Sharon shales.*—Dark shales containing 1 ft. of iron ore at top and filled below with fossil plants characteristic of Sharon coal, and containing thin layers of coal in lowest exposed part. Thickness 7 ft. to bed of Connoquenessing Creek, Beaver Co., Pa. Underlie Connoquenessing ss.

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 65–66). The so-called *Sharon coal series* is a name adopted by J. T. Hodge in first geological survey of Beaver River waters 40 years ago and retained by Prof. H. D. Rogers in his Final Rept. of 1858. It is synonymous with Beaver River group. [Further along in this rept, btw. pp. 308 and 316, he states that Sharon coal series underlies Connoquenessing ss.]

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Interconglomerate or Sharon group* extends from base of Piedmont (Tionesta) ss. (=Homewood ss.) to base of Sharon coal. [In footnote on p. xxxi J. P. Lesley says *Sharon* here should read *Mercer*. In same rept I. C. White applied *Sharon iron shales* to 0 to 25 ft. of dark-bluish sandy shales (with much iron ore scattered in nodular masses and a more or less regular stratum of iron ore near top) underlying Lower Connoquenessing ss. and overlying Sharon coal.]

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, pp. xxi-xxxvi and 319–333). *Sharon series* (also *Sharon group*).—Includes (descending) *Sharon Upper or Iron shales*, Sharon coal, *Sharon Lower shales*, and *Sharon cgl.*

D. White and M. R. Campbell, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, p. 132). *Sharon sh. group*.—Underlies Connoquenessing ss. and uncon. overlies Mauch Chunk fm. Includes (descending): (1) Sh. with some coal in places; (2) Sharon coal; and (3) *Sharon cgl.*

The U. S. Geol. Survey treats Sharon sh. and Sharon cgl. as two distinct members, the cgl. being the basal one. In N. Y. the Sharon sh. has been called "Olean sh."

Named for Sharon, Mercer Co., Pa.

Sharon conglomerate member (of Pottsville formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, pp. xxi-xxxvi and 319–333). *Sharon cgl.*—Basal part of *Sharon series or group*. Underlies Sharon Lower shales. Whether it be the base or whether it has anything whatever to do with the Pottsville cgl. will be seen hereafter. The reader of this volume must be on his guard against Mr. White's prepossession in favor of assumption that the Homewood, Connoquenessing, and Sharon, taken together, represent the great Pottsville cgl., No. XII. [Page xxxiv.] [The index to this volume states that the Sharon cgl. is the "lower member of Pottsville cgl. (No. XII)."]

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3). *Sharon cgl.*—At Sharon, Mercer Co., Pa., it is a pebbly ss. about 20 ft. thick, in 2 layers of equal thickness and without interval. Upper layer is moderately coarse ss., almost snow white; lower layer is a mere mass of pebbles, loosely cemented in matrix of coarse bluish-gray sand. In Mercer Co. it rests on Shenango shales [Burgoon ss.] and is separated from overlying Sharon coal by 5 ft. of fire clay and shales.

I. C. White, 1891 (U. S. G. S. Bull. 65, p. 204). *Sharon cgl.*, massive cgl., 0 to 40 ft. thick in Pa. and Ohio. On New River, W. Va., is represented by 300 to 400 ft. of shales, sss., and cgls. Basal memb. of Pottsville series. Underlies New River series in W. Va. Overlies Mauch Chunk series.

D. White and M. R. Campbell, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, p. 132). *Sharon cgl.*, basal memb. of Sharon sh. group.

The U. S. Geol. Survey treats Sharon cgl. of NW. Pa. as a *memb.*, underlying Sharon sh. memb. In NE. Ohio the Sharon cgl. is sole representative of the Pottsville and is treated as a *fm.*

Sharon coal group. (In Pottsville formation.)

The coal-bearing strata in Pottsville fm. of western Md. that overlie Sharon cgl. memb., and are essentially the same as Sharon sh. memb.

†Sharon group.

†Sharon series.

See under *Sharon sh. memb.*

Sharon sandstone.

Same as *Sharon cgl.*

Sharon clay.

A name applied in some Ohio repts to the clay, 0 to 3 ft. thick, underlying the Sharon coal.

Sharon syenite.

Devonian (?): Southeastern Massachusetts (Norfolk County).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 182–184 and map). *Sharon syenite.*—Chiefly dark mafic rocks that range in composition from augite-hornblende syenite through diorite to gabbro. Principal development in town of Sharon. They form Moose Hill.

Sharon Mountain quartz diorite.

Pre-Cambrian (?): Northwestern Connecticut.

W. M. Agar, 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 202–238). *Sharon Mtn quartz diorite.*—Biotite-andesine quartz diorite; a medium-grained gray gneiss with a cataclastic texture composed of strained and broken quartz, slightly strained andesine with occasional spindles of low-refracting potash feldspar; considerable titanite. Occurs in one large mass in Barrack Mtn granite gneiss. Contacts hidden and probably gradational, but is believed to be younger than Barrack Mtn gneiss and is younger than Grenville. Is intruded by Becket quartz monzonite gneiss. Confined, so far as known, to range of hills btw. Sharon, Conn., and Housatonic River. Assigned to pre-Camb. [As mapped it appears to occur on Sharon Mtn, Litchfield Co.]

Sharon Springs member (of Pierre shale).

Upper Cretaceous: Northwestern Kansas (Logan and Wallace Counties) and eastern Colorado.

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7). *Sharon Springs sh. memb.*—Basal memb. of Pierre sh. in Wallace Co., Kans., and its lithology differs widely from that of rest of fm. *Upper 65 ft.* consists of flaky, somewhat bituminous black sh. and, rarely, porous light-gray sh., both with abundant fish scales, gigantic septarian and smaller ordinary tough ls. concretions, also abundant soft concentric concretions, and very few thin bentonite streaks. *Lower 90 ft.* consists of flaky, somewhat bituminous black sh. with abundant small fish bones and scales, also gray, somewhat rusty sh.; thin rusty limonite streaks rare; concretions nearly absent. Underlies Weskan sh. memb. of Pierre and overlies Niobrara chalk. Is believed to extend into Nebr. and S. Dak. Does not seem to be developed W. and S. of western Kans. [Mapped at and around Sharon Springs, Wallace Co., Kans.]

Sharpsville sandstone member (of Cuyahoga formation).

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3, pp. 61–62). *Sharpsville ss.*—A well-defined and persistent group of alternating layers of ss. and sh., in beds 1 to 5 ft. thick. The sh. layers are usually much thinner than the ss. layers. The sss. are of peculiar dark grayish-brown color and fine grain and are quarried at many places along Shenango River [Mercer Co., Pa.], especially at Sharpsville. Thickness of fm. 50 to 60 ft. Underlies Crawford shales [Meadville sh. memb.] and overlies Orangeville shales. [This is commonly accepted definition of Sharpsville ss.]

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 83–90), separated Sharpsville ss. into 3 divisions, as explained under †*Meadville group.* The U. S. Geol. Survey, however, does not apply the same name to a unit and to a part of that unit. It therefore uses *upper ss.* and *lower ss.*, and, Meadville being adopted for a younger sh. memb., the thin ls. in the Sharpsville ss. is simply called *ls. bed* (not *Meadville Lower ls.*).

In NE. Ohio the Cuyahoga is treated by U. S. Geol. Survey as a *group* and the Sharpsville ss. as a *fm.*

Sharpsville formational suite.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal. vol. 21, No. 71, table opp. p. 61, p. 131). *Sharpsville formational suite* underlies Byham ls. memb., overlies Orangeville sh. memb., and is divided into (descending) *Sharpsville ss. memb.* [*restricted* to upper part of Sharpsville ss. memb.], West Mead ls. (formerly called *Lower Meadville ls.*), and Shaws ss. memb. [lower part of Sharpsville ss. memb. of other geologists]. [*West Mead* and *Shaws* are here used for first time.]

Shasta series (or **epoch**).

Lower Cretaceous: California and Oregon.

W. M. Gabb, 1869 (Calif. Geol. Surv. Pal., vol. 2, pp. vii, xiv, 129, 133).

A provincial series term applied to lower part of marine Cret. rocks as developed on Pacific coast. These rocks are now divided into Horsetown fm. above and Knoxville fm. below, and are uncon. overlain by Chico fm. and uncon. underlain by Franciscan fm.

Named for development of the rocks in Shasta Co., Calif. (For definition see U. S. G. S. Bull. 769, p. 61.)

†Shasta-Chico series.

Lower and Upper Cretaceous: California and Oregon.

J. S. Diller, 1893 (Geol. Soc. Am. Bull., vol. 4, pp. 205–224). An essentially conformable and continuous series of sediments formed without distinct interruption. For this series Mr. [T. W.] Stanton and I have agreed to use the name *Shasta-Chico series*. Includes Chico, Horsetown, and Knoxville fms., or all of known Cret. of Calif.

†Shastan system.

†Shastian system.

Terms proposed by T. C. Chamberlin and R. D. Salisbury (Geology, vol. 3, pp. 107–137, 1906) for major part of Lower Cret. series. (See U. S. G. S. Bull. 769, pp. 60–61 and plate.)

Shawangunk conglomerate.

Silurian: Southeastern New York and northern New Jersey and Pennsylvania.

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 246–250). *Shawangunk grit.*—Varies from cgl. to fine-grained grit rock and is almost entirely siliceous. Generally white or light gray, *but there is one bed at the upper part of its mass that is red.* In some places the upper strata are more or less loaded with pyrites. Thickness 0 to 500 ft. Is millstone grit of Eaton. [On pp. 254–255 is heading *Red rock of the Shawangunk group*, which is subordinate to *Shawangunk grit* heading, and beneath which is following statement:] A stratum of red rock has been mentioned as *lying on top* of Shawangunk grit. It is observed covering it in several places, but it is usually thin, and varies in texture from compact hard red grit to red crumbling shale. [The red qtzitic ss. and sh. overlying the coarse qtzite and cgl. are now known as *High Falls fm.*, and are treated as distinct from Shawangunk cgl.] Conformably underlies Helderberg ls. group [here applied to Helderberg and Cayuga rocks] and uncon. overlies Hudson River sl. group.

In subsequent repts. the Shawangunk was considered to be same as Oneida cgl. Later it was regarded by many geologists as younger than the Oneida and of Salina age, Salina fossils having been reported from it by J. M. Clarke in 1907 (N. Y. State Mus. Bull. 107). In 1910, however, Gilbert Van Ingen (Sci., June 11, 1911, p. 905) stated his conviction, after discussing the fossil evidence, that the Shawangunk is of "Medina, Clinton, and Niagara age," and therefore older than Salina; and in 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 531–534) Schuchert assigned it to Medina and Clinton epochs. But Grabau and other stratigraphers stated Shawangunk deposition was continuous with overlying beds of Salina age, "with which no physical break is discernible." Schuchert, however, considered, from evidence to W. and S., that there is a break at top of Shawangunk cgl. In northern N. J. the Shawangunk rests uncon. on Ord. Martinsburg sh., is overlain by High Falls fm., and has estimated thickness of 1,500 to 1,600 ft. (Grabau gives 1,900 ft. in Delaware Water Gap.)

In 1924 (Geol. Soc. Am. Bull., vol. 35, p. 105) C. K. Swartz stated: In going E. cgls. replace first the lower, then the upper beds of the Tuscarora, of Medinan age, passing into the Shawangunk of eastern N. Y. Also: The Clinton appears to merge with the Shawangunk of N. J. The same year (Pa. Geol. Surv. 4th ser., Bull. M$_5$) E. S. Moore and T. G. Taylor stated that typical Tuscarora qtzite merges into Shawangunk grit in E. part of Pa.

In 1926 (N. Y. State Mus. Bull. 270) F. Holzwasser stated: It is thought likely Shawangunk cgl. is Lower Sil. in age.

B. Willard, 1928 (Jour. Pal., vol. 1, pp. 255-258), argued for Ord. age of Shawangunk cgl.

C. K. and F. M. Swartz, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 467-474) and 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 622-661). Both faunal and strat. evidence combine to show that the Shawangunk is united Clinton and Tuscarora at Delaware River. The Shawangunk cgl. at Delaware Water Gap can be followed without break NE. into Shawangunk Mtn at Otisville, Orange Co., N. Y. The relationship of upper or Otisville sh. memb. (484 ft. thick) of the Shawangunk of Otisville, N. Y., to the deposits observed elsewhere is unknown. A similar sh. occurs above the cgls. of the Shawangunk at Delaware Water Gap. [They described the Shawangunk of other areas as consisting almost wholly of conglomeratic sss. Their Otisville sh. memb. is a local unit.] At that place the same 5 species of eurypterids that are found in Rose Hill fm. (of the Clinton) and in the Tuscarora of Swatara Gap, Pa., are found in black sh. bands in massive gray conglomeratic ss. resembling in all respects, lithologically, the corresponding beds of Delaware River. [They correlated their Otisville sh. memb. with Rochester sh., which they showed as later than their Rose Hill fm.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 318, 333), included *Shawangunk cgl.* in Clinton epoch on p. 318 and stated on p. 333: Latest view is that this basal Sil. deposit began earlier in Pa., and that, as it overlaps northward upon the old land surface, its base is made by younger and younger beds, so that in N. Y. the Shawangunk is mainly or entirely of Clinton age or younger (Ulrich).

Named for occurrence on Shawangunk Mtn., Ulster Co., N. Y., which is N. continuation of Kittatinny Mtn of N. J.

†Shawangunk group.

A term applied by Mather to High Falls fm. See under *Shawangunk cgl.*

Shawmut group.

Devonian or Carboniferous: Eastern Massachusetts (Boston Basin region).

W. O. Crosby, 1877 (Geol. map of eastern Mass.). *Shawmut group* consists of amygdaloid above and breccia below.

W. O. Crosby, 1880 (Boston Soc. Nat. Hist. Occ. Papers No. 3, with map). A series of semicrystalline rocks, of very dissimilar composition, but appearing to be identical in age and geognostic relations, which, having their greatest development in vicinity of Boston, I have named collectively the *Shawmut group*, Shawmut being the ancient Indian name of Boston. The rocks included in Shawmut group are those commonly known in vicinity of Boston as the breccia and the amygdaloid. They are found chiefly within radius of 10 to 15 mi. of Boston, and occur also on Marblehead Neck and neighboring islands and in basin of Parker River. Have been unable to satisfy myself whether the breccia underlies the amygdaloid, or vice versa.

Is a part of Mattapan volcanic complex, as mapped by B. K. Emerson in U. S. G. S. Bull. 597, 1917.

Shawmut amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Is younger than Shawmut cgl. The mineralized part is the Shawmut lode. Named for occurrence in Shawmut mine, Houghton Co.

Shawmut flow.

Includes Shawmut amygdaloid and the underlying trap.

Shawmut conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 527, 536, 546, 554, pls. 11, 12, fig. 50). Thickness of *Shawmut cgl.* 74 ft. Occurs at Shawmut mine, on Elm River property.

According to B. S. Butler (personal communication) this cgl. is probably No. 11 or No. 12 of Central Mine group and is older than Shawmut amygdaloid.

Named for occurrence at Shawmut mine, Houghton Co.

†Shawnee limestone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 888, 895, plates opp. pp. 889, 900, 921). *Shawnee or Buff ls.*—Buff ls., 1 to 3 ft. thick, 100 to 110 ft. above Hanging Rock or Gray ls. [Vanport ls.] in Hocking Valley and 130 to 140 ft. above that ls. in Hanging Rock dist. About 100 ft. below Cambridge ls.

Later repts state that this ls. is same as Upper Freeport ls. memb

Named for Shawnee, Perry Co.

Shawnee group. (In Kansas and Nebraska.)
Shawnee formation. (Missouri and Iowa.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1898 (Kans. Univ. Geol. Surv., vol. 3, pp. 93–94). *Shawnee fm.*—Alternating lss. and shales in general characterization decidedly similar. Extend from top of Oread ls. up to base of Burlingame ls.

Until 1931 the commonly accepted definition of Shawnee included all beds btw. base of Burlingame ls. (at top) and top of Oread ls.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart), redefined *Shawnee group*, by including in it the deposits beneath base of Severy sh. (=top of Topeka ls.) and above Lawrence sh. This definition subtracted several fms. at the top and included Oread ls. at base.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 93, 96). It is proposed to redefine *Shawnee group* to include the prominent lss. and intervening shales that occur btw. base of Oread fm. and top of Topeka fm. [This definition was adhered to by Moore and G. E. Condra in their Oct. 1932 revised classification chart of the Penn. of Kans. and Nebr., by Condra in his 1935 classification, and by Moore in his 1936 classification.]

In eastern Kans. and Nebr. the Shawnee is treated as a group; in the other States it has usually been treated as a fm. and its subdivisions as members. The modified definitions have not been considered by U. S. Geol. Survey.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Shawnee sandstone.

See under *Thurman ss.*

Shaws sandstone member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 132), proposed *Shaws ss. memb.* for basal part of Sharpsville ss. memb. of other geologists, and restricted Sharpsville ss. memb. to upper part, applying *West Mead ls. memb.* to the thin ls. in Sharpsville ss. of other geologists. Good exposures of this ss. in ravine behind Shaws brick school house on Meadville-Franklin highway, Meadville quad.

Sheep Bay granite.

Paleozoic (?): Southeastern Alaska (Prince William Sound region).

U. S. Grant and D. F. Higgins, 1910 (U. S. G. S. Bull. 443, pp. 43, 46). *Sheep Bay granite.*—Light-gray coarsest-grained granite of the Sound region. Occupies NE. third of point of land separating Port Gravina from Sheep Bay. Cuts rocks referred to Orca group.

Sheep Creek beds.

Miocene: Western Nebraska and eastern Wyoming.

W. D. Matthew and H. J. Cook, 1909 (Am. Mus. Nat. Hist. Bull., vol. 26, art. 27, pp. 362–363). *Sheep Creek beds*.—Soft fine-grained sandy "clays," light buff, free from pebbles and containing harder calc. layers. Near top is 2-ft. layer of dark-gray volcanic ash. Middle Mio. fossils. Thickness 100 ft. Uncon. underlies Snake Creek beds and uncon. overlies lower Mio. beds equiv. to *Daemonelix* beds of Niobrara Valley. [According to H. F. Osborn, 1909 (U. S. G. S. Bull. 361, pp. 72, 73), the *Daemonelix* zone is lower part of Harrison fm. of repts and is lower Mio.] Named for Sheep Creek, Sioux Co., Nebr.

H. J. Cook, 1915 (Nebr. Geol. Surv. vol. 7, pt. 11, pp. 72–75). *Sheep Creek beds* (middle Mio.) underlie Snake Creek beds at Spoon Butte, Wyo. In Whistle Creek Valley, Sioux Co., Nebr., they are 100 ft. thick, and overlie Upper Harrison beds.

C. C. O'Harra, 1920 (S. Dak. School Mines Bull. 13, p. 36). *Sheep Creek beds* are Middle Mio.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 16, 17), assigned these beds to early middle Mio., but H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, p. 44), assigned them to upper and middle Mio.

Sheep Creek conglomerate.

Mesozoic or late Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 91, map). *Sheep Creek cgl.*—Cgls. of pebbles $\frac{1}{16}$ in. to 4+ in. diam., but prevailingly less than 1 in., usually water-worn and rounded, and of chert, quartz, qtzite, argillite, and andesite, cemented by an argill. ss. The cgl. grades into hardened sh. and sandy sh., always dark gray. Lava flows are interbedded. Thickness probably at least 500 ft. Exposed on E. side of Sheep Creek at Int. Bdy. Contemp. with Rossland volcanic series. No fossils collected by writer, but leaf impressions collected by Canadian Geol. Surv. from the same cgls. just N. of bdy are determined by Prof. Penhallow to indicate Tert. age. [See *Rossland volcanic group.*]

Sheep Mountain andesite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13). [The field name *Sheep Mtn fm.* crept into print in this bulletin, along with the formally adopted name *Summitville andesite*. (See under *Summitville*.) Mr. Larsen later discovered that the rocks around Summitville are older, instead of younger, than Treasure Mtn latite, and that they belong to Conejos andesite. He therefore abandoned "Summitville andesite," and adopted *Sheep Mtn andesite* for the fm. overlying Treasure Mtn latite and underlying Alboroto quartz latite, as shown in following definition.]

E. S. Larsen, 1933 (U. S. G. S. Bull. 843). *Sheep Mtn andesite*.—Overlies Treasure Mtn quartz latite rather regularly, but where it overlies Conejos andesite it was deposited on a surface made up of mtns and deep canyons. The fm. is present in 3 parts of the mtns and differs considerably in the 3 areas. One is a volcanic cone in drainage of Lost Trail Creek near center of San Cristobal quad.; one is about Sheep Mtn in NW. part of Summitville quad.; and the third and by far the largest is in Del Norte and Saguache quads. Most of Lost Trail Creek area is largely chaotic breccia of light-colored andesite-latite with much glass in ground-mass. Small bodies of massive rock that varies from rhyolites to andesites are scattered through the breccia. These commonly show irregular relations and are in part intrusive and in part effusive. The predominant rock of both the massive rock and the breccia is a dark-colored hornblende-pyroxene andesite somewhat like the rock of Sheep Mtn area except that it has smaller phenocrysts and has hornblende in most of the bodies. The body about Sheep Mtn is a low dome composed of dark flows and chaotic breccia and brecciated flows of pyroxene andesite with conspicuous tabular feldspar. Little tuff breccia is present. The bodies of Sheep Mtn in NE. part of San Juan Mtns probably represent remnants of several volcanic piles. The rocks are all lighter-colored than those of the other two domes and are latite andesites. The rocks of Del Norte quad. and adjoining areas are much alike and are chiefly in thick flows extruded upon a mountainous topography with deep canyons. The common rock is rather dense and light gray to purple drab in color. It is made up nearly half of phenocrysts up to 3 cm or more across. White calcic andesine is chief phenocryst, but prisms of black hornblende, flakes of biotite, and grains of green augite are present in moderate amount. The groundmass is fine-textured and made up of small plagioclase laths in a spongelike intergrowth of orthoclase and quartz.

Sheep Mountain quartzite.

Pre-Cambrian (Belt series): Central western Montana (Missoula to Helena region).

C. H. Clapp and C. F. Deiss, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 683, figs. 2, 3). *Sheep Mtn fm.*—Consists of (descending): (1) 1,050 ft. of massive red and some white qtzite, with beds of clay galls near top, deep-red weathering; (2) 695 ft. of massive pink-white coarse-grained cross-bedded qtzite, with some beds of coarse-grained ss. in upper part, all beds weathering gray red; (3) 555 ft. of massive pink and white coarse-grained cross-bedded qtzite with numerous bands of clay galls near base. Top fm. of Missoula group. Rests conformably on Garnet Range fm. Thickness 2,300 ft. on upper slopes of Sheep Mtn, T. 15 N., R. 18 W., sec. 24, and T. 14 N., R. 17 W., sec. 30.

Sheep Pen sandstone.

See under *Sheep Pen Canyon fm.*

Sheep Pen Canyon formation.

Triassic (?): Northeastern New Mexico (Union County).

B. H. Parker, 1930 (Kans. Geol. Soc. 4th Ann. Field Conf., p. 132, Mimeo). *Sheep Pen Canyon fm.*—Tan to buff massive and thin-bedded ss., 0 to 68 ft. thick. Of Triassic (?) age. Uncon. underlies La Plata group and overlies Sloan Canyon fm. [Derivation of name not stated.]

B. H. Parker, 1933 (Jour. Geol., vol. 41, No. 1, pp. 40–43). *Sheep Pen ss.*—Buff to tan ss., thin-bedded to massive, uncon. underlying Exeter ss. and conformably overlying Sloan Canyon fm. At type loc., where it caps a small mesa in E½ NW¼ sec. 35, T. 32 N., R. 35 E., it is 68 ft. thick. In places completely removed by erosion. Named for Sheep Pen Canyon, which joins Cimarron Valley about ½ mi. NW. of type loc. Tentatively assigned to Triassic (?). Has been confused with Exeter ss.

†Sheep Rock conglomerate.

A name applied by J. P. Lesley (Am. Phil. Soc. Proc., vol. 12, pp. 492-496, 1873) to cgl. forming Sheep Rock, btw. Big Tom's Creek and Little Tom's Creek, E. of Gladeville (now called Wise), Wise Co., Va. This cgl. is a local area of Gladeville ss. as defined and mapped by M. R. Campbell in 1893. In attempting to follow this cgl. to the E. Lesley confused it with older cgls. of Lee fm. (See U. S. G. S. Bull. 111, p. 28, 1893.)

Sheffield formation.

Upper Devonian or Mississippian: Central northern Iowa.

C. L. Fenton, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 355–376). *Sheffield fm.*—Blue nonfossiliferous clayey shales, about 90 ft. thick. Uncon. or discon. underlies Hackberry stage. Exposed at Hackberry Grove but is unrelated to Hackberry stage, although included in that stage by Webster (1889) and Calvin (1897). Uncon. overlies Nora fm., which possibly belongs to Cedar Valley stage. Is Dev.

According to A. O. Thomas (Iowa Geol. Surv. vol. 30, p. 116, footnote, 1925) the shales at Sheffield, Franklin Co., are basal fm. of Kinderhook group, and not same as the Upper Dev. shales that underlie Cerro Gordo substage of Fenton. The name *Sheffield* being therefore considered by him inappropriate for the Upper Dev. sh., he replaced it with *Juniper Hill fm.*, while Van Tuyl, in same volume (pp. 52, 91, 101, 107) applied *Sheffield sh.* to the younger fm., which he tentatively included in Kinderhook group, but with statement that lower two-thirds (40 ft.) may prove to be Upper Dev.

R. C. Moore, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., fig. 1, p. 245), included these beds in Kinderhook group (Miss.), but L. R. Laudon (p. 246 of same rept, also 1931, Iowa Acad. Sci. Proc., vol. 37, p. 251) stated that fauna with little question is late Upper Dev. M. A. Stainbrook (p. 249 of 1935 publication cited) also refers *Sheffield fm.* to Upper Dev., places Juniper Hill btw. Cerro Gordo and Nora, and treats it as basal memb. of Lime Creek sh.

Named for exposures in vicinity of Sheffield, Franklin Co.

Sheffield gas sand.

Sheffield oil sand.

Drillers' terms, NW. Pa. Of Chemung age. The Sheffield gas sand is said to be same as *Hague gas sand* and lower than *Sheffield or Blue Jay oil sand*. Named for Sheffield, Warren Co. J. D. Sisler, 1933 (Pa. Geol. Surv., 4th, Bull. M_{19}, p. 28), says *Sheffield sand* probably corresponds to Cooper sand of Warren Co. and is in approx. strat. position of 2d Bradford sand of Bradford dist.

Sheguindah beds.

Upper Ordovician: Ontario (Manitoulin Island).

A. F. Foerste, 1912 (Ohio Nat., vol. 13, p. 43). *Sheguindah beds.*—At base clay shales (with no trace of ls.) about 43 ft. thick. At 43 ft. first trace of ls. was found, but ls. layers do not become common until 100 ft. above base; these upper lss. and interbedded clays contain typical Eden fauna. Underlie Wekwemikongsing beds (of Lorraine age) and rest on Collingwood fm. (of Trenton age). Exposed along road from Little Current to Sheguindah.

Shelburn formation.

Pennsylvanian: Southwestern Indiana.

E. R. Cumings, 1922 (Hdb. Ind. Geol. pt. 4, Sep. Pub. 21, chart and pp. 408, 525, 529). *Shelburn fm.*—Name proposed for interval from top of Indiana coal No. 7 to base of Merom ss. Includes Ditney fm. (dropped), Somerville ls., and all of Millersburg fm. (dropped) except coal No. 7. Discon. underlies Merom ss. and discon. overlies Petersburg fm. (redefined). Is of post-Allegheny age. Includes Busseron ss. (possibly=Anvil Rock ss. of Ky.) at base.

Named for Shelburn, Sullivan Co.

†Shelburne gneiss.

W. O. Crosby (Rept. on geol. map of Mass., Mass. Commission to Centennial Exposition, Boston, 1876, pp. 1–42) referred, in two places, to the gneiss at Shelburne Falls, Mass., as *Shelburne gneiss*, but there is no subsequent record of the use of this name. According to B. K. Emerson (U. S. G. S. Bull. 597, 1917) the so-called "gneiss" at Shelburne Falls is Pelham granite.

Shelburne marble.

Lower (?) Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 115). *Shelburne marble.*—Almost entirely marble, light-colored, for most part white, but also light buff or cream, bluish white, and various beds of mottled cream white or blue and white. A few thin beds of light-gray dol. occur in various parts of the fm. Thickness visible along Winooski River is about 200 ft., but upper limit is not there shown, and total is doubtless twice as great. Is overlain by Williston ls. No contacts are known btw. Shelburne marble and Milton dol., the next underlying fm., but it appears to be conformable. The Shelburne is believed to be younger than Highgate sl. The main belt of the marble and two much smaller parallel strips occur in town of Shelburne [Burlington quad.].

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 373, 375). *Shelburne marble* in Middlebury, Brandon, Proctor, and Danby is overlain by Williston ls., with great uncon. btw. them, which appears to be represented in St. Albans region by St. Albans sl., Mill River cgl., and Highgate sl. The marble contains no fossils so far as known, but it is uniform and is a regular unit in Lower Camb. succession of E. part of valley, where it grades downward into Clarendon Springs dol. In Burlington region it overlies Milton dol., which here consists of dol. cgl.

C. Schuchert, 1933 (Am. Jour. Sci., 5th, vol. 25, pp. 353–381), stated that Keith's so-called Milton dol. of central sequence is not true Milton dol. (Upper Camb.), but is Middle Camb., and he renamed it *Rugg Brook cgl.* The Upper Camb. age of true Milton dol. is now generally accepted. If the Shelburne marble, which Keith stated overlies true Milton dol., does in fact overlie that fm., it would be Upper Camb. instead of Lower Camb.

†Shelby limestone.

Middle Devonian: Central Indiana.

A. F. Foerste, 1898 (Ind. Dept. Geol. and Nat. Res. 22d Ann. Rept., pp. 234–235, in a description of the rocks of Shelby Co. from Waldron to Geneva). *Shelby bed.*—Brownish or bluish dolomitic ls. 31 ft. thick, with 2 ft. of massive dark-brown ls. at base. Uncon. overlies Louisville ls. Assigned to Lower Dev. [Type loc. not stated, but the fm. appears to have been named for Shelby Co.]

E. M. Kindle, 1901 (Ind. Dept. Geol. and Nat. Res. 25th Ann. Rept., p. 536). *Shelby bed* of Foerste is same as Geneva ls. and should be abandoned for the older name.

†Shelby dolomite.

Silurian (Niagaran): Western New York.

J. M. Clarke and R. Ruedemann, 1903 (N. Y. State Mus. Mem. 5, pp. 9–13), gave following (downward) section of Lockport dol. along Oak Orchard Creek, from 0 to 1¾ mi. S. of Shelby village, in Shelby, the SW. Twp of Orleans Co.: (1) Second Guelph fauna, *upper Shelby dol.*, 8 to 10 ft.; (2) Lockport dolomites, 32 ft.; (3) first Guelph fauna, *lower Shelby dol.*, 3 ft.; (4) Lockport dolomites (largely covered), 62+ ft. "We are thus presented with conclusive evidence of an invasion of the Guelph fauna from the west into western N. Y., while the Lockport dolomites were being deposited and at about the middle of the period of their formation."

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19), excluded Guelph dol. from Lockport dol., and included *Upper Shelby* and *Lower Shelby* in Guelph.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114), divided *Niagara fm.* (as he called it) in Rochester and Ontario Beach quads. as follows (descending):

Lockport dolomites with interbedded Guelph faunas 130± ft.:

1. Second Guelph fauna, *upper Shelby dol.*, 8–10 ft. Is top of section at Shelby but we are not prepared to say positively that it terminates the series everywhere in N. Y. Presence of Lockport species more pronounced in this upper fauna.
2. Lockport dolomites, 32 ft. Characteristic Lockport fauna, and no Guelph species.
3. First Guelph fauna, *lower Shelby dol.*, 3 ft. Is purer Guelph fauna.

Lockport dolomites, 62 ft. Characteristic Lockport fauna.

Rochester sh., 85 ft.

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348), divided Niagaran into (descending) (1) *Guelph dol.* (*Shelby*); (2) Lockport; (3) * * *

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 50–51), included *Upper Shelby dol.* and *Lower Shelby dol.* in Guelph dol. and excluded Guelph from Lockport dol. He stated: Shelby is to be regarded both as a faunistic and a lithologic Guelph element in the succession of the strata.

M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111), stated that *upper Shelby beds* of N. Y. belong to Guelph dol., which "includes beds from base of upper Shelby beds up," and which he treated as distinct from and overlying the Lockport dol.

E. O. Ulrich and R. S. Bassler, 1923 (Md. Geol. Surv. Sil. vol., p. 260). The terms *Lower Shelby* and *Upper Shelby dol.* used by Clarke and Ruedemann as designations for the two zones of Lockport dol. in which Guelph fauna is found in western N. Y. obviously were not intended as formally proposed names of distinct formational units or of members of the Lockport. In fact even the name *Lockport* as employed by these authors in work just cited [1903 reference above] refers to faunal content of the beds rather than to a definite formational unit.

The U. S. Geol. Survey includes the beds containing the Guelph fauna in Lockport dol.

See also *Guelph dol.*

Shelbyville morainic system.

Pleistocene (Wisconsin stage): Southern Indiana and southern Illinois. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53, and in part on moraine map in U. S. G. S. P. P. 106. Named for Shelbyville, Shelby Co., Ill.

Sheldon limestone. (In Calhoun sh.)

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 47). The ls. underlying Iowa Point sh. and overlying Jones Point sh. is not Meadow ls. (which belongs down in Stanton ls.), and is here named *Sheldon ls.* In Sand Point section, Cass Co., Nebr., it consists of 3½ ft. of massive bluish-gray fossiliferous ls. that weathers buff or brownish. It is middle memb. of Calhoun sh. [Derivation of name not stated.]

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.), transferred Sheldon ls. and underlying Jones Point sh. to Deer Creek ls. and restricted Calhoun sh. to the beds they had previously called *Iowa Point sh.* This change made Sheldon ls. the top bed of Deer Creek ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 11), divided *Calhoun sh. fm.* into (descending) Iowa Point sh., Sheldon ls., and Jones Point sh., and this classification was followed by R. C. Moore in his 1936 revised classification (Kans. Geol. Surv. Bull. 22, p. 48). But on pp. 187-194 Moore proposed to redefine Sheldon ls., Jones Point sh., and Ervine Creek ls. on a cyclothem basis, expanding *Sheldon* to include some beds now included in Ervine Creek, and transferring Jones Point to a part of the Ervine Creek. These proposed changes involve a redefinition of present lower bdy of Calhoun sh. and upper bdy of Deer Creek ls. Moore stated that Sheldon ls. was named for outcrops in Sheldon quarry, just E. of Nehawka, Nebr.

Shelikof formation.

Upper Jurassic: Southwestern Alaska (Shelikof Strait).

S. R. Capps, 1923 (U. S. G. S. Bull. 739, pp. 91, 97, map). *Shelikof fm.*—Upper part, 700 to 1,000 ft. of black sh. with some ls. lenses at top; lower part, a thick series of ss., with minor amounts of cgl. and sandy to calc. sh. Thickness of fm. 5,000 to 7,000 ft. Large Upper Jurassic fauna. Is prevailing rock fm. on NW. shore of Shelikof Strait, from Katmai Bay at least as far SW. as Kialagvik Bay, and in Cold Bay dist. it forms nearly all bold headlands and coastal mtns visible from the strait. Underlies Naknek fm. and uncon. overlies Kialagvik fm.

†Shell Bluff marl. (In Barnwell formation.)

†Shell Bluff group. (In Barnwell formation.)

Eocene (upper): Eastern Georgia and South Carolina.

T. A. Conrad, 1866 (Am. Jour. Sci., 2d, vol. 41, p. 96). *Shell Bluff group.*—Black lignite clay and gray sand, with fossils [listed]. Thickness 5 ft. Named for Shell Bluff, on Savannah River, where *Ostrea georgiana* is abundant.

T. W. Vaughan, 1911 (Ga. Geol. Surv. Bull. 26, p. 240), treated *Ostrea georgiana* zone at Shell Bluff, on Savannah River, as topmost bed of McBean fm., and referred the McBean and the overlying Barnwell sand to Claiborne group.

C. W. Cooke and H. K. Shearer, 1918 (U. S. G. S. P. P. 120C), showed that the faunas of Barnwell sand and of *Ostrea georgiana* zone are of Jackson age, restricted Claiborne group of Ga. and McBean fm. to the beds beneath *Ostrea georgiana* zone and above Wilcox fm., and included the paleontologic zone referred to in Barnwell fm. Cooke stated (orally) that the *Ostrea georgiana* zone is the †Shell Bluff group of Conrad. On p. 61 they give a section of beds exposed at Shell Bluff, where both Barnwell and McBean fms. are present, and where thickness of *Ostrea georgiana* zone is given as 30 ft. and thickness of overlying red argill. sands composing rest of Barnwell fm. at that locality is given as 35 ft. These are present approved definitions of Barnwell and McBean fms.

Named for a bluff on Savannah River in Burke Co., Ga., where *Ostrea georgiana* occurs in profusion. This bluff is several mi. NE. of village of Shell Bluff, Burke Co.

Shell Rock limestone.

Upper Devonian: Central northern Iowa.

A. O. Thomas, 1924 (Iowa Geol. Surv. vol. 29, pp. 411–412). In parts of Butler, Floyd, NE. Cerro Gordo, and counties to N. there come in recognizable fms. which are higher and faunally separable from the Cedar Valley. They are not thick, probably not exceeding 100 ft. in vertical extent. The general group of these is called *Shell Rock ls.*, from their typical development along Shell Rock River btw. Rockford and Nora Springs and on northward, also about Mason City and to N. and NW. The upper memb. of this group is Nora ls., whose sharp contact with basal blue sh. of Lime Creek stage may be seen on Lime Creek just W. of Rockford. Below the Nora at this point, and separated by a slight erosional uncon., is a dolomitic ls., the Mason City dol. of Calvin. It is suggested that eventually the Shell Rock may be made a stage with the Nora, Mason City, and possibly other horizons as substages.

C. L. Fenton and C. L. Webster, 1924 (Univ. Mich. Pub., Contr. Mus. Geol., vol. 1, map, frontispiece), restricted *Shell Rock* to beds below Nora ls. and above their Lower Cedar Valley, and divided it into (descending) *Pachyphyllum* zone, *Aulopora* sh., Bloody Run zone, Lithographic beds, and Mud-crack zone.

C. H. Belanski, 1927 (Am. Mid. Nat., vol. 10, No. 10), included Nora ls. in his *Shell Rock stage*, but redefined Nora so as to include in it some beds (First *Actinostroma* zone) previously included in Mason City substage. He divided his *Shell Rock stage* into (descending): (1) Nora substage (including Second *Actinostroma* zone, *Platyrachella* zone, First *Actinostroma* zone); (2) Rock Grove substage (*Schizophoria* zone and *Paracyclas* zone); (3) Mason City substage (*Lepidocentrus* zone, *Trigonotreta* zone, and *Aulopora* zone), and defined it as resting uncon. on Cedar Valley ls. [restricted usage of name].

L. R. Laudon, 1931 (Iowa Geol. Surv., vol. 35, p. 344). In north-central Iowa the *Shell Rock fm.* uncon. overlies Cedar Valley ls. and in N. part of north-central province it is uncon. overlain by Juniper Hill sh. In S. part of north-central province it is undoubtedly directly overlain by Sheffield fm. Consists of hard gray fossiliferous ls. and dol.

The Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, adopted Belanski's 1927 definitions of *Shellrock fm.* and Cedar Valley ls., in that they divided their Shellrock fm. into Nora, Rock Grove, and Mason City members, and showed it as uncon. on Cedar Valley ls. restricted. On p. 256 M. A. Stainbrook gives thickness of *Shellrock fm.* as 16 to 65 ft.

Named for development along Shell Rock River, as stated in original definition above.

Shelton granite gneiss.

Pre-Cambrian: Central southern Virginia and northern North Carolina.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). *Shelton granite gneiss.*—Pink muscovite granite gneiss. Mapped from S. of Danville northeastward nearly to Wren, Charlotte Co.

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 18–23, map). *Shelton granite gneiss facies of Columbia granite.*—Mylonitized granite which occurs in 2 zones [described] in central Va. and extends into N. C., where it is quarried near Shelton, for which it is named. Intrudes Wissahickon fm. Is pre-Camb.

Shelton sand.

A subsurface sand, of Penn. age. in Stephens Co., southern Okla., lying at 1,900 ft. depth in Empire pool, the Cantrell sand lying at 1,800 ft., and the Smith at 2,000 ft.

Shelton Cliff sandstone.

Pennsylvanian: Southwestern Indiana.

W. N. Logan, 1924 (Ind. Dept. Cons. Pub. 42, p. 16). [Mentions "two rather massive sss., the Merom or Inglefield ss. and the *Shelton Cliff ss.*," in description of "Post-Allegheny group" of SW. Ind.]

Shenandoah limestone.

Lower Cambrian to Middle Ordovician: Western Virginia and eastern West Virginia.

H. R. Geiger and A. Keith, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 157–163, pl. 4). *Shenandoah ls.*—Lss. [character and thickness not described] underlying Martinsburg sh. in Blue Ridge Mtns near Harpers Ferry, W. Va. Contains Chazy-Calciferous fossils. Shenandoah River, W. Va., is characterized by this ls.

N. H. Darton, 1892 (Am. Geol., vol. 10, p. 13). In Staunton, Va., region the *Shenandoah ls.* consists of great mass of impure mag. lss. below, grading upward through a series of cherty beds of no great thickness into several hundred ft. of light-colored, heavily bedded purer lss. Lower beds not fossiliferous; in cherty beds a few middle Ord. gastropods were found. Underlies Martinsburg sh.

A. Keith, 1894 (U. S. G. S. Harpers Ferry folio, No. 10, p. 3). *Shenandoah ls.*—In general a series of blue and gray lss. and dolomites, with occasional beds of mottled blue ls. Prevailing calc. character locally modified by series of slates and sandy shales interbedded with the ls., about 1,000 ft. below its top; these beds best exposed along Antietam Creek, where they become less calc. and assume reddish-purple color. Also contains bed of white marble, probably below the slaty ls. series. Lower Sil. fossils in upper part, Lower Camb. fossils in lower part. Forms the Great Shenandoah Valley and reaches from N. Y. to Ala. Underlies Martinsburg sh. and overlies Antietam ss.

The Shenandoah ls. of early repts is now subdivided, in most areas, into several fms. (see Pa., Va., and W. Va. charts), and where subdivided it has in some repts been called *Shenandoah group.* The fms. into which it has been differentiated in Pa. reach a max. thickness of 6,800 ft., in W. Va. more than 10,000 ft., and in Va. more than 12,000 ft.

Shenandoah Mountain granite.

Pre-Cambrian: Southeastern New York (Poughkeepsie quadrangle).

C. E. Gordon, 1911 (N. Y. State Mus. Bull. 148, pp. 11, 17–18). *Shenandoah Mtn granite* [in heading], *Shenandoah granite* [in table]. Coarse white granite, made up almost entirely of quartz and feldspar. Occurs on Shenandoah Mtn, at summit of steep NW. slope, along road from East Hook to Hortontown. Assigned to pre-Cambric. "Has earmarks of a plutonic rock and bears little evidence of gneissoid structure, so that if it is of Precambric age it must be thought of as having escaped any pronounced foliation."

Shenandoan.

A name proposed by A. W. Grabau (see Pan-Am. Geol., vol. 66, No. 1, 1936, p. 27) for the "retreatal Lower Ord. series, commonly called Canadian, or even Beekmantown, even though it lacks the distinctive Beekmantown fauna, except in so far as this has transgressed the barrier of the Albany axis, during the period of maximum expansion."

†Shenango series.

Pennsylvanian and Mississippian: Western Pennsylvania.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 1–9). *Shenango series* [in table], *Shenango River series* [in text].—Underlies cgl. No. XII (Seral) and overlies Catskill series. Includes Sharon coals and Tionesta coals, or "all coal measures underlying the cgl., and at base red sh." [The term "Seral cgl." as used in this rept applied to Homewood ss., top memb. of Pottsville fm., and the names *Shenango* and *Shenango River* covered the rest of Pottsville fm. and underlying Mauch Chunk and Pocono fms.]

Named for Shenango River, Mercer Co.

Shenango sandstone.

Mississippian: Northwestern Pennsylvania (Mercer County).

J. P. Lesley and I. C. White, 1879 (2d Pa. Geol. Surv. geol. map of Mercer Co.). *Shenango ss. (No. X?).*

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_3, p. 25). *Shenango ss.* is underlain by brown and olive Chemung shales.

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3, pp. 59–61). *Shenango ss.*—Massive ss., coarse, brownish white, charged with nodular iron ore and fish remains. Thickness in Mercer Co. 15 ft. Underlies Shenango shales and overlies Crawford shales. Has been quarried at many places along Shenango River [in Mercer Co.]. [In Rept. Q_4, 1881, White gives thickness of 15 to 35 ft. in Erie and Crawford Counties, Pa.]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61), divided his *Shenango stage* (*Shenango monothem*) into Hempfield sh. memb. (new name to replace Shenango sh. of White) and Shenango ss. memb.

The U. S. Geol. Survey at present treats this ss. as a part of Burgoon ss., top fm. of Pocono group in NW. Pa.

Shenango shale.

Mississippian: Northwestern Pennsylvania (Mercer County).

I. C. White, 1880 (2d Pa. Geol. Surv. Rept. Q_3, pp. 59–60; name proposed by J. P. Lesley, footnote on p. 59). *Shenango shales.*—Interstratified sandy shales and flaggy sss., 36 to 50 ft. thick. Underlie Sharon cgl. and overlie Shenango ss. in Mercer Co. [Named for exposures on Shenango River, Mercer Co.]

Is part of Burgoon ss., top fm. of Pocono group of U. S. Geol. Survey classification. K. E. Caster (1934) renamed it *Hempfield sh. memb.*

†Shenango group.

Mississippian: Northwestern Pennsylvania and northeastern Ohio.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 66, 77–81). *Shenango group.*—In Erie and Crawford Counties, Pa., divided into Shenango sh. (above) and Shenango ss. (below).

Replaced by *Burgoon ss.*, top fm. of Pocono group of NW. Pa. K. E. Caster has renamed "Shenango sh.," *Hempfield sh. memb.*, and has proposed *Shenango stage* (*Shenango monothem*) to include the sh. and ss. of White. (See Bulls. Am. Pal., vol. 21, No. 71, 1934, pp. 138–139.)

Shenango stage.

See under †*Shenango group.*

Shenango monothem.

See under †*Shenango group.*

†Shenango River series.

See 1875 entry under *Shenango series.*

Shepard formation.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park) and southern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 324). *Sheppard qtzite.*—Yellow ferruginous qtzite, 700± ft. thick. Rests on extrusive diabase flow, which overlies Siyeh ls. Is older than Kintla argillite. Forms crest of Lewis Range in vicinity of Mount Cleveland and Sheppard Glacier, Mont., btw. Belly River and central Flattop Mtn.

The U. S. Geog. Bd. has approved *Shepard* (instead of *Sheppard*).

Shepherdstown gravel.

Probably Pliocene: Southern Pennsylvania (along the Susquehanna) and northern West Virginia.

M. R. Campbell, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 3, pp. 558–573). Along the Susquehanna 2 distinct berms, seemingly representing the same cycles of erosion as those along the Potomac, were identified, and, as a matter of convenience, in this general region they will be called by the same names as the gravels which rest upon them. Thus, the uppermost berm is called *Bryn Mawr*, because that name has long been applied to gravel that rests upon it at town of Bryn Mawr, a few mi. NW. of Phila.; and the term *Shepherdstown* is here proposed for the gravel-covered berm that in this region lies normally 100 ft. below the Bryn Mawr and is well developed at Shepherdstown, W. Va., in Shenandoah Valley. The Bryn Mawr gravel is well developed on both sides of Susquehanna River mouth at elev. of 400 ft. The *Shepherdstown gravel* lies normally about 100 ft. below the Bryn Mawr. [Describes distribution.] The nearly continuous tracing of the Shepherdstown gravel seems to show beyond question that after deposition of Bryn Mawr gravel and before Shepherdstown gravel was laid down, an anticlinal uplift, the axis of which trends nearly at right angles to the river, elevated Bryn Mawr berm at Safe Harbor to 250 ft. above its former position, but there is no trace of such uplift in vicinity of Harrisburg, where these 2 gravel-bearing berms are separated by interval of only 100 ft. For a long time writer has had opinion the Shepherdstown gravel was deposited near close of Plio. and Bryn Mawr berm was probably formed in early Plio.

Sheppard quartzite.

See *Shepard fm.*, the geographic spelling adopted by U. S. Geog. Bd.

Sheppard granite.

Tertiary: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 8, 117°30' to 118°). *Sheppard granite.*—Biotite granite, stocks and dikes, of Tert. age, B. C. and Wash.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 315, 355). *Sheppard granite* forms small stock at head of Sheppard Creek, B. C. Cuts Rossland volcanic group, Pend D'Oreille schists, Trail cgl., and cgl. of Lake Mtn.

Sherbrooke limestone.

Upper Cambrian: British Columbia.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, p. 2). *Sherbrooke fm.*—Bluish-gray aren. dolomitic massive and thin-bedded to shaly lss., with a few oolitic layers and cherty inclusions. Thickness at Mount Bosworth, 1,360 ft. Top fm. of Upper Camb. Overlies Paget fm. Contains Upper Camb. fossils, passing at summit into Ord. Type loc. W. slopes of Mount Bosworth, overlooking Sherbrooke Lake, 5 mi. N. of Hector, on Canadian Pacific Ry, B. C.

†Sherbrookian series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). In descending order: Lss., 365 ft.; oolites, 200 ft.; and shales 350 ft. Underlies Chancellorian series and overlies Sawbackian series. Of Late Cambric age. [Apparently same as Sherbrooke fm.]

Sherburne flagstone member (of Portage formation).

Upper Devonian: Eastern New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 381). *Sherburne flagstone.*—Fine-quality flagstones, of various grades of thickness, alternating with greenish or olive-colored sh. Overlain by Ithaca group and underlain by black sh. [Geneseo] that rests on Tully ls. Named for occurrence near Sherburne, Chenango Co.

L. Vanuxem, 1842 (Geol. N. Y., pt. 3, pp. 171–174). Hall's name *Sherburne flags* changed to *Portage or Nunda group* [one of the several discarded uses of *Portage* and *Nunda*]. Underlies Ithaca sh. and overlies Genesee sl.

C. S. Prosser, 1893 (Am. Jour. Sci., 3d, vol. 46, pp. 212–230). *Sherburne flagstones* of Vanuxem are a mass of sss. in Chenango Valley above horizon of Tully ls., which are mostly nonfossiliferous and are synchronous with lower part of Portage as exposed farther W. They are not same as "Sherburne group" of Conrad.

J. M. Clarke and C. S. Prosser, 1897 (N. Y. State Geol. 15th Ann. Rept.), adopted *Sherburne sss.* (or *Sherburne flagstone*) for lower Portage beds btw. Ithaca group and Genesee sl., which Prosser stated are 250 ft. thick in Chenango Valley.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19), classified *Sherburne flagstone* as younger than Middlesex sh. and as = Cashaqua sh.

H. S. Williams, 1913 (U. S. G. S. P. P. 79). *Sherburne flagstone memb.*, basal memb. of Portage fm., is overlain by Ithaca sh. memb. of Portage and underlain by Genesee sh. Is characterized by *Reticularia laevis* zone at top. [According to Williams (1907) his Sherburne flagstone memb. is same as Sherburne flagstone of Vanuxem.]

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, No. 1, p. 69), correlated Sherburne with Cashaqua sh. [of Portage group].

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 121–122). Upper limit of Hamilton in central N. Y. is zone of *Hypothyridina venustula* (Hall), which is generally accepted as base of Upper Dev. This zone is at base of Tully ls., a thin wedge extending from E. side of Canandaigua Lake at least as far E. as village of Sherburne, on E. side of Chenango Valley. This ls. uncon. overlies the Hamilton. East of Sherburne the characteristic ls. has been replaced by *Sherburne ss.*, but the *Hypothyridina* zone still persists at base of the ss., marking top of the Hamilton as far E. as village of Mount Vision, in Otego Valley. It is evident lower part of the Sherburne at its type loc. and probably for considerable distance eastward is actually a clastic phase of the Tully.

W. Goldring, 1931 (N. Y. State Hdb. 10, p. 369), correlated Sherburne with Cashaqua, which overlies Middlesex sh. and is a part of Portage group. She included Sherburne in Portage group and showed it as overlying Genesee black sh., which name she restricted to basal memb. or Geneseo sh. of Chadwick.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, p. 351), placed Sherburne above the Tully.

G. A. Cooper, 1933 (Am. Jour. Sci., 5th, vol. 26, p. 544), placed Sherburne of Chenango Valley above Genesee. In 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 5–7) Cooper explained further regarding *Hypothyridina* zone; stated that "so far as known the whole Sherburne, including the part of it assignable to the Tully, is quite unfossiliferous;" and described lithology of *Sherburne fm.* in different areas.

G. H. Chadwick, Feb. 28, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2), correlated *Sherburne* with the Genesee, and stated (p. 310) that *Sherburne ss.* at type loc. embraces the sandy facies of the Geneseo [basal memb. of Genesee] and even the Tully.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862), correlated *Sherburne flagstone fm.* with upper and major part of the Genesee (i. e., with Standish, West River, and Genundewa), and stated that at Sherburne itself even the basal (Geneseo) memb. of the Genesee and the underlying Tully ls. "have changed into essentially a part of type Sherburne."

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 10, 56–62), removed *Spirifer (Reticularia) laevis* zone from top of Sherburne memb. and named it *Cornell memb.*

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 785, 803, 805, 807, 818, 825–830). The whole sequence of Tully, Geneseo, and *Sherburne* E. of Chenango Valley passes laterally into rocks carrying Ithaca fossils and formerly designated "Ithaca" but found to be mostly of pre-Ithaca age. [On p. 805 is section 3 mi. S. of Sherburne, showing Otselic memb. of Ithaca fm. resting on 180 ft. of *Sherburne fm.*, which rests on Geneseo fm.] Prosser measured the *Sherburne* at type section as 250 ft. thick, but from this 65 ft. (representing Tully and Geneseo) must be deducted. It is 230± ft. thick in Norwich and Morrisville quads (N. of Sherburne) and 210± ft. thick in Cazenovia and Tully quads. To E. it becomes more difficult to recognize. In Unadilla Valley it is impossible to separate Geneseo and Sherburne. Due to rapid infiltration of Ithaca species in the Sherburne E. of Chenango Valley, it is practically impossible to recognize the fm. and separate it from overlying Otselic memb. Therefore it is best to abandon *Sherburne*, also *Ithaca* E. of Unadilla Valley, and use in their place *Unadilla fm.*, proposed by Prosser. *Sherburne* will be useful for the unfossiliferous fine-grained sss. and dark shales btw. Geneseo sh. and Otselic memb. from Chenango Valley eastward. The confusion in stratigraphy of eastern N. Y. is largely result of misidentification of middle Hamilton ss. in Schoharie Valley as Sherburne fm. In that valley the true position of *Sherburne ss.* is probably 2,000 ft. higher than Prosser identified it.

†Sherburne group.

Devonian: New York.

T. A. Conrad, 1841 (N. Y. Geol. Surv. 5th Ann. Rept., p. 31). *Sherburne group* underlies Tully ls. and overlies shales near Apulia.

C. S. Prosser, 1893 (Am. Jour. Sci., 3d, vol. 46, pp. 212–230). "Sherburne group" of Conrad is not same as *Sherburne flagstones*.

Is a part of Hamilton (Middle Dev.).

†Sherburne shale.

Devonian (Middle): Central southern New York.

W. W. Mather, 1843 (Geol. N. Y., vol. 1). Erie div. includes[* * *] Ludlowville sh., Encrinal ls., Moscow sh., Apulia and *Sherburne shales*, and Cazenovia group. [*Sherburne sh.* not defined.]

Sherburne conglomerate.

Lower Cambrian: Southwestern Vermont (Rutland County) and southeastern Vermont (Windham County).

C. H. Richardson, 1929 (16th Rept. Vt. State Geol., pp. 208–246, table opp. p. 288). *Sherburne cgl.* (Lower Camb.) was discovered by author in 1892 and named by him [published?]. Flanked on W. by Algonkian gneiss and on E. by Camb. schists. Carries pebbles and boulders up to 1 ft. diam. of pre-Camb. qtzites, granites, and gneisses. A good outcrop is about 2 mi. SE. of north Sherburne [in Rutland quad. and Rutland Co.], at head of the narrow valley leading down to Sherburne. Is a basal cgl. Uncon. overlies Algonkian terranes.

Sheridan quartzite.

Pre-Cambrian: Yellowstone National Park.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Nat. Park folio, No. 30). *Sheridan qtzite.*—Chiefly dense bluish-white qtzite. Found at only 3 places in the park. Best exposed on slopes of Mount Sheridan. Oldest fm. in the park. Assigned to Algonkian.

†Sheridan beds.

Pleistocene: Panhandle of Texas to South Dakota.

W. B. Scott, 1897 (Intr. to geol., pp. 532–533). Over the Great Plains, from S. Dak. to Tex., the surface fm. is a fine calc. sandy clay, which lies uncon. on eroded surfaces of older strata, from the Blanco to Cret. This fm. may be called *Sheridan stage* (*Equus beds*), from Sheridan Co., Nebr., where it is admirably shown, and is Pleist. in age, probably corresponding to one of Glacial stages, though by some it is regarded as Plio.

Geographic name is preoccupied, and U. S. Geol. Survey uses as a general designation the paleontologic term *Equus* zone.

A. L. Lugn, 1934 (Nebr. State Mus. vol. 1, Bull. 41, p. 355). There is some doubt that any of "Sheridan beds" is as old as Aftonian or Nebraskan.

Sheridan sandstone.

Silurian: Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 45, 47–49, 51). *Sheridan ss.* is a peculiar rock, looking like an ordinary ss. of various degrees of fineness and in its coarsest state a pebbly cgl. Color greenish gray to rather dull brown. When closely inspected it is found to be composed of soft and hard rocks, both rounded and angular—quartz and feldspar; jasper, sl., and argill. sh., green, red, and black; and fragments of fossils, corals, and crinoids, but particularly pieces of brachiopods of size large enough to recognize. Most conspicuous feature is the angular pieces of black sl., which at first suggest fragments of carbonaceous matter but are evidently fragments of the more ancient slates. Igneous materials also are associated with them, emphasizing their close association in origin with the tuffs and volcanic ash beds with which they are stratigraphically associated. Believed to be of about same age as Ashland shales and older than Ashland lss. Fauna presents affinities with both Clinton and Niagara of New York. Is regarded as younger than Aroostook ls. Named for exposures on Sheridan Plantation, S. of Aroostook River, Aroostook Co.

Sheridan formation.

Middle Ordovician: Northwestern Michigan (Iron River district).

R. C. Allen, 1910 (Mich. Geol. and Biol. Surv. Pub. 3, geol. ser. 2, p. 113). *Sheridan fm.*—Consists of (in what is believed to be descending order) coarse quartz ss., buff or red color, generally friable, 35 or 40 ft.; cgl. of unknown but not great thickness, composed of angular fragments of chert up to a couple of inches in diam. in matrix of same composition but finer-grained, and forming basal memb. of fm. on Sheridan Hill, Iron River dist.; nonmag. ls., of dove or buff color, flaggy, containing fossils correlated by Ulrich with Lowville of N. Y. Uncon. overlies Michigamme sl.

Sherman diorite.

Miocene: Yellowstone National Park, Wyoming.

A. Hague et al., 1904 (U. S. G. S. Mon. 32, Atlas, Canyon sheet). *Sherman diorite.*—Light-colored crystalline intrusive rock, exposed on Sulphur Creek in vicinity of Hot Springs, Canyon quad.

Derivation of name not stated and not apparent from map.

Sherman granite.

Pre-Cambrian: Southeastern Wyoming (Albany County) and northern Colorado.

E. Blackwelder, 1908 (Sci., n. s., vol. 27, pp. 778–788). *Sherman granite.*—Coarse red granite, essentially unaltered, except that it is deeply weathered. Probably Algonkian.

E. Blackwelder, 1910 (U. S. G. S. Laramie-Sherman folio, No. 173, p. 3). *Sherman granite.*—Coarse-grained massive granite, composed chiefly of pink feldspars, glassy quartz, and black hornblende mica, a spotted pink aspect being the result. Is pre-Camb. [Mapped over large area at and around Sherman.]

On 1935 geol. map of Colo. this granite was included in the newly established Front Range granite group.

Sherman marble.

Lower Cambrian (?): Southeastern Vermont (Windham County).

G. D. Hubbard, 1924 (14th Rept. Vt. State Geol., pp. 269–276 and map). *Sherman marble.*—[Describes several occurrences of marble in Readsboro and Whitingham Twps, and says:] Since in all these occurrences the marble dips outward from an axis beneath other layers, since all the marble in the area is quite similar, and since the rock succession above the marble is always the same, it seems reasonable to infer that the marble is continuous beneath other rocks from one area to another. And if it underlies thus a considerable portion of the southern part of our area, we also infer that it underlies the whole area. The marble is usually gray to white, coarse crystalline, granular, and does not hold together very well, but at Sherman some of it is very firm and would handle well. The friableness in other localities may be due to weathering. Other colors than gray and white are known. Pink tints occur in the old pit across the river from Sherman. Yellow bands occur at Sherman. Pink marble in beautiful tints is found in the extreme southwestern outcrops of the Whitingham area. The marble is usually medium-grained, but near the top some coarse beds appear, and where the graphite is coarse the calcite crystals are generally large too. The marble is rarely pure calcium carbonate, even for single layers and for short distances. Nearly every sample gives a feeble iron reaction. Dolomite is common. The fm. could well be called dolomitic, but in some places accessory minerals make up a very considerable part of the rock. At Sherman graphite is common, particularly in the lower layers exposed. It becomes obvious from the discussion of the last few pages that the marble varies visibly from place to place. Yet these are all within a narrow range and do not seem to indicate more than one formation. The thickest exposures are at Sherman, where fully 200 ft. can be seen, but we believe there is at least 600 ft. of the marbles. Is oldest rock in area studied. Is overlain by Whitingham schist. Is essentially=Bellowspipe ls. of Mass., which is assigned to Ord. by Emerson.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol, table opp. p. 288), assigned this fm. to Lower Camb., but without discussion, and correlated it with Plymouth marble.

Named for town of Sherman, on Hoosac Tunnel & Wilmington Railroad, Whitingham Twp, Windham Co., where it is most extensively exposed and worked.

Sherman Fall formation. (In Trenton group.)

Middle Ordovician: Central New York.

G. M. Kay, 1929 (Jour. Geol., vol. 37, No. 7, pp. 664–671; name suggested by J. J. Galloway). *Sherman Fall fm.*—Here defined as the "Prasopora beds" or Trenton restricted of Raymond, Johnston, and others. Includes about 105 ft. of thin-bedded lss. with shaly partings, extending to seam in cliff of upper High Fall about 20 ft. from top of fall. Comprises zones F to K of Raymond (Bull. Am. Pal.

No. 17, 1903) and zone A_3 and most of overlying zone A_4 of Prosser and Cumings. Named for Sherman Fall, in Trenton Falls gorge of West Canada Creek, Oneida Co., N. Y. Its base, a bed in which *Prasopora simulatrix orientalis* is abundant, lies immediately above a stratum of massive dark-blue ls. about 3 ft. thick that is conspicuous in side of gorge along path above Sherman Fall, the bed A_4 of Prosser and Cumings (N. Y. State Geol. 15th Ann. Rept., p. 615, 1897). Is younger than Hull fm. and older than Lower Cobourg.

See also G. M. Kay, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 225–244).

Sheroli formation.

Miocene: Costa Rica.

A. H. Redfield, 1923 (Econ. Geol., vol. 18, p. 364) and 1924 (Revista econ. San Salvador, año 11, No. 4, p. 176).

Sherwin glacial stage.

Pleistocene: Sierra Nevada, California.

E. Blackwelder, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 91–92) and 1931 (G. S. A. Bull., vol. 42, pp. 865–922). *Sherwin stage.*—Glacial till on E. slope of Sierra Nevada of a stage younger than McGee stage and older than Tahoe stage. Correlated with Kansan stage. Best developed in area N. of Sherwin Hill, NW. of Bishop, in Mount Morrison quad.

†Sherwood limestone.

Lower Cambrian: Central western Virginia.

H. D. Campbell, 1905 (Am. Jour. Sci., 4th, vol. 20, pp. 445–447). *Sherwood ls.*—Upper part consists of heavy beds of light-blue and gray mag. ls. with occasional beds of sh. and shaly ls. Basal several hundred ft. consist of white crystalline dol. Thickness of fm. 1,600 to 1,800 ft. Underlies Buena Vista sh. and rests on qtzites and shales. Named for exposures in James River at Sherwood, Va.

Same as Shady dol.

Shetlerville formation.

Mississippian: Southeastern Illinois and adjacent parts of Kentucky.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41). *Shetlerville fm.*—Lss. interbedded with more or less calc. shales, but the ls. and sh. succession is not uniform from place to place, and the ls. layers also grade into shales horizontally, so that in places ls. may constitute nearly entire fm., while elsewhere shales may compose the greater part. The lss. are commonly crystalline, dark gray or blue, and usually more or less cross-bedded. The unweathered shales are chiefly blue, although thin layers of red sh. occur in places. The lss. weather yellowish or buff; the shales weather yellowish, buff, or ashy gray. Thickness of fm. 30± ft. Lithologically in strong contrast to underlying Ste. Genevieve ls., being much more shaly, much more irregularly bedded, and much less uniform in character. Is entirely foreign to any part of true Ste. Genevieve ls. as typically developed in Ste. Genevieve Co., Mo., although it has been included in the Ste. Genevieve, being a part of Ulrich's Ohara ls. memb. The Ohara memb. is a complex, of which Shetlerville fm. constitutes lower part of upper div., while the lower div. of the Ohara properly belongs to the Ste. Genevieve. The Shetlerville fm. rests uncon. on "Lower Ohara," and is uncon. overlain by Renault ls., which was also included in Ulrich's Ohara ls. The Shetlerville is faunally more closely related to overlying Renault than to underlying Ste. Genevieve ls.

S. Weller, 1921 (Ky. Geol. Surv., ser. 6, vol. 4, pp. 27, 30). *Shetlerville* better be considered as memb. of Renault, rather than as an entirely distinct fm., and it is so considered in this rept. Rests uncon. on underlying Ste. Genevieve ls.

E. O. Ulrich and C. Butts contend that all of Ohara ls. memb. is present at Ste. Genevieve, and that so-called "Upper Ohara" and Shetlerville of Weller belong to Ste. Genevieve ls., as well as so-called "Lower Ohara" and underlying beds. (See also under *Ste. Genevieve ls.*)

Named for Shetlerville, Hardin Co., Ill. Well exposed just E. of that town, btw. Rich and Melcher Hills.

Shickshock formation.

Ordovician (?): Quebec (Matapedia Valley).

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 368–385). *Shickshock fm.*—Interbedded volcanic rocks and arkosic qtzite. Forms summit of Shickshock Mtns from Lake Matapedia to Table Top Mtns. Type is section at Lake Matapedia. Overlies Quebec group. Is overlapped by Val Brillant fm. (Sil.). No fossils.

Shiloh marl member (of Kirkwood formation).

Miocene (upper): Southern New Jersey.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, pp. 40–44). *Shiloh marls.*—At Shiloh [Cumberland Co.] consist of (descending): Unfossiliferous "yellow marl," 2 ft.; uncon. on unfossiliferous "black marl," 2 to 3 ft.; uncon. on fossiliferous "shell marl," 8 to 10 ft. Assigned to Mio. Overlies barren black sand and underlies Quat.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 141). *Shiloh marl.*—Gray, highly fossiliferous marl containing undoubted Mio. fossils. Occurs in limited area in Salem and Cumberland Counties. Rests on Alloway clay and underlies Cohansey sand.

W. B. Clark, H. B. Kümmel, and B. L. Miller, 1909 (U. S. G. S. Trenton folio, No. 167). *Shiloh marl memb. of Kirkwood fm.*—Brown clay and fine clayey gray sand containing great numbers of shells. Thickness 30 ft. Forms top memb. of Kirkwood fm. Underlies Cohansey sand, probably uncon. Overlies 80 to 90 ft. of clay (of chocolate to drab and locally black color) exposed to SW., about Woodstown and Alloway.

Shimer gypsum member (of Blaine gypsum).

Permian: Central southern Kansas and western Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 27, 28, 31). *Shimer gyp.*—Upper gyp. memb., 0 to 10 ft. thick, of Cave Creek fm. Separated from underlying Medicine Lodge gyp. by 7 to 10 ft. of clay sh. called *Jenkins clay*. Underlies Dog Creek shales.

C. N. Gould, 1902 (Okla Geol. Surv. 2d Bien. Rept., p. 49). *Shimer gyp. memb. of Blaine div.*—Top memb. of Blaine div. Thickness 15 to 18 ft. Overlies Altona dol. memb. of Blaine and underlies Dog Creek shales.

C. N. Gould later abandoned Altona dol. memb., and defined Shimer as separated from underlying Medicine Lodge gyp. by red shales (see 1906 and 1927 entries under *Altona dol. memb.*), but he did not explain to what bed his Altona dol. corresponded.

The correlation of the beds in Okla. that have been called Shimer gyp. with typical Shimer gyp. of Kans. has in recent years been seriously questioned. Some geologists believe that Shimer of Kans. is the Medicine Lodge of some areas in Okla., and that typical Medicine Lodge of Kans. is so-called Ferguson gyp. of Okla. (See 1931 entry under *Medicine Lodge gyp.*)

Named for Shimer Twp, Barber Co., Kans.

Shinarump conglomerate.

Triassic (Upper ?): Southwestern, southern, and southeastern Utah, northern Arizona, northwestern New Mexico, and southeastern Nevada.

G. K. Gilbert, 1875 (U. S. Geol. and Geog. Surv. W. 100th M., vol. 3, pp. 1–187). *Shinarump cgl.*—Underlies Upper Trias marls [Chinle fm.] and overlies Lower Trias marls [Moenkopi fm.] in western Utah and northern Ariz.

E. E. Howell, 1875 (U. S. Geol. and Geog. Surv. Terr. W. 100th M., vol. 3, pp 247–248, 270–273, 284). *Shinarump cgl.*—Yellow cgl. with silicified wood very abundant. Thickness 100 ft. in Pine Mtn, southern Utah; 50 ft. btw. Paria Settlement and Last Bluff, southern Utah. Overlain by variegated gypsiferous marl series of the Trias and underlain by chocolate and light-colored Trias shales. Occurs also in Virgen Range, Nev., near Toquerville, Utah, and from Pine Valley Mtns to Le Verken Creek, Utah.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns). *Shinarump cgl.*—A fine cgl. not easily recognized, toward N. about 20 ft. [thick]; to S. increases to 200 ft. Caps Shinarump Cliffs. Overlain and underlain by badland sss., with much gyp.; often argill., sometimes indurated sss.

The fm. overlying Shinarump cgl. is now known as *Chinle fm.*, and the fm. underlying it as *Moenkopi fm.* The cgl. is of Triassic age, but whether Upper or Middle Triassic is a debated question.

Type loc., Shinarump Cliffs, S. of Vermilion Cliffs, southern part of Kane Co., Utah.

†Shinarump group.

Triassic (Upper, Middle (?), and Lower): Utah, Arizona, northwestern New Mexico.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 53, 54, 68, 150, 152). *Shinarump group.*—Consists of: (1) *Upper Shinarump* (badland sss. with much gyp.; often argill.; sometimes indurated sss.); (2) *Shinarump cgl.* (a fine cgl. not easily recognized, about 20 ft. thick to N. and 200 ft. to S.; caps Shinarump Cliffs); (3) *Lower Shinarump* (badland sss. with much gyp.; sometimes argill.; in a few places indurated sss.; sometimes uncon. below, with a cgl. at base composed of rounded and angular fragments of Carbf. rocks). In Uinta Mtns the variegated beds both above and below Shinarump cgl. are seen in many places on either flank of the mtns. Thickness 1,800 ft. Underlies Vermilion Cliff group and uncon. overlies Upper Aubrey group (Carbf.). Named for Shinarump Cliffs [S. of Vermilion Cliffs, Kane Co., southern Utah].

The use of a name in two senses (for a group and for a fm. within that group) being contrary to practice of U. S. Geol. Survey, the Upper Shinarump of Powell in *southern* Utah and adjacent areas was renamed *Chinle fm.*, and his Lower Shinarump was renamed *Moenkopi fm.*, the name *Shinarump* being retained for the *cgl.*, which is of rather wide distribution. Powell's Shinarump group in *NE.* Utah appears to correspond to Woodside sh. and Thaynes ls. of SW. Wyo. But according to some geologists (A. R. Schultz, U. S. G. S. Bull. 702, 1920, and G. R. Mansfield, U. S. G. S. P. P. 152, 1927) the White Cliff group and Vermilion Cliff group of Powell in *NE.* Utah are the same beds, and the Ankareh sh. is included in upper part of †Shinarump group.

Shinarump clay.

Name applied by A. C. Lawson (Econ. Geol., vol. 8, 1913, p. 435) to the beds in southern Utah now known as *Chinle fm.* He defined his Shinarump clay as overlying Shinarump cgl. and underlying Vermilion Cliff ss.

Shinarumpian series.

A term applied by C. R. Keyes to Triassic deposits stated by him to be older than his Doloresian series and younger than his Documan series.

Shinersville conglomerate. (In Pottsville formation.)

Pennsylvanian: Northeastern Pennsylvania (Sullivan County).

F. Platt, 1880 (2d Pa. Geol. Surv. Rept. G_2, pp. 186–199). *Shinersville cgl.*—Very massive ss., mostly gray, occasionally bluish and spotted, and with numerous layers of regularly stratified white quartz pebbles. Thickness about 50 ft. Near Shinersville school house 30 to 40 ft. is exposed. Basal div. of Pottsville cgl. Rests on Mauch Chunk red sh.

Shinumo quartzite. (Of Unkar group.)

Pre-Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Shinumo qtzite.*—Hard, compact cross-bedded ss. and qtzite, usually of fine and even grain. Thickness 1,564 ft. Conformably underlies Dox ss. and conformably overlies Hakatai sh., all of which belong to Unkar group. Named for exposures in canyon of Shinumo Creek, Shinumo quad.

†Shirley stage.

Upper Jurassic: Southeastern Wyoming.

W. C. Knight, 1900 (Geol. Soc. Am. Bull., vol. 11, pp. 377–388). *Shirley stage.*—Marine beds consisting of bands of sh., ls., ss., and clay, a few ft. to 200 ft. thick. Middle Jurassic. Extends from SE. Wyo. to Black Hills and westward. Not known in southern Wyo. or northern Colo. Named for Shirley Mtns, SE. Wyo., on S. side of which it is well developed.

Same as *Sundance fm.*, which has priority.

Shiwits shale.

Permian: Northwestern Arizona (Mojave County).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 338). *Shiwits shales.*—The uppermost red sh. section of Supaian series, as exposed in canyon walls, especially around Shiwits Plateau, N. of Peach Springs, Mojave Co. Thickness 400 ft.

Shnabkaib shale member (of Moenkopi formation).

Lower Triassic: Southwestern Utah (Washington County) and northwestern Arizona.

H. Bassler and J. B. Reeside, Jr., 1921 (U. S. G. S. Bull. 726C, pp. 90, 92). *Shnabkaib sh. memb.*—Sandy sh. and soft ss., fine-grained, creamy white, with some pinkish layers and gyp. Thickness 360 to 630 ft. Lies 405 to 475 ft. below top of Moenkopi fm. and 400 to 435 ft. above Virgin ls. memb. of Moenkopi, this interval being occupied by brick-red ss. and sh. and reddish and light bluish-gray gyp. Named for striking isolated Shnabkaib Mesa, 2 mi. SE. of town of Washington, on NW. flank of Washington dome. [See also U. S. G. S. P. P. 129D, 1922.]

Shoal Creek limestone member (of McLeansboro formation).

Pennsylvanian: Central western and southwestern Illinois.

H. Engelmann, 1868 (Ill. Geol. Surv., vol. 3, pp. 148, 159–164, 175, 220). *Shoal Creek ls.*—Light-colored, grayish or bluish compact, close-textured ls., 4 to 15 ft. thick, in Coal Measures of Washington, Clinton, and Jefferson Counties, Ill. Overlain by Upper Sandstone Formation of Coal Measures (200 to 250 ft. thick) and underlain by Slaty Division of Coal Measures (15 to 50 ft. thick).

According to G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 26, pp. 17–44), and 1926 (Ill. Acad. Sci. Trans., vol. 19, p. 257), *Shoal Creek ls.* lies 100± ft. above Carlinville ls., which lies higher than coal No. 8, and coal No. 8 lies 140 ft. above coal No. 7.

H. R. Wanless, 1931 (Geol. Soc. Am. Bull., vol. 42, p. 804), placed base of Shoal Creek ls. 100± ft. above top of Carlinville ls. and 35± ft. above coal No. 9.

G. E. Ekblaw, 1933 (Ill. Acad. Sci. Trans., vol. 25, pp. 143–145). The ls. called *Shoal Creek ls.* by Wallace Lee in U. S. G. S. Mount Olive-Gillespie folio, No. 220, 1926, appears to occupy same position as LaSalle ls., and it seems *LaSalle* may well be applied to it. It lies 52± ft. above the ls. that crops out extensively along Shoal Creek in Bond and Clinton Counties, which is unquestionably the one originally named Shoal Creek. The section was traced N. and it was found Worthen's local *Carlinville ls.* is identical with Shoal Creek ls. This lower ls. was called *Carlinville ls.* in folio cited. *Carlinville* should be abandoned.

J. R. Ball, 1934 (Ill. Acad. Sci. Trans., vol. 26, p. 97). "Carlinville" ls. is same as Shoal Creek ls.

See Ill. correlation chart compiled by M. G. Wilmarth, 1936.

Named for outcrops along Shoal Creek, Clinton Co.

†Shoal Creek limestone.

Lower Cretaceous (Comanche series): Central Texas.

R. T. Hill, 1889 (Am. Geol., vol. 3, p. 289; Am. Jour. Sci., 3d, vol. 38, p. 470; Tex. Geol. Surv. Bull. 4, pp. xiv, xxii). *Shoal Creek or Vola ls.*—Impure ls., 50 or 75 ft. thick. Top fm. of Washita div. and of Comanche series in Burnet and Travis Counties. Uncon. underlies Upper Cret. and overlies *Exogyra arietina* clays (Del Rio clay).

Preoccupied. Replaced by *Buda ls.*

Named for Shoal Creek at Austin.

Shoal Creek cyclical formation.

A name applied by H. R. Wanless (Geol. Soc. Am. Bull., vol. 42, 1931, pp. 801–812) to a part of McLeansboro fm. (Penn.) of central western Ill. Includes Shoal Creek ls. Derivation of name not stated.

Shoal Lake conglomerate.

Pre-Cambrian (lower Huronian): Western Ontario (Rainy Lake district).

C. K. Leith, Robt. Bell, W. G. Miller, F. D. Adams, A. C. Lane, C. R. Van Hise, 1905 (Jour. Geol., vol. 13, p. 95). *Cgl. known as Shoal Lake cgl.* holds numerous large well-rotted fragments of underlying rocks and forms base of sedimentary series. Exposed at Shoal Lake, Ont.

†Shoal River marl member. (In Shoal River formation.)

Miocene (middle): Northwestern Florida.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept., table opp. p. 50 and pp. 91, 104–106). *Shoal River marl memb. of Alum Bluff fm.*—Very fossiliferous greenish to gray sands, clays, and marls interbedded. Recently discovered by T. W. Vaughan (unpublished notes) in west Fla. Thickness about 50 ft. Lies stratigraphically about 30 ft. above Oak Grove sand memb. Included in upper part of Alum Bluff fm.

Later studies by Julia Gardner resulted in finding Shoal River fauna in all beds btw. top of Oak Grove sand and base of Choctawhatchee marl. The name *Shoal River fm.* was therefore adopted (U. S. G. S. P. P. 142, pp. 1–3, 1926), to include not only †Shoal River marl memb. of earlier repts but underlying and overlying beds carrying the Shoal River fauna. Named for exposures on Shoal River, Walton Co.

Shoal River formation. (In Alum Bluff group.)

Miocene (middle): Northwestern Florida and probably southeastern Alabama.

Julia Gardner, 1926 (U. S. G. S. P. P. 142, pp. 1–3). *Shoal River fm.*—Marls, clays, and sands, occurring stratigraphically above Oak Grove sand and underlying Choctawhatchee marl. Characterized by a distinctive fauna. Top fm. of Alum Bluff group. Includes "Shoal River marl memb." of Matson and others and underlying and overlying sands and clays containing same fauna.

Named for exposures on Shoal River, Walton Co., Fla., especially at Shell Bluff.

Shoemaker limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 33, 35, 173). *Shoemaker ls.*, 8 to 9 ft. thick, lies 6 to 7 ft. above base of Lawrence sh. memb. and 40 to 43 ft. below top of the Lawrence in vicinity of Nehawka, Cass Co. Has been eroded from the Platte exposures. Was erroneously correlated as Oreapolis bed by Condra and Bengston in Nebr. Acad. Sci., vol. 9, No. 2, p. 10, 1915. Named for Shoemaker farm and Shoemaker Bridge, about 3 mi. NW. of Nehawka, Nebr.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., p. 11). The so-called Lawrence sh. of Bull. 1 is Ladore sh.

This name does not appear in subsequent classifications and seems to have been dropped.

shoe-string sands.

A descriptive term popularly applied to the oil and gas sands of eastern Kans. whose length greatly exceeds their width.

Shohola formation.

Upper Devonian: Northeastern Pennsylvania (Wayne and Pike Counties).

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 585–587). Underlying the Damascus red sh. in Wayne and Pike Counties, particularly in Delaware

Valley, is a succession of continental beds here named *Shohola fm.*, from Shohola, on Delaware River near mouth of Lackawaxen Creek. The fm. consists of 2 members, Paupack ss. above and Barryville memb. below. Evidently the Barryville memb. corresponds to and is a thickened continuation of the beds below Paupack ss. which so puzzled I. C. White [and which he named *Paupack shales and ss.*]. The Barryville and Paupack members are grouped together as *Shohola fm.* because they fall naturally together btw. Damascus sh. above and Delaware River flags below. The fm. is of Chemung age except for at least upper part of Paupack ss., which is probably early Canadaway. The Shohola extends W. across Pike Co. The Paupack is lost, and the Barryville either thins or becomes dominantly red and merges with lower part of Damascus red beds and is not recognized beyond central Monroe Co., along Brodhead Creek.

Sholem Alechem limestone.

Pennsylvanian: Southwestern Oklahoma (Cotton County).

W. F. Cloud, 1930 (Okla. Geol. Surv. Bull. 40MM). *Sholem Alechem ls.*, 470± ft. thick in Cotton Co., is probably=lower ls. body of Hoxbar fm. and the ls. of upper part of Deese fm. Is not exposed. Rests uncon. on Honey Creek ls. or Wilberns fm. of Tex. [Fig. 2 shows it underlying Hoxbar fm. Derivation of name not stated.]

Shongalo greensand. (In Claiborne group.)

Eocene (middle): Northwestern Mississippi (Carroll County).

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 164–165). *Ferruginous greensand of Claiborne group—Shongalo greensand.*—The highly ferruginous sand occurring in railroad cut at Vaiden Station, near Shongalo, Carroll Co., and also in cuts btw. that place and Rockport; contains a considerable percentage of greensand grains.

Is a part of Winona sand memb. of Lisbon fm. (See geol. map, pl. 2, in U. S. G. S. W. S. P. 576, 1928.)

Shoofly formation.

Mississippian: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Shoo Fly beds.*—Thickness 8,600 ft. Contain a ls. which crops out on Clear Creek, about 2 mi. SE. of Shoo Fly Bridge. Probably either Triassic or Carbf., with slight presumption in favor of latter.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Shoo Fly fm.*—Mainly clay slates above and qtzite below. The slates are light to dark gray, generally dull but sometimes silky, and in places slightly micaceous and contain occasional films of gray or black flinty material as well as thin beds of ss. and fine cgl. of quartz pebbles. Here and there are traces of beds composed exclusively of volcanic fragments, some of which are clearly vesicular. Near middle are ls. lentils, some over 50 ft. thick. The qtzites that prevail in upper part are thin-bedded, somewhat slaty, and indistinctly schistose, with micaceous partings. Thickness 6,800± ft. Everywhere separated from underlying Arlington fm. by Taylor meta-andesite. Is older than Peale fm., but relations not determined.

Named for exposures in road btw. Shoo Fly Bridge and Spanish Creek, Taylorsville region.

Short Creek oolite member (of Boone limestone).

Mississippian (Warsaw): Southwestern Missouri, southeastern Kansas, and northeastern Oklahoma.

W. S. T. Smith and C. E. Siebenthal, 1907 (U. S. G. S. Joplin folio, No. 148). *Short Creek oolite memb (of Boone fm.).*—Thin but persistent bed of oolitic ls., 1½ to 8 ft. thick. Generally a single massive homogeneous bed, but in some places divides into 2 beds which may have slightly different characteristics. Lies about 100 ft. above Grand Falls chert memb. and about 100 ft. below Carterville fm. Named for exposures along Short Creek, a stream flowing westward btw. Galena and Empire in Cherokee Co., Kans.

C. E. Siebenthal, 1908 (U. S. G. S. Bull. 340, p. 190). *Short Creek oolite memb.* of Boone fm. occurs in E. half of Wyandotte quad. wherever its horizon is exposed, but W. of Spring and Neosho Rivers it usually pinches out or loses its oolitic character.

This oolite memb. is assigned to Warsaw epoch by R. C. Moore, 1928, also 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245).

Shoshone.

See 1901 entry under †*Popo Agie beds*.

†Shoshone group.

Upper Cretaceous and Eocene: New Mexico to Montana.

W. Cross, 1909 (Wash. Acad. Sci. Proc., vol. 11, pp. 27–45). *Shoshone group*.—Included, through misapprehension, by King and others in original Laramie, but because of uncon. should be separated. Map published by Bur. Ethnology illustrating distribution of great linguistic families of North American Indians shows dist. once occupied by Shoshonean family to embrace greater part of Rocky Mtn area with a part of Great Basin. The mtns were especially the land of Utes and Shoshones, two tribes of this family. With this broad derivation it is proposed to apply *Shoshone group* to the deposits which uncon. succeed Laramie and their equivalents and which are overlain by Fort Union or Wasatch beds, when they are present. Embraces lacustrine, fluviatile, or terrestrial deposits, composed of detritus from rising land area of Rocky Mtn province, formed btw. Laramie and Fort Union epochs. Embraces beds which have been called "Post-Laramie" or "Upper Laramie;" *Denver fm.* and *Arapahoe fm.* of Denver dist.; *Middle Park* and *Animas beds* of Colo.; the *Carbon* and *Evanston beds* of Wyo.; *Livingston beds* and *Hell Creek beds* of Mont.; and the Converse Co. "Ceratops beds" of Wyo.

Shoshone Falls andesite.

Miocene? (upper Miocene?): Southern Idaho (Twin Falls and Jerome Counties).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Shoshone Falls andesite*.—Purple and black massive vitreous porphyritic andesite, overlain by a deep-red soil 1± ft. thick. Thickness of fm. 200+ ft. Forms Shoshone Falls and Pillar Falls, in Twin Falls and Jerome Counties. Exposed along Snake River from foot of Twin Falls down as far as Perrine ranch, a distance of 6 mi. Uncon. underlies Pillar Falls mud flow, which fills irregularities in its surface, and rests uncon. on Paleozoic lss.

Shoshoni limestone.

Cambrian: Western Wyoming (Wind River Mountains).

See under *Bull Lake Creek shales*.

†Shot Pouch sandstone.

Mississippian: Western Kentucky.

See under *Tar Springs ss.*, 1856 item.

Shreveport gas sand.

A subsurface sand in NW. La. that is believed to lie at horizon of Nacatoch sand.

Shriver chert. (In Oriskany group.)

Lower Devonian: Central Pennsylvania to eastern West Virginia, western Maryland, and central western Virginia.

C. K. Swartz et al., 1913 (Md. Geol. Surv. Lower Devonian vol., p. 91 and table opp. p. 30). *Shriver chert memb.*—Dark siliceous sh. with much black impure chert in nodules or layers of nodules. Thickness 0 to 100 ft. Basal memb. of Oriskany fm. Underlies Ridgeley ss. and overlies Becraft memb. of Helderberg fm. Meager fauna. Named for Shriver Ridge, at Cumberland, Md.

Shublik formation.

Upper Triassic: Northern Alaska (Canning River region).

E. D. Leffingwell, 1919 (U. S. G. S. P. P. 109, pp. 103, 115, map). *Shublik fm.*—About 1,350 ft. of dark ls., sh., and ss., overlying Sadlerochit ss. (Penn.) and underlying Kingak sh. (Lower? Jurassic); probably conformable, but contacts not seen. Type loc. is at Shublik Island, on Canning River, at SW. corner of Shublik Mtns. Fauna is Upper Triassic.

Shulaps volcanics.

Triassic(?): British Columbia.

W. S. McCann, 1922 (Canada Geol. Surv. Mem. 130, p. 26).

Shulie formation.

Carboniferous: Nova Scotia.

W. A. Bell, 1913 (12th Int. Geol. Cong. Guidebook 1, p. 342). [In Canada Geol. Surv. Summ. Rept. 1912, p. 369, 1914, Bell assigned this fm. to Penn.]

Shultz limestone member (of Talpa formation).

Permian: Central Texas (Concho County).

W. Kramer, 1934 (A. A. P. G. Bull., vol. 18, No. 12, pp. 1579, 1582). Uppermost 50 ft. of Talpa fm. in Concho Co. contains 2 persistent ledge makers. The lower of these members is a 2-foot bed of yellow ls., lying 950 ft. above Coleman Junction ls. It is here called *Shultz memb.*, from ranch house of Mrs. Winifred Shultz, which is on the ledge formed by the outcrop (in NE¼ T. & N. O. R. R. Co. survey No. 127) 8 mi. SE. of Paint Rock. The upper ls. is top bed of Talpa fm. and here called *Hartgrove memb.* Has been traced across SE. part of Runnels Co. to point 9.3 mi. N. of SE. corner of that county.

Shumla sandstone.

Upper Devonian: Western New York (Chautauqua Co.).

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 25 and chart). *Shumla ss.* in Chautauqua Co. lies well up in Chemung fm. Is younger than Laona ss.

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1027-1029). *Shumla ss.* (*Hall*).—The sss. exposed at Shumla, 2½ mi. S. of Laona, are 260 to 280 ft. above Laona ss.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 85). Quarries in this [Shumla] ss. on the Canadaway at Shumla were mentioned by Hall (1843). The fm. as yet has not been traced outside of Chautauqua Co. [The compiler has not found that Hall used the name *Shumla ss.*]

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), and 1924 (N. Y. State Mus. Bull. 251, p. 151), applied *Westfield sh.* to beds btw. Laona ss. and Shumla ss. and *Northeast sh.* to beds overlying Shumla ss. This classification is also that of W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), who included all these beds in the Chumung. Chadwick, however, has transferred all of them to his Canadaway group, q. v.

Shunganunga shale.

Pennsylvanian: Northeastern Kansas.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 29). *Shunganunga sh.*—Very fossiliferous sh., 10 in. to 10 ft. thick, varying in color from dark olive to bluish or even jet black. Included in Upper Coal Measures of Shawnee Co. Underlies Wabaunsee fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 203, 206, 255). Beede applied †*Shunganunga sh.* to the few ft. of beds btw. top of Nodaway coal and base of Church ls., but there seems no good reason for recognizing this as a separate unit. It is included, without differentiation, in Severy sh., where Bachelor Creek ls. memb. of Howard ls. is absent.

Named for Shunganunga Creek, Shawnee Co.

†Shushitna slate.

A typographical error in U. S. G. S. Bull. 191, 1902, p. 374, for the fm. spelled *Sushitna sl.* in publication cited, but now spelled *Susitna sl.*

Shuswap series.

Pre-Cambrian: British Columbia and Yukon.

G. M. Dawson, 1890 (Canada Geol. Surv., n. s., vol. 4, pp. 29B, 31B).

Shuswap granites.

Pre-Cambrian: British Columbia.

C. [R.] Keyes, 1917 (Iowa Acad. Sci. Proc., vol. 24, p. 56).

†Shutesbury serpentine.

Name applied by B. K. Emerson (U. S. G. S. Mon. 29, 1898, p. 55) to an exposure of serpentine 1 mi. S. of village of Shutesbury, Mass., and later discarded by him. Not mentioned in his U. S. G. S. Bull. 597, 1917.

Shutler formation.

Pleistocene and late Tertiary: Central northern Oregon.

E. T. Hodge, 1932 (Univ. Oreg. Pub. Suppl. to Geol. ser., vol. 1, No. 5, p. 6). Arlington lake beds occur N. of T. 2 S. and E. of Deschutes River and adjacent to Columbia River. The bdy of this fm. on E. side of Deschutes River, as shown on map, is arbitrary, since field evidence shows it is intergradational with Madras fm., and in fact beds of lacustrine origin occur btw. Deschutes River and T. 13 E. The name is not wholly distinctive of this fm. and in later publications we propose to call it *Shutler fm.*, because of its well-developed occurrence near Shutler post office, T. 2 N., R. 21 E. The fm. E. of Alkali Creek is made up of water-worn river gravels in its lower portion. These are overlain by the lake beds that occur from Alkali Creek westward to Deschutes River. The lake beds are in turn overlain by gravels that begin near Arlington and can be traced westward to The Dalles. The lake beds consist of beds of diatoms, volcanic ash, and silt. All of beds lie absolutely flat and uncon. upon Columbia River basalt. Pleist. fossils in older gravels; perhaps part of Arlington lake beds are Recent.

Siamo slate.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 554+). *Siamo sl.*—Most typical rock is a sl., but locally it passes into graywacke and often into a rock approaching qtzite. Thickness 1,250 ft. Conformably underlies Negaunee fm. and grades into underlying Ajibik qtzite. Named for exposures on Siamo Hill, just S. of W. part of Teal Lake. Assigned to Algonkian.

Siberia limestone. (In Chester group.)

Mississippian: Southern Indiana (Perry, Dubois, and Crawford Counties) and Breckinridge County, Kentucky.

C. A. Malott, 1920 (Sci., n. s., vol. 51, pp. 521–522) and 1925 (Ind. Acad. Sci. Proc. vol. 34, pp. 109–132). *Siberia ls.*—Coarse crystalline fossiliferous ls. in upper Chester. Frequently quite siliceous and is laminated or cross-bedded on weathered faces. Rarely seen in place. Usually thin, but in some sections is 10 to 20 ft. thick. Below it occurs a rather persistent yellow ls. ledge which frequently contains fossils. This yellow ledge may be considered a part of it, though it is usually separated from the main ledge by a few ft. of sh. The Siberia ls. normally is 175 ft. above Glen Dean ls., and lies from 32 to 33½ ft. above Wickcliff ss. It appears beneath Mansfield ss. in latitude of Schnellville and Wickcliff in Dubois and Crawford Counties and extends beyond Ohio River in Breckinridge Co., Ky. Named for exposures in vicinity of Siberia, Perry Co., Ind.

Sibley series.

Pre-Cambrian (Keweenawan): Western Ontario (Thunder Bay region).

T. L. Tanton, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 114, abstract). [See under *Kaministikwia group.*]

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned *Sibley clastics and ls.* of Thunder Bay region to Keweenawan.

Sicamous limestone.

Pre-Cambrian: British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 167). Included in Shuswap series.

Sicamous series.

A term employed by C. [R.] Keyes to cover rocks in Cordilleran region interpreted as having been formed during later part of Keewatin epoch. (See Iowa Acad. Sci. Proc., vol. 24, p. 56, 1917.)

Sicker series.

Jurassic: British Columbia (Vancouver Island).

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A), and C. H. Clapp, 1912 (Canada Geol. Surv. Mem. 13, p. 71). Assigned to Jurassic or Triassic.

H. C. Cooke, 1917 (Canada Geol. Surv. Mem. 96, p. 125), and R. W. Goranson, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 76).

Sickle series.

Pre-Cambrian: Manitoba.

G. W. H. Norman, 1934 (Canada Geol. Surv. Summ. Rept. 1933, pt. C, No. 2347, p. 30).

Siderian.

Pre-Cambrian: General.

See under *Pelodian*.

Siebert tuff.

Miocene (upper): Central Nevada (Tonopah region).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 51–55, maps, etc.). ***Siebert tuff*** (*lake beds*).—White stratified tuffs that form conspicuous feature of geology near Tonopah. As a rule beautifully and uniformly bedded and composed of well-assorted material. Where beds of cgl. occur the pebbles are perfectly rounded. Since these sediments do not vary in character for thicknesses of several hundred ft., it is plain that they were laid down in a large body of standing water that lasted a considerable length of time. That this body was a lake is indicated by numerous general considerations derived from study of geology of surrounding region and by presence of numerous fresh-water Infusoria in some of strata. In contrast to general regular stratification, cross-bedded strata may occasionally be found. The lake came into existence at close of most active period of Tonopah rhyolite-dacite eruptions. Because of complex faulting max. thickness cannot be given, but on E. slope of Siebert Mtn an unbroken section of 600± ft. is exposed. As neither top nor bottom was seen it is likely the maximum is much more than 600 ft. Rests, in different places, on earlier andesite, on later andesite, on Fraction dacite breccia, and on Tonopah rhyolite-dacite, which is younger than the Fraction. Thin sheets of Tonopah rhyolite-dacite in places occur within the tuff series. Is uncon. overlain by basalt.

The Siebert tuff of Spurr is in good standing in Tonopah region, where is its type loc., but *Siebert fm.* in broad sense in which it was used in subsequent repts is now replaced by Esmeralda fm.

†Siebert formation.

Miocene (upper): Southern and central Nevada and southeastern California.

S. H. Ball, 1907 (U. S. G. S. Bull. 308, pp. 27, 32–34, map). *Siebert lake beds*.—Thick masses of sediments occur in majority of ranges of the area [SW. Nev. and Inyo Co., Calif.], and on lithologic and strat. grounds are correlated with Siebert lake beds, of Mio. age, at Tonopah, Nev., described by Spurr. These tuffaceous sss. and cgls., largely composed of rhyolitic material, reach an observed maximum (in Amargosa Range) of 1,150 ft. Are uncon. underlain by rhyolite and uncon. overlain by rhyolite. In southern Klondike Hills and Silver Peak Range the Siebert lake beds are interbedded, without erosional uncon., with rhyolites and siliceous latites and dacites. [As above defined and mapped Ball's Siebert lake beds include Fraction rhyolite breccia, which is not a part of Siebert tuff of Spurr.]

The Siebert fm. of F. L. Ransome (U. S. G. S. Bull. 303, 1907, and P. P. 66, 1909) in Goldfield dist., Nev., also included Fraction rhyolite breccia and is therefore a larger unit than Siebert tuff as originally defined by Spurr. This broad use of Siebert has been abandoned by U. S. Geol. Survey, being same as Esmeralda fm., the older name. (See H. G. Ferguson, 1924, U. S. G. S. Bull. 723, pp. 42–43.)

Sierra limestone.

Mississippian: Southwestern New Mexico (Sierra County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. 19, pp. 7-21). *Sierra ls.*—Compact, massively bedded gray lss., 50 ft. thick. Contains upper Burlington and lower Keokuk fauna. Overlies Lake Valley ls. [restricted] at Lake Valley. The latter ls. consists of 150 ft. of shaly, highly fossiliferous lss. containing a lower Burlington fauna. [Derivation of name not given.]

Sierra Blanca series.

Sierra Blanca coal measures.

Upper Cretaceous (Benton): Southern central New Mexico (Sierra Blanca region).

D. R. Semmes, 1920 (Am. Jour. Sci., 4th, vol. 50, pp. 415–420). *Sierra Blanca series.*—Interbedded sss., and sh., coal seams, an occasional ls., and, near base, a massive coarse-grained buff ss. (Dakota?). Thickness 1,500 to 2,500 ft. Regarded as Upper Cret., but may possibly be post-Laramie. The upper memb. is actually of post-Laramie age. The series sometimes rests on variegated shales, thin beds of ls., sss., and cgls., which are probably Morrison fm.

Probably named for Sierra Blanca, Lincoln and Otero Counties, in vicinity of which occurs a great thickness of Upper Cret. rocks (of Fox Hills, Pierre, Colorado, and Dakota age), underlain by Morrison fm.

G. H. Hansen, 1931 (Geo. Wash. Univ. Bull., Summaries of doctoral theses 1925–28, pp. 84–85). *Sierra Blanca coal measures.*—Yellow, gray, and brown clays intercalated btw. sss. and coal beds of variable thickness and quality. Thickness 600± ft. So different from underlying Tucson ss. that a strat. break might be supposed to exist btw. them, but no evidence of break was found. Believed to be of Benton age and not Montana, as once supposed. [Type loc. not given.]

Sierra Blanca limestone.

Eocene (upper): Southern California (southern part of Santa Ynez quadrangle, Santa Barbara County).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 10, pp. 350, 352–354, pl. 46, and map). *Sierra Blanca ls.*—Remarkably pure massive, almost white foraminiferal ls., its upper 10 or 15 ft. grading into medium- to fairly coarse-grained gray ss. interbedded with gray sh. Thickness 0 to 200 ft. In Indian Canyon 200 ft. thick. Decreases in thickness to E. and disappears a little over 1 mi. W. of Mono Creek. Rests conformably on Mono sh. On S. side of San Rafael Mtns it is overlain by 25 ft. of massive maroon-gray to gray sh. of Eo. age. It is also uncon. overlain by Mio. strata. Is conspicuously exposed on S. side of Sierra Blanca Mtn, 1½ mi. SW. of Loma Pelona. Assigned to Eo.

M. F. Keenan, 1932 (San Diego Soc. Nat. Hist. Trans., vol. 7, No. 8, pp. 53–84), assigned these rocks to middle Eo., "older than Tejon restricted, and younger than Martinez."

Sierra de Cayey tuffs.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, p. 61).

Sierran.

Pliocene and Quaternary.

J. Le Conte, 1899 (Jour. Geol., vol. 7, pp. 525–544). *Sierran* proposed to replace *Ozarkian* (preoccupied), applied to a time of general uplift and erosion, longer than both the Glacial and the Champlain put together. In E. part of continent the Ozarkian grades into the Tert. In Sierra Nevada it is sharply marked off from the Tert. That it belongs to the Quat. is certain.

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 88–95). The term *Sierran* is not the equiv. and cannot properly replace the term *Ozarkian*. As I understand Le Conte, *Sierran* is derived from the canyons of Sierra Nevada region, and its definition may be given as the designation of that period during which these canyons were in process of formation. Under Le Conte's definition *Sierran* apparently covers at least part of the Ozarkian or preglacial portion of Pleist., and nearly all of the Glacial period as latter has been established in Eastern States and Europe. I have avoided applying *Ozarkian* in Calif. because, the Glacial period being so very imperfectly represented here, I could not distinguish the work of the Ozarkian from that of later time.

O. H. Hershey, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 3, pp. 1-29). Le Conte's Sierran period is divided into (descending):

Erosion epoch not named.

San Pedran epoch (deposition). May be approx.=Iowan.

Los Angelan epoch (erosion).

Red Bluff epoch (deposition).

Santa Claran epoch (erosion).

J. P. Smith, 1910 (Jour. Geol., vol. 18, No. 3, p. 227), divided Quat. of Calif. into (descending) Terrace epoch, Champlain epoch, and Sierran epoch (including Glacial and pre-Glacial).

J. E. Eaton, 1928 (A. A. P. G. Bull., vol. 12, p. 119), divided the Pleist. of Calif. into (descending) Champlain, Glacial, Sierran, and Pedroian.

Siesta formation.

Pliocene: Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, pp. 384-390 and map). *Siestan fm.*—Fresh-water cgls., sss., and shales, with lignites, clays, ls., chert, and tuff. Included in Upper Berkeleyan. Overlies in places Grizzly Peak andesite and underlies in places a fresh-water ls. memb. of Upper Berkeleyan.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Siesta fm.*—Lake beds. [Same lithology as above.] Thickness 200 ft. Underlies Bald Peak basalt and overlies Moraga fm. Is middle fm. of Berkeley group.

Named for development in Siesta Valley, Berkeley Hills.

†Siestan formation.

See *Siesta fm.*

Siggins sand.

A subsurface sand or sands in McLeansboro fm. (Penn.) of Siggins pool, Cumberland Co., SE. Ill. (See Ill. Geol. Surv. Bull. 54, index.)

Signal Hill formation.

Pre-Cambrian: Newfoundland.

J. B. Jukes, 1839 (Rept. on geol. Newfoundland), and 1840 (Edinburgh New Philos., Jour., vol. 29, p. 107). *Signal Hill ss. and cgl.* [Age not given.]

J. B. Jukes, 1843 (Gen. rept. geol. of Newfoundland, pp. 51+), assigned *Signal Hill ss.* to Algonkian, as did C. D. Walcott (Geol. Soc. Am. Bull., vol. 10, 1889, p. 219) and later writers.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geology of Newfoundland, No. 4). *Signal Hill fm.*—Red sss. with cgls. and slates. No fossils. Upper fm. of Huronian. Uncon. underlies Random fm. (Keweenawan) and overlies Avalonian fm. (Huronian). [Derivation of name not stated.]

Signal Mountain formation.

Upper Cambrian: Southeastern Oklahoma (Wichita and Arbuckle Mountains).

E. O. Ulrich, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 742-747). *Signal Mtn fm.* is named for exposures in sec. 8, T. 2 N., R. 12 W., about 1 mi. S. of Signal Mtn, one of prominent peaks at E. end of Wichita Range. Signal Mtn itself is a pre-Camb. hill, but the beds to which the name is here applied are in plain sight of it, and no other good name is available. In this section Signal Mtn fm. overlies Fort Sill fm., the base being marked by a clastic zone, about 35 ft. thick, consisting of calc. ss. with abundant green glauconite grains. This is followed by a zone of flat-pebble cgls. about 20 ft. thick, which in turn is overlain by about 130 ft. of thin-bedded, more or less coarsely crystalline gray and yellowish-gray ls. separated by thin sh. partings. Glauconite grains are fairly abundant throughout the fm., and this aids in separating it from the underlying Fort Sill, in which very few grains occur. Also, the ls. is much more crystalline than that of the Fort Sill. It contains following well-marked faunal zones (ascending): (1) *Elkia* zone, which lies about 25 ft. above thick top ls. beds of Fort Sill fm.; was not seen in section S. of Signal Mtn, but may fall in sandy beds which mark base of fm. there. (2) *Stenopilus* zone, which occurs just above the sandy basal ls. in sections S. and SE. of Signal Mtn. (3) *Saukinae* zone, which lies 30± ft. above *Stenopilus* zone in Signal Mtn region and ranges upward through about 50 ft. of strata, but on N. side of Wichita uplift, where the fm. is much thicker, this zone comes in at a somewhat higher level and extends through about 100 ft. of beds. It contains the largest and most widely distributed fauna of the fm. (4) *Eurekia* zone, which lies about 50 ft. above most fossiliferous layers of *Saukinae* zone in sections S. of Signal Mtn and about 100 ft. above base of fm. (5) *Euptychaspis* zone, the 5th and highest zone, is characterized by small species of *Euptychaspis;* occupies uppermost 50 ft. of fm. The Fort Sill and Signal Mtn fms. occur in base of Arbuckle ls. in both Arbuckle and Wichita uplifts. In Wichita Mtns the Fort Sill is everywhere succeeded by Signal Mtn fm., but in the Arbuckles 100 to 600 ft. of Royer marble wedges in btw. them.

See also under *Arbuckle group*, Decker, 1933.

Silica shale. (In Traverse formation.)

Middle Devonian: Northwestern Ohio (Lucas County).

G. A. Stewart, 1927 (Ohio Geol. Surv., 4th ser., Bull. 32, pp. 5–9). *Silica sh.*—Bluish-gray sh., soft, highly calc.; disintegrates very rapidly on exposure; contains much iron pyrite. About 10 ft. thick in quarry of Sandusky Cement Co. ½ mi. N. of village of Silica, Lucas Co. Evidently thickens rapidly westward, where two test holes indicate its thickness may be 15 to 17 ft. More typical Hamilton fauna than any previously found in Ohio. Overlain by thick-bedded bluish-gray ls. and grades into underlying heavy blue ls., all of which are included in Traverse fm.

E. R. Pohl, 1930 (Tenn. Acad. Sci. Jour., vol. 5, pp. 60–62). "Silica sh." of Ohio is nothing more than southern extension of basal deposit of Long Lake stage (Bell sh.) [of northern Mich.].

†Siliceous group.

Descriptive term applied in early Tenn. repts to Fort Payne chert and Grainger sh.

†Siliceous limestone.

Descriptive term applied in early repts to ls. in western Pa., W. Va., and Md. later named *Loyalhanna ls.*

Sillery formation.

Ordovician or Cambrian: Quebec.

W. E. Logan, 1863 (Canada Geol. Surv. Rept. 1843–63, pp. 225–297). *Sillery fm.*—Lower Sil.; synonym Chazy (?); eastern Canada; included in Quebec group.

Some later Canadian writers refer this fm. to Ord. and others refer it to Camb. and to Dev.

†Silo sandstone.

Upper Cretaceous: Southeastern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79, p. 6). *Silo ss.*—Fine brown friable ss. and sandy clays, locally indurated by ferruginous cement, sh., and shaly ss. Thickness 200 to 500 ft. Top fm. of Cret. in Atoka quad. Overlies Bennington ls.

Same as Woodbine sand, older and better-established name.

Named for Silo, Bryan Co.

Silurian period (or system).

The time (and the rocks) of one of the Paleozoic periods (following the Ordovician period and preceding the Devonian period). In early geologic repts called "Upper Silurian," but "Lower Silurian" was replaced by *Ordovician system* in 1879, and *Silurian* is now restricted to post-Ordovician and pre-Devonian time and rocks. For definition see U. S. G. S. Bull. 769, pp. 80–81

Siluric.

A variant of Silurian employed by some geologists.

Siluronian.

A name proposed by A. W. Grabau (Pan-Am. Geol., vol. 66, No. 1, 1936, pp. 30, 31) "for the new system, composed of the old Upper Sil., a transgressive series, and the old Lower Dev. as a retreatal series, the two together forming a complete pulsation system." The Oriskany to be basal bed of Dev. system as Grabau would restrict it.

Silver shales.

Upper Devonian: Southwestern New Mexico (Grant County).

C. R. Keyes, 1908 (Am. Inst. Min. Engrs. Bi-Mon. Bull. 19, pp. 7-21). *Silver shales.*—Black argill. shales, nonfossiliferous, 100 ft. thick. Underlie Bella shales and uncon. overlie Santa Rita ls. (Sil.). Assigned to Dev. upon strat. position. Type loc., Silver City, Grant Co.

Appears to correspond to lower part of Percha sh.

Silver City granite.

Age (?): Southwestern Idaho (Silver City).

A. M. Piper and F. B. Laney, 1926 (Idaho Bur. Mines and Geol. Bull. 11, p. 15). [*Granodiorite or Silver City granite* is used in heading, but the rock is mapped simply as *Granodiorite*.]

Silver Creek limestone member (of Sellersburg limestone).

Middle Devonian (Hamilton): Southern Indiana and central northern Kentucky.

C. E. Siebenthal, 1901 (Ind. Dept. Geol. and Nat. Res. 25th Ann. Rept., p. 345). *Silver Creek Hydraulic ls.*—Homogeneous fine-grained bluish to drab argill. mag. ls. 0 to 16 ft. thick. Formerly included in Sellersburg ls. Overlain by what author calls Sellersburg ls. [upper part of Sellersburg as originally defined], and underlain by Jeffersonville ls.

C. Butts, 1915 (Ky. Geol. Surv., 4th ser., vol. 3, pt. 2, pp. 118, 120), divided Sellersburg ls. as originally defined by Kindle into Beechwood ls. memb. above (=Sellersburg ls. of Siebenthal, 1901) and *Silver Creek ls. memb.* below. This is now the generally accepted definition of Sellersburg ls. Contains Hamilton fossils.

Named for Silver Creek, Clark Co., Ind.

†Silver Creek shale.

Upper Devonian: Western New York (Chautauqua County).

D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, pp. 1019-1029). *Silver Creek light soft shales*, 112 ft. thick, underlie Dunkirk black sh. and overlie Angola soft shales with concretions in Lake Erie section of Portage group.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 76). *Hanover shales* (*nom. nov.*).—Name is from exposures in town of Hanover, Chautauqua Co., and is here used in place of *Silver Creek* (preoccupied). Excellent exposures in Walnut and Silver Creek Ravines. Equiv. to upper part of Hatch sh. and flags of eastern sections.

G. H. Chadwick, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 157). *Hanover shales* much younger than Hatch shales and=Wiscoy shales. Discon. overlie Angola shales and discon. underlie Dunkirk black sh.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [In this table Chadwick seems to have restricted *Hanover sh.*, because he gave following as succession in Chautauqua Co. (downward): Dunkirk sh.; Hanover sh.; *Pipe Creek sh.*; hiatus (?) equiv. to Nunda ss.; and Angola sh.; and correlated Hanover and Pipe Creek shales with Wiscoy sh.]

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 149). *Hanover sh.* (formerly *Silver Creek sh.*), is highest memb. of Portage group on Lake Erie. Has been traced continuously into Wiscoy sh. of Genesee Valley.

Silver Dyke breccia.

Tertiary: Central Montana (Little Belt Mountains).

P. A. Schafer, 1935 (Mont. Bur. Mines and Geol. Mem. 13, map of Neihart min. dist.) *Silver Dyke breccia.*—Brecciated granite porphyry and quartz porphyry with occasional fragments of gneiss. [Map shows it occurring W. of Silver Dyke mine, and as older than Carpenter Creek porphyry and younger than Snow Creek porphyry. On p. 51 is a "sketch map showing geol. and surface plant in vicinity of Silver Dyke mine," which maps "breccia" but without a name. Page 52 states: It is possible that the fracturing which accompanied the injection of the Carpenter Creek porphyry caused the brecciation of the brittle Snow Creek quartz porphyry.]

†Silverheels porphyry (also porphyrite).

Eocene: Northeastern part of Mosquito Range, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215–230) and 1886 (U. S. G. S. Mon. 12, pp. 83, 104–107). *Silverheels porphyry.*—Extremely fine-grained greenish-gray rock characterized by fine needles of decomposed hornblende and carrying quartz in small amount, two feldspars, and hornblende and biotite. [On p. 342 of Mon. 12 Whitman Cross describes the rock as *Silverheels porphyrite.*]

In U. S. G. S. P. P. 148, pl. 2, 1927, mapped with the other masses of Gray porphyry, without a distinctive name.

Named from fact it forms important intrusive sheets on Mount Silverheels, NE. of Alma.

Silver Hill formation.

Middle Cambrian: Central western Montana (Philipsburg region).

F. C. Calkins and W. H. Emmons, 1913 (U. S. G. S. P. P. 78). *Silver Hill fm.*—In descending order: (1) Calc. sh., strongly banded in brown, white, and green, interbedded with laminated ls., 90 ft.; (2) ls. with thin brown siliceous laminae, 120± ft.; (3) sh., dark green, not notably calc., with a 3-ft. sheet of dark intrusive igneous rock near base, 120 ft. Underlies Hasmark fm. and overlies Flathead qtzite. Named for Silver Hill, S. of Silver Lake, on whose steep E. face the best section is displayed.

Silver Hills facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, 1931, pp. 77, 94, 96) to a lithologic development of New Providence fm. in a part of southern Ind. and Jefferson Co., Ky.

Silver Hoard formation.

Carboniferous: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60) and 1920 (Canada Geol. Surv. Mem. 117, p. 15).

Silverhorn dolomite.

Middle Devonian: Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Eng. Trans., No. 1647, p. 7) and 1932 (U. S. G. S. P. P. 171). *Silverhorn dol.*—A succession of varied dolomites with some beds of ls., and in upper part beds of qtzitic ss. with a capping qtzite 20 to 100 ft. thick; the whole not less than 3,000 ft. thick. In fault contact with Sil. ls. Conformably underlies West Range ls. (Upper Dev.). Fossils assigned to high Middle Dev. by E. Kirk. Named for exposures S. of old Silverhorn mining camp, 4 mi. NW. of Bristol Pass.

Silveria formation.

Pleistocene: Northwestern Illinois (Stephenson County).

O. H. Hershey, 1896 (Am. Jour. Sci., 4th, vol. 2, pp. 324–330). *Silveria fm.*—Blue and brown laminated silts, 100 ft. thick, called "Kansan Buried Loess" in previous paper. Neither preglacial nor interglacial. Separated from overlying Kansan drift by erosion interval. [According to F. Leverett (U. S. G. S. Mon. 38, pp. 111–118, 1899) this sand and silt is overlain by Illinoian drift and it appears to be underlain by Yarmouth soil.]

Named for extinct Lake Silveria, in Pecatonica Basin, Stephenson Co.

Silver King dolomite member.

Middle Cambrian: Southeastern California (San Bernardino Mountains).

J. C. Hazzard and J. F. Mason, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 2, pp. 236–237). *Silver King dol.*—Dark-gray to black medium- to coarse-grained dol., 200 to 250 ft. thick, lying in upper part of Bonanza King fm., 200 to 250± ft. below its top. Most distinctive and easily recognizable memb. of Bonanza King fm. in Providence Mtns. Named for Silver King mine, on E. side of Providence Mtns. Not present in Marble Mtns.

Silver Lake shale. (In Scranton shale.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 30). *Silver Lake sh.*—Olive-colored sh., not very fossiliferous, 15 to 35 ft. thick, containing a thin, very argill. ls. Included in Upper Coal Measures of Shawnee Co. [From statement on p. 28 appears to overlie Silver Lake coal and underlie Stanton ls.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 41, 58). *Silver Lake sh.*, named by Beede, is top unit of Scranton sh. Thickness 8 ft. in Nebr., increasing to 20 ft. or more a few mi. W. of Topeka, Kans. Overlies Rulo ls., beneath which is Silver Lake coal.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 214). *Silver Lake sh.* underlies Burlingame ls. and overlies Rulo ls. Can be traced practically continuously from Nebr. across eastern Kans. into northern Okla. Type loc. in vicinity of Silver Lake, Shawnee Co., Kans. [Moore discarded Scranton sh. and treated Silver Lake sh. as a fm. in his redefined Wabaunsee group.]

Silver Lake group.

Pliocene: Central southern Oregon.

T. Condon, 1902 (The two islands). *Silver Lake group*, Pliocene lake bed. Fossils.

†Silver Ledge porphyry.

Mississippian (upper): Central northern Utah (Mercur district).

A name applied by J. E. Spurr to an altered ls. containing the silver ores of Mercur dist., which occur in Great Blue ls.

Silver Mountain monzonite porphyry.

Eocene (?): Southeastern Colorado (Huerfano County).

R. C. Hills, 1900 (U. S. G. S. Walsenburg folio, No. 68). *Silver Mtn monzonite porphyry.*—Belongs to Silver Mtn center of eruption and is well represented in Huerfano Park quad., adjoining Walsenburg quad. on W.

Silver Peak group.

Lower Cambrian: Southwestern Nevada and Inyo County, California.

H. W. Turner, 1902 (Am. Geol., vol. 29, pp. 261–272). *Silver Peak fm.*—Lower Camb. rocks in mtns N. of Clayton Valley, Esmeralda Co., Nev., consisting of (ascending): (1) Massive dol.; (2) massive green qtzite; (3) knotted schists; (4) *Archeocyathus* ls. and green *Olenellus* sl. with dark ls. and some qtzite and thin-bedded sl. near top. Also exposed in Silver Peak Range, Esmeralda Co., Nev. Uncon. overlain by Upper Camb. Emigrant fm. Rests on Algonkian rocks. According to C. D. Walcott's division line btw. Camb. and Algonkian, items 1, 2, and 3 of section N. of Clayton Valley would belong to Algonkian, but they are here included in Lower Camb. [Thickness not given.]

The Silver Peak deposits are regarded as divisible into two or more fms., and hence have been called *Silver Peak group* and *Silver Peak "series."* They have been identified, with a thickness of 7,000 ft., by E. Kirk (U. S. G. S. P. P. 110, 1918) in Inyo Range, Calif. C. D. Walcott also identified them in Inyo Range in 1908.

Silver-pipe limestone.

Mississippian: Central New Mexico.

C. L. Herrick, 1904 (Am. Geol., vol. 33, pp. 310–312). [See under †*Graphic-Kelly ls.*]

Not a geographic name but miners' descriptive term.

Silver Plume granite.

Pre-Cambrian: Central northern Colorado (Georgetown quadrangle).

S. H. Ball, 1906 (Am. Jour. Sci., 4th, vol. 21, p. 389). *Silver Plume granite.*—Biotite granite, in stocks, dikes, and irregular masses; is a medium grained hypidiomorphic granular rock. Cuts all pre-Camb. fms. of Georgetown quad. except the pegmatite and associated granite and granite porphyry. Forms S. wall of Clear Creek canyon at mining town of Silver Plume.

For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

†Silver Reef sandstone.

A name locally applied in Washington Co., SW. Utah, to 25 ft. of variable coarse arkosic cross-bedded ss. banded with gray, white, and mauve, lying 260 ft. above base of Chinle fm. (Upper Triassic) at Virgin City, where it is said to be the same zone that in the Silver Reef, near Leeds, about 10 mi. W. of Virgin City, contains the fossil logs impregnated with silver minerals which in the eighties supported several flourishing enterprises. (See U. S. G. S. P. P. 129, p. 62, 1922.)

†Silver Terrace sandstone.

Jurassic (?): Western California (San Francisco).

R. Crandall, 1907 (Am. Phil. Soc. Proc., vol. 46, pp. 3–58). *Silver Terrace ss.*—Sss., with some shales, tuffs, and lignites. Thickness 500 ft. Forms Silver Terrace Hills, in E. part of San Francisco. Is older than Telegraph Hill ss. In places is overlain by the upper jasper bed. Is a part of the Franciscan.

A. C. Lawson (U. S. G. S. San Francisco folio, No. 193, 1914) mapped this ss. as *Marin ss.*

Silvertip conglomerate member.

Mississippian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 46 and passim). *Silvertip cgl. memb.*—Basal memb. of Madison ls. Consists of massive ls.-breccia cgl. with angular pebbles up to 4 or 5 inches long. On Pentagon Mtn the pebbles are of banded gray ls.; on Lone Butte they are of brown petroliferous ls. Matrix is light-gray, crystalline, argill., white-gray weathering ls. In general the pebbles are finer grained than the matrix, and some of them are slightly rounded. Is known to occur in only 3 areas—Lone Butte, Spotted Bear Mtn, and Pentagon Mtn. Thickness 140 ft. on Lone Butte, 23 on Spotted Bear Mtn. Underlies Saypo ls. memb. and discon. overlies Spotted Bear ls. memb. of Jefferson ls. (Middle Dev.). Named for Silvertip syncline, because it is thickest on Lone Butte, which lies nearly in center of the syncline.

Silverton volcanic series.

Miocene: Southwestern Colorado.

W. Cross, 1901 (U. S. G. S. Bull. 182, pp. 29–39). *Silverton series.*—Complex of andesitic flows and tuffs alternating with rhyolitic flows, flow breccia, and tuff. In Telluride quad. and at most places in Silverton quad. the lowest memb. is a rhyolitic flow or flow breccia of peculiar character. This complex as a whole contrasts markedly with underlying San Juan series (which is purely andesitic and entirely fragmental) and with overlying Potosi series (which is almost entirely rhyolitic). In Telluride folio was called "Intermediate series." Rests uncon. on San Juan series. Covers greater part of Silverton quad. Thickness 300 to 5,000 ft.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120), called these rocks *Silverton volcanic series,* and divided them into several units.

W. Cross and E. Howe, 1907 (U. S. G. S. Ouray folio, No. 153), introduced new name *Henson tuff* for uppermost fm. of Silverton volcanic series and stated that in Silverton folio the upper part of Henson tuff was included in overlying Potosi volcanic series and that lower part was included in the underlying pyroxene andesite, which was then called uppermost part of Silverton volcanic series.

Includes Henson tuff, Burns latite tuff, Eureka rhyolite, and Picayune volcanic group, also unnamed pyroxene andesite.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Silvies River beds.

Lower Jurassic: Southeastern Oregon.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, p. 105). [Table showing *Silvies River beds*, Lower Jurassic sss. and red impure ls., 950 ft. thick. Younger than Eagle Creek beds (Upper Triassic) and older than Knoxville (?) fm. Probably named for Silvies River, Harney Co.]

W. D. Smith, 1924 (Univ. Oreg. Commonwealth Rev., vol. 6, No. 4, p. 74), repeated above table, in which *Silvies River beds, Lower Jurassic* appears.

Simi conglomerate.

Eocene (lower): Southern California (Ventura County).

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 15, No. 11, pp. 400–401 and map). *Simi cgl.*—A very persistent cgl. of well-rounded pebbles and boulders of all sizes up to 1 ft. diam., in matrix of coarse-grained arkosic ss. Occasionally, especially near top, there are lenticular beds of ss. varying in thickness from 6 in. to several ft. The pebbles are chiefly qtzite, but granite and rhyolite pebbles are abundant, and the fm. also contains pebbles of diorite, ss., gneiss, and schist. Thickness, few ft. to 800 ft. on W. side of the faults S. of Simi Valley, with max. of about 1,500 ft. E. of main fault. Is basal fm. of Martinez group (lower Eo.). Rests uncon. on Chico fm. Grades vertically and laterally into overlying Las Virgenes ss. Named for occurrence on flanks of Simi Hills, Ventura Co.

Similkameen beds.

Tertiary: British Columbia.

J. W. Dawson, 1890 (Canada Roy. Soc. Proc. and Trans., vol. 7, sec. 4, pp. 75–91). Included in Mio.

†Similkameen formation.

Cretaceous (Lower): Central northern Washington.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137, map). *Similkameen fm.* (text heading); *Similkameen system* (map).—Mainly sss., shales, and lss.; 800 to 1,000 ft. of qtzite, cgls., and breccias at base. Total thickness 4,000 or 5,000 ft. These rocks appear to constitute a well-defined fm., which I propose to term provisionally *Similkameen fm.*, since it is exposed throughout a large part of elevated region drained by headwaters of Similkameen River.

Preoccupied in British Columbia. Replaced by *Pasayten fm.*

Similkameen granite.

Tertiary (?): British Columbia and central northern Washington (Okanogan batholith).

R. A. Daly, 1906 (Geol. Soc. Am. Bull., vol. 17, pp. 329–376). Possibly irrupted in late Mio. or even Plio. Trenched by deep valley of Similkameen River.

J. B. Umpleby, 1911 (Wash. Geol. Surv. Bull. 5, pp. 64–74), assigned this granite to *pre-Tert., preferably late Cret.*

†Simmons Bluff beds.

Pleistocene: Southern South Carolina (Charleston County).

W. H. Dall, 1897 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 336, published in 1897 as House Doc. 5, 55th Cong., 2d sess.). *Simmons Bluff beds.*—The Pleist. of Simmons Bluff, S. C., carries a rich and finely preserved marine fauna.

According to C. W. Cooke (personal communication, 1935) the beds exposed at Simmons Bluff, about 12 mi. below Rantowles, Charleston Co., are a facies of Pamlico fm.

Simms sand.

A subsurface sand assigned to upper part of McElroy memb. of Fayette ss. of eastern Tex. by O. L. Brace (A. A. P. G. Bull., vol. 15, No. 7, 1931, pp. 779–781).

Simojovel formation.

Tertiary: Mexico.

W. A. VerWiebe, 1925 (Pan-Am. Geol., vol. 44, p. 133). *Simijovel fm.*, Mexico, assigned to Tert.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 325). *Simojovel fm.*, Mexico, assigned to upper Mio.

Simon quartz keratophyre.

Middle Triassic: Central Nevada (Cedar Mountains).

A. Knopf, 1921 (U. S. G. S. Bull. 725H). *Simon quartz keratophyre* believed to have been erupted contemporaneously with Middle Triassic lss. Named for Simon mine.

Simon limestone.

Mississippian: Southeastern Arizona (Cochise County).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 243, 251, 338). *Simon lss.*—The basal Mississippian beds, carrying Chouteau fauna, as exposed in face of Chiricahua Mtns and overlooking San Simon bolson [NE. corner of Cochise Co.]. Thickness 300 ft.

†Simon sandstone.

A shortened form of *Mount Simon ss.*, employed by C. [R.] Keyes.

Simons syenite.

Pre-Cambrian: Long Lake quadrangle, Adirondack Mountains, New York.

H. P. Cushing, 1907 (N. Y. State Mus. 60th Ann. Rept., pt. 2, map only). "Red to green quartzose syenite, forming a granitic phase—*Simons syenite.*"

Exposed on shores of Simons Pond, Franklin Co.

Simons sand.

A subsurface sand in central eastern Okla., which is said to correlate with part of Tyner fm., of Ord. age.

Simonson dolomite.

Middle Devonian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421-432). *Simonson dol.*—Characteristic rock is dark- to medium-gray dol. in which individual grains are sufficiently large to be distinguished by unaided eye. Beds 1 to 2 ft. thick. Fine lamination is generally present, and commonly extremely irregular in detail. Two nonpersistent dol. cgls. occur within the fm., and a third, which persists throughout outcrop of fm., has been chosen to mark top bdy. Thickness 1,000 ft. Middle Dev. fossils. Grades into underlying Sevy dol. and is overlain by Guilmette fm. Named for exposures in Simonson Canyon, on W. side of Deep Creek Range, Gold Hill region.

See also U. S. G. S. P. P. 177, 1934, by Nolan.

Simpson group.

Lower and Middle Ordovician: Central southern Oklahoma (Arbuckle Mountains).

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Simpson fm.*—Sss. and fossiliferous ls., with interbedded greenish clay shales and marls separable into several quite distinct members. Thickness 1,600 ft. In Tishomingo quad. and in Arbuckle Mtns, where fm. is completely exposed, it varies in thickness from 1,200 to 2,000 ft. Underlies Viola ls. through transition, and overlies Arbuckle ls.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). According to E. O. Ulrich the fauna of lower part of Simpson fm. has decided similarities to that of Chazy of N. Y. and Canada, and fauna of upper part bears close relations to that of upper div. of Stones River group in Tenn. and Ky., but certain species indicate age=Black River fauna of Minn., though it may be these forms appeared earlier in Tishomingo region.

J. A. Taff, 1904 (U. S. G. S. P. P. 31, p. 25). [Statements about fossils of Simpson fm. similar to 1903 above, except that there is no mention of Black River.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), assigned *Simpson fm.* [restricted] wholly to Stones River (early Chazyan) and an older "unnamed epoch" (later named "Big Buffalo," etc.); allocated the overlying beds, of late Chazy and Black River age, to a new fm. which he called *Bromide;* and designated the uncon. overlying beds of Trenton age as *Viola ls.* According to F. C. Edson, 1927, the beds at Bromide type loc. were mapped by Taff as *Viola ls.* See under *Bromide fm.*

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 30), showed *Simpson fm.* as of upper, middle, and lower Chazy age, and as including at top "typical Bromide (of late Chazy age)," while the overlying beds of Black River age he "provisionally referred to Bromide fm."

F. C. Edson, 1927 (A. A. P. G. Bull., vol. 11, No. 9, pp. 967-975), suggested that *Simpson fm.* be divided into (descending): (1) Bromide group (all "post-Wilcox" beds, of lower Black River age, underlying Viola ls., of upper Black River and Richmond age); (2) "Wilcox" sand, of upper Chazy age; and (3) *Simpson fm.* [restricted], of lower Chazy or Stones River age.

E. O. Ulrich, in ms. chart prepared in April 1928 but first published (by C. E. Decker) in Dec. 1930 (A. A. P. G. Bull., vol. 14, p. 1495), divided Simpson fm. into (descending): (1) West Spring Creek with Criner memb. (of early Trenton and late Black River age); uncon. on (2) Bromide fm. (of Chazy age); and (3) Oil Creek fm. (also of Chazy age).

E. O. Ulrich in chart submitted at Dec. 1928 meeting of Geol. Soc. Am. in N. Y., but first published (by C. E. Decker, from ms. rept. by C. N. Gould) in Dec. 1930 (same reference as above), divided Simpson fm. into (descending) Bromide, Criner, Tulip Creek, McLish, Falls, Nebo, and Joins Ranch.

E. O. Ulrich, Feb., 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73), showed *Simpson fm.* as including at top the lower part of Bromide (which part he assigned to Black River) and divided the rest of the Simpson into several new but undefined fms., named (descending) Criner, Tulip Creek, Falls, McLish, Oil Creek, and Joins, all of Chazy age.

C. E. Decker, Dec. 1930 (A. A. P. G. Bull., vol. 76, art. 21, p. 1498), divided Simpson fm. into (descending) Bromide (including Criner), Tulip Creek, McLish (same as *Falls,* dropped), Oil Creek, and Joins fms.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 11-13). The *Simpson* is here raised to a *group,* divided into 5 fms. (ascending), Joins, Oil Creek, McLish, Tulip Creek, and Bromide. These fms. represent 5 more or less complete sedimentary cycles with a basal sand at bottom of each of 4 upper ones and a cgl. at base of lowest one.

E. O. Ulrich, 1933 (Geol. Soc. Am. Bull., vol. 44, p. 105). *Simpson group* is divided into 8 fms.: Bromide fm. (correlates with Lowville); Criner fm.; Cool Creek fm.; Tulip Creek fm.; McLish and Falls fms., of middle Chazyan age; and Oil Creek and Joins fms., of lower Chazyan age.

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55+), divided *Simpson group* into Bromide, Tulip Creek, McLish, Oil Creek, Joins, West Spring Creek (not defined), Alden ls. (not defined), and Cool Creek ls.

Named for former village of Simpson, just N. of Pontotoc, Johnston Co.

Simpson shale.

Devonian: Northwest Territories, Mackenzie, and Alberta.

A. E. Cameron, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 26).

Simpson sand.

A subsurface sand in Robberson field, central southern Okla., lying lower than Jackson sand and higher than Pugh sand. Assigned to Ord. in Okla. Geol. Surv. Bull. 40Q, 1928, p. 179.

Simsboro sand member (of Rockdale formation).

Eocene (Wilcox): Central and southern Texas (between Brazos and Frio Rivers).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 586, etc.). *Simsboro sand.*—Middle memb. of Rockdale fm. in central and southern Tex. Named by W. A. Reiter during his detailed work on the Wilcox in Mexia dist., from typical exposures at town of Simsboro, Freestone Co. Has been mapped by Reiter (letter Oct. 27, 1932) from near Rockdale, Milam Co., to Trinity River, and has been traced by other geologists over a still larger area. Consists of 240 to 300 ft. of gray soft sand containing fossil wood, lumps of water-rolled clay, seams and lentils of blue-gray clay (in some places chocolate brown), and a little lignite. Underlies Calvert Bluff clay memb. of Rockdale and overlies Butler clay memb.

Sinbad limestone member (of Moenkopi formation).

Lower Triassic: Central eastern Utah (San Rafael Swell).

J. B. Reeside, Jr., C. E. Dobbin, A. A. Baker, and E. T. McKnight (name proposed by Reeside and Gilluly), 1927 (A. A. P. G. Bull., vol. 11, No. 5, p. 797). In Green River Valley the Moenkopi fm. contains near middle (about 320 ft. above base) a thin marine ls. (*Sinbad ls. memb.*) near base of a thick zone of light greenish-gray sandy sh. Type Sinbad is in San Rafael Swell.

J. Gilluly and J. B. Reeside, Jr., 1928 (U. S. G. S. P. P. 150, table opp. p. 62, p. 65). On W. side of San Rafael Swell the Moenkopi fm. includes, about 200 ft. above base, a fairly persistent memb. of thick-bedded light-gray sandy ls. and ss., 40 to 150 ft. thick, here named *Sinbad ls. memb.*, from excellent exposures in Sinbad [Plateau].

Sinclair formation.

Ordovician: British Columbia.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, pp. 14, 34, 50).

Singleshot member (of Appekunny argillite).

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park).

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Singleshot memb.*—Basal memb. of Appekunny fm. Consists of 300 to 400 ft. of metargillites with interbedded thick qtzites and dolomitic sss. Colors range from brown through greenish and white to red. Mud cracks and coarse ripple marks common. Underlies Appistoki memb. of Grinnell fm. Overlies Altyn fm. Best seen on Singleshot Mtn. near St. Mary Lake, Glacier Nat. Park.

Sing Sing marble.

See under *Tuckahoe marble*.

Sinian system.

Term advocated by A. W. Grabau (Geol. Soc. Am. Bull., vol. 36, p. 175, 1925) "for those pre-Cambrian deposits which are but little altered." Is a modification of Von Richthofen's term *Sinian series*, most of which, according to Grabau, is pre-Camb. and continental, but the upper part of which is Camb. and principally marine.

Sinks Grove limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 451, 484). *Sinks Grove ls.*—Blue hard, somewhat sandy and impure deposit, containing throughout a vast amount of black nodular carbonaceous chert which weathers gray. Marine fossils in matrix and in chert. Thickness 175 to 330 ft. Underlies Patton sh. and overlies Hillsdale ls.; all members of Greenbrier series [ls.]. Type loc. along Sinks Grove-Knobs road, in vicinity of Sinks Grove, Monroe Co. Also observed in Mercer Co., W. Va.; in Giles Co., Va.; and in Washington Co., Va., where it reaches 415 ft. in thickness but thins and disappears before Ky. and Tenn. lines are reached.

Siouan series.

A name applied by C. [R.] Keyes in 1912 (Iowa Acad. Sci. Proc., vol. 19, pp. 147–151) to include Sioux qtzite.

Sioux quartzite.

Pre-Cambrian (Huronian): Southeastern South Dakota, southwestern Minnesota, northwestern Iowa, and northeastern Nebraska.

C. A. White, 1870 (Iowa Geol. Surv. vol. 1, pp. 26, 167–171). *Sioux qtzite.*—Red ss. or qtzite outcropping in banks of Big Sioux River, Iowa [and S. Dak.]. Completely metamorphosed; very hard and compact; breaks with splintery fracture; color varies from bright red to deep red. Thickness 50 ft. Believed to be older than [so-called] Potsdam ss. Assigned to Huronian (?).

N. H. Winchell, 1873 (Minn. Geol. Nat. Hist. Surv. 1st Ann. Rept.), gave thickness at New Ulm as 350± ft.

J. E. Todd, 1900 (U. S. G. S. W. S. P. 34). *Sioux qtzite* (Algonkian), is 500+ ft. thick in SE. S. Dak. Chiefly red or purplish qtzite of intensely compact and durable character. Is frequently called *Sioux Falls "granite,"* from extensive exposures and numerous quarries in vicinity of Sioux Falls, S. Dak.

†Sioux Falls granite.

Popular term for *Sioux qtzite*, from extensive exposures and numerous quarries in vicinity of Sioux Falls, S. Dak.

Sir Donald formation.

Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 138).

Siskiyou terrane.

Pre-Cambrian (?): Northwestern California (Klamath Mountains).

N. E. A. Hinds, 1932 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 11, pp. 375-410). While Abrams and Salmon fms. may be of different ages, they form a distinct strat. group in Klamath-Siskiyou region, hence I propose to consider them as members of a single terrane for which I suggest the name *Siskiyou*, from the wide exposure of these strata in Siskiyou Mtns. They are pre-Middle Dev. and probably pre-Sil.

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1, 2, p. 84). Writer believes Siskiyou fms. are definitely pre-Sil. and probably pre-Camb. The Abrams and Salmon fms. are separated by an erosional uncon. Though of different ages they form a distinct strat. group, since they are much more highly metamorphosed than any of later fms. so far known from this region, and their degree of recrystallization is similar.

The U. S. Geol. Survey at present classifies Abrams schist and Salmon fm. as *pre-Camb.* (*?*).

Siskiyou granodiorite.

Jurassic: Northwestern California (Del Norte and Siskiyou Counties).

J. H. Maxson, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1, 2, Jan. and Apr., p. 131, map). *Siskiyou granodiorite.*—Coarse-grained plutonic rock containing green hornblende, biotite, sodic plagioclase, orthoclase and quartz, and, as accessory minerals, apatite and magnetite. Correlated with granodiorites of Sierra Nevada batholith, of late Jurassic age. Intrudes Preston diorite and serpentine and is intruded by Patrick greenstone, of supposed Cret. age.

Sisquoc formation.

Pliocene (lower): Southern California (Santa Maria district).

W. W. Porter II, 1932 (A. A. P. G. Bull., vol. 16, No. 2, pp. 135-143). *Sisquoc fm.* (*lower Plio.*).—Silts, sss., and diatomites, 1,150 to 1,190± ft. thick, divided into (descending): (1) In general 550 ft. of fine, friable, ordinarily ferruginous fossiliferous ss. interbedded with finer material, and with a very fossiliferous ss. near top; (2) two thin iron-stained cgl. stringers, which separate beds above from beds below; (3) 600± ft. of chiefly fine muddy, silty friable gray ss., with some beds of shaly diatomite containing fish remains, radiolarians, sponge spicules, and at one place volcanic glass; (4) at base 40 ft. of pebbly cgl. with ss. partly impregnated with dry oil or tar. In Purisima Hills is represented by upper part of the 2,300± ft. of diatomite exposed on Harris Grade road. Conformably underlies Foxen fm. (middle Plio.) and uncon. overlies Santa Margarita fm. (upper Mio.). Named for well-exposed section on Sisquoc ranch, on S. side of Sisquoc River, in Sisquoc grant.

Sitgreaves tuff.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). *Sitgreaves tuff.*—Cream-colored pumiceous tuff in thick beds; a flow. Thickness 0 to 300± ft. Overlies Meadow Creek trachyte. Named for Sitgreaves Pass.

Siwash series.

Carboniferous: British Columbia.

C. Camsell, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 109), and A. M. Bateman (p. 126 of same rept).

Sixmile granite.

Pre-Cambrian: Central Texas (Llano uplift).

H. B. Stenzel, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 144). Pre-Camb. granites intrusive into Valley Spring gneiss and Packsaddle schist are divided, on basis of lithology and structure, into: (1) *Sixmile granites* (the youngest), gray fine-grained granites; (2) *Oatman Creek granites*, gray medium-grained granites that form a small en échelon swarm of intrusive bodies SE. of Llano; (3) *Town Mtn granites* (the oldest), red coarse-grained granites. [Derivation of names not stated. But in 1935 (Univ. Tex. Bull. 3501, p. 116) Stenzel stated that Sixmile granite is quarried at Sixmile, near Llano, Tex.]

Six Mile shale member.

Upper Devonian: Central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). *Six Mile sh. memb.*, 50 to 80 ft. thick, is top memb. of Middlesex sh. fm. in Ithaca region. Probably of upper Middlesex age. Overlies Renwick sh. memb. [Derivation of name not stated.]

Siyeh limestone.

Pre-Cambrian (Belt series): Northwestern Montana (Glacier National Park), southwestern Alberta, and southeastern British Columbia.

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 323). *Siyeh ls.*—Chiefly ls. but interbedded with argillite. The ls. usually very massive, of mural aspect, dark blue or grayish, weathering buff. Often characterized by peculiar internal structures and large concentric growths. Indistinctly fossiliferous. Thickness 4,000± ft. Forms mass of Mount Siyeh, at head of Canyon Creek, a tributary from the S., which enters Swift Current Creek at Altyn. Constitutes upper part of all principal summits of Lewis Range N. of Mount Siyeh, including Mounts Gould, Wilbur, Merritt, and Cleveland. Extends W. into Livingston Range and forms massive peaks btw. Waterton and North Fork drainage lines. Is intruded by sheet of diorite 60 to 100 ft. thick. Rests conformably on Grinnell argillite and overlain by sheet of extrusive igneous rocks.

Skagit volcanic formation.

Tertiary or Cretaceous: Southwestern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv. Dept. Mines Mem. 38, map 15, 121° to 121°30'). [Mapped following two units (descending):

Skagit volcanic fm. (liparite tuff).
Skagit volcanic fm. (andesite flows and pyroclastic deposits).]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 528). *Skagit volcanic fm.*—Local accumulation of andesitic breccias, associated with flows and with more acid lava. Thickness 5,000+ ft. Extends from first summit W. of Skagit River to summit of Custer Ridge, the main divide of Skagit Range. Lies uncon. on Custer batholith and Hozomeen sediments. Of Olig. (?) age; may be Lower Cret.; probably not younger than Mio. [On p. 531 he described *Skagit harzburgite*, which cuts Custer gneiss.]

Skajit limestone.

Silurian: Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 238). *Skajit fm.*—Heavy-bedded ls. and mica schist, 4,000 ft. thick. The ls. is highly altered, finely crystalline, schistose, and often micaceous; some layers becoming more and more foliated grade into mica schist. Appears to underlie Totsen series, with uncon. [Now known to overlie †Totsen series, which is same as Birch Creek schist.] Tentatively assigned to Sil. on imperfect fossil evidence.

Named for Skajit Mtns, Endicott Range.

Skajit River beds.

Lower Cretaceous: Canada.

G. M. Dawson, 1889 (Am. Jour. Sci., 3d, vol. 38, p. 126).

A local facies of Kootenai fm.

Skaneateles shale. (In Hamilton group.)

Middle Devonian: Central and western New York.

L. Vanuxem, 1840 (N. Y. Geol. Surv. 4th Rept., p. 380). *Skaneateles shales.*—Highly fossiliferous shales underlying Hamilton group and overlying the upper shales of Marcellus, which are less highly colored than underlying deep black Marcellus shales. Cover N. end of both sides of Skaneateles Lake.

J. Hall, 1842 (Am. Jour. Sci., 1st, vol. 42, pp. 57–62). *Skaneateles sh.* underlies Ludlowville sh. and overlies Marcellus sh.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, pp. 66–67). The term *Skaneateles* as here applied refers to that bed of strata for which the name was originally used by Vanuxem. The fm. is recognized from east-central N. Y. to western limits of State. The term is from the lake of this name in Onondaga Co. Is basal subdivision of Hamilton beds. Underlies Ludlowville sh. (including Centerfield ls. at base) and overlies Cardiff sh. (top memb. of Marcellus beds).

D. D. Luther, 1914 (N. Y. State Mus. Bull. 172, pp. 6–30), treated Centerfield lss. as top memb. of Skaneateles sh.

See also *Shaffer sh.*

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 214–219). *Skaneateles fm.* [redefined].—In Chenango and Unadilla Valleys is divisible into (descending) Colgate, Berwyn, Pompey, Delphi, and Mottville members. To W. of Cayuga Lake all of the Skaneateles except Stafford ls. (here transferred from underlying Marcellus sh. to Skaneateles fm., as it is=Mottville memb. to E.) is here included under the new name *Levanna memb.* (which replaces *Shaffer sh.* of Clarke). The Skaneateles underlies Centerfield ls. memb. of Ludlowville fm. and overlies Marcellus sh. There are practically no exposures of the rock at N. end of Skaneateles Lake, but Vanuxem's 1842 rept. gave a clearer description of the fm. on Cayuga Lake, which justifies retention of name.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 391, 392). *Skaneateles fm.* underlies Ludlowville sh., overlies Marcellus sh., and includes Stafford ls., supposed Cardiff sh., and *Skaneateles sh.* Extends from east-central N. Y. to extreme W. limits of State.

The U. S. Geol. Survey calls this fm. *Skaneateles sh.*, since it is chiefly sh., and includes in it the same beds included in it by N. Y. State Survey (Goldring, 1931).

Skeena sandstone.

Skeena series.

Skeena formation.

Lower Cretaceous: British Columbia.

G. M. Dawson, 1881 (Canada Geol. Surv. Rept. 1879–80, pp. 128, 129). *Skeena ss.*

W. W. Leach, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 64). *Skeena series.*

R. G. McConnell, 1913 (12th Int. Geol. Cong. Guidebook 10, p. 15) and 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 58). *Skeena fm.*

Most Canadian geologists now use *Skeena fm.*

Skelley limestone. (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, p. 27). *Skelley ls.*—Ls. similar to older Ames ls., overlying Duquesne coal and underlying Birmingham sh. Occurs nearly everywhere in [eastern] Ohio except where replaced by massive ss. Included in Conemaugh fm.

Named for Skelley Station, on Pa. R. R., in Jefferson Co.

Skelt shale. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

D. B. Reger, 1920 (W. Va. Geol. Surv. Rept. Webster Co., p. 198). *Skelt sh.*—Dark-gray fissile sh., with marine fossils, 0 to 5 ft. thick. Underlies Guyandot ss. and is separated from underlying Sewell B coal by 2 ft. of ss. Exposed on N. side of Sugar Creek, ½ mi. E. of Skelt P. O.

Skelton shale. (Buried.)

Mississippian: North-central Kansas.

J. S. Barwick, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 183). *Skelton sh.*—Unit No. 2 encountered in wells in Salina Basin, Kans. Not exposed. Thickness over most of basin 100 to 150 ft. In wide belt through Marion, McPherson, Rice, and Reno Counties it rests on Engle sh. (unit No. 4; not exposed), and the two have been penetrated in many wells. At S. end of basin it consists of 70± ft. of black fissile sh. that correlates with Chattanooga. To N. this black sh. thins or fingers out, and above it are patches of gray, green, and red shales and limes, which attain thickness of 150 ft. Named after Skelton No. 1 well of Danciger Oil & Refining Co., sec. 26, T. 15 S., R. 2 W., Saline Co., which entered this horizon at 3,085 to 3,205 ft. depth. Underlies "Mississippi lime" (unit No. 1) and overlies Younkin fm. (unit No. 3) where present.

†Skiatook shale.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 34). *Skiatook sh.*—Chiefly sh., some ss. in upper part, and a ls. at about horizon of Hogshooter ls. Thickness 250 to 500 ft. Overlies Nowata sh. and underlies Dewey ls. Includes Lenapah ls. at base.

Now divided into (descending) Nellie Bly fm., Hogshooter ls., Coffeyville fm., and Lenapah ls.

Named for Skiatook, Tulsa Co.

Skidegate formation.

Cretaceous: British Columbia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 217).

Skinner sand.

A subsurface sand, of Penn. age and 20± ft. thick, in Okla. that lies 250 to 400± ft. below Oswego lime and is correlated with a part of Cherokee sh.

Skinners Eddy limestone. (In Catskill formation.)

Upper Devonian: Northeastern Pennsylvania (Wyoming County).

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G7, pp. 117, 118, pl. X). *Skinners Eddy ls.*—Brecciated ls., 2 ft. thick. Quarried on land of Mr. Kinney, about ⅓ mi. below Skinner's Eddy, on Tuscarora Creek, Braintree Twp, Wyoming Co. Included in Delaware flag series of Catskill series.

Skoki formation.

Ordovician: Alberta.

C. D. Walcott, 1928 (Smithsonian Misc. Coll., vol. 75, p. 217).

Skolai volcanics.

Triassic: Eastern Alaska (Skolai Range).

O. Rohn, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, pp. 429-430, pl. 52, map). *Skolai volcanics.*—Amygdaloidal basic volcanics of Skolai Range. Intermediate in age btw. Nikolai greenstone and recent basaltic lavas. Much younger than Nikolai greenstone.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, chart opp. p. 206), assigned these volcanics to Triassic.

Skonun formation.

Tertiary: British Columbia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 220).

Skrainka diabase.

Pre-Cambrian: Southeastern Missouri.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 253). *Skrainka terrane.*—Diabases. Younger than Iron Mtn and uncon. below Pilot Knob.

J. Bridge, 1930 (personal communication). Skrainka diabase of Keyes is considered to be probably Algonkian.

Named for old post office at Skrainka, SW. of Mine LaMotte Station, Madison Co.

Skull Creek shale member (of Graneros shale).

Upper Cretaceous: Northeastern Wyoming.

A. J. Collier, 1922 (U. S. G. S. Bull. 736, table opp. p. 76, p. 79, etc.). *Skull Creek sh. memb.*—Basal memb. of Graneros sh. in Osage oil field, Weston Co., Wyo. Mainly dark bluish-gray sh., about 200 ft. thick. Contains a few calc. concretions and near base some siliceous sh. Very few fossils. Is called Thermopolis sh. by drillers but represents only basal part of true Thermopolis sh. Is well exposed along Skull Creek SE. of Osage, btw. outcrops of Dakota ss. below and Newcastle ss. above.

Skull Hill formation.

Miocene: British Columbia.

W. L. Uglow, 1922 (Canada Geol. Surv. Summ. Rept. 1921, pt. A, p. 86).

Skunnemunk conglomerate.

Devonian (Upper): Northern New Jersey and southeastern New York.

N. H. Darton, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 367–394). *Skunnemunk cgl.*—Thickness 300 to 2,500 ft. Overlies Bellvale flags. Assigned to Dev. May represent Oneonta fm. or may be later and=coarse beds of Chemung age in southern Catskills, or it may be a purely local feature.

H. Ries, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, 4 mo.). In its typical development *Skunnemunk cgl.* is an aggregate of quartz and some sh. pebbles in matrix of reddish quartz and argill. material, local layers of red sl. interbedded in upper portions; also contains beds of pebbly qtzite and red quartzitic ss. Caps Bellvale and Skunnemunk Mtns, Orange Co., N. Y. Grades into underlying Bellvale flags. Assigned to Hamilton epoch.

H. B. Kümmel and S. Weller, 1902 (N. J. Geol. Surv. Ann. Rept. State Geol. 1901). *Skunnemunk cgl.* forms great mass of Bearfort Mtn, the southward continuation of Bellvale Mtn of N. Y., and also forms central part of Skunnemunk Mtn. In previous repts the cgl. of Bearfort Mtn was miscorrelated with Green Pond cgl.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 404). *Skunnemunk cgl.* is thought to represent Portage time with the upper beds as late as Catskill.

On U. S. G. S. *Schunemunk* topog. map the name of this mtn is spelled *Schunemunk*.

Skwentna group.

Jurassic(?): Southern Alaska (Cook Inlet region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 149–152, 180). *Skwentna series.*—Ancient volcanic rocks interstratified with tuffs and derived slates and some arkoses, all highly folded. First seen on Skwentna River 10 or 15 mi. above junction with Yentna River, then on right bank of the Skwentna some miles below mouth of Hayes River. On E. side of Tordrillo Mtns it conformably underlies Tordrillo series; on W. side it conformably underlies Terra Cotta series. Assigned to Jurassic(?).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, p. 234, table opp. p. 270). *Skwentna group* contains no fossils. From available evidence is probably Lower Jurassic. The overlying Tordrillo fm. is Middle Jurassic.

Sky Blue Quarry limestone.

Paleozoic (?): Southern California (Riverside County).

J. W. Daly, 1935 (Am. Min., vol. 20, No. 9, pp. 638–647, map). *Sky Blue Quarry ls.*—Except for development of blue calcite and more intense metamorphism near some of quartz monzonite dikes, this fm. is lithologically similar to Chino Quarry ls.; no evidence to show that the original sediments of these 2 fms. differed appreciably in chemical composition. Thickness 500± ft. Top fm. of Jurupa series. Contact with underlying Chino Quarry qtzite obscured by intrusives; may be uncon. Named for quarry at Crestmore.

Skyline formation.

Carboniferous: British Columbia.

S. J. Schofield, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. B, p. 60) and 1920 (Canada Geol. Surv. Mem. 117, p. 16).

Slate Hill shale.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 320, 329–330, 356, 364). *Slate Hill shales.*—Greenish shales with sandy layers and sss. near top. Composes upper part of Aquidneck series. Overlain by Purgatory cgl. Exposed at Slate Hill [Middletown Twp, Newport Co.].

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, map), mapped the rocks of Slate Hill as Rhode Island fm.

Slater sandstone member (of Mingo formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 40). *Slater ss. memb.*—Cliff-making ss., 0 to 100 ft. thick, in Mingo fm., lying 300 ft. below top of Mingo.

Named for Slater Fork of Catron Creek, Bell Co., Ky.

†Slatington shale.

Silurian: Southwestern Arkansas and southeastern Oklahoma.

A. H. Purdue, 1909 (Geol. Soc. Am. Bull., vol. 19, p. 557). *Slatington sh.*—Sh. uncon. overlying Blaylock ss. and underlying Missouri Mtn fm. [not Missouri Mtn sl. but a younger fm.]. Slatington sh. and Missouri Mtn fm. may possibly be Sil. [The rocks are same as those named *Missouri Mtn sl.* by Purdue later in 1909.]

Apparently named for Slatington, Montgomery Co., Ark.

Slave Point limestone.

Devonian: Northwest Territories, Mackenzie, and Alberta.

A. E. Cameron, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 26).

Slesse diorite.

Miocene(?): British Columbia and northern Washington.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 532).

Slickford sand.

A subsurface sand in New Providence fm. of Wayne Co., eastern Ky.

Slide Mountain series.

Mississippian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 18).

Slide Mountain conglomerate.

Upper Devonian: Eastern New York (Catskill Mountains).

G. H. Chadwick, 1933 (Am. Jour. Sci., 5th, vol. 26, pp. 480, 482, 483). *Slide Mtn cgl.*—White cgl. topping the reds on highest peaks [of the Catskills?]. Caps highest peak, Slide Mtn. Overlies Katsberg red beds. Possibly of Chautauquan age.

G. H. Chadwick, Feb. 1935 (Am. Jour. Sci., 5th, vol. 29, No. 170, p. 140). A cgl. constitutes 1,000 ft. and more of summit of Wittenberg, where it is best exposed, and others of the high central Catskills. It is easy to show by tracing that this *Wittenberg cgl.* is upper Enfield, =upper part of Hatch sh. of western N. Y., of Naples age. Above it, capping only the one highest pinnacle of the Catskills, is the thinner *Slide Mtn cgl.*, corresponding apparently to Grimes ss., basal bed of Chemung.

G. H. Chadwick, Nov. 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 859, 861, 862). Of Chemung rocks only the Cayuta or Catawissa reds appear to be represented E. of Delaware River in N. Y., and these only on the higher lands rising rapidly to the mtn tops and being present in the Catskills proper only as the white *Slide Mtn cgl.* capping the highest peak alone.

Slippery Rock sand.

A subsurface sand of Miss. age in western Pa. (Butler and Zelienople quads.), that is found in wells in gorge of Slippery Rock Creek.

Sloan Canyon formation.

Triassic(?): Northeastern New Mexico (Union County).

B. H. Parker, 1930 (Kans. Geol. Soc. 4th Ann. Field Conf., p. 132, Mimeo). *Sloan Canyon fm.*—Varicolored earthy and calc. shales with thin beds of gray marl and ss. Thickness 125 to 150 ft. Of Triassic(?) age. Overlies Dockum group and underlies Sheep Pen Canyon fm. [Derivation of name not stated.]

B. H. Parker, 1933 (Jour. Geol., vol. 41, No. 1, pp. 40–43). *Sloan Canyon fm.*—Pale, variegated argill. and calc. shales with thin layers of hard gray marl and a bed of red ss. near base. Estimated thickness 125 to 150 ft. Conformably underlies Sheep Pen ss. and overlies the red beds assigned by Darton to Dockum group. Typically exposed throughout lower part of valley of Sloan Canyon in east-central part of T. 31 N., R. 35 E., Union Co., N. Mex. Because of poor induration of the shales the basal contact is generally concealed, and consequently the true character of the lowermost 25 to 50 ft. of the deposit is not known. Contains numerous fragmental fish teeth and bones and, at one place, many tracks, probably of reptilian origin. On basis of strat. position the Sloan Canyon and overlying Sheep Pen fms. are referred to Triassic (?). Darton assigned this fm. and Exeter ss. to Morrison fm., but this does not seem tenable in light of pronounced angular uncon. that separates the Sloan Canyon beds and Exeter ss. and which involves complete removal by erosion of Sheep Pen ss. at several localities where the shales of Sloan Canyon fm. and Exeter ss. are in contact.

†Sloans Valley limestone. (In Chester group.)

Mississippian: Western Kentucky and southeastern Illinois.

A. D. Brokaw, 1916 (Ext. from Ill. Geol. Surv. Bull. 35) and 1917 (Ill. Geol. Surv. Bull. 35, p. 12, pl. 1). *Sloans Valley fm.*—Interbedded lss. and shales, 40 to 95 ft. thick, underlying Tar Springs ss. and overlying Hardinsburg ss. in parts of Saline, Johnson, Pope, and Williamson Counties, southern Ill.

S. St. Clair, 1917 (Ill. Geol. Surv. Bull. 35, p. 46, pl. 4). *Sloans Valley fm.*—Interbedded lss. and shales, 50 ft. thick, underlying Tar Springs fm. and overlying Hardinsburg fm., in parts of Williamson, Union, and Jackson Counties, Ill.

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41, pp. 191, 197). Glen Dean ls. was called *Sloans Valley fm.* by Brokaw and by St. Clair, from a locality in Pulaski Co., Ky. Glen Dean is preferable name. The Sloans Valley section is less well known than that of SE. Ill. and adjacent portions of Ky., and it is not unlikely the section includes much more than exact equiv. of the strata for which the name has been used in Ill.

Slocan series.

Carboniferous or Triassic: British Columbia.

C. V. Corless, 1902 (Canadian Min. Inst. Jour., vol. 5, p. 506). [Age not given.]

O. E. LeRoy, 1913 (12th Int. Geol. Cong. Guidebook 9, p. 63). Slocan series assigned to Carbf. (?).

M. F. Bancroft, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. B, pp. 29, 36) and 1920 (Summ. Rept. 1919, pt. B, p. 41), and S. J. Schofield, 1920 (Canada Geol. Surv. Mem. 117, p. 15), assigned these rocks to Carbf.; J. F. Walker, 1929 (Canada Geol. Surv. Summ. Rept. 1928, pt. A, p. 127), and C. E. Cairnes, 1934 (Canada Dept. Mines Geol. Surv. Mem. 173, No. 2358, p. 52), assigned them to Triassic.

Slollicum series.

Triassic: Central northern Washington and adjacent British Columbia.

C. H. Crickmay, 1930 (Geol. Mag., vol. 67, map, pp. 488, 489). *Slollicum series.*—Schists, argillites, and greenstones, 10,000 ft. thick. In B. C. underlies Harrison Lake fm. (Middle Jurassic). In Wash. underlies Paleocene. Overlies Triassic volcanics in both Wash. and B. C. Assigned to Triassic. [Derivation of name not stated and no geographic feature of that name shown on map.]

Sluss sand.

A subsurface sand in Butler Co., Kans., that is said to lie at approx. horizon of Stapleton zone.

Smalls Brook limestone.

Carboniferous: Nova Scotia.

H. M. Ami, 1899 (British Ass. Adv. Sci. Rept. 1899, p. 756).

Smelt Brook formation.

Carboniferous: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 212).

Smelter granite.

Jurassic: British Columbia and northern Washington.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 381).

Smethport oil sand.

Drillers' term for an oil-bearing sand, 26± ft. thick, in vicinity of Smethport, McKean Co., NW. Pa., which lies 360 ft. below Bradford oil sand. (See C. A. Ashburner, 1880, 2d Pa. Geol. Surv. Rept. R.)

†Smethport shale member (of Knapp formation).

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, pt. 1, p. 203). *Smethport sh. memb. of Knapp fm. (part of "Riceville," Knapp sh.)*—Basal memb. of Knapp fm. Includes Marvin Creek ls., *Syringothyris* zone (in upper Chagrin). Overlies Riceville fm. restricted. Was formerly included in Riceville. The *Syringothyris* zone is lower Smethport memb. (lower upper Riceville), and an unfailing guide throughout most of area.

In 1934 Caster replaced this name with *Kushequa sh. memb.*

Smethport magnafacies.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 27). Westward the Catskill magnafacies gives way to purple- and chocolate-weathering shales and sss. in which occur, as a normal feature, flat-pebble cgls., usually as local lenses, but in the later parvafacies some carry over into adjoining facies province to W. It is proposed that this *magnafacies* be known by name *Smethport*, from town of Smethport, McKean Co., Pa. The *Cattaraugus parvafacies* of Olean, N. Y., area is best-known parvafacies of Smethport magnafacies.

Smith sand.

A subsurface sand, 10 to 30 ft. thick, lying at or near base of Penn. section of Graham field, NW. part of Carter Co., southern Okla., and from 250 to 350 ft. below Sutherland oil sand. The name has also been applied to an apparently older sand lying in upper part of Cromwell sand (of basal Penn. or uppermost Miss. age) of central Okla.; and also to a Perm. sand in Pecos River region of western Tex., as explained under *Yates sand*.

†Smith Creek beds.

See under *†Smith River lake beds.*

Smithfield limestone member (of Marlboro formation).

Pre-Cambrian: Eastern Rhode Island.

E. Emmons 1843 (N. Y. Nat. Hist. Agric., vol. 1, pp. 90–91), mentioned the *Smithfield ls.* of R. I., which he believed to be same as the younger Stockbridge ls.

E. Emmons, 1846 (Agric. N. Y., vol. 1, pp. 90–93). *Smithfield ls.* lies in valley of Blackstone River about 10 mi. N. of Providence, R. I. It is white or clouded ls. enclosed in mag. sl.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 107–109). *Smithfield lss.*—Finely granular dolomitic crystalline aggregates, forming top div. in Blackstone series. Overlie Ashton schists. Owing to setting off of Lincoln from Smithfield in 1871, the areas of ls. formerly designated by this name are no longer in town of Smithfield. The areas of this rock are isolated, ovoidal in outline, and have no very systematic distribution.

B. K. Emerson and J. H. Perry, 1907 (U. S. G. S. Bull. 311, pp. 8, 11, 16–26, and map). *Smithfield ls. memb. of Marlboro fm.*—Generally pure white but in some places banded in dark gray or tinged yellow with iron or pink with manganese.

Varies from massive saccharoidal marbles of fine to above medium grain to rocks laminated through shearing. Thickness 0 to 150± ft. Is a subordinate memb. of Marlboro fm., and changes into tremolite schist, steatite, and serpentine.

Smith Fork glacial stage.

Pleistocene: Northeastern Utah.

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). Youngest glacial stage in Uinta Mtns of NE. Utah (only). Probably of Wisconsin age. Named for long train of lateral moraines left by its glaciers in valley of East Fork of Smith Fork, Utah.

Smith Point formation.

Lower Cambrian: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geol. of Newfoundland, No. 4). *Smith Point fm.*—Red ls. with red sh., carrying *Hyolithes*, etc. Forms top fm. of Etcheminian series. Discon. overlain by Hanford fm., and underlain by Brigus fm. [Derivation of name not stated.]

†Smith River lake beds.

Miocene (middle): Central southern Montana (Little Belt Mountains region).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Smith River lake beds.*—Irregularly bedded sands and loosely cemented cgls., with beds of marl and volcanic dust. Deposited in lake that once filled valley of Smith River, btw. Little Belt and Big Belt Ranges. Rest uncon. on all older rocks. Contain middle Mio. fossils.

The stream for which these beds were named *Smith River* is now known as *Deep River*. (See *Deep River beds.*) The beds have also been called "Smith Creek beds."

Smiths Ferry sand.

Drillers' term for a sand in Pocono fm. of SW. Pa. and W. Va., lying lower than Papoose sand and higher than Murrysville sand.

†Smithville chert lentil. (In Stanley shale.)

Mississippian: Southeastern Oklahoma (McCurtain County).

H. D. Miser and C. W. Honess, 1927 (Okla. Geol. Surv. Bull. 44, p. 11). *Smithville chert lentil.*—Black chert, about 25 ft. thick, occurring in middle of Stanley sh. Crops out in northern McCurtain and southern Le Flore Counties. Until now has always been described and mapped (Okla. Geol. Surv. Circ. No. 3, pl. 1) as black chert of Stanley sh. Is of importance in mapping structure and calculating thicknesses of adjacent beds and is therefore named, for village of Smithville, E. of which, in T. 1 S., R. 26 E., Okla., there are typical exposures. Name proposed by Honess.

Smithville formation.

Lower Ordovician (Beekmantown): Northern Arkansas (Sharp and Lawrence Counties) and southeastern Missouri (?).

G. C. Branner, 1929 (geol. map of Ark.). *Smithville ls.*—Uncon. underlies Black Rock ls. and uncon. overlies Powell ls. in Ozark region. Thickness 0 to 200± ft. Assigned to Upper Canadian [which is Beekmantown of U. S. G. S.]. [Mapped at and around Smithville, Lawrence Co., Ark.]

H. S. McQueen, 1930 (Insoluble residues as a guide in stratigraphic studies, published March 1930; Reprint of App. I, 56th Bien. Rept., 1931, p. 25, pl. 1). [See under *Black Rock fm.*] Thickness of Smithville in SE. Mo. 0 to 120 ft.

E. T. McKnight, 1936 (U. S. G. S. Bull. 853, on Yellville quad., Ark.). *Smithville fm.*—Chiefly fine-grained gray mag. ls. or dol. that weathers drab or whitish, with minor amounts of ss. and blue-gray ls. Thickness in Sharp and Lawrence Counties, Ark., 200± ft. Absent in Yellville quad. Not studied in detail. Uncon. underlies Black Rock fm. The Black Rock and Smithville fms. resemble Everton fm. in lithology but are believed by E. O. Ulrich, on basis of fossil evidence, to occupy an interval btw. Everton fm. above and Powell dol. below and to be uncon. with Everton and with Powell.

Smithwick shale. (Of Bend group.)

Pennsylvanian (Pottsville): Central Texas.

S. Paige, 1911 (U. S. G. S. Bull. 450, p. 25). *Smithwick sh.*—Soft, very dark or nearly black carbonaceous sh., in which are included a number of ss. lentils. Thickness probably 400 ft. Overlies Marble Falls ls. and is overlapped by Cret. sediments in central Tex. mineral region. Named for old town of Smithwick, Burnet Co.

See also S. Paige, 1912 (U. S. G. S. Llano-Burnet folio, No. 183), and see under *Bend group*.

E. H. Sellards, 1933 (Univ. Tex. Bull 3232, p. 101). Type loc. of Smithwick fm. is at Smithwick, but the exposures at this place are sandy shales and coarse sss. with indeterminate plant fragments, the exposure suggesting Strawn rather than Smithwick. If these exposures prove to be Strawn, the name *Smithwick*, well established, will doubtless be retained, and Bend post office may be given as suitable type loc., the fm. being well exposed there throughout most of its entire thickness.

†Smithwick lime.

Drillers' term for a black ls. in lower part of Smithwick sh. (Penn.) of Tex. Also called "Caddo lime," "Breckenridge lime," and "False Black lime" by oil men. (See U. S. G. S. Bull. 736, p. 123, 1923.)

Smock sand.

A subsurface sand in Butler Co., Kans., that is said to lie at approx. position of Stapleton sand.

Smoky Hill chalk member (of Niobrara formation).

Smoky Hill marl member (of Niobrara formation).

Upper Cretaceous: Northwestern Kansas and eastern Colorado.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 51). *Smoky Hill chalk.*—Chalky and marly lss. and chalk composing upper fm. of Niobrara div. Overlies Osborne ls. (lower fm. of Niobrara div.) and underlies Lisbon shales of Fort Pierre div. Named for Smoky Hill River, Kans.

Top memb. of Niobrara fm. in Kans. Overlies Fort Hays ls. memb. of Niobrara and underlies Pierre sh. In eastern Colo. it is called *marl* memb. (instead of *chalk* memb.).

Smoky River series.

Upper Cretaceous: British Columbia.

G. M. Dawson, 1881 (Canada Geol. Surv. Rept. 1879–80, p. 15B). *Smoky River series;* included in Colorado group.

Snake Creek beds.

Miocene (upper) and Pliocene (lower): Western Nebraska and eastern Wyoming.

W. D. Matthew and H. J. Cook, 1909 (Am. Mus. Nat. Hist. Bull., vol. 26, art. 27, pp. 362–363). *Snake Creek beds.*—Clean sand, with gravel scattered through it. Contains bones, jaws, etc., of great variety of lower Plio. fossil mammals. Regarded as outlier of Ogalalla fm., known to Kans. geologists as "mortar beds." Lack calc. cement, but otherwise are very like the "mortar beds" of Republican River Valley. Overlie Sheep Creek beds (middle Mio.) with erosion uncon.

H. J. Cook, 1915 (Nebr. Geol. Surv. vol. 7, pt. 11, pp. 72–75). "Spoon Butte beds" of Peterson, which cap Spoon Butte, Wyo., are a cemented phase of *Snake Creek beds* (lower Plio.), and overlie Sheep Creek beds (middle Mio.).

H. F. Osborn, 1910 (Age of mammals, pp. 341, 353, 354, 355), J. C. Merriam, 1911 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 6, No. 11, pp. 199–304), W. B. Scott, 1913 (History of land mammals of Western Hemisphere, pp. 17, 127, 222, 388), W. J. Sinclair, 1915 (Am. Phil. Soc. Proc., vol. 54, pp. 74–75) assigned these beds to lower Plio.

E. H. Barbour, 1915 (Am. Jour. Sci., 4th, vol. 39, p. 87, in a paper on Burge, Cherry Co., Nebr.). Snake River deposits border a stream variously termed Snake Creek and Snake River. Latter name is preferable, since it avoids confusion with Snake Creek and the Snake Creek beds of Sioux Co., to which the beds around Burge are equiv. [See also under *Snake River stage.*]

J. C. Merriam, 1917 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 10, No. 22, pp. 435–443). It seems possible Snake River fauna represents more than one stage.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., n. s., vol. 2, pt. 1, pp. 23, 27, 28, 34), assigned these beds to upper Mio. and lower Plio., as did H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, p. 44).

See also under *Valentine beds*.

Snake Hill formation.

Middle Ordovician (early Trenton): Eastern New York.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). Subdivisions of Trenton in east-central N. Y. (descending): Canajoharie sh., Dolgeville, *Snake Hill sh.*, and Basal Trenton.

J. M. Clarke, 1912 (N. Y. State Mus. Bull. 158, p. 21). *Snake Hill beds*.—Thick fm. of shales, grits, and cherts of lower Trenton age. Overlies Normanskill sh. Field work by R. Ruedemann.

R. Ruedemann, 1912 (N. Y. State Mus. Bull. 162). *Snake Hill beds*.—A belt of slates, grits, and sss. which in Hudson Valley extends btw. Canajoharie sh. and Normanskill sh., from both of which it is distinguished by its fauna, and from Canajoharie in character of the sh. and greater intercalation of aren. beds. Deposited in Levis Basin upon Normanskill sh. and brought to mouth of the Mohawk and in contact with Canajoharie sh. by overthrusting and compression of the shales of Levis Basin. The Snake Hill fauna occurs in lowest Mohawk Valley, where there appears to be an intermixture of Snake Hill beds with Canajoharie sh. But considering all the evidence the Snake Hill beds are believed to be older than Canajoharie sh. and deposited in a separate basin. Nowhere have they been observed btw. Canajoharie sh. and Glens Falls ls., on which Canajoharie rests.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 41). *Snake Hill beds (1912 Ruedemann)* are shales, grits, and sss. above Normanskill sh. in Levis trough and of Trenton age. Name is from the very fossiliferous beds at Snake Hill, on E. side of Saratoga Lake. Other fossiliferous exposures are at Green Island, opposite Troy, and at Mechanicville.

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 66–99, and map). *Snake Hill sh.*—Dark-gray to black, bluish, and greenish-gray argill. shales. Mainly on account of large and distinguishing faunas obtained around Albany, Green Island, and Cohoes, and especially at Snake Hill, on shore of Saratoga Lake, the beds have recently (1912) been considered a separate fm. by writer and named *Snake Hill beds*, from most fossiliferous outcrop. Lithologically similar to Normanskill beds, but lack strong development of grits and white beds as distinct divisions, though both are present in thinner intercalations; possess a cgl. with characters peculiar to itself. Probably rests on upper div. of Normanskill sh. and is youngest fm. in Levis Basin. [In chart on p. 140 shown to be of early Trenton and late Black River age and as uncon. overlying Rysedorph Hill cgl.]

In N. Y. State Mus. Bull. 227, 228, 1921, p. 101) Ruedemann described new fossils from *Snake Hill sh.* of Hudson River Valley, and stated that it is of lower and middle Trenton age.

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 412, 414), showed *Snake Hill sh.* as older than Schenectady, younger than Canajoharie sh., and of late Trenton age.

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285). [On p. 25 *Snake Hill sh.* is placed beneath Canajoharie sh.; on p. 27 it is correlated with Canajoharie sh.; on p. 131 Snake Hill is placed above Canajoharie and below Schenectady. The latter position is assigned to *Snake Hill sh.* by Ruedemann in 16th Int. Geol. Cong. Guidebook 1, 1933.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 286). *Snake Hill beds* are contemp. with Canajoharie.

†Snake Hills trap.

Name applied by N. H. Darton (U. S. G. S. Bull. 67, p. 55, 1890) to 200 ft. of intrusive "trap" (now called Palisade diabase) on Big and Little Snake Hills, W. of Bergen Hill, N. J.

Snake Ridge formation.

Upper Cretaceous: Mexico (Sonora).

See under *Cabullona group.*

Snake River basalt.

Tertiary and Quaternary (probably chiefly Pliocene, but includes Recent, Pleistocene, and Miocene basalt flows): Southern Idaho.

W. Lindgren, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, pl. 8), mapped *Snake River basalts* (*Pliocene*) from Nampa eastward to and beyond Lincoln Co., Idaho, and *Columbia lava fm.* (*Miocene*) across SW. Idaho, also in Washington and Wallowa Counties and around Hailey. In text heading and text, however, he did not use *Snake River basalt*, but simply called the younger rocks *Pliocene basalts.*

I. C. Russell, 1902 (U. S. G. S. Bull. 199, pp. 38+, 59+, map). *Snake River lava* is here proposed as general term by which to designate the basaltic rocks that underlie by far the larger part of Snake River Plains and to a great extent form their actual surfaces. It includes also the lava streams and associated cinder cones, etc., which have descended lateral valleys or adjacent mtn slopes and united with the sheets of similar material extruded from numerous craters on the plains. When this extensive fm. is studied in detail, it will, I judge, be found practicable to separate it into several distinct portions and to correlate some of these with sed. beds containing fossils and thus determine their precise geol. age. Estimated area covered by Snake River lava is in neighborhood of 20,000 sq. mi. [Mapped across southern Idaho from Nampa to S. half of Fremont Co., over large part of Bingham Co., and N. part of Bannock Co.] So far as now definitely known there is but one lava field in No. Am. of greater extent, namely, Columbia River lava. In Snake River Canyon below Shoshone Falls nearly 700 ft. of lava in horizontal sheets are exposed, but whether this is max. thickness cannot be told. As a rule the sheets of lava are relatively thin, averaging perhaps 50 to 80 ft., and widely extended. Is similar in all its features to Columbia River lava. The country separating these two areas of basaltic rock has not yet been geologically explored, and while it is possible a direct connection btw. them may be discovered, it seems more probable they are distinct and have somewhat different histories. It appears by far the greater part of Snake River lava is much younger, although its basal members seem to be of about same age. The principal part of Columbia River lava, as shown by fossil leaves in associated sediments, is Mio. The older part of Snake River lava, as indicated by relation to Payette fm., etc., is also Mio. Much reliance should not at present be placed in this correlation. The latest outpourings of molten rock over Snake River Plains occurred probably within recent times, and are perhaps not over 100 to 150 yrs old.

J. P. Buwalda, 1923 (Idaho Bur. Mines and Geol. Pam. 5). *Snake River lavas* either overlie or are interbedded with Idaho fm. and lie in central part of valley. They occur in thin sheets and in many cases appear very recent, having uneroded and fresh surfaces.

V. R. D. Kirkham, 1931 (Jour. Geol., vol. 39, No. 3, pp. 201–239). *Snake River basalt* is interbedded with upper members of Idaho fm. and Columbia River basalt (Mio.) discon. underlies Idaho fm.

H. T. Stearns (U. S. G. S. W. S. P. 774, in press) has mapped in detail a large part of area mapped in reconnaissance by Russell, and subdivided the basalts into many newly named fms. His work showed that Snake River basalt as defined and mapped by Russell included basalt flows of Mio., Plio., Pleist., and Recent age. The U. S. G. S. uses the old name *Snake River basalt* as a blanket term to cover undiff. basalt flows of these ages in southern Idaho.

Snake River stage.

Pliocene: Northwestern Nebraska (Cherry County).

E. H. Barbour, 1915 (Am. Jour. Sci., 4th, vol. 39, p. 87), described remains of a mastodon found near Burge, Cherry Co., in deposits "bordering a stream variously termed Snake Creek and Snake River," and stated: Latter name is preferable, since it avoids confusion with Snake Creek and the Snake Creek beds in Sioux Co. "The beds around Burge are equiv. to the well-known Snake Creek, and it might be sufficiently distinctive, as well as associative, to call these deposits the *Snake River stage.*"

Snake River series.

Permian (?): Northern Idaho (Orofino region).

V. R. D. Kirkham, 1927 (Idaho Bur. Mines and Geol. Pam. 24, pp. 3–6). *Snake River series (?)*.—Qtzite, cgl., sh., ss., impure ls., and highly altered schistose andesitic lavas and greenstone schist. Exposed in Clearwater River Canyon near Asahka. Appears on lithologic grounds to be an extension of Perm. rocks exposed in Snake and Salmon River Canyons farther W. and S. Relations to Belt series not clear.

Snaring formation.

Upper Cambrian: Alberta (Jasper Park).

P. E. Raymond, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 291, 292, 300). *Snaring fm.*—Yellow-weathering unfossiliferous dolomites, exposed along the Snaring about 1 mi. up the river from the bridge. Rests on sh. containing trilobites believed to be Upper Camb. [On p. 300 he seems to include the sh.] The Snaring is probably a shallow-water, near-shore equivalent of upper part of Lynx fm. of Mount Robson. Overlies Bosche ls. and sh. and underlies Mons dol. (Lower Ord.).

Snee sand.

Drillers' name, long in use, for a sand of Upper Dev. or early Carbf. age, in western Pa. Lies lower than Nineveh 30-foot sand. Considered same as Blue Monday sand.

Sneeds limestone lentil (of Everton limestone).

Lower Ordovician: Northern Arkansas.

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202). *Sneeds ls. lentil.*—Basal beds of Everton ls. in Hemmed-in Hollow, 2 mi. S. of Compton, Harrison quad. Typically exposed on Sneeds Creek. Underlies (uncon.) Kings River ss. memb. of Everton and uncon overlies Powell ls. Consists of sandy hard, compact dark-drab mag. ls. in thick layers; lowest layer contains many pebbles of underlying Powell ls. Greatest thickness 50 ft. Present only locally.

†Sneedville limestone.

Silurian (late): Eastern Tennessee.

J. M. Safford, 1856 (Geol. reconn. Tenn., 1st Rept., p. 157). *Sneedville ls.*—Band of gray ls. in eastern Tenn., 100 to 200 ft. thick, resting on variegated shales, with fine sss. and containing iron ore. Lies lower than Carbf. or Dev. black sl. Assigned to Dev.

Replaced by Hancock ls., later but better-established name, under which it has been mapped over large areas. Is of upper Cayuga age.

Named for Sneedville, Hancock Co.

Sneffels member (of San Juan tuff).

Tertiary (Miocene? or Oligocene?): Southwestern Colorado (Ouray district).

W. S. Burbank, 1930 (Colo. Sci. Soc. Proc., vol. 12, p. 187). *Sneffels memb. of San Juan tuff.*—Upper memb. of San Juan tuff in vicinity of Canyon Creek, Sneffels, and Ouray. Overlies Canyon Creek memb. of the San Juan and is uncon. overlain by Silverton volcanic series. Is characterized in lower part by uniform nature of lava fragments of which it is composed. These fragments are mostly of finely porphyritic lava containing numerous small phenocrysts of feldspar. Cgl. beds are much less common than in Canyon Creek memb. and are essentially absent in lower part. Thickness 1,500 to 2,000 ft. Becomes more heterogeneous in upper part as base of Silverton volcanic series is approached. On the whole the memb. is characterized by many light-colored beds of reddish or pinkish tone. At many places the breccia at base of Sneffels memb. is of reddish color. Ranging from 700 to 900 ft. below top of Sneffels memb. there is locally an andesitic flow, or several flows, interbedded in the memb., which range in thickness from 25 to 50 ft. These flows are of dark-gray or reddish color and characterized by amygdaloidal and scoriaceous tops.

Sniabar limestone.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 90, 97). [See under *Schubert Creek ls.* and *Swope fm.*] Named elsewhere in this Guidebook by Jewett.

J. M. Jewett, 1932 (pp. 99, 101, 103 of book cited above). *Sniabar ls.* will be proposed by N. D. Newell to replace "Hertha" as used for ls. at base of Kansas City fm. at Kansas City. It extends from Kansas City and beyond to near Linn-Bourbon Co. line. Thickness at Kansas City as much as 12 ft., but where present in Kans. it is generally less than 8 ft. Is memb. of Swope fm., underlying Elm Branch sh. and overlying Mound City sh.

J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, p. 134). *Sniabar ls.* at Kansas City has long been called *Hertha*, but writer has found this ls. pinches out near Linn-Bourbon Co. line and that the Hertha is really the Bethany Falls. The Sniabar pinches out to S. Named for Sniabar Creek in Mo., E. of Kansas City.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 25). Lower memb. of Hertha ls., well developed in NE. Kans. and adjoining parts of Mo., is here termed *Sniabar ls.*, from exposures along Sniabar Creek, SE. part of Jackson Co., NW. Mo. It consists of thick-bedded ferruginous fine-grained ls., generally drab or gray when fresh, weathering brown. Uppermost part is granular. Generally consists of a single bed. Averages 6 ft. thick in Miami Co., Kans. Rather unfossiliferous. Upper memb. of Hertha is Schubert Creek ls. of Jewett. A characteristic exposure is ½ mi. N. of Knobtown, Jackson Co. Outcrops at 4 places [described] in Miami Co., but does not outcrop in Johnson Co. [See also under *Hertha ls.*, 1935 entry.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 80), discarded *Sniabar ls.*

Sni Mills limestone.

Pennsylvanian: Northeastern Kansas (Jackson County).

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, pp. 19, 20). *Sni Mills ls.*—Gray or thin band of calc. fossiliferous marl; "brecciated" and algal in thicker phase. Thickness 0 to 1 ft. In lower part of Bourbon fm., higher than Warrensburg ss. [Derivation of name not stated, but p. 18 mentions "Stop 2. Sni Mills."]

Snoqualmie granodiorite.

Miocene: Central Washington (Snoqualmie quadrangle).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139). *Snoqualmie granodiorite.*—Batholith of massive granodiorite and granite, exposed about headwaters of Snoqualmie River. Intrudes Guye fm. and Keechelus andesitic series, both of which are Mio. Age must be late Mio. or post-Mio.

Snowbank granite.

Pre-Cambrian (lower or middle Huronian): Northeastern Minnesota (Vermilion district).

N. H. Winchell, 1899 (Minn. Geol. Nat. Hist. Surv. Final Rept., vol. 4). *Snowbank Lake granite* is intrusive into upper Keewatin.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 136). *Snowbank granite* is confined to Snowbank Lake and vicinity. Varies from fine-grained to coarse-grained, the medium-grained facies being most abundant; porphyritic facies also occur. Mineralogically it varies from normal mica and hornblende granite to augite granite and syenite. Intrudes Ogishke cgl. and Knife Lake sl.

†Snowbank Lake granite.

Same as *Snowbank granite.*

Snowbird formation.

Lower Cambrian: Western North Carolina and eastern Tennessee.

A. Keith, 1904 (U. S. G. S. Asheville folio, No. 116, p. 5 and columnar section). *Snowbird fm.*—Mainly fine and coarse qtzite. With this are interstratified beds of cgl. and arkose and subordinate layers of gray and black sl. Some of qtzites contain much feldspar in small grains, while others contain little but quartz grains. Most beds are light-colored, white or gray, but there are considerable variations in this respect. Southwest of Max Patch Mtn the lower layers are dark bluish gray, due to presence of oxides of iron btw. the quartz grains. When considerably weathered the iron oxides give the rock a rusty-brown or red color. In vicinity of Stackhouse they are dark gray, and on waters of Shelton Laurel Creek the bluish-gray and black layers are of frequent occurrence. The arkose beds which lie at base of fm. are either light gray or reddish, varying with color of feldspar fragments. Thickness 0 to 5,000 ft. Basal fm. of Camb. system. Underlies Hiwassee sl. Rests on pre-Camb. crystalline rocks.

Named for development in Snowbird Mtn, on bdy btw. Cocke and Haywood Counties in Mount Guyot quad., N. C.

Snow Creek porphyry.

Early Tertiary(?): Central Montana (Neihart district, Cascade County).

P. A. Schafer, 1935 (Mont. Bur. Mines and Geol. Mem. 13, map, pp. 10-15). *Snow Creek (Neihart) rhyolite or quartz porphyry.*—The rock called *Neihart porphyry* by Weed forms large intrusive mass exposed continuously from vicinity of I. X. L. mine across lower end of Poverty Ridge, a short distance above junction of Snow and Carpenter Creeks, across Carpenter Creek near mouths of Hegener and Mackey Creeks, and extending to divide at heads of those creeks. Can be traced 3 mi. Crosscuts Pinto diorite and the gneiss. Is probably early Tert.

Snowdrift sandstone.

Pre-Cambrian: Northwest Territories, Canada.

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 378).

Snow Fork limestone. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio.

E. Orton, 1878 (Ohio Geol. Surv., vol. 3, pp. 889, 897, pls. opp. pp. 889, 921). *Snow Fork ls.*—Buff ls. in Coal Measures, about 20 or 30 ft. above the great coal seam of Hocking Valley and stratigraphically btw. Norris and Hanging Rock lss.

Later repts state it is same as Norris and Lower Freeport lss.

Named for Snow Fork of Monday Creek, Hocking Co.

Snow Hill marl member (of Black Creek formation).

Upper Cretaceous: Coastal Plain of southern North Carolina and eastern South Carolina.

L. W. Stephenson, 1923 (N. C. Geol. and Econ. Surv. vol. 5, pt. 1, pp. 9-10). *Snow Hill calc. marl memb.*—Laminated sands and clays interstratified with layers or lenses of more or less calc. greensand and marine clay, some of which contain an abundant marine fauna, as at Snow Hill. Is largely a calc. deposit. Top memb. of Black Creek fm.

Named for exposures at Snow Hill, Greene Co., N. C.

†Snyder shale.

An abbreviated form of *Snyder Creek sh.*, employed by C. [R.] Keyes.

Snyder sands.

Subsurface sands of Chester (Miss.) age in Ind., the higher one (*Snyder shallow sand*) being correlated with Elwren ss. of Malott, and the lower one (*Snyder deep sand*) being correlated with Mooretown ss. of Cumings.

Snyder Creek shale.

Upper Devonian: Central Missouri.

J. A. Gallaher, 1900 (Mo. Geol. Surv. vol. 13, p. 153). *Snyder Creek shales.*—Shales overlying Western Hamilton or Callaway ls. and older than Genesee black sh. Limited almost exclusively to Callaway Co.

C. R. Keyes, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 285). *Snyder shales.*—Green and blue shales, 50 ft. thick, highly fossiliferous. Immediately underlie Chouteau ls. on Snyder Creek and overlie Callaway ls.

According to M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.), this sh. outcrops in Boone, Callaway, Montgomery, and Warren Counties.

E. B. Branson, 1923 (Mo. Bur. Geol. and Mines vol. 17, 2d ser., pp. 38–46). *Snyder Creek sh.* is overlain uncon. by Sylamore ss. over most of its extent, but Chouteau ls., Burlington ls., and Cherokee sh. are occasionally in contact with it.

Named for exposures on Snyder Creek (probably same as Craghead Creek), which flows through Snyder farm, Callaway Co.

Snyder Hill formation.

Permian: Southeastern Arizona (Whetstone Mountains).

A. A. Stoyanow, April 30, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 530–532, 536). *Snyder Hill fm.*—In Whetstone Mtns. above the ls. with Manzano fauna, are thin-bedded, very fossiliferous black ls. beds with wide array of gastropods, large and small. These black ls. beds are placed at base of Snyder Hill fm., on basis of their fauna. As defined at present the Snyder Hill fm. is a rather empirical unit. Its strat. position has been established as btw. beds containing Manzano fauna and beds containing fauna of memb. B of Kaibab fm. As yet no area has been located in which the entire Snyder Hill fm. is present. Thickness unknown, but estimated btw. 200 and 500 ft. Type loc. is Snyder Hill, an isolated hill, surrounded by Cret. deposits, 10± mi. SW. of Tucson. Base of fm. is not exposed there. Top beds in type loc. are gray lss. carrying silicified bryozoan reefs. [Assigned to Perm. and placed below Chiricahua ls.]

Snyderville shale. (In Oread limestone.)

Pennsylvanian: Southeastern Nebraska, eastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 32, 33, 38). *Snyderville sh.*, in Oread ls. memb., is largely argill.; in most exposures its upper part is bluish or grayish and lower part is reddish. Thickness 11 ft. in SE. Nebr., 15 to 17 ft. in NW. Mo., and 12 to 16 ft. in Kans. Underlies Leavenworth ls. and overlies Weeping Water ls. Named for exposures in Heebner Creek E. of Snyderville quarry, located btw. 3 and 4 mi. W. of Nehawka, Nebr.

Sobrante sandstone.

Miocene (lower): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Sobrante ss.*—Ss., somewhat variable in character, but prevailingly fine-grained and light-colored, though it shows local ferruginous staining. Some beds are gritty and some flaggy. Near base a bed of volcanic ash that ranges in thickness from a few in. to 20 or more ft. Is basal fm. of Monterey group. Thickness 400 ft. Underlies Claremont sh. and uncon. overlies Tejon fm. Named for exposures on Sobrante Ridge, Contra Costa Co.

In 1918 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 11, No. 2, pp. 54–111) B. L. Clark proposed to restrict *Sobrante ss.* to upper 80 to 100 ft. of Lawson's Sobrante ss., or to beds containing *Arca montereyana* fauna, and to transfer the lower (and uncon.) part to San Lorenzo (Olig.) or *Agasoma gravidum* zone.

Sockanosset sandstone.

Pennsylvanian: Eastern Rhode Island (Providence County).

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 159–163). *Sockanosset sss.*—Sss. and conglomeratic beds, well exposed in Sockanosset Ridge E. and W. of reservoir near Providence. Overlie Pawtucket shales, both of which are included in Cranston beds, and belong to Kingstown series of Foerste.

Socorran series.

A term applied by C. R. Keyes (Sci., n. s., vol. 23, p. 921) to 300 ft. of Miss. lss. in SW. N. Mex., said to underlie his Ladronesian series (shales) and to overlie Dev. lss.

Sodus shale member (of Clinton formation).

Silurian: Central and western New York.

J. M. Clarke, 1906 (N. Y. State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12). [See under *Irondequoit ls.*]

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114, pp. 5–35). *Sodus sh.*—Soft bright-green sh., 24 ft. thick, forming basal memb. of Clinton fm. in Rochester and Ontario Beach quads. Underlies Furnaceville ore and rests on Medina fm. [In Niagara quad. is 2½ to 6 ft. thick.]

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). The Furnaceville ore bed lies *in* and not *below* the Wolcott ls. [See further under *Furnaceville iron ore.*]

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 461–463), included *Sodus sh.* in Medina, but all published repts by other geologists include it in Clinton.

M. Y. Williams, 1914 (Canada Geol. Surv. Summ. Rept. 1913), stated that Wolcott ls. of Niagara escarpment rests successively on Sodus sh., Thorold ss., and Cabot Head sh.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Sodus sh.* restricted to beds as developed at type loc. of Sodus sh., which are shown to be younger than Sodus sh. of repts, the beds separating this redefined Sodus sh. from Thorold ss., being named (descending) Sterling Station ore, Reynales ls., Furnaceville ore, Bear Creek sh., Martville ss., and Maplewood sh. "Hartnagel defined this name as from town of Sodus [Wayne Co.], 'where this division is well shown in vicinity of Sodus Bay;' but, misled by Hall's error, he extended it to the basal or Maplewood sh. at Rochester." [Chadwick also stated that his Bear Creek and Maplewood shales are below water around Sodus Bay; that his restricted Sodus sh. is 18 ft. thick at Rochester and 55 ft. at Sodus; and that Hartnagel's Sodus sh. at Rochester is the much older Maplewood and Bear Creek shales. See further explanation under *Maplewood sh.*]

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 347), adopted Chadwick's 1918 classification of the Clinton of N. Y., but showed true Sodus sh. absent at Rochester.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 326, 327), placed *Sodus sh.* below Wolcott ls. and above Bear Creek sh.; included in it, at base, Sterling Station ore; stated it consists mainly of purple sh. with thin layers of highly fossiliferous pearly ls.; that it is absent at Rochester; and that it is 40 ft. thick at Wolcott, Wayne Co., 31 ft. at Lakeport, Oneida Co., and 55 ft. or more at Sodus, Wayne Co.

Soldado Rock formation.

Eocene: Trinidad.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 701).

Soldier Creek shale. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 30). *Soldier Creek sh.*—Sh., very aren. and moderately fossiliferous, 40 ft. or less thick. Included in Upper Coal Measures of Shawnee Co. [From statement on p. 28 appears to underlie Wakarusa ls. and overlie Stanton ls. The ls. underlying Soldier Creek sh. has for several years been known to be Burlingame ls. (see Condra, Nebr. Geol. Surv., 2d ser., Bull. 1, 1927), which is much younger than Stanton ls.; and the Oct. 1932 revised classification chart of Penn. of Kans. and Nebr., by R. C. Moore and G. E. Condra, defined Soldier Creek sh. as basal bed of Humphrey sh., and as underlying Wakarusa ls. and overlying Burlingame ls.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10), dropped Humphrey sh. from his classification and stated that *Soldier Creek sh. fm.* underlies Wakarusa ls. fm. and overlies Burlingame ls. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 218–221). Soldier Creek sh. underlies Wakarusa ls. and overlies Burlingame ls. Beede's original *Wakarusa ls.* is unit here called *Reading ls.*, and Wakarusa ls. as now defined by usage, mainly by Condra, was included in upper part of Beede's "Stanton" (=Burlingame) ls. It is apparent, therefore, that name *Soldier Creek* is transferred to a sh. that lies below that originally signified. Present application of Auburn sh. is synonymous with Beede's Soldier Creek sh. The Soldier Creek sh. is a bluish-gray to bluish clayey to sandy or silty micaceous unit locally containing a little ss. and a thin coal in upper part. In a few places marine invertebrates occur at top. Thickness 15 to 25 ft. in southern Nebr. and part of northern Kans., but near Kansas River and southward for many mi. it is less than 6 ft. thick; in southern Kans. it is 12 to

18 ft. thick; minimum 2± ft. Type loc. not designated, but presumably it is on "Big and Little Soldier Creeks about 3 mi. from Silver Lake," Shawnee Co., Kans.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

†Soledad division.

Miocene (upper): Southern California (Los Angeles County).

O. H. Hershey, 1902 (Am. Geol., vol. 29, pp. 349–372). *Soledad div.*—Gravel and sand, chiefly granitic, with lava pebbles and cobbles less abundant than in Lang div., and finer and more evenly bedded. Supposed to be marine. Thickness 3,000 ft. Conformably underlies Saugus div. and conformably overlies Lang div.

W. S. W. Kew, 1924 (U. S. G. S. Bull. 753, p. 81). The "*Soledad div.*" of Hershey is now thought by writer to be equiv., in greater part at least, to upper part of Mint Canyon fm. (upper Mio.) of this rept.

Named for exposures in Soledad Canyon, near Saugus, Los Angeles Co.

Soledad beds.

Cretaceous: Mexico.

E. Harrmann, 1913 (Deutsche geol. Gesell. Zeitschr., Bd. 65, Monatsb. 1, p. 25).

Soledad group.

Miocene (lower) or Oligocene: Southern California (Los Angeles County).

D. S. Jordan, 1919 (Leland Stanford Jr. Univ. Pub., Univ. ser., Fossil fishes of southern Calif., pp. 3–5). *Soledad group.*—Sss. and shales; the sss. of pale-yellow color, also soft white sss. and rather fine white shaly ss. Considerably older than the diatomaceous deposits referred to Monterey, which are sometimes segregated under name *Puente*. The fish fauna is older than Monterey and of lowest Mio. or possibly Olig. age. Well developed about Soledad Pass, in extreme N. part of Los Angeles Co., about 40 mi. N. of Los Angeles.

Soledad volcanic conglomerate member (of Catahoula tuff).

Tertiary (lower Miocene or Oligocene): Southwestern Texas coastal plain.

T. L. Bailey, 1926 (Univ. Tex. Bull. 2645, pp. 65, 80–89, 178–179). *Soledad memb. of Gueydan fm.*—Interbedded friable grayish-pink trachyandesite or acid andesite tuffs, pumice-pebble cgls. or lapilli beds, coarse to fine volcanic cgls. and volcanic sss. and tuffaceous sss. Middle memb. of Gueydan fm. [Thicknesses in sections 33 and 55 ft.] Underlies, conformably, Chusa memb. of Gueydan fm. and overlies Fant memb. of Gueydan. Assigned to Olig. because it correlates with lower part of Catahoula ss. Named for fact Soledad Hills, in western Duval Co., are composed of this memb.

The *Gueydan fm.* is same as Catahoula tuff, and "Gueydan" has been discarded by both Tex. Geol. Survey and U. S. Geol. Survey.

Soledad rhyolite.

Tertiary (?): Southern New Mexico (Dona Ana County).

K. C. Dunham, 1935 (N. Mex. School Mines Bull. 11, pp. 53, 56). *Soledad rhyolite.*—Flows 2,500 ft. thick. Overlies Cueva rhyolite. Exposed in mtns adjacent to Soledad Canyon, its type loc. Covers greater part of the lava field and occupies surface area of 35± sq. mi. In absence of evidence assigned to Tert.

Soleduck formation.

Cretaceous (?): Northwestern Washington (Olympic Peninsula).

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22, p. 161). *Soleduck fm.*—Hard gray ss. and flinty slates of N. slopes of the Olympics. At N. is mostly hard gray ss., but nearing the Soleduck, and btw. the tributaries of that stream it is chiefly flinty dark-colored sl., though soft carbonaceous shales are exposed on S. slope of ridge that separates main channel of Soleduck from its northern fork; the sl. weathers iron-rust color. From Soleduck Springs S. to top of Soleduck-Bogachiel divide the fm. is alternating very hard to soft sh. and ss. Thickness 20,000± ft. Rests uncon. on Bogachiel fm. No fossils, but believed to be Cret. [In this same publication Reagan mapped the *Pliocene plutonic rocks* as *Soleduck fm.*, thus using *Soleduck* in 2 senses.]

Soleduck formation.

Pliocene: Northwestern Washington (Olympic Peninsula).

A. B. Reagan, 1909 (Kans. Acad. Sci. Trans., vol. 22), mapped the Plio. plutonic rocks of Olympic Peninsula as *Soleduck fm.*, and also applied *Soleduck fm.* to a great thickness of ss. and sl. of Cret. (?) age in the same region.

Solen beds.

Miocene (?): Northwestern Oregon.

E. D. Cope, 1880 (Am. Nat., vol. 14, pp. 457–458, and Am. Phil. Soc. Proc., vol. 19, p. 62). *Solen beds.*—Extensive tertiary deposit rich in Mollusca, which is usually interrupted by the central elevations of the mountain axis. The unpublished notes of Prof. Condon, formerly State Geologist, refer them to upper Mio., under the name *Solen beds*. [Paleontologic name.]

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 321). Astoria group includes *Solen bed* of Condon.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 578, 601–605), correlate *Solen beds* of Condon with Empire fm., Astoria ss., and San Lorenzo or basal Astoria, which they assigned to Olig.

Solen limestone.

Middle (?) Devonian: Iowa.

See *Solon ls.*

Solitario slate.

Pre-Cambrian: Central northern New Mexico (Las Vegas region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 11). *Solitario slates.*—Extensive section of tilted Archeozoic beds lying above the main ls. exposed in Solitario Mtn. NW. of Las Vegas. Thickness 800 ft.

Solitario formation.

Upper Ordovician (?): Southwestern Texas (Solitario Peak).

W. A. J. M. Van der Gracht, 1931 (K. Akad. Wetensch. Amsterdam Verh., Afd. Natuurk, Deel 27, No. 3, table Vc, p. 64). The table of fms., furnished this author by C. L. Baker, describes "15 or 20 ft. of bright-green siliceous and clay shales" btw. the Maravillas and Caballos, which is designated as the "Solitario fm."

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 79). Overlying Maravillas chert in Solitario uplift is a green sh., the max. observed thickness of which does not exceed 25 or 50 ft. This sh., lying btw. these heavy cherts and the Dev. [?] novaculite, is but imperfectly exposed and as a rule is seen only as a grass-covered slope btw. these 2 fms. Best exposures seen were in fault blocks in SW. and NE. parts of the basin. A similar sh. of lesser thickness is locally present in Marathon uplift, btw. Maravillas chert and Caballos novaculite.

Solitude granite.

Pre-Cambrian: Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Solitude granite.*—Granite and muscovite granite. Intrudes Pinal schist, which is overlain by Apache group. One area lies at head of Solitude Gulch, Globe quad.

Solomon gypsum. (In Sumner group.)

Permian: Central Kansas.

G. P. Grimsley, 1899 (Univ. Geol. Surv. Kans., vol. 5, pp. 58–61). [On p. 58 Grimsley gave a geol. section at Solomon gyp. mine, Dickinson Co., showing 7 beds of gyp. separated by sh. or by ls. On p. 61 the text beneath the heading "Other exposures" begins with: The lower gyp. horizon which, for convenience of description, may be called *Solomon gyp.*, outcrops ¼ mi. S. of the Dillon mill, where 5 ft. of rock is exposed covered with 5 ft. of dirt. This locality is 2 mi. W. of Hope shaft and the rock is 10 ft. lower.]

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 717). "Solomon gyp." of Grimsley lies 100 ft. lower than "Greeley gyp." of Cragin, both occurring in lower part of Marion fm. At Hope, in SE. part of Dickinson Co., the Greeley gyp. and Hope gyp. occur, separated by 100 ft. of shales and lss.

I. Perrine, 1918 (A. A. P. G. Bull., vol. 2, pp. 73–90). Solomon gyp. of Dickinson Co. lies 100 ft. lower than Greeley gyp. of same Co.

Solomon schist.

Pre-Ordovician (?): Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 50–53, etc., maps). *Solomon schist.*—Highly metamorphosed quartzose and calc. schists, with some interbedded lss. and numerous quartz veins. Of pre-Ord. (?) age. Oldest fm. in Solomon and Casadepaga quads. Underlies Sowik ls., probably uncon. Exposed along Solomon River.

Solomon Creek member (of Seguin formation).

Eocene (lower): Southeastern Texas.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 575, 576, 577). *Solomon Creek memb.*—Lower memb. of Seguin fm. Consists of gray laminated silty clay, fine, uniformly grained gray sand containing large flat, rough-surfaced calc. concretions from 1 to 12 ft. long and from a few in. to several ft. thick, and layers of silty carbonaceous clay containing plant remains, sulphur and gyp. crystals. Carries no lignite beds. Type loc. in Solomon's Creek, 6 mi. S. 25° W. of Elgin, Bastrop Co.

Solomon's Corner limestone.

Lower Ordovician (Beekmantown): Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 7).

Solon limestone.

Middle (?) Devonian: Central eastern Iowa.

W. H. Norton, 1897 (Iowa Geol. Surv., vol. 6, p. 148). *Solon substage.* [Only definition is use of name in table for basal part of Cedar Valley ls., underlying Mason City substage of Cedar Valley and overlying Wapsipinicon ls.]

C. [R.] Keyes (Iowa Acad. Sci. Proc., vol. 19, p. 149, 1912, and vol. 20, p. 206, 1913). *Solon terrane.*—Consists of 15 ft. of gray shaly ls. containing *Megistocrinus*, underlain by 10 ft. of compact bluish ls. containing *Phillipsastrea*. Overlain by Rapid ls. div. of Cedar Valley and underlain by Wapsipinicon ls. Included in Senecan.

Named for Solon, Johnson Co.

Solsberry formation.

Mississippian: Southwestern Indiana.

F. C. Greene, 1911 (Ind. Acad. Sci. Proc. for 1910, pp. 275, 281). *Solsberry fm.*—[Definition not clear, but seems to apply name to all Miss. rocks in western Monroe and eastern Greene Counties, above Mitchell ls. and uncon. underlying the Penn. As thus used it includes most of Chester group.]

Named for Solsberry, Greene Co.

Solsville member.

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 133, 219+). *Solsville memb. of Marcellus fm.*—Sandy sh., fine ss., and a calc. ss., 45 to 50 ft. thick, transitional into underlying Bridgewater sh. memb. of Marcellus in Chenango and Unadilla Valleys. Overlain by Pecksport memb. of Marcellus. Characterized by typical Hamilton fossils in an unusual assemblage. ["Common forms" are listed.] Forms ridges on sides of hills N. of Solsville [Madison Co.]. Type section is falls in Woods gully, 2 mi. NW. of Solsville. Also occurs in Reilly's quarry, 4 mi. NW. of Bridgewater. Not known W. of Pine Woods, Morrisville quad.

Somerset shale member (of Warsaw formation).

Mississippian: Southeastern Kentucky.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, pp. 89, 104). *Somerset sh. memb.*—Calc. sh. or shaly ls. with variable amount of highly fossiliferous ls. of usual Warsaw ("Harrodsburg") type intercalated in it in thick and thin layers. Thickness 10 to 50 ft.; 20 ft. at Somerset. Lies near top of Warsaw fm., but stratigraphically lower than Garrett Mill ss. memb. Is overlain by a few ft. of thick-bedded ls. containing Warsaw fossils, and above this ls. lies St. Louis ls. Named for Somerset, Pulaski Co., where it is well exposed in R. R. cut a short distance N. of R. R. station.

Somerset member. (In Pottsville formation.)

Pennsylvanian: Southern Illinois (Saline County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 311–312). *Somerset memb. of Carbondale fm.*—Those Penn. strata in southern Ill. which occur btw. Curlew ls. and Murphysboro or Davis coal, which were formerly included in Tradewater fm. Named for exposures in vicinity of Somerset, Saline Co. [The U. S. Geol. Survey draws top of Pottsville fm. at base of Murphysboro coal. These beds therefore belong to Pottsville fm. of most authors.]

Somerville limestone.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and G. H. Ashley, 1902 (U. S. G. S. Ditney folio, No. 84, p. 2). *Somerville fm.*—Ls., 30 ft. thick, with sh. memb. in middle. Overlain by Ditney fm. and underlain by Millersburg fm.

The Ind. Geol. Survey now includes these beds in Shelburn fm. (See Cumings, Hdb. Ind. Geol., pt. 4, Sep. Pub. 21.)

Named for Somerville, Gibson Co.

†Somerville slate.

Carboniferous or Devonian: Eastern Massachusetts.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, No. 4, pp. 196–197). *Somerville sl.* is lithologically similar to recognized Camb. slates of the [Boston] region and markedly dissimilar to known Carbf. rocks of neighboring areas, especially to those of Narragansett Basin.

F. H. Lahee, 1914 (Am. Jour. Sci., 4th, vol. 37, p. 316). *Somerville slates*, 2,300 ft. thick, grade into underlying Squantum tillite of Roxbury cgl. through transition beds of shales or slates, sss., and cgls. 200 to 300 ft. thick.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks at and around Somerville as Cambridge sl., and the name "Somerville sl." has been discarded.

Somerville granite.

Pre-Cambrian: Northeastern Virginia (Fauquier County).

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30). *Somerville granite*, typically developed near Somerville. Is coarse-grained biotite-muscovite granite, massive, pegmatitic, of pre-Camb. or Camb. age, and closely related to Locust Grove granite.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped the granite at and around Somerville, Fauquier Co., as pre-Camb. and as intrusive into Glenarm series (Algonkian?).

Sonoma tuff.

Pliocene: Northern California (Sonoma County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 39–87). *Sonoma tuff.*—Andesitic in character and interbedded with thin flows of basalt, and with sss. and volcanic cgls. to W., where it is of fluviatile origin. To E. is interbedded with volcanic aggls. and breccias and is largely of aeolian origin. Rests conformably on Mark West andesite. Thickness 1,700 ft.

Probably named for exposures in Sonoma Mtns, Sonoma Co.

Sonoma group.

Sonoma volcanics.

Pliocene: Northern California (north of San Francisco Bay region).

R. E. Dickerson, 1922 (Calif. Acad. Sci. Proc., 4th ser., vol. 11, No. 19, with maps). *Sonoma group.*—Basalts, andesites, rhyolites, tuff-breccia, fine-grained tuff, and other aggls. Generalized section running N. from Adobe Fort to Petaluma Reservoir shows following sequence (descending): Basalt, tuff, basalt, cgl., basalt, *Neohipparion gidleyi* beds, and tuff, resting uncon. on Petaluma fm. Includes Sonoma tuff, Mark West andesite, and St. Helena rhyolite of Osmont. Is overlain by Millerton fm. In Pinole syncline is known as *Pinole tuff*. The tuffaceous facies of Sonoma group are represented as interbedded tuff members of marine Merced group.

R. R. Morse and T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 10, pp. 1437–1455). *Sonoma volcanics* overlie, with angular uncon., Petaluma fm. in Petaluma dist. and are probably = Merced fm. *Neohipparion gidleyi* occurs in Petaluma fm., and not in Sonoma group. [On map the Sonoma is assigned to *upper or middle Plio.;* but in text authors seem to incline to *middle Plio.*]

Named for typical exposures on W. flanks of Sonoma Mtns, Sonoma Co.

Sonora sandstone.

Mississippian: Southeastern and central eastern Iowa and northwestern Illinois (Carroll County).

C. R. Keyes, 1895 (Iowa Geol. Surv. vol. 3, pp. 320, 344–350). *Sonora ss.*—Sandy mag. ls., 8 ft. thick, forming top memb. of Augusta ls. in Lee Co., Iowa. Overlies Warsaw shales and underlies St. Louis ls. Named for Sonora quarries, on Ill. side of Miss. River., opp. Nashville and below Belfast.

According to F. M. Van Tuyl (Iowa Geol. Surv. vol. 30, 1925, p. 225) this is an aren. facies of Spergen fm., 20 ft. thick, and was formerly quarried extensively in Miss. River bluff 1 mi. S. of Sonora, Carroll Co., NW. Ill., where it underlies St. Louis ls. and overlies Warsaw sh.

Sonora shale.

Pennsylvanian: Missouri.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 252). *Sonora terrane.*—Shales, 100 ft. thick, underlying Cherokee sh. and overlying Chester in Mo.

Is basal part of Cherokee sh.

Derivation of name not stated.

Sonora formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 334).

Sonyea.

Upper Devonian: Western New York (Genesee River region).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96, 98). To the combined Middlesex and Cashaqua, which are a natural unit, the name *Sonyea* is herein applied, from exposures on Cashaqua Creek at that place, near Portage. Overlain by Attica (combined Rhinestreet and Hatch), and all included in Nunda (Naples) group.

G. H. Chadwick, Feb. 28, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 314, 352). [See 1935 entry under *Ithaca sh. memb.*]

G. H. Chadwick, Dec. 1935 (letter dated Dec. 11). *Sonyea* was introduced to emphasize that Middlesex-Cashaqua constitute continuous sedimentation. Since these beds, instead of the Attica, now prove to be the Ithaca, the name has no lasting value save for a facies (parvafacies) of the Ithaca, and I have abandoned it.

Soo series.

Pre-Cambrian (early Huronian): Western Ontario.

R. G. McConnell, 1927 (Ont. Dept. Mines 35th Ann. Rept., pt. 2, p. 12). *Soo series,* pre-Camb., Ont.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned these rocks to early Huronian.

Sooke formation.

Miocene or Oligocene or both: Northwestern Washington and British Columbia (Vancouver Island).

J. C. Merriam, 1896 (Univ. Calif. Dept. Geol. Bull., vol. 2, pp. 105–108). *Sooke beds.*—The cliffs at mouth of St. Johns River and near Sooke, on S. coast of Vancouver Island, contain the Sooke fauna [listed], show considerable thickness of soft ss. with some cgl. In places the ss. is full of well-preserved fossils. Evidence indicates Sooke beds are middle Neocene and considerably later than Carmanah Point beds, whose fauna seems to be Mio.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 336–343). *Sooke beds* were named for Sooke Inlet, S. coast of Vancouver Island.

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A), assigned Sooke fm. to *Olig.-Mio.*

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, p. 575). Occupying several disconnected areas along S. coast of Vancouver Island from Becher Bay W. to Sombrio River near Port San Juan, and perhaps farther, is the fm. termed *Sooke beds* by Merriam. Excepting type area btw. Muir and Coal Creeks, several mi. W. of Sooke, where drillings have shown the sediments to be more than 1,500 ft. thick, the beds comprise only a few ft. of basal cgl., usually less than height of the sea cliffs, which lies on Vancouver greenstone diorites. Is only local sediment, of Olig. age.

C. H. Clapp, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 50), assigned Sooke fm. to *Mio.*, and 1917 (Canada Geol. Surv. Mem. 96, p. 329) assigned it to *Mio. (?)*.

B. L. Clark and R. Arnold, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 303–308). *Sooke fm.* or *Agasoma acuminatum* beds underlies San Lorenzo fm. or *Molopophorus* zone, but fauna is probably only a facies of latter. Assigned to Olig.

H. C. Cooke, 1919 (Canada Geol. Surv. Mus. Bull. 30, p. 2), assigned Sooke fm. to Mio.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2) assigned Sooke fm. to Mio.

Sooke gabbro group.

Sooke intrusives.

Oligocene: British Columbia.

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A) and C. H. Clapp, 1912 (Canada Geol. Surv. Mem. 13, p. 113).

Sooy conglomerate. (Buried.)

Pennsylvanian: Central Kansas.

F. C. Edson, 1935 (Tulsa Geol. Soc. Digest, May 7, 1934, pp. 30–32). The "Sooy" cgl. is widely distributed in western central Kans. but has no definite strat. position. Rests on beds ranging from pre-Camb. to upper Bendian, and is overlain by beds from Morrow to upper Lansing in age. It is an orogenic molasse deposit representing the 2 subphases of Wichita orogeny as well as several lower and middle Penn. orogenic periods. The "Sooy" cgl. and the Morrow-Atoka-Cherokee-Marmaton-Kansas City-lower Lansing groups represent, in part, simultaneous deposition of unlike sediments, although the "Sooy" is everywhere overlain by some part of the more marine group. The Gorham sand is a phase of it. It includes the weathered beds that overlie the "Chester," and I think the Welch chert. I place top of the "Sooy" at top of the red chert pebbles. It is more difficult to get the base. It contains a surprisingly small amount of Decorah sh. [On p. 31 I. H. Cram stated: If this cgl. was on the surface it would be a mappable unit and would be a fm.]

E. A. Koester, 1935 (A. A. P. G. Bull., vol. 19, No. 10, p. 1413). *Sooy cgl.* (named by Edson, Tulsa Geol. Soc. Digest, 1934) is a transgressive deposit, overlying rocks of pre-Camb. to Miss. age and underlying beds ranging in age from Cherokee in central Kans. to possible Perm. in NW. Kans. Name derived from one of first wells drilled in western Kans., in Barton Co. In its most common development it is a coarse cherty, partly sandy cgl. commonly cemented with red sh. Represents the first deposit of a transgressive sea. Locally contains several sand zones. Gorham sand is a near-shore phase of Sooy cgl.

†Sopchoppy limestone.

Miocene (lower): Northwestern Florida (Wakulla County).

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 119–122, 158, 334). *Sopchoppy ls.*—Very soft ls. containing numerous imprints of shells and many fragments of vertebrate ribs and other bones, also Conrad's orbitolite and about 30 species of shells, most of which are common to Chipola marl or *Orthaulax bed*. The horizon is probably not far from that of Chipola marl. Thickness unknown. Referred to Older Miocene.

Julia Gardner, 1926 (U. S. G. S. P. P. 142A, p. 2). "Sopchoppy ls." is nothing more than a shallow-water facies of Chipola fm.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept.). Hawthorn fm. restored to good standing and "Sopchoppy ls.," of Chipola age, included in it.

Named for exposures at Sopchoppy, Wakulla Co.

Sophie Mountain conglomerate.

Tertiary: British Columbia.

E. L. Bruce, 1917 (B. C. Dept. Mines Bull. 4, p. 5).

Sopris coal group. (In Vermejo formation.)

Upper Cretaceous: Eastern Colorado (Elmoro region).

R. C. Hills, 1899 (U. S. G. S. Elmoro folio, No. 58), applied *Sopris group* to 80 ft. of sh., shaly ss., and coal beds, lying 35 to 40 ft. above Engle [coal] group. Both of these coal groups belong to Vermejo fm. of present terminology.

Sorel sand.

Quaternary: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 225).

Soudan iron-formation.

Pre-Cambrian (Keewatin): Northeastern Minnesota (Vermilion district).

C. R. Van Hise and J. M. Clements, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Soudan fm.*—Iron-bearing; cherty iron carbonates, pyritic quartz rocks, ferruginous cherts, jaspilites, and ore bodies. Thickness 0 to 1,000 ft. Overlies Ely greenstone and is intruded by granite, greenstone, and porphyry. Named for occurrence on Soudan Hill, Vermilion dist.

The U. S. Geol. Survey has recently adopted *iron-formation* as a lithologic term.

Sougahatchee granite.

Age (?): Central eastern Alabama (Tallapoosa County).

G. I. Adams, 1933 (Jour. Geol., vol. 41, pp. 168–169). The basic rocks of the older intrusives of Dadeville belt are cut by granitic intrusives, the larger and more conspicuous areas of which are shown in a general way on the sketch map. The granite is here named *Sougahatchee granite*, from the creek near which it is exposed at many places in SW. border of Dadeville belt. Is much more gneissic than Pinckneyville granite.

Soulala formation.

Quaternary: Nicaragua.

O. H. Hershey, 1912 (Geol. Soc. Am. Bull., vol. 23, p. 507).

Soultan series.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). *Soultan series.*—Qtzites which with the uncon. overlying unnamed lavas and granites comprise Algomic period of Archeozoic era in Lake Superior region. [In 1917 (Iowa Acad. Sci. Proc., vol. 24, p. 56) Keyes removed these qtzites from his Algomic period and placed them in his underlying Huronic period.]

Derivation of name not stated.

Sour Dough limestone.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Exposed in Sour Dough Canyon, in S. part of Panamint Range.]

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). *Sour Dough ls.*—Crystalline micaceous, aren. gray ls. with alternating white and gray stripes which in some places are corrugated. Thickness 50 to 60 ft. Basal fm. of Telescope group. Underlies Middle Park fm. and overlies Surprise fm., all of which are assigned to lower Paleozoic (?).

Souris Lignitic.

Upper Cretaceous: Canada.

G. M. Dawson, 1881 (Canada Geol. Surv. Rept. 1879–80, p. 128). Local name for Upper Cret. beds on Souris River that have been referred to Laramie fm.

†Sourland Mountain trap.

Name applied by N. H. Darton (U. S. G. S. Bull. 67, 1890) to the sheet of diabase on Sourland Mtn, N. J., which intrudes Brunswick and Lockatong fms., of Newark group (Upper Triassic). This local geographic name considered unnecessary and is not used by U. S. Geol. Survey.

South Ada limestone.

Miners' name for an ore-bearing ls., 8 ft. thick, in lower part of Oquirrh fm. (Penn.), Stockton dist., central northern Utah. Lies 18 ft. below their North Ada ls. and 230 ft. above their Maverick ls. Exposed in Ada claim. (See U. S. G. S. P. P. 173, 1932.)

South Amboy fire clay.

Economic term for a clay bed, 5 to 30 ft. thick, in Raritan fm. of NE. New Jersey. See G. H. Cook and J. C. Smock, 1877 (N. J. Geol. Surv. map of clay dist. of Middlesex Co.), and G. H. Cook, 1878 (N. J. Geol. Surv. Rept. on clays, p. 34). Named for occurrence at South Amboy.

South Bend limestone. (In Stanton limestone.)

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 23). *South Bend ls.*—Exposed in bed of Salt Creek SW. of C., B. & Q. station at Ashland, at track level near mouth of Salt Creek, in valley sides from Pawnee Creek to Louisville, and from State Fish Hatcheries to Meadow. Thickness 8 to 9 ft. Along railroad ½ mi. E. of Pawnee Creek it shows: Light-gray ls., 10 in.; light-colored sh. with calc. concretions, 1 ft. 3 in.; light-gray ls., 2 ft. 10 in.; light bluish gray sh., 1 ft. 10 in.; ls. with large flint nodules, 2 ft. 6 in. Lies 6 to 10 ft. above Louisville ls. and 16 to 18 ft. below Ashland ls. [Pl. 2 shows the ls. exposed in cliff at South Bend, Cass Co.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 41, 58). *South Bend ls.*, 9 ft. thick, is in lower part of Scranton sh. It overlies Rock Lake sh. and underlies Plattford sh. Named for exposures just N. of South Bend.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 13, 27, 32). In Ashland section what was supposed to be *South Bend ls.* is Iatan ls. The South Bend ls. underlies Weston sh. and overlies Rock Lake sh. and is top bed of Stanton ls. memb. [This is definition adopted by R. C. Moore and Condra in their Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.]

South Bend sandstone and shale. (In Graham formation.)

Pennsylvanian: Central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 37; Univ. Tex. Bull. 2132, pp. 127–136). *South Bend ss. and sh.*—A memb. of Graham fm. (of Canyon group), underlying Gunsight ls. memb. and overlying Bunger ls. memb. Consists of light-gray fine-grained lenticular ripple-marked sss. and blue-gray sandy fossiliferous shales 50 to 110 ft. thick. Typically exposed at South Bend, Young Co. Thins to S.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 104, 113, 114). *South Bend* is preoccupied and now replaced by *Necessity sh.*

South Bosque marl.

Upper Cretaceous: Central Texas (McLennan County).

J. K. Prather, 1902 (Tex. Acad. Sci. Trans., vol. 4, pt. 2, No. 8). *South Bosque marl.*—Marl, of clay-yellow color, with a few thin beds of argill. ls. interbedded. Thickness 100 to 250 ft. Underlies Austin chalk and overlies Eagle Ford clay. Included in Austin chalk by R. T. Hill.

According to L. W. Stephenson (personal communication, June 1930) the beds referred to belong to upper part of Eagle Ford fm.

Named for exposures at South Bosque Station, McLennan Co.

South Britain conglomerate.

Upper Triassic: Western Connecticut.

W. H. Hobbs, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 40–43, 49–51, 63–64). *South Britain cgl.*—Coarse arkose cgl. with included layers of Newark system [group]. Found principally in village of South Britain, Conn.

South Butler amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs to Central Mine group. Is younger than Ogima amygdaloid and older than Butler amygdaloid. The mineralized part is the South Butler lode. Probably named for its occurrence S. of the Butler amygdaloid, in Ontonagon Co.

South Butler flow.

Includes South Butler amygdaloid and the underlying trap.

South Carrollton limestone.

Pennsylvanian: Western Kentucky.

C. J. Norwood, 1878 (Ky. Geol. Surv., 2d ser., vol. 4, pt. 7, pp. 296-301, 319). *South Carrollton ls.*—Somewhat mottled ls., having a somewhat ferruginous exterior, marked with dove, drab, or ashy-white splotches. On fractured surface seems mainly blue or dove-colored, changing at places to drab or chocolate brown. Thickness 3 to 13 ft. In vicinity of South Carrollton [Muhlenberg Co.] the surface of the ls. is usually thickly studded with large crinoid columns. Probably identical with Madisonville ls. Exposed in bluff ½ mi. NW. of South Carrollton.

Southerland sand.

See *Sutherland sand.*

†Southern drift.

Descriptive term used in early La. and Miss. repts for Plio. deposits now in part at least included in Citronelle fm.

†Southern Lignitic.

See under *†Grand Gulf group.*

Southern Belle quartzite.

Middle Cambrian: Southeastern Arizona (Santa Catalina Mountains).

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 476-477, 482). *Southern Belle qtzite* (Middle Camb.) consists of 26 ft. of cliff-forming massive white qtzite, underlying Abrigo fm. (Upper Camb.) and overlying Santa Catalina fm. in Peppersauce Canyon, Santa Catalina Mtns.

South Fork limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, pp. 5, 10). Burlingame ls. fm. divided into (descending): (1) *South Fork ls.* (one massive bed, or 2 or 3 beds separated by sh., 2½ ft.); (2) Winnebago sh. (bluish, argill., some limy fossiliferous seams, 8 to 12 ft.); (3) Taylor Branch ls. (bluish gray, massive, weathering brownish, 2 to 4½ ft.). The South Fork lies high in hill ¾ mi. SW. of DuBois [Pawnee Co., SE. Nebr.], at W. side of South Fork Valley; type of the Winnebago is in Mo. River bluffs S. of mouth of Winnebago Creek, N. of Rulo, Richardson Co., Nebr.; the Taylor Branch is lowest heavy ls. at top of opening in clay pit S. of Taylor Branch, S. of Table Rock, Nebr. These members have been traced through Kans. to Okla.

Southgate member. (In Latonia shale.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and north-central Kentucky.

R. S. Bassler, 1906 (U. S. Nat. Mus. Proc., vol. 30, p. 9). *Southgate.*—Blue to yellow shales, 20 ft. thick, with fewer lss. than in rest of Eden. Comprises middle memb. of Eden. Overlain by McMicken memb. and underlain by Economy memb.

Is middle part of Latonia sh.

Named for Southgate, Campbell Co., Ky.

South Hampton granite.

Age (?): Southeastern New Hampshire (Rockingham County).

E. Hitchcock, 1823 (Am. Jour. Sci., 1st, vol. 6, pp. 3-6). In painting on the map what I have denominated *South Hampton granite* I have comprehended most of the Chesterfield and Goshen granite. Texture of South Hampton granite is rather coarse. It contains the South Hampton lead mine. [South Hampton is in Rockingham County, N. H.]

South Higgins moraine.

Pleistocene (Wisconsin stage): Northern central Michigan (Roscommon County).

W. A. Ver Wiebe, 1927 (Papers Mich. Acad. Sci., Arts, and Lett., vol. 7, p. 161). Lies just S. of Higgins Lake.

South Mapleton andesite.

Paleozoic: Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 113, 169, 173). *South Mapleton andesites.*—Andesites outcropping in 10 or 12 places in fields in S. part of Mapleton Twp, to N. and S. of Mapleton-Presque Isle road. They are either identical with or present only minor variations from the Edmunds Hill and Hobart Hill masses. Assigned to Paleozoic.

On 1933 geol. map of Maine, by A. Keith, the andesites of NE. Maine are assigned to Dev.

South Moat flows.

Devonian (?): Northern New Hampshire (North Conway quadrangle, White Mountains).

M. Billings, 1928 (Am. Acad. Arts and Sci. Proc., vol. 63, No. 3, map, pp. 72, 92). *South Moat flows.*—Flows of comendites (quartz porphyries) and trachyte included in Moat volcanics, the rest of Moat volcanics being Pequawket breccia. The comendites are typically exposed on South Moat Mtn. The trachyte is found as a distinct flow only on S. slopes of South Moat Mtn. The South Moat flows are same as quartz porphyry of Hitchcock. [On map *South Moat flows* is divided into 2 blocks, the upper one labeled *comendites* and the lower one *trachyte*. See also under *Moat volcanics.*]

South Mountain slates.

Cambrian: Southern Pennsylvania.

F. Platt, 1877 (2d Pa. Geol. Surv. Rept. H., p. xxiv), divided Camb. system of Pa. into (descending) *Potsdam ss. (No. 1)*, *South Mountain slates*, and *Blue Ridge cgls.*, etc.

South Mountain quartzite.

A name casually applied in some early repts to the Lower Camb. Chickies qtzite of South Mtn, Pa., and western Md. See C. D. Walcott, Am. Jour. Sci., 3d, vol. 47, pp. 37–41, 1894, and U. S. G. S. Bull. 134, p. 33, 1896.

South Mountain gneiss.

A name casually applied in some early Pa. Survey repts to the gneiss of South Mtn. Also called "Laurentian gneiss."

†South Mountain type.

A field name applied by E. S. Larsen to part of Fisher quartz latite on South Mtn, Platoro-Summitville region, Rio Grande Co., Colo. (See Colo. Geol. Surv. Bull. 13, 1917.)

†South Pass group.

Pliocene: Northwestern Wyoming.

T. B. Comstock, 1874 (Rept. of reconn. of NW. Wyo. made in 1873 by Wm. A. Jones, table opp. p. 103), applied *South Pass group* to Plio. deposits divided into volcanic rocks (above) and *Yellowstone Lake group* (below). In text he used *South Pass beds*. Neither *South Pass group* nor *Yellowstone Lake group* is defined, and both have been ignored by other geologists working in region.

South Pewabic amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. R. Marvine, 1873 (Mich. Geol. Surv. vol. 1, pt. 2, pp. 52, 76, 77 and chart).

Belongs to Ashbed group. Is younger than Pewabic cgl. and older than Ashbed amygdaloid. The mineralized part is the South Pewabic lode. Named for occurrence in old South Pewabic mine, in Houghton Co.

South Pewabic flow.

Includes South Pewabic amygdaloid and the underlying trap.

South Prairie formation.

Eocene: Western Washington (Puget Sound region).

B. Willis, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 424 to 430). [See under †*Pittsburg fm., Eocene*, 1898 and 1899 entries.]

South Saskatchewan gravels.

Late Tertiary or Quaternary.

R. G. McConnell, 1886 (Geol. and Nat. Hist. Surv. Canada Ann. Rept. 1885, vol. 1, p. 70C).

South Tunnel bed.

Silurian (Niagaran): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402). *South Tunnel bed.*—Overlies Baker (Clinton) ls. and underlies Whites Bend (Laurel) ls. Thickness 0 to 12 ft. Included in Clifton ls. Same as Osgood shaly clay of Ind.

Named for South Tunnel, Sumner Co.

South Valley limestone.

Name used by J. P. Lesley on map 43, Pa. Geol. Surv. Rept. X, 1885.

†South Valley Hill slates and mica schists.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania.

C. E. Hall, 1881 (2d Pa. Geol. Surv. Rept. C_6, pp. 31+). These slates and schists form a prominent ridge flanking Chester County ls. on S. and called South Valley Hill, hence the name—*South Valley Hill slates and mica schists.*

Include Wissahickon fm. and part of Peters Creek schist.

Southward Bridge formation. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama.

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Southward Bridge fm.*—Consists of (descending): (1) Fossiliferous ls.; (2) thick sh. and ss.; (3) fossiliferous ls.; (4) thick sh. Thickness 80 ft. Underlies Forest Grove fm. and overlies Southward Spring ss. Exposed in bluffs of Bear Creek SE. of Southward Spring.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details of fm., including thicknesses of subdivisions, as follows: Upper ls., 5½ ft.; lower ls., 2 to 4 ft.; interval btw. the lss., 45 to 50 ft.; and basal sh. or clay, 31± ft. Type loc., Southward Bridge, near old village of Mingo, at confluence of Bear Creek and Cedar Creek Valleys [which his map shows is in Ala.], where fm. is 82 ft. 7 in. thick.

Southward Pond formation. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama.

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Southward Pond fm.*—Of oolitic texture and at many places contains asphalt. Whole fm. fossiliferous. Thickness 80 to 100 ft. Consists of (descending): (1) Sh. or shaly ls.; (2) *Pond ls. "C,"* 1 or 2 ft.; (3) sh. or shaly ls.; (4) *Pond ls. "B,"* 1 or 2 ft.; (5) sh. or shaly ls.; (6) *Pond ls. "A,"* 5 to 15 ft.; (7) sh. or shaly ls. Underlies Southward Spring ss. and overlies Allsboro ss. Named for exposures around bluffs of Southward or Cypress Pond.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details of this fm., and described the lss. as follows: *Pond ls. "C,"* 3± ft. of somewhat cross-bedded hard bluish-gray, coarsely crystalline fossiliferous ls.; *Pond ls. "B,"* 0 to 1 ft. of very fossiliferous crystalline ls.; *Pond ls. "A,"* 1 to 16½ ft. of massive, slightly reddish-gray oolitic or foraminiferal ls., everywhere asphaltic. Pond ls. "C" lies 10 to 12 ft. above Pond ls. "B," which lies 10 to 27½ ft. above Pond ls. "A." Latter lies 6 to 25 ft. above Allsboro ss. Fm. named for exposures in bluffs of Southward (or Cypress) Pond, at Southward homestead. The pond is perhaps an old meander of Bear Creek.

Southward Spring sandstone. (In Chester group.)

Mississippian: Northeastern Mississippi (Tishomingo County) and northwestern Alabama (?).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Southward Spring ss.*—Impure shaly ss., somewhat calc., underlying Southward Bridge fm. and overlying Southward Pond fm. Thickness 30± ft.; 15 ft. exposed at Southward Spring.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details of fm. On p. 118 he says "Southward Spring ss. is well exposed at the spring south of the [Southward or Cypress] pond."

Sowik limestone.

Ordovician (?): Northwestern Alaska (Seward Peninsula).

P. S. Smith, 1910 (U. S. G. S. Bull. 433, pp. 50, 54+, maps). *Sowik ls.*—Massive bluish-white nondolomitic ls., 400 to 1,000 ft. thick. Overlies Solomon schist, probably uncon., and underlies Hurrah sl. The N. end of this ls. is near settlement of Sowik, whence name. Tentatively assigned to Ord. (?).

†Spadra shale.

Pennsylvanian (Allegheny): Western Arkansas coal field.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Spadra stage.*—Shales and sss., with several coal beds. Thickness 0 to 500 ft. Underlie Sebastian stage and overlie Norristown stage.

A. J. Collier, 1907 (U. S. G. S. Bull. 326). *Spadra sh.*—Sh. with ss. lenses. Thickness 350 to 500 ft. Overlies Hartshorne ss. and underlies Fort Smith fm. Includes Lower Hartshorne coal at base. Is basal fm. of McAlester group.

Named for Spadra, Johnson Co.

Has been discarded. See explanation under *McAlester fm.*

Spafford member.

Middle Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. **11, 50**). *Spafford memb. of Ludlowville fm.*—Relatively fine and very fossiliferous sh. overlying Ivy Point memb. and underlying *Spirifer tullius* zone (Owasco memb.) of the Ludlowville. Thickness 25± ft. Type section is in first ravine N. of Ivy (or Willow) Point on E. side of Skaneateles Lake, about ¾ mi. N. and slightly W. of Spafford Landing.

Spaniard limestone member (of Savanna sandstone).

Pennsylvanian: East-central Oklahoma.

S. W. Lowman, 1933 (Tulsa Geol. Soc. Digest, p. 31). *Spaniard ls.*—Occurs in midst of Savanna ss. of east-central Okla. Overlain by ss. of Rattlesnake Mtn and underlain by an unnamed ss. Named for a well-exposed outcrop in Spaniard Creek, S. of Muskogee, about center of N½ sec. 11, T. 13 N., R. 18 E.

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Spaniard ls. memb. of Savanna ss.* is 3 to 10 ft. thick, lies 40 to 50 ft. below Sam Creek ls. memb. of Savanna ss., and rests on Keota ss. memb. of the Savanna.

†Spanish formation.

Mississippian: Northern California (Lassen Peak region).

J. S. Diller, 1892 (prel. proof-sheet edition of U. S. G. S. Lassen Peak folio, No. 15). *Spanish fm.*—Chiefly qtzites and slates with occasional lenses of ls. Has yielded no fossils. Is younger than Caribou fm. and older than Arlington fm. Named for fact it surrounds N. end of Spanish Peak.

In published Lassen Peak folio (No. 15) these rocks are mapped and described as Calaveras fm.

Spann limestone member (of Pennington shale).

Mississippian: Southeastern Kentucky (Wayne County).

M. J. Munn, 1914 (U. S. G. S. Bull. 579, p. 33). *Spann ls. memb.*—Massive cherty geodic ls., 3 to 15 ft. thick, in middle of Pennington sh.

Named for Spann, Wayne Co.

Sparksville facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 172, etc., 1931) to a lithologic development of his Carwood fm. in a part of southern Ind.

Sparland cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to a middle portion of McLeansboro fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 7. Derivation of name not stated.

†Sparry limestone.

A descriptive term applied in early N. Y. repts (1) to lower part of Trenton ls. as now defined; (2) to Stockbridge ls. of eastern N. Y. and Mass.; and (3) to a ls. in Helderberg group. The term appears to have originated with E. Emmons (Agric. N. Y., vol. 1, 1843, pp. 72–74; or, possibly with A. Eaton, 1824. In some early N. Y. repts "Grey Sparry ls." was applied to Onondaga ls.

†Sparta sands.

Tertiary: Northern Louisiana.

T. W. Vaughan, 1895 (Am. Geol., vol. 15, p. 225). *Sparta sands.*—Deep quartz sands, sometimes with gravel. Is = the "Drift" of Hopkins and Lerch. Thickness 60–100 ft. Underlies Pleist. second bottoms and uncon. overlies Grand Gulf group of Hilgard.

T. W. Vaughan, 1896 (U. S. G. S. Bull. 142, pp. 25–26). *Sparta sands, age undetermined.*—These sands and gravels have been called drift by Hopkins and Lerch. In order not to venture an opinion as to their age, and not to attempt a correlation of all superficial upland sands and gravels of NW. La., I have proposed a local name and desire to include under it deposits of whose homogeny and contemporaneity there can be no reasonable doubt. Extending across central portion of La. are deep quartz sands, whose northern extent is as follows: They reach to T. 16 N., on Louisiana meridian; the bdy from there passes 2 mi. S. of Gansville, thence NW. to Sparta. From Sparta the bdy runs S. to NW. corner of Natchitoches Parish, and thence it is formed by Black Lake Bayou and Black Lake, to mouth of that lake. West of Red River the line runs from Victoria by Fort Jessup and S. to mouth of Bayou Toreau. Except a narrow strip along Ouachita River, nearly all of region btw. the fluviatile deposits of Red and Ouachita Rivers is covered by these sands, which overlap both Lower Claiborne and Grand Gulf, extending entirely across the Jackson and Vicksburg. The material is usually almost pure quartz sands, sometimes with reddish coloring matter. In Grand Parish there is a great deal of quartz gravel. In southern gravelly portion transported fossils have been found. The sands and gravel of this fm. range in thickness from a trifling veneer to 60 and sometimes to 100 ft. Along the contact with the Eocene as seen near Provencal, there is some clay at base. These deposits rest with a distinct uncon. upon the older rocks. Named for good development near Sparta, Bienville Parish.

According to W. C. Spooner (A. A. P. G. Bull., vol. 10, No. 3, p. 326, 1926) the Sparta sands of Vaughan as above defined included Sparta sand of Spooner, 1926, "as well as portions of Catahoula ss. of Oligocene [Mio. ?] age, and Citronelle fm. of Pliocene age."

Sparta shale.

Upper Cambrian: Southwestern Wisconsin (Monroe County).

W. D. Shipton, 1916 (Iowa Acad. Sci. Proc., vol. 23, pp. 142–145). *Sparta sh.*—In Sparta quad. the Mendota is missing and a new Camb. memb. is recognizable. It consists of layers of argill. ss. alternating with thin fissile aren. and calc. layers, all with more than 50 per cent of sand; the aren. beds are mostly thin, but a few reach 2 ft. in thickness; the more limy layers are rarely more than 1 inch thick; the layers apparently become more calc. near contact with overlying Madison ss.; the fissile shales vary in color, some are of a green color, due to disseminated grains of glauconite. Thickness 200 ft. Faunally there is difference btw. the Mendota and Sparta beds. It is possible that Sparta beds may be=Franconia fm. of Ulrich (Bull. 35 Wis. Surv.), but since no description of Franconia beds has been published it is impossible to make definite statement to that effect. Winchell recognized the St. Lawrence and associated shaly beds as having total thickness of 200 ft. Those beds are probably=Sparta memb., which overlies Dresbach ss., 820 to 879 ft. thick.

Sparta sand. (In Claiborne group.)

Eocene (middle): Northwestern Louisiana and northeastern Texas.

W. C. Spooner, 1926 (A. A. P. G. Bull., vol. 10, No. 1, p. 7, and No. 3, pp. 220, 224, 227, 237). *Sparta sand.*—Middle div. of Lower Claiborne or St. Maurice fm. as originally defined and heretofore used. Limited below by Cane River beds and above by lowest fossiliferous horizon of St. Maurice beds as here restricted. Thickness of Sparta sand 400 to 550 ft. Upper half contains a relatively greater amount of clay than lower half; massive sands alternate with beds of finely laminated sandy clay, in part lignitic and in many places containing fossil leaves; upper 50 ft. contains considerable lignitic material and some thin lignitic beds which are well exposed in vicinity of town of Bienville. Lower half is chiefly massive sand with interbedded subordinate members of laminated sandy clay; the sands are made up of quartz grains somewhat coarser than found in Wilcox fm. Fossils generally absent, but a few species of near-shore forms are found near middle of fm. The Sparta sand of Vaughan (U. S. G. S. Bull. 142, p. 25, 1896) included Sparta sand as here defined as well as parts of Catahoula ss. (of Olig. age) and Citronelle fm. (of Plio. age).

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Sparta sand memb. of Claiborne fm.* occurs below Crockett memb. and above Weches memb. as defined in this paper. Is thickest in La., being 450 ft. thick in Palmer Corporation Crichton No. 1 well in Webster Parish, thinning toward S. part of Sabine uplift and in Tex.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, pp. 1347–1361). *Sparta sands*, of Cook Mtn fm., underlie Crockett fm. and overlie Mount Selman fm. Thickness 250 or 300 ft.

H. K. Shearer, 1930 (A. A. P. G. Bull., vol. 14, No. 4, pp. 433–450). *Sparta sand* is nonmarine.

In La. the Sparta sand was formerly treated as a memb. of St. Maurice fm. In Tex. it was for a time treated as basal memb. of Cook Mtn fm., but it is now treated as a distinct fm. by U. S. Geol. Survey, and St. Maurice fm. has been abandoned. A. Deussen, however (1934 and 1936), continues to include Sparta sand in Cook Mtn fm.

H. B. Stenzel, 1935 (Univ. Tex. Bull. 3501, pp. 267–279), restricted *Crockett* to upper part of Crockett as previously defined, and applied new name *Stone City beds* to lower part. He stated the latter interfinger with underlying Sparta sand.

Named for development near Sparta, Bienville Co., La.

Sparta sand.

A subsurface sand in Chester group (Miss.) of Randolph Co., Ill.

Spartanburg zone.

Pre-Cambrian: Northern South Carolina.

See *Anderson-Spartanburg zone.*

Named for exposures in Spartanburg Co.

Spavinaw granite.

Pre-Cambrian (?): Northeastern Oklahoma (Mayes County).

N. F. Drake, 1897 (Am. Phil. Soc. Proc., vol. 36, pp. 338–341). [Describes a dike, 1,200± ft. long by 50± ft. wide, on N. side of Spavinaw Creek, 6± mi. from its mouth and ¾ mi. W. of Spavinaw post office, and in one place (on p. 341) he casually refers to it as *Spavinaw granite.*]

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 54). *Spavinaw granite.*—Dark-red, mottled fine-grained granite, of unknown thickness and unknown age, but presumably pre-Camb. Outcrops where it crosses Spavinaw Creek below Tulsa waterworks dam, NE. part of Mayes Co. The exposure is about ¼ mi. long and in places 200 ft. wide. Has been regarded by Drake, Snider (Okla. Geol. Surv. Bull. 24, pp. 50–53, 1915), Hutchison (Okla. Geol. Surv. Bull. 2, p. 152, 1911), and others as a granite dike. Aurin, Clark, and Trager, however (A. A. P. G. Bull., vol. 5, 1921), consider it the top of a buried granite mtn now being uncovered by erosion.

Spearfish formation.

Triassic (?): Western South Dakota, Wyoming, and northwestern Nebraska.

N. H. Darton, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 387). *Spearfish fm.* (Red beds), of Triassic age, uncon. underlie Sundance fm. in Black Hills, S. Dak.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 516). *Spearfish fm.*—Red sandy clays or shales with gyp. beds, which sometimes are 30 ft. thick. Thickness of fm. in Black Hills 350 to 500 ft. Overlies Minnekahta ls. and uncon. underlies Sundance fm. Named for Spearfish, S. Dak.

Spearhead rhyolite.

Tertiary (Pliocene?): Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 71, etc.). *Spearhead rhyolite.*—Rhyolitic flows; the upper and thicker memb. is soft, porous pinkish-gray rhyolite containing so many fragments of pumice as to warrant name of "flow breccia;" the lower memb. is essentially same as upper memb. but of brown color. Thickness 20 to 80 ft. Conformably overlies Pozo fm. and underlies Rabbit Spring fm. [Mapped at and around Spearhead Point, Goldfield dist.]

Spechts Ferry member.

Middle Ordovician (late Black River): Northeastern Iowa, southwestern Wisconsin, southeastern Minnesota, and northwestern Illinois.

G. M. Kay, 1928 (Sci., n. s., vol. 67, p. 16). *Spechts Ferry memb.*—Basal memb. of Decorah fm. At type loc. (ravine SW. of C. M. & St. P. R. R. station of Spechts Ferry, Dubuque Co., Iowa, it consists of 8½ ft. of shales and interbedded lss. It includes the "glass rock" and overlying shales at top of typical Platteville. Fossils are of latest Black River (Watertown) age. Overlies Platteville ls. and underlies Guttenberg ls. memb. of Decorah fm. [See also Kay, Jour. Geol., vol. 37, No. 7, Oct.–Nov. 1929, pp. 639–671, where he stated this memb. corresponds to "*Rhinidictya* bed" and "*Stictoporella* bed" of Minn.]

G. M. Kay, 1931 (Jour. Geol., vol. 39, p. 370), redefined Spechts Ferry memb. by excluding the "glass rock," which he stated was found to be older than the 8½ ft. of shales with intercalated thin lss. in type section of the memb.

G. M. Kay and G. I. Atwater, 1935 (Am. Jour. Sci., 5th, vol. 29, Feb., p. 101), continued to include Spechts Ferry memb. in the Decorah and to classify it as of late Black River age and rest of Decorah as Trenton.

G. M. Kay, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, pp. 286–287), treated *Spechts Ferry memb.* as top memb. of Platteville; named the underlying (conformable) beds *McGregor memb.*; called the overlying beds *Guttenberg memb. of Decorah fm.*; included the "glass rock" in top of his McGregor memb.; and classified his Spechts Ferry memb. as of Black River age. He also further redefined the memb. by transferring to overlying Guttenberg memb. of Decorah "the 10-in. beds of ls. containing pyritic and phosphatic nodules originally considered as the top of the memb." On pp. 285, 288 he stated: Spechts Ferry memb. is stratigraphically and faunally more closely related to underlying members of Platteville fm. But northern extension of the memb., being succeeded by other more calc. shales with which it comprises a lithologic unit, it is *more convenient* to consider the Spechts Ferry as a lowest memb. of Decorah fm. in Minn. and northern Iowa. On p. 295 he showed an uncon. btw. his Guttenberg and Spechts Ferry members in Minn. and Ill.

C. A. Bays and G. O. Raasch, 1935 (pp. 297–299 of Conf. Rept cited above), removed from McGregor memb. of Kay its upper part and renamed these upper beds *Magnolia memb.* Their Magnolia memb. underlies Spechts Ferry memb. of Kay.

The Committee of 9th Ann. Conf. Rept. Kans. Geol. Soc., 1935, transferred these beds to Platteville ls., and restricted Decorah sh. to Ion and Guttenberg members of Kay. These changes have not yet been considered by U. S. Geol. Survey for its publications.

Speck Mountain limestone member (of Thrifty formation).

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 408). *Speck Mtn ls. bed.*—Massive dark rough-weathering ls., 3 to 5 ft. thick, well developed on top and to W. of Speck Mtn. Northeast of Rockwood consists of 5 ft. of hard massive white ls., and near Trickham of 2 to 4 ft. of white barren, rather friable ls. Memb. of Cisco div. Overlies Speck Mtn clay bed and underlies Lohn bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, p. 24; Univ. Tex. Bull. 2132, p. 158). *"Speck Mtn" ls.* of Drake, of Colorado River Valley, is same as Ivan ls. memb. of Thrifty fm. of Brazos River region. (Speck Mtn has long priority.)

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103). *Speck Mtn ls.* of Drake is in Thrifty fm. It underlies Lohn sh. and lies higher than Blach Ranch ls.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197, 198, 221), showed *Speck Mtn ls.* as top memb. of Graham fm. and as underlying Avis ss. and overlying Wayland sh. memb.

According to C. O. Nickell (rept in press), Speck Mtn ls. memb. of Brown and Coleman Counties underlies Lohn sh. memb. and lies above 32 to 51 ft. of sh. called "Speck Mtn clay" by Drake. All these members belong to Thrifty fm. The Speck Mtn ls. lies considerably higher than Avis ss., basal memb. of Thrifty fm. [This is definition adopted by U. S. Geol. Survey.]

Named for Speck Mtn, Coleman Co.

†Speck Mountain clay. (In Thrifty formation.)

Pennsylvanian: Central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 407). *Speck Mtn clay bed.*—Fossiliferous sandy clay, bluish, purplish, or slightly red, 25 ft. thick, with a little ss. and some carbonaceous shaly clay. Memb. of Cisco div. Overlies *Bellerophon* bed and underlies Speck Mtn ls. bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132). *Speck Mtn clay of Drake* is included in Thrifty fm. of Cisco group.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), included this bed in Thrifty fm.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+), included in Graham fm. of Colorado River region all beds up to top of Speck Mtn ls.

The present definition of U. S. Geol. Survey includes in Thrifty fm. of Colorado River region all beds from top of Chaffin ls. down to base of Bellerophon ls. of Drake.

Named for Speck Mtn, Coleman Co.

Speechley sand.

Drillers' term. Western Pa. and W. Va. Of Chemung age. Has been considered older than Warren Third sand and younger than Tiona sand. Named for Speechley farm, about 5 mi. NE. of Oil City, Venango Co., Pa. A sand btw. Speechley and Warren Third sand has been called *Speechley Stray sand.*

Speiser shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 232, 234). *Speiser sh.*, top div. of Garrison sh. memb., consists of (descending): (1) Greenish-blue sh. with small calc. bodies, 9± ft.; (2) argill. sh. in bluish and reddish bands, 10 ft.; (3) 2 beds of light-gray lss., separated by 4 to 5 ft. of sh., 7 to 8 ft.; (4) bluish or bluish-gray sh., with a thin band of maroon sh. near base, small calc. concretions in the grayish zones, 18 to 23 ft. Total thickness of Speiser sh. 47± ft. Overlies Sabetha ls. Named for Speiser Twp, Richardson Co., Nebr.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 23). Speiser sh. of Condra 1927 here divided into (descending) *Speiser sh. restricted*, Funston ls., and Blue Rapids sh. Thickness of Speiser sh. as now constituted increases southward from 18 or 19 ft. in Nebr. to 34 or 35 ft. in southern Kans. Type loc. is W½ sec. 35, T. 1 N., R. 13 E., Speiser Twp. Also well exposed 3½ mi. SE. of Randolph, Kans.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Spence shale member (of Ute limestone).

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 5, 6, 8). *Spence sh.*—Argill. shales, 30 ft. thick W. of Liberty, Bear Lake Co., Idaho, and also in Blacksmith Fork, Cache Co., Utah. Basal memb. of Ute fm. Abundant Middle Camb. fauna. Type loc. Spence Gulch, a ravine running up into Danish Flat from Mill Canyon, about 5 mi. W.-SW. of Liberty, Bear Lake Co., Idaho.

The sh. memb. at base of Howell fm. of House Range, Utah, has been correlated by Walcott with Spence sh. memb. of Ute ls. of NE. Utah. (See pp. 183, 197 of vol. cited above.)

Spence Bridge volcanic group.

Jurassic or Cretaceous: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 119).

Spence Bridge series.

Tertiary: British Columbia.

D. D. Cairnes, 1923 (Canada Geol. Surv. Summ. Rept. 1922, pt. A, p. 93).

Spencer chert.

Upper Ordovician (Richmond): Central Missouri (Camden County).

G. H. Scherer, 1905 (Bradley Geol. Field Sta. Drury Coll. Bull., vol. 1, pt. 2, p. 59). Local outcrop, just N. of Decaturville Hotel, in road from Decaturville [Camden Co.] to Lebanon, of chert and ls. differing from any in dist. E. O. Ulrich, from certain fossils discovered, designates it as a cherty form of the Maquoketa, of Richmond fm., which Shepard has named *Spencer chert*.

E. M. Shepard (letter dated Jan. 29, 1916), stated that he never published this name but used it provisionally in carbon prints given to his students for field work.

Spergen limestone. (Of Meramec group.)

Mississippian: Southern Indiana, Illinois, western Kentucky, eastern Missouri, and Iowa.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines, 2d ser., vol. 2, p. 110) and 1905 (U. S. G. S. P. P. 36, pp. 28–30). *Spergen Hill ls.*—Generally massive layers of oolitic ls., of light- or dark-gray, buff, or drab color, with interbedded thinner layers of various kinds of ls. and occasionally thin seams of yellowish sh., occurring in Ind., Ill., western Ky., and eastern Mo. Thickness few ft. to 125 ft. Included in St. Louis ls. of previous repts. Overlain by St. Louis ls. [restricted] and underlain by Warsaw fm. Included in Meramec group.

Adopted instead of *Bedford ls.* (preoccupied) and *Salem ls.* (Cumings, 1901), because of long-established use of terms *Spergen Hill fauna* and *Spergen fauna*, to designate the fauna contained in this fm., and because the name had acquired a formational significance long before *Salem ls.* was introduced, e. g.: S. S. Lyon, 1860 (St. Louis Acad. Sci. Trans., vol. 1, p. 619), described strat. horizon in Ky. which he stated to be equiv. to "Spergen Hill" beds of Washington Co., Ind.; C. E. Siebenthal, 1897 (Ind. Dept. Geol. and Nat. Res. 21st Ann. Rept., p. 298), stated that the Bedford oolitic ls. had also been called *Spergen Hill ls.* by other writers; S. Weller, 1898 (Jour. Geol., vol. 6, p. 313), stated: "One of the best known of the St. Louis ls. faunas is that of the *Spergen Hill beds* in Indiana;" H. S. Williams, 1900 (Ark. Geol. Surv., vol. 5, p. 348), stated: "The age of the Spring Creek ls. is about equivalent to the Warsaw, St. Louis, or *Spergen Hill* formations." *Salem ls.*, however, is name used by Ind. and Ill. Geol. Surveys. The Spergen is middle fm. of Meramec group. It is overlain by Mitchell ls. in Ind. and by St. Louis ls. in Ill., eastern Mo., Iowa, and western Ky.; underlain by Warsaw sh. in Ill., Iowa, and eastern Mo., and by Warsaw (†Harrodsburg) ls. in Ind. and western Ky. It is opinion of C. Butts (Ky. Geol. Surv., ser. 6, vol. 7, pp. 119–120, 1922) that Spergen ls. of Ind. is only a local lithologic facies of Warsaw ls., but most geologists consider it a distinct geologic unit of equal rank with Warsaw, St. Louis, and other fms. W. H. Twenhofel, however (Ky. Geol. Surv., ser. 6, vol. 37, 1931), inclined to Butts' view.

Named for Spergen Hill, near railroad station of Harristown, a few mi. SE. of Salem, Washington Co., Ind.

†Spergen Hill limestone.

Same as *Spergen ls.*, which see.

Sphinx conglomerate.

Eocene: Central southern Montana (Three Forks quadrangle).

A. C. Peale, 1896 (U. S. G. S. Three Forks folio, No. 24). *Sphinx cgl.*—In Sphinx Mtn is a group of beds which once may have spread over an extensive area, although now occupying only about 2 sq. mi. This remnant consists of btw. 2,000 and 3,000 ft. of reddish sss. and coarse cgls. of ls. pebbles and boulders cemented with reddish sand; compose entire mass of the peak. Beds are horizontal and distinctly stratified. No fossils. Arbitrarily referred to Eocene, but are certainly younger [older] than Bozeman lake beds (Neocene) and older [younger] than Livingston fm. (Cret. ?).

Spickert Knob facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 77, 127, 1931) to a lithologic development of his Locust Point fm. in a part of southern Ind. "This Spickert Knob facies is that of the type loc. of the [Locust Point] fm. at Locust Point."

Spieden formation.

Lower Cretaceous: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 93, 113–118). *Spieden fm.*—Cgl., breccia, ss., sh., and argill. ls.; 85 percent cgls. Isolated outcrops, which apparently are confined to Spieden Island, Sentinel Island, and Sentinel Rock. Thickness 2,000+ ft. The cgls. differ from those of upper Cret. Nanaimo series in scarcity of boulders of granodiorite and other batholithic rocks. Fossils [described] identified by T. W. Stanton as lower Cret. and = upper part of Knoxville of Calif.

Spiral Creek formation.

Age (?): Greenland.

C. Teichert, 1933 (Meddelelser om Grönland, Bd. 95, No. 1, pp. 49, 74).

Spiro sandstone member (of Savanna sandstone).

Pennsylvanian: Eastern Oklahoma (Muskogee, LeFlore, and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Spiro ss. memb. of Savanna ss.*—Dark-brown ss., regularly bedded, blocky, fine to medium texture. Plant fossils. Thickness in Muskogee-Porum area 12 ft. Lies 50± ft. above Keota ss. memb. of Savanna ss. and 60± ft. below Cavanal coal in Muskogee-Porum area. Caps ridge in secs. 13 and 14, T. 9 N., R. 25 E., just N. and NE. of Spiro, LeFlore Co.

Spitzenberg conglomerate.

Triassic (?): Southeastern Pennsylvania (Berks County).

L. Whitcomb and J. A. Engel, 1934 (Pa. Acad. Sci. Proc., vol. 8, pp. 37–43). *Spitzenberg cgl.*—A peculiar cgl. that caps the conical hill in Berks Co. which, because of its shape, has been named the Spitzenberg. The cgl. is in form of a gently dipping spoon-shaped syncline, resting upon Martinsburg sh. Is different from all other rocks of region. Best exposure is at NE. end of ridge, where its cross-bedded character can be seen. Matrix is fairly coarse sand that weathers gray or red.

Split Creek shale and sandstone member.

Oligocene: Southeastern Alaska (Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 771–775). *Split Creek sh. and ss. memb.*—Basal memb. of Katalla fm. Consists of 800 ft. of ss. grading down into hard dark-colored, rather platy shales, 700 ft. of which are exposed. Exposed only in N. part of area, in drainage to Bering Lake, in very narrow belt along Bering River, and in N. part of ridge btw. Redwood Creek and Katalla River. [Origin of name not stated.] Assigned to upper Olig., on basis of correlation with similar fossiliferous rocks in Yakataga dist., which are assigned to upper Olig. by B. L. Clark. Conformably overlain by Burls Creek sh. memb. of Katalla fm.

The U. S. Geol. Survey classifies typical Katalla fm. as Mio. (?).

Split-Rock slate.

Pre-Cambrian: Northwestern Iowa.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 187; Sci., n. s., vol. 40, p. 144). Slates, 75 ft. thick, younger than Sioux qtzite and comprising top fm. of Animikean series.

Derivation of name not stated.

Split Rock.

See under *Adirondack anorthosyte.*

Spokane shale (also **formation**).

Pre-Cambrian (Belt series): Western central and central southern Montana (Helena to Little Belt Mountains).

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 199–215). *Spokane shales.*—Massive beds of deep-red siliceous shales, 1,500 ft. thick. Underlie Empire shales and overlie Greyson shales. Type loc. in Spokane Hills, 15 mi. E. of Helena, although base is not there exposed.

Spokane glaciation.

Pleistocene: Washington.

J. H. Bretz, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 580). *Spokane glaciation* introduced for ice sheet older than Wisconsin drift of Wash. Named for development of the till, striated erratic boulders, outwash material, and drainage channels in vicinity of Spokane, Wash.

Spokane clays.

A term loosely applied commercially in eastern Wash. to the kaolins and buff-burning clays in general vicinity of Spokane, some of which belong to Latah fm. (Mio.).

Spoon Butte beds.

Miocene (upper) and Pliocene (lower): Western Nebraska and eastern Wyoming.

O. A. Peterson, 1909 (Carnegie Mus. Mem., vol. 4, No. 3, pp. 74–77). *Spoon Butte beds.*—Hard stratum of pinkish-gray ss., 25 to 50 ft. thick. No fossils. Assigned to Plio (?) or Mio. May represent Ogallala fm. Named for Spoon Butte, Laramie Co., Wyo. Overlies upper Harrison beds (middle Mio.).

H. J. Cook, 1915 (Nebr. Geol. Surv. vol. 7, pt. 11, pp. 74–75). *Snake Creek beds* cap Spoon Butte, Wyo., where they overlie Sheep Creek beds. They were called "Harrison beds" by Peterson in 1906, and regarded by him as "upper Harrison beds." In 1909 he named them "Spoon Butte beds," and considered them younger than upper Harrison beds. These cemented beds are a phase of Snake Creek beds of Matthew and Cook.

Spoon River sandstone and shale. (In Pottsville formation.)

Pennsylvanian: Central western Illinois (Fulton County).

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 307–316), applied *Spoon River ss. and sh.* to basal part of Pottsville fm. in Fulton Co., or to beds underlying clay beneath Seville (No. 1) coal and uncon. overlying St. Louis ls. Derivation of name not stated.

H. R. Wanless, 1929 (Ill. Geol. Surv. Bull. 57). Basal 50 to 80 ft. of Pottsville fm. in Alexis quad., NW. Ill., is=Spoon River of Savage (1927), so named because well exposed along Spoon River [which is chiefly in Fulton Co.].

†Spot Pond granite.

A name that has been applied locally to a stock of Dedham granite in Boston region, Mass.

Spotted Bear limestone member.

Middle Devonian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 44 and passim). *Spotted Bear ls. memb.*—Top memb. of Jefferson ls. in Spotted Bear, Pentagon, and Monitor Mtns. Thickest (426 ft.) on Monitor Mtn; thinnest (282 ft.) on Pentagon Mtn; not known to be present in intervening area. Most striking feature is variety of lss. and shales that compose the memb. Consists of (descending): (1) 4 ft. of platy cream-white argill. ls. that weathers light buff; (2) 22 ft. of massive platy brown-gray crystalline ls. that weathers gray; (3) gray medium bedded ls. in upper and lower parts and massive argill. tan-gray finely crystalline ls., 61 ft.; (4) gray to tan-gray argill. crystalline ls. that weathers irregular gray in lower part and sugary gray in upper part, 114 ft.; (5) massive thin-bedded gray crystalline ls., 86 ft., thicker-bedded upward; weathers dull gray. Discon. underlies Silvertip cgl. memb. of Madison ls. and overlies Lone Butte ls. memb. of Jefferson ls. Well exposed btw. elevations of 6,880 and 7,005 ft. on NW. slope of Spotted Bear Mtn, in NE¼ sec. 26, T. 25 N., R. 15 W.

Sprakers.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, No. 2104, p. 400). *Sprakers* introduced for lower middle Canajoharie or zone of *Diplograptus amplexicaulis* in Mohawk Valley.

Sprayan series.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). *Sprayan series.*—Shales, 1,400 ft. thick, composing all of Late Triassic of Alberta. The Triassic Spray fm. may be a compact provincial series; it may be composed of two or more distinct provincial series; or it may prove to be a composite fm. comprising two or more interlocking provincial series. If the Triassic section prove to be but a single provincial series, then the name Spray River may be shortened and given serial ending and be known as Sprayan series; otherwise, if there be really two or more series they should be so denominated, the title Sprayan then being properly restricted to one of the subdivisions of serial rank.

Named for exposure in Spray River gorge, 7 mi. above Banff, Alberta.

Spray River formation.

Triassic: British Columbia and Alberta.

E. M. Kindle, 1924 (Pan-Am. Geol., vol. 42, pp. 113–124).

Spring Branch limestone. (In Lecompton limestone.)

Pennsylvanian: Southeastern Nebraska (?), northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 44, 47). *Spring Branch ls.*, basal unit of Lecompton ls., is exposed in Mo. and Kans.; probably not exposed in Nebr. Massive above and chalky and friable below. Weathers yellowish or brownish. Thickness in Mo. and Kans. 4 to 8 ft. Underlies Doniphan sh. and overlies Kanwaka sh. memb. Named for exposures on Spring Branch N. of Big Springs, Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 163, footnote). The absence of Spring Branch and "Curzen" lss. in Nebr. has been recognized by Condra. Conclusion that Spring Branch ls. is absent in Nebr. may require modification when restudy of correlation of "Plattsmouth ls." section of Snyderville quarries and other places in Nebr. has been completed, for it is possible topmost part of "Plattsmouth" as previously identified may prove to be Spring Branch ls.

Spring Canyon tongue (of Star Point sandstone).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Spring Canyon tongue.*—Massive ss., 150 to 200 ft. thick, forming top part of Star Point ss. (basal fm. of Mesaverde group in Wasatch Plateau and Book Cliffs). Interfingers with tongues of marine Mancos sh. Forms conspicuous white cliffs in Spring Canyon, N. part of Castlegate quad., Carbon Co.

Spring Canyon coal group. (In Blackhawk formation.)

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Spring Canyon coal group.*—A group of 2 to 5 coal beds, with accompanying beds of sh., etc., in part underlying and in part grading laterally into Aberdeen ss. memb. of Blackhawk fm. In places a thin tongue of Mancos sh. separates the coal group from underlying Star Point ss.

Spring Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 381). *Spring Creek bed.*—Bluish sandy clay, 300 ft. thick, with 50 ft. of ss. near middle. Memb. of Strawn div. Underlies Cottonwood Creek bed and overlies Brown Creek bed.

Named for Spring Creek, San Saba Co.

Spring Creek granite.

Pre-Cambrian: Eastern Colorado (Cripple Creek district).

W. Cross, 1895 (U. S. G. S. 16th Ann. Rept., pt. 2, p. 23). *Spring Creek variety.*—A peculiar variety of granite which occurs opposite Red Mtn. on Spring Creek, in Cripple Creek dist. The rock is of medium grain, has a more or less distinct porphyritic structure, and is marked by brilliant-red color, due to very heavy impregnation of all the feldspar by iron oxide. Quartz appears in small irregular grains abundantly disseminated through the mass. No other constituents are visible to naked eye. Biotite was probably an original constituent of this granite, but it has been decomposed and mainly replaced by muscovite. Fluorite occurs sparingly all through the granite.

W. Lindgren and F. L. Ransome, 1906 (U. S. G. S. P. P. 54). Age of *Spring Creek granite* with reference to other granites of Cripple Creek dist. is unknown [p. 20]. Pikes Peak granite is probably intrusive into Spring Creek granite [p. 23].

L. C. Graton, 1906 (U. S. G. S. P. P. 54). *Spring Creek granite.*—Bright red, even-grained. No evidence as to relative age. Occurs only on SW. half of Red Mtn and on hill to S. on opposite side of Spring Creek, Cripple Creek dist.

†Spring Creek limestone. (In Moorefield shale.)

Mississippian: Northern Arkansas.

H. S. Williams, 1895 (Am. Jour. Sci., 3d, vol. 49, pp. 94–101). *Spring Creek ls.*—Dark-colored ls. and associated calc. shales at Spring Creek, a few mi. W. of Batesville. Overlies Boone chert and underlies Batesville ss. Contains Warsaw, St. Louis, and Spergen Hill fossils. According to Ark. geologists, this interval is to W. occupied by Fayetteville sh. [miscorrelation].

S. Weller, 1898 (N. Y. Acad. Sci. Trans., vol. 16, pp. 279, 281). *Spring Creek ls. and sh.*—This fm. has heretofore been referred to Fayetteville [Moorefield] sh. by Ark. geologists. Since correlation of black shales and lss. of Batesville region with Fayetteville sh. is based wholly on stratigraphy, and as strat. column is somewhat dissimilar in the two regions, it is thought best to assign a distinctive name to the fm. in Batesville region, until investigation of faunas of two areas proves it to be wholly or in part = the more western fm. The Spring Creek ls. is typically developed on Spring Creek, 2 mi. W. of Batesville, and is a black fetid ls. abounding in fossils. East of Batesville, in vicinity of Moorefield, it is more shaly and attains thickness of 300 ft. Fauna is unique. Overlies Boone chert and underlies Batesville ss.

E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 102–104). A few mi. NW. of Batesville there is a local deposit of highly fossiliferous ls. and limy sh. which

H. S. Williams has called *Spring Creek ls.* Apparently this calc. fm. rests on Boone fm. and underlies Moorefield sh. (=Fayetteville sh. in part of Branner), while increase in argill. matter toward top of exposure probably indicates the calc. beds grade up into the sh. Though of small consequence areally, this calc. fm. is too important geologically to be entirely neglected in classification of Miss. rocks of Ark. Perhaps it is sufficiently accounted for by ranking it as a memb. of Moorefield fm.

The †Spring Creek ls. is 0 to 15 ft. thick and is now treated by U. S. Geol. Survey as basal part of Moorefield sh.

Named for Spring Creek, 2 mi. W. of Batesville, Independence Co.

†Spring Creek clays.

Lower Cretaceous (Comanche series): Central southern Kansas.

C. N. Gould, 1898 (Am. Jour. Sci., 4th; vol. 5, pp. 170–174). *Spring Creek clays.*—Bluish-white clay, with clay-ironstone concretions; 20 to 80 ft. thick. Underlies Greenleaf ss. and overlies Kiowa shales. Basal div. of Medicine beds.

Named for Spring Creek, 12 mi. W. of Belvidere, Kiowa Co.

This name was discarded by U. S. Geol. Survey in 1921, the bed (in Kiowa sh.) being regarded as so local as to have no strat. value.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9), revived the name (in the form *Spring Creek sh. memb. of Belvidere fm.*), as explained in 1924 entry under *Belvidere sh.*

Spring Creek erosion cycle.

Recent: Southeastern Idaho.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713, pp. 17, 71). *Spring Creek cycle*, a postglacial (Recent) erosion cycle in SE. Idaho. Named for Spring Creek, which rises and has its entire course in the Fort Hall bottoms.

Springer formation.

Pennsylvanian (Pottsville): Central southern Oklahoma.

W. L. Goldston, Jr., 1922 (A. A. P. G. Bull., vol. 6, No. 1). *Springer memb.*—Basal memb. of Glenn fm. Largely black and blue shales separated by thin beds of ss. and ls. The shales at base are black and soft. Near top blue predominates, but there are zones of black sh. several ft. thick. To N. of Ardmore it contains no calc. members, but there are 12 brownish or drab sss. ranging in thickness from a few ft. to 100+ ft., some of which grade into shales to S. and E. Around Criner Hills sss. are less important and numerous beds of thin brownish lss. occur. Thickness 4,000 to 6,000 ft. Town of Springer [Carter Co.] is in midst of this memb. Fossils listed. Rests conformably on Caney sh. and underlies Otterville ls. memb.

G. H. Girty and P. V. Roundy, 1923 (A. A. P. G. Bull., vol. 7, No. 3, pp. 331–347). Goldston's Springer memb. seems to us to include both pre-Glenn and post-Glenn beds. We are satisfied Springer beds were excluded from Glenn fm. as originally defined, and that they are part of Caney sh.; in places they probably included the Hoxbar.

H. D. Miser, 1925 (Okla. Geol. Surv. Bull. 35, p. 26, footnote). [See this entry under *Hoxbar fm.*]

S. Powers, 1927 (A. A. P. G. Bull., vol. 11, No. 10, pp. 1067–1085), mapped *Springer fm.* as underlying Glenn fm.

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, pp. 7–21). *Springer fm.*, 3,000 or more ft. thick, includes all beds below Jolliff ls. memb. of Dornick Hills fm. and above Caney sh. Its basal memb. is here named *Rod Club ss. memb.* On Miser's map of Okla. these rocks were included in Caney sh.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46). *Springer fm.*, 3,000 to 3,500 ft. thick, as here defined corresponds closely with Goldston's Springer memb. of Glenn fm. in its type area and elsewhere. It was included in Glenn fm. by Taff in Tishomingo folio, but was excluded by Girty, Roundy, and Miser. It underlies Jolliff memb. of Dornick Hills fm. and overlies Caney sh.

The present approved definition of Springer fm. is that it underlies Wapanucka ls. in the Ti Valley-Choctaw belt of Ouachita Mtns, Okla., and elsewhere it underlies Dornick Hills fm. It overlies Caney sh. (now restricted to beds of Miss. age). (See H. D. Miser, A. A. P. G. Bull., vol. 18, No. 8, 1934, pp. 971–1009.)

Springfield limestone.

Silurian (Niagaran): Southwestern Ohio.

E. Orton, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 271, 274–277, 301). *Springfield stone or Blue Cliff.*—Massive blue crinoidal lss., with some buff and drab beds and interstratified sh. or blue clay, and with 5 to 15 ft. of blue sh. at base. Thickness 20 to 45 ft. Overlain by Cedarville or Guelph ls. and underlain by West Union or Lower Cliff ls. (the yellow cliff). All included in Niagara group. Occurs in Highland Co. and northward. [In index this fm. is called *Springfield ls.*]

The foregoing definition of *Springfield ls.* was used in Ohio Geol. Surv. repts 1873, 1874, 1884, 1888, 1893, 1905, 1915, and 1916, and, so far as known, is still followed by that Survey. In 1917 A. F. Foerste introduced *Euphemia dol.* for the beds underlying *Springfield dol.*, as he called the fm., and included (ascending) Euphemia dol., Springfield dol., and Cedarville dol. in his Durbin fm. It appears that Foerste's *Springfield dol.* is only a part of Orton's *Springfield ls.*

A. F. Foerste, 1935 (Denison Univ. Bull., Jour. Sci. Lab., vol. 30, p. 155). *Springfield* was introduced by Orton in 1871. Type loc. was Springfield, Ohio, where this fm. has long been quarried W. of city, where the typical well-bedded fine-grained Springfield dol. is 10 ft. thick, the underlying dense but somewhat mottled rock being 4 ft. thick, giving 14 ft. for entire Springfield dol. section, which rests directly on Euphemia dol. It is overlain by Cedarville dol.

Springfield clay.

Pleistocene: Southwestern Ohio.

E. Orton, 1873 (Ohio Geol. Surv. vol. 1, pp. 431, 443). *Springfield clay.*—Fine-grained yellow glacial clay, in Hamilton, Montgomery, Clark, and probably Clermont Counties; 15 to 30 ft. thick. Overlies sand, gravel, and streaks of loam and underlies soil. Included in [Pleistocene] drift.

Named for Springfield, Clark Co.

Springfield conglomerate.

Cambrian (probably): Southeastern Vermont (Windsor County).

C. H. Richardson, 1931 (17th Rept. Vt. State Geol., pp. 200–201). *Springfield cgl.*—Introduction of this term is demanded by discovery, on W. side of Skitchewaug Mtn, of a new cgl. It lies on E. side of Spencer Hollow road, the nearest approach to which is a few rods E. of Spencer School House [1½ mi. E. of Springfield, Claremont quad.], where the cgl. outcrops. Pebbles range from fraction of in. to 6 in. diam. Most of them are quartz; a few of mica schist were seen. The matrix is mica schist, the mica mostly muscovite. The cgl. carries much secondary quartz in veinlets and stringers. In some outcrops the rock appears as quartz schist; in others as coarse-textured qtzite. Some pebbles are well rounded; others are stretched or elongated. Metamorphism intense. Highly folded and crumpled and dips in all directions. More field work needed to determine exact age and true strat. position. There is no evidence of anything Ord. in either pebbles or matrix, both of which appear to be Camb.

Spring Grove member (of Wapsipinicon limestone).

Middle Devonian: Eastern Iowa (Linn County).

A. C. Trowbridge, M. L. Thompson, and E. H. Scobey, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., figs. 1, 2, and pp. 36, 424). *Spring Grove memb. of Wapsipinicon ls.*—At Linwood quarry, Scott Co., consists of (descending): Stylolitic ls., 13 ft.; ss., 6 in.; ls., 3 ft.; covered, 10 ft.; mag. ls. 5 ft. Underlies Davenport memb. of Wapsipinicon ls. [In fig. 1 is shown as overlying Kenwood memb. of Wapsipinicon.]

M. A. Stainbrook, 1935 (pp. 251–252 of rept. cited above). *Spring Grove ls.*—Name here proposed for a terrane distinct from the Kenwood, with which it hitherto has been included. Type loc. is natural exposure in right bank of Wapsipinicon River in center of sec. 24, Spring Grove Twp, Linn Co. Entire thickness of 18 ft. is exposed, with 12 ft. of Kenwood below and 8 ft. of Davenport above. The ls. is subdolomitic, fine-grained, more or less massively bedded, but finely laminated. Has greater northward extent than any Dev. beds below. Outcrops in southern Winnishiek Co. (valley of Crane Creek), along E. Dev. border of Fayette Co., and in Linn and Cedar Counties. No fossils. Lies uncon. on Kenwood in Linn Co. and on Sil. in Fayette Co., and is uncon. below Davenport memb.

Spring Hill limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 97). [See under *Merriam ls.* On p. 46 *Spring Hill ls.* is described as consisting of 15 to 21½ ft. of gray even-bedded ls.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 71–73). *Spring Hill ls. memb.*—Upper memb. of Plattsburg ls. Lower half or less is even gray ls. containing brachiopods and bryozoans. Remainder is oolitic or granular and contains large molluscan element. Overlies Hickory Creek sh. memb. and underlies Vilas sh. Named for exposures at town of Spring Hill, in S. part of Johnson Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Springler Knob facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol. Pub. 98, pp. 76, 222, etc., 1931) to a lithologic development ("that of type loc. of the fm.") of his Edwardsville fm., in a part of southern Ind.

Spring Point greenstone. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). [*Spring Point greenstone* mentioned as a fm. in Casco Bay group. Not defined.]

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 170). *Spring Point greenstone.*—Gray to dark-green actinolite schist, in part thoroughly schistose and in part massive; chloritic schists; and some schistose rocks that still show their original coarsely and irregularly fragmental texture and contain secondary felts of small actinolite needles and small blebs of blue quartz. Is very probably volcanic material locally but conformably intercalated btw. Cape Elizabeth fm. below and Diamond Island sl. above. Included in Casco Bay group. Assigned to Penn. (?). Named for exposures at Spring Point, South Portland, Cumberland Co.

Spring River sandstone.

Pennsylvanian: Southwestern Missouri.

D. White, 1897 (Geol. Soc. Am. Bull., vol. 8, p. 288). *Spring River ss.* proposed by W. P. Jenney [unpublished ms.] for thin, very irregular ferruginous ss., which intervenes btw. the coal-bearing shales and the Eocarboniferous bottom. Regarded as equiv. to "Millstone grit."

Named for Spring River, Jasper Co.

†Spring Rock limestone.

Pennsylvanian: Eastern Kansas.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 9). *Spring Rock.*—Hard bluish-gray fine-grained ls., 2 to 4 ft. thick, containing many fossils and crystalline particles of calc spar. Forms bed 16 of geol. section of Miami Co.

In a later rept Swallow applied this term to his bed No. 162, and identified it at Beaver Creek, Marais des Cygnes, W. of Topeka, and at Lecompton, confusing it with several lss.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 204). Howard ls. is part of †Spring Rock ls. of Swallow, which is abandoned.

Named for fine springs which come to surface from crevices in the rock.

†Spring Rock series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 21). *Spring Rock series.*—Series of lss., sss., and shales, 88 ft. 2 in. thick, including beds Nos. 158 to 166, inclusive, of geol. section of eastern Kans. Underlies Einstein ss. and overlies Well Rock series.

Not a definite unit, but confused with several divisions, being in places the same as his Well Rock series and in other places the same as his Cave Rock series.

Appears to be named for the Spring Rock (bed No. 162), the source of many fine springs.

†Springvale beds.

Mississippian: Southeastern Iowa.

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 320). *Springvale beds.*—Blue, somewhat calc. sh., in places aren. and locally called ss.; 20 to 25 ft. thick; basal memb. of St. Louis fm. Underlie Verdi beds (middle [upper now] memb. of St. Louis) and overlie Augusta [Spergen] fm.

F. M. Van Tuyl (Iowa Geol. Surv. vol. 30, pp. 181, 231, 1925) stated that the beds at old Springvale mill belong in upper part of Keokuk ls., and he introduced *Croton ls.* for the beds which Bain defined as "Springvale beds."

Named for old Springvale mill, 5 mi. S. of Delta, Keokuk Co.

Springvale sandstone.

Middle Devonian: Ontario (Hagersville region).

C. R. Stauffer, 1913 (12th Int. Geol. Cong. Guidebook 4, pp. 83–85, 89). Lower portion of Onondaga ls. in region around Hagersville, Ont., is usually aren. and very cherty—in some places an aren. chert and in others a true ss., as at Springvale, where lower part of Onondaga assumes such marked resemblance to true Oriskany that it has often been confused with it. But fauna is in every case Onondaga. Because of decided lithologic difference from ordinary appearance of fm. to which they belong, the beds are here referred to as *Springvale ss.* Consists of 5½ to 8 ft. of coarse white to yellowish ss., lower part rather massive, upper layers somewhat irregular and seem to contain more fossils. Material doubtless reworked Oriskany ss. Rests uncon. on Oriskany ss. or on eroded Sil. surface.

Spring Valley limestone. (In McLeansboro formation.)

Pennsylvanian: Central western Illinois.

G. H. Cady, 1921 (Ill. Geol. Surv. Cooperative Min. Ser. Bull. 26, pp. 36, 38), stated on p. 38 that in N. part of 4th dist. of Ill. the *Spring Valley ls.* lies 150± ft. above No. 7 coal. His section on p. 36 shows it 10 to 15 ft. above coal No. 8, 100± ft. above Lonsdale ls., and 25± ft. below LaSalle ls. The section shows *Spring Valley ls.* to be about 5 ft. thick. [Derivation of name not stated. There is a town called Spring Valley in Bureau Co., but that Co. is N. of the counties he lists as comprising 4th dist.]

Springville shale.

Mississippian: Southwestern Illinois (Union County).

T. E. Savage, 1920 (Am. Jour. Sci., 4th, vol. 49, pp. 169–178). *Springville sh.*—Greenish sh. that weathers variegated and mottled in shades of brown and red. From mottled color Worthen called it "Calico sh." He considered it youngest Dev. fm. in southern Ill. Lower part of fm. contains fossils [listed] that ally it with early Miss. Rockford ls. of SW. Ind. Well exposed in bed and banks of a creek a short distance NW. of Springville, SE¼ sec. 13, T. 13 S., R. 1 W., hence name. Lies uncon. on Mountain Glen sh. [He described this fm. under Upper Dev. heading, but did not list it in his table of Dev. rocks.]

Sprout Brook limestone.

Pre-Cambrian: Southeastern New York (Westchester and Putnam Counties).

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). Coarsely crystalline ls. or dol., equiv. to Inwood ls. of Manhattan Island, lies next above Lowerre qtzite. It is 200 to 800 ft. thick. [Throughout paper he calls the ls. *Inwood ls.*, but on p. 370, under description of Sprout Brook Valley (which lies in Westchester and Putnam Counties), he in several places calls it *Sprout Brook ls.*] "My interpretation is that the ls. of Sprout Brook is the Inwood ls." [On his cross section he calls the ls. at Sprout Brook the Inwood ls.]

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68). Inwood ls. correlates with Cockeysville marble, of Glenarm series (Algonkian).

"Algonkian" has recently (1934) been discarded as a time term, and Inwood ls. is now classified by U. S. Geol. Survey simply as pre-Camb.

Spurwink limestone. (In Casco Bay group.)

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 198). [*Spurwink ls.* mentioned as a fm. of Casco Bay group. Not defined.]

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 171). *Spurwink ls.*—Thin interlaminated lenses of fine-grained white and light-bluish crystalline ls., fine-grained dark-gray calc. mica schist, and fine gray siliceous mica phyllite. Is pyritiferous, in places richly so. Thickness about 200 ft. Belongs to Casco Bay group. Conformably overlies Scarboro phyllite, and conformably underlies Jewell phyllite. Assigned to Penn. (?). Named for exposures on Spurwink River, in Scarboro and Cape Elizabeth, Cumberland Co.

Squam granite.

Early Carboniferous: Northeastern Massachusetts.

C. H. Clapp, 1910 (Igneous rocks of Essex Co., Mass., pp. 9, 10, 12).

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 195 and map). Small masses of granite intrusive into Quincy granite along Squam River and in Danvers have been called *Squam granite* by Clapp. The rock is apparently related to main granite mass, but is finer-grained and richer in mafic minerals. Its feldspar is mainly orthoclase or microcline.

C. H. Clapp, 1921 (U. S. G. S. Bull. 704, pp. 26, 91), described mineral constitution of *Squam granite*.

Squanjum marl.

Misprint (on p. 378 of U. S. G. S. Bull. 191) for *Squankum marl*.

†Squankum marl.

Eocene: Eastern New Jersey.

T. A. Conrad, 1869 (Am. Jour. Sci. 2d, vol. 47, pp. 363–364), in a description of Shark River, N. J., stated that the "Eocene greensand known by the name of Squankum marl" consists of 4 ft. of hard gray rock underlain by an unknown thickness of loose greensand; that it contains few organic remains; and that it is overlain by Mio. marl.

The 1912 geol. map of N. J., issued by N. J. Geol. Surv., maps the beds around Squankum, Monmouth Co., as Kirkwood fm. (Mio.), with Cohansey sand (Mio.?) 2 or 3 mi. away. These fms. are of Mio. age, but Shark River marl, which consists of greensand with slight admixture of argill. materials, is of Eo. age.

Squantum tillite member (of Roxbury conglomerate).

Devonian or Carboniferous: Eastern Massachusetts (Boston Basin).

R. W. Sayles, 1914 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 56, pp. 141–170). *Squantum tillite.*—Tillite; contains a gravel bed in places 15 to 30 ft. thick. Underlies Cambridge sl. and overlies a lower sl. which rests on Roxbury cgl. proper at Squantum Head.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 57). *Squantum tillite memb. of Roxbury cgl.*—Cgl. and tillite, with some interbedded ss. and sl. Thickness appears to range from 50 to 600 ft. or more. Grades into overlying Cambridge sl. and overlies Dorchester sh. memb. of Roxbury cgl., possibly uncon. Named for peninsula of Squantum, in Quincy.

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 102, 106), excluded *Squantum tillite* from Roxbury cgl. and assigned both to Permian.

L. La Forge, 1932 (U. S. G. S. Bull. 839), treated *Squantum tillite* as top memb. of Roxbury cgl., which he assigned to Dev. or Carbf.

†Squantum slates.

A name applied by F. H. Lahee (Am. Jour. Sci., 4th, vol. 37, p. 316, 1914) to the slates overlying Squantum tillite in Boston Basin, Mass., which are the Cambridge sl.

Square Lake limestone.

Lower Devonian (Helderbergian): Northeastern Maine (Aroostook County).

H. S. Williams, 1900 (U. S. G. S. Bull. 165, pp. 21, 22, 26, 30–33, 51, 54–78). *Square Lake ls.*—Gray fragmental ls., chiefly fragments of corals, crinoids, and more or less perfect fossil shells. Contains Lower Helderberg fauna and is older than Chapman ss. Named for exposures on W. shore of Square Lake (or Sedgwick Lake), Aroostook Co.

Squaw sand.

Drillers' name for two sands in upper part of Pocono fm. (Miss.) of SW. Pa. and W. Va. The higher one (*Squaw No. 1 sand*) is in W. Va. said to lie higher than Big Injun sand, but in SW. Pa. the name *Squaw No. 1 sand* has been applied to a sand in the Big Injun (Burgoon ss. memb.). The lower sand (*Squaw No. 2 sand*) lies lower than Big Injun and higher than Papoose sand, and is correlated by Pa. Geol. Surv. with Sharpsville ss. memb. of Cuyahoga fm. (See G. H. Ashley and J. D. Sisler, Pa. Geol. Surv., 4th ser., Bull. M_{10}, p. 6.)

Squaw sand.

A subsurface sand of early Penn. (Cherokee) age in central northern Okla., lying lower than Bartlesville sand and correlated with Taneha and Tucker sands.

Squaw Bay limestone.

Middle Devonian: Northeastern Michigan (Thunder Bay region).

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Traverse group* subdivided [as shown in 1935 entry under *Traverse fm.*]. *Squaw Bay ls.*—Brown ls., some beds dolomitic; contains *Styliolina* and upper Dev. goniatites. Thickness exposed 3 ft.; nearby wells indicate probable total of 12 ft. Underlies Antrim black sh.; separated from underlying Partridge Point fm. by 3-foot covered interval. Type loc., Squaw Bay shore line of Partridge Point, center S. line of sec. 11, T. 30 N., R. 8 E., Alpena Co. "This fm. probably should be excluded from Traverse group."

Squirrel sand.

A subsurface sand, of Penn. age and 0 to 138± ft. thick, in NE. Okla. that lies in upper part of Cherokee sh. and is correlated with Prue and Perryman sands. In western Mo. the term has been used by drillers (see F. C. Greene, Mo. Bur. Geol. Mines, 57th Bien. Rept., App. 2, 1933, pp. 14, 16) for upper 100 ft. of Cherokee sh., being thus called because of manner in which the sand "jumps around" in well logs. The Squirrel sand of drillers in SE. Kans. occurs in upper part of Cherokee sh. and is regarded as probably approx.=the Squirrel sand of drillers of Okla. It outcrops in SE. Kans.

†Squirrel Creek formation.

Eocene: Southern Texas (Medina County).

R. A. Liddle, 1921 (Univ. Tex. Bull. 1860, p. 77, map, and columnar section). *Squirrel Creek fm.*—Impure gray and yellow gray lss.; medium hard; very glauconitic in places, no glauconite in other places; distinguished from underlying Elstone fm. by presence of brown calcite crystals and concretions. Thickness 75 to 100 ft. Upper fm. of Midway group in Medina Co. Uncon. underlies Buttsgin fm. Named for its largest exposure on E. and W. branches of Squirrel Creek above old Capt. Smith ranch house.

G. H. Chadwick, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 117). Extended field work has shown that Elstone and Squirrel Creek fms. have been inverted, the Elstone actually being the higher, and there is possibly a third memb. present locally above the Elstone glauconitic ls.

Julia Gardner (personal communication, July 1930). See under †*Elstone fm.*

Squirrel Gulch latite.

Tertiary: Southern Colorado (Bonanza district, Saguache County).

W. S. Burbank, 1932 (U. S. G. S. P. P. 169). *Squirrel Gulch latite.*—Massive flows of hornblende-biotite latite, 300 to 500 ft. thick. Underlies Porphyry Peak rhyolite and overlies Bonanza latite. Most prominent development occurs at upper part of Squirrel Creek and in N.-S. ridges W. of Kerber Creek in sec. 23.

Stacy dolomite member (of Gatesburg formation).

Upper Cambrian: Central Pennsylvania (Blair County).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 527, 534, 537). *Stacy dol. memb.*—Coarse thick-bedded steely blue ls., without qtzite. Basal memb. of Gatesburg fm. Overlies Warrior ls. Named for Stacy Hill, a knob 4 mi. slightly W. of S. of Williamsburg, Blair Co. [Thickness 500 ft. Exposed on summit and W. side of Stacy Knob.]

Stadler sand.

A term that has been locally applied to Newburg sand, which occurs about 200 ft. above base of Niagara ls. in Cleveland region, Ohio. Newburg has priority as well as usage. The sand has supplied gas to plant of Stadler Rendering & Fertilizing Co. on Cuyahoga River, just N. of mouth of Big Creek. (See also under *Newburg sand.*)

Staff limestone member (of Graford formation).

Pennsylvanian: Central northern Texas (Brazos River region).

F. Reeves, 1922 (U. S. G. S. Bull. 736E, p. 120). *Staff ls. memb. of Graford fm.*—Lies 159 ft. below Adams Branch ls. memb. Upper half weathers in gray fragments; lower part is massive, hard, and yellow. Thickness 10 ft. Outcrops near Staff, Eastland Co.

Stafford limestone member (of Skaneateles shale).

Middle Devonian: Western and central New York.

J. M. Clarke, 1894 (N. Y. State Mus. 47th Ann. Rept., pp. 342, 351). At 823 ft. depth in Livonia salt shaft, at Livonia, Livingston Co., occurs 2 ft. of compact grayish or chocolate-colored ls., somewhat bituminous, shaly at top, which I have named *Stafford ls.*, from its excellent development at Stafford, Genesee Co. Hamilton fossils very abundant [listed]. It persists from Livonia eastward probably not less than 50 mi. In the shaft section, as at all its observed outcrops, it bears a Hamilton fauna with a few Marcellus species. From this horizon upward there are no more lss. in the Marcellus section. The Stafford ls. rests on 28 ft. of compact black, very bituminous but not heavy-bedded shales [the fossils of which are listed].

I. P. Bishop, 1897 (N. Y. State Geol. 15th Ann. Rept., vol. 1, p. 314). *Stafford ls.* lies in midst of the jet-black Marcellus shales, 20 ft. above Corniferous [Onondaga] ls.

F. J. H. Merrill, 1898 (N. Y. State Mus. Bull. 4, No. 19). *Stafford ls.* is a thin ls. about 40 ft. above base of Marcellus sh. Extends from central N. Y. to Lake Erie. Well exposed at Stafford, Genesee Co.

Has sometimes been called *Manlius ls.*, because well exposed 2 mi. W. of village of Manlius (D. D. Luther, 1899), but is much younger than true Manlius ls., which is Sil. Thicknesses given range from 2 ft. to 8 ft. 4 in.; distances above Onondaga ls. vary from zero to 159 ft.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 215–216). *Stafford ls.* is basal memb. of Skaneateles fm. It is a gray ls. that weathers chocolate brown; in places is quite shaly, in other places highly calc. and massive. At Stafford [Genesee Co.] it is 3 ft. thick; at Lancaster 8½ ft.; at Lake Erie 15 ft. The upper 2 ft. of the Stafford at Lancaster is like typical Stafford, but presents considerable variations in fauna and lithology from the 6½ ft. below it, which should probably be placed in underlying Oatka Creek memb. of Marcellus. The beds above the Stafford are here named *Levanna memb.* of Skaneateles fm. The Stafford is considered=Mottville memb. [See under *Mottville memb.*]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Stafford ls.* is basal bed of Skaneateles sh. [On p. 391 she stated it has recently been proved to be=Mottville ls.]

The U. S. Geol. Survey has adopted the definition of Skaneateles sh. that includes in it the Stafford ls. of N. Y. repts.

Stafford Store quartz monzonite.

Post-Ordovician: Northeastern Virginia (Stafford County).

J. T. Lonsdale, 1927 (Va. Geol. Surv. Bull. 30, p. 40), described geographic distribution and petrography of *Stafford Store quartz monzonite*, "which is typically developed near Stafford Store post office, Stafford Co."

Staghorn Point submember.

Middle Devonian: Central New York (Skaneateles quadrangle).

B. Smith, 1935 (N. Y. State Mus. Bull. 300, pp. 46–47). About 50 ft. above Centerfield ls. occurs the lower coral bed or reef of Otisco memb. of Ludlowville sh. and the hard and coarsely bedded platform on which the coral bed rests. This coral bed is 3 or 3½ ft. thick but may thin to almost nothing. The platform on which it rests is 5 or 10 ft. thick. Both are beautifully displayed in vicinity of Staghorn Point, on E. side of Skaneateles Lake, about 1⅕ mi. NW. from Spafford Landing. The term *Staghorn Point submember* is here proposed for the coral bed or reef typically shown just S. of Staghorn Point.

†Staked Plains formation.

Pliocene: Northwestern Texas.

R. T. Hill, 1890 (Am. Ass. Adv. Sci. Proc., vol. 38, p. 243). The Staked Plains are shown to be an extensive mesa, which was an interior baselevel in late Tert. or early Quat. time. Its surface is covered by a fresh-water lacustrine sediment, consisting of loam and gravel, for which name *Staked Plains fm.* is proposed.

These blanket deposits of the Staked Plains or Llano Estacado are now called *Ogallala fm.* (*Plio.*). (See 1937 geol. map of Tex.)

Stalk group.

Pre-Cambrian: Canada (Northwest Territories).

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 379).

Stalnaker sand.

A subsurface sand, of Penn. age, in southern Kans. and northern Okla., lying at about 2,050 ft. depth in Udall pool, Cowley Co., Kans.; also produces in E. part of adjoining Sumner Co., Kans. Correlated with top part of Lansing group. Believed to be same as Tonkawa sand. In Mervine pool, Kay Co., Okla., it is 22 ft. thick and lies at 1,800 ft. depth, the Endicott lying at 1,500 ft. and the Burbank at 3,100 ft.

Stamford granite gneiss.

Pre-Cambrian: Southwestern Vermont (Bennington County) and western Massachusetts.

C. H. Hitchcock, 1861 (Rept. geol. Vt., vol. 2, p. 601). Climbing the great hill W. of Stamford monstrous boulders of granite appear, and presently the granite itself, which contains blue hyaline quartz. So peculiar is this granite that it has been called *Stamford granite* in our notes. It may be eruptive. Extends btw. 3 and 4 mi. to E. part of Pownal.

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pl. 97). *Stamford gneiss*, pre-Camb., underlies Vermont fm. in western Mass.

J. E. Wolff, 1894 (U. S. G. S. Mon. 23, pp. 45–48). *Stamford gneiss* (*the "Stamford granite" of Vt. geol. rept.*).—Coarse banded granitoid gneiss. Underlies Vermont fm.

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B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 151, and map). *Stamford granite gneiss.*—Described by Pumpelly and Wolff (U. S. G. S. Mon. 23, p. 45, 1894). Forms core of Hoosac Mtn proper. Was named for exposures at Stamford, Vt.

Intrudes Mount Holly gneiss. (L. M. Prindle and E. B. Knopf, Am. Jour. Sci., 5th, vol. 24, Oct. 1932.)

Stamper zone.

Drillers' name for 110± ft. of sandy dol. of Ord. age in Oklahoma City field, NE. Okla., containing fossils that correlate it with Joins fm. Underlies Kinter ss. of drillers and overlies beds identified as Arbuckle ls. Basal 0 to 40 ft. consists of gray and white mottled coarsely crystalline soft to hard ls., in places partly or completely dolomitic, which are called *Stamper ls.* (See A. A. P. G. Bull., vol. 16, No. 10, pp. 967+.) Derivation of name not known.

Stamper limestone.

See under *Stamper zone.*

Stanbridge slate.

Middle and Upper (?) Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 7).

Standish flagstone. (In Genesee group.)

Upper Devonian: West-central New York.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, p. 29). *Standish flags and shales.*—Thin uneven bluish-gray flags and olive shales 15 ft. thick, overlying West River sh. and underlying Middlesex black shales of Portage group. Top div. of Genesee beds or group. Seems entitled to designation because it marks a transition from argill. shales of West River beds into aren. sedimentation characterizing for most part the mass of Portage strata. Not persistent for any great distance from Canandaigua and Naples quads. Fauna sparse and chiefly that of beds below.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 73). *Standish flags and shales* named for Standish Gully, town of Italy, Yates Co. Is a local fm. not recognized E. of Yates Co. and to W. thins to disappearance in Genesee Valley. Top div. of Genesee beds.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included *Standish sh.* and underlying West River sh. and Genundewa ls. in Portage group, and restricted Genesee to its basal memb., or the Geneseo sh. of Chadwick.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2), included Standish and underlying beds in *Genesee group.*

The U. S. Geol. Survey has adopted *Standish flagstone* as the name of this unit, and includes it in Genesee group.

†Standley shale.

Mississippian: Eastern Oklahoma.

See *Stanley sh.*

Standpipe sandstone. (In Elmdale formation.)

Pennsylvanian: Central northern Oklahoma (Pawnee County).

F. C. Greene, 1928 (Okla. Geol. Surv. Bull. 40CC). "Standpipe ss." lies 5 to 8 ft. below Neva ls. in Pawnee Co.

Standpipe limestone member (of Clear Fork formation).

Permian: Central northern Texas (Taylor County).

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 27, pl. 1). *Standpipe ls.*—Dark-gray fossiliferous ls., 1 to 3 ft. thick, forming top memb. of Wichita-Albany. Type loc. is the lime outcropping at base of hill upon which is located the standpipe in E. part of Abilene, Taylor Co. Is used in unpublished rept of W. A. Riney.

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, No. 8, pl. 9, pp. 948, 949). *Standpipe ls.*—Lies 125 ft. above Lytle ls., in lower part of Clear Fork fm. Is noticeable chiefly on account of its outcrop in SW. part of city of Abilene. Is of local extent.

Stanford conglomerate.

Probably late Tertiary: Central northern Montana (Fort Benton quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Stanford cgl.*—Cgl. found in the very prominent hills rising above the flat prairie near that town. The road E. of Stanford crosses a flat bench covered with this cgl. Thickness 0 to 100 ft. Uncon. overlies Montana fm. (Upper Cret.). Of Pleist. or Tert. age.

This gravel is now considered by W. C. Alden to probably be=Flaxville gravel, which is considered to be of upper Mio. or Plio. age.

Stanhope sand.

A subsurface sand in Stanhope pool, secs. 15 and 22, T. 26 S., R. 8 E., Kans. Lies in or on top of Mississippi lime.

Staniukovich shale.

Lower Cretaceous: Southwestern Alaska (Alaska Peninsula).

W. W. Atwood, 1911 (U. S. G. S. Bull. 467, pp. 25, 38, etc.). *Staniukovich sh.*—Shales and thin sss., 1,000+ ft. thick, conformably underlying Herendeen ls. (Lower Cret.) and overlying Naknek fm. (Upper Jurassic). Exposed on Herendeen Bay, also on Staniukovich Mtn. and E. to Port Moller. Is Lower Cret.

Stanley shale.

Pennsylvanian (Pottsville): Central southern and southeastern Oklahoma and western Arkansas.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Standley sh.*—Upper part bluish and greenish fissile green shales and massive and thin-bedded friable drab sss.; lower part siliceous and cherty fissile sh. Thickness 6,100 ft. Underlies Jackfork ss. and overlies Talihini chert.

A. H. Purdue, 1909 (Ark. Geol. Surv. Slates of Ark.). *Stanley sh.*—Greenish clay sh., with, locally, black sl. near base and greenish qtzitic ss.; frequently a cgl. at base. Thickness 6,000 ft. Uncon. overlies Fork Mtn sl., 0 to 125 ft. thick. [Stanley sh. as used in this rept included Hot Springs ss. of Hot Springs area. This definition of Stanley sh. (to exclude †Fork Mtn sl.) was also used by Purdue in U. S. G. S. Bull. 586, 1914.]

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 66). Some sh. at base of Stanley sh. has in places been altered to sl., to which name "Fork Mtn sl." has been earlier applied. In Caddo Gap and DeQueen quads. Ark. and Okla., the Stanley rests uncon. on Arkansas novaculite and underlies Jackfork ss.

Age of Stanley sh. was changed to Penn. in 1934. (See H. D. Miser, A. A. P. G. Bull., vol. 18, No. 8, 1934.)

Named for Stanley, Pushmataha Co., Okla.

Stanstead granite.

Post-Devonian (?): Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

Stanton limestone. (In Lansing group, Kansas.)

Stanton limestone member (of Lansing formation, in Missouri).

Pennsylvanian: Northwestern Missouri, southwestern Iowa, southeastern Nebraska, eastern Kansas, and northeastern Oklahoma.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 6). *Stanton ls.*—Lss., 28 ft. thick, forming bed No. 7 of geol. section of Miami Co., Kans. At top thick beds of soft light-gray mag. ls. full of small brown ferruginous spots; in middle harder, regular beds of medium thickness; at bottom bluish-gray ls., weathering brown and separating into angular fragments by plane or conchoidal fractures. Overlain by 9 ft. of sh. and ss., and underlain by 15 to 28 ft. of ss., which passes into shales and fire clays at top and bottom, and rests on Cave ls.

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1, pp. 71–85). Stanton ls. of Swallow overlies Vilas sh. and underlies LeRoy sh. Is same as Piqua ls. of Adams.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13) and 1917 (U. S. G. S. Leavenworth-Smithville folio). *Stanton ls.* is top memb. of Lansing fm. Overlies Vilas sh. memb. and underlies Weston sh. memb. of Douglas fm.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 76). Swallow's original Stanton is equiv. to ls. now called *Plattsburg ls.* Usage has transferred application of name *Stanton* to the ls. next above the Plattsburg; and accordingly as used in this rept *Stanton* now applies to 3 ls. and 2 sh. members, all named, that are exact equiv. of Stanton of Hinds and Greene in Leavenworth-Smithville area. Stanton is top fm. of Lansing group.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 131–132). Swallow's original Stanton ls. is ls. now called *Plattsburg ls.* The name *Stanton* has been shifted by usage to ls. next above that exposed at Swallow's type loc. As now defined it overlies Vilas sh., underlies Weston sh., and is uppermost fm. of Lansing group. It is typically exposed in road cuts near SE. cor. sec. 3, T. 13 S., R. 21 E., and adjacent area along Captain Creek. Thickness 20 to 100+ ft.

†Stanton limestone series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., p. 20). *Stanton ls. series.*—Series of lss., sss., and shales, 74 ft. thick, including beds Nos. 151 to 155, inclusive, of geol. section of eastern Kans. Includes at top Stanton ls., 6 to 28 ft. thick. Underlain by Cave Rock series (of which Cave ls. is top bed) and overlain by Chocolate ls. series.

Preoccupied by Stanton ls. memb. of Lansing fm. Included Stanton ls. and Vilas sh. members of Lansing fm.

Probably named for its topmost memb., the Stanton ls.

Stanton sand.

Drillers' name for a Sil. sand in Ky.

Stapleton zone.

Name applied to lowest producing zone in Eldorado field, Butler Co., Kans., which lies at 2,350 to 2,750 ft. depth. According to J. R. Reeves (A. A. P. G. Structure symposium, vol. 2, 1929, p. 166) these rocks are in the Ord., either in Viola ls., Siliceous lime, or St. Peter ss.

Star limestone.

Carboniferous: British Columbia.

S. J. Schofield, 1920 (Canada Geol. Surv. Mem. 117, p. 15). Included in Slocan series.

†Staran series.

Triassic (Upper?): Humboldt County, Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52, 59). The great *Star Peak ls.*, or *Staran series*, of Humboldt Mtns. reported to be more than 5,000 ft. thick [thickness assigned by Keyes, 3,000 ft.], appears to fade out long before reaching southern and eastern confines of State. Uncon. below Jurassic Lovelockian series and above Koipatoan series. Of late Triassic age.

Named for exposures in Star Peak Mtn, Humboldt Co.

Starbird formation.

Devonian: British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 35).

Stark shale.

Pennsylvanian: Eastern Kansas, western Missouri, and southwestern Iowa.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 91, 97). [See under *Dennis fm.* Derivation of name not stated.]

J. M. Jewett, 1932 (pp. 99, 102, 103 of book cited above). *Stark sh.* is proposed for the sh. above Canville ls. and below Winterset ls. Its lower part is dark or black and carbonaceous, and upper part is commonly yellow, although the yellow upper part is not persistent. Traced by writer from Kansas City, Mo., to Dennis, Labette Co., Kans. Is easily distinguished from Galesburg sh. by means of the black sh.

at its base, even though Canville ls. be not present, as is case at Kansas City. Thickness 8 to 11 ft.

J. M. Jewett, 1933 (Kans. Acad. Sci. Trans., vol. 36, p. 133). Type loc. of Stark sh. is near Stark, Neosho Co., Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 92). N. of point in Linn Co. where Canville ls. disappears, Stark sh. memb. of Dennis fm. rests on Galesburg sh., but because lower part of Stark memb. is black fissile sh. (1 to 3 ft. thick) it is easy to separate Stark and Galesburg shales. In southern Kans., where Canville is missing, the absence of black platy sh. at horizon of Stark memb. makes it impossible to recognize Stark sh., and upper bdy of Galesburg sh. is extended up to base of Winterset ls. The upper part of Stark sh. consists of gray or buff calc. clay sh. 2 to 5 ft. thick. At Kansas City total thickness of Stark sh. is 4 ft. Jewett is author of name.

Starmount limestone.

Middle Cambrian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 435). *Starmount ls.*—Mostly argill.; 600 ft. thick. Corresponds in character and position to Meagher ls. of Little Belt section, but positive identification with Meagher ls. is impossible, hence local name. Upper (and major) part is more massively bedded and of darker color, mottled, and contains less silica and clay than lower 250 ft., which consists of light-gray thin-bedded argill. ls. Underlies Hobo Gulch fm. and overlies an intrusive granite porphyry that is believed to be intruded into and to conceal a sh. that corresponds to Wolsey sh. of Little Belt section. Named for Starmount mine, Elkhorn min. dist.

Probably same as Meagher ls.

Star Peak formation.

Upper and Middle Triassic: Northwestern and northern Nevada.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map V) and 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 267–278, 544). *Star Peak group.*—Upper 10,000 ft. of Triassic section in West Humboldt Range. In descending order: (1) Pure qtzite, 2,200 to 2,800 ft.; (2) ls., 1,000± ft.; (3) pure thinly bedded qtzite, 800 to 1,000 ft.; (4) heavy ferruginous lss., 2,000 ft.; (5) black slates, 250 ft.; (6) slaty qtzite, 1,250 ft.; dark carbonaceous ls., 1,500 ft. Rests conformably on Koipato group. Named for development at Star Peak Mtn.

Star Point sandstone. (Of Mesaverde group.)

Upper Cretaceous: Central eastern Utah (Wasatch Plateau and Book Cliffs).

E. M. Spieker and J. B. Reeside, Jr., 1925 (Geol. Soc. Am. Bull., vol. 36, p. 442). *Star Point ss.*—Basal fm. of Mesaverde group. Thickness 200 to 450 ft. in Wasatch Plateau. Conformably underlies Blackhawk fm. and grades into underlying marine Mancos sh. It really represents the retreating or closing phase of Mancos sea and is more closely allied in origin with the Mancos than with the Mesaverde type of rocks but is included in Mesaverde in conformity with accepted practice of giving that name to the sss. of Montana age immediately overlying Mancos sh. Star Point, a prominent headland of Wasatch Plateau SW. of Price, is formed by this ss.

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Star Point ss.* consists of non-coal-bearing medium-grained buff sss. separated by tongues of marine Mancos sh., into which it grades laterally in part and in part overlies. The 3 larger tongues of Star Point ss. are named (descending) Spring Canyon tongue, Storrs tongue, and, at base, Panther tongue.

Starr conglomerate.

Starrs conglomerate.

Lower Cambrian: Southeastern Tennessee.

C. W. Hayes, 1895 (U. S. G. S. Cleveland folio, No. 20, p. 2). *Starr cgl.* in text (*Starrs cgl. on map*).—Cgl., usually quite coarse and containing many large feldspar pebbles. Thickness 0 to 660 ft. Is middle memb. of Sandsuck sh.

Named for exposure near Starr Mtn, Monroe Co.

Starrucca shale. (In Catskill or Chemung formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. G_5, pp. 59, 70, 73). *Starucca olive shales.*—Olive or greenish shales containing many thin sss. and in places topped by a massive ss. Thickness 105 ft. in Susquehanna and Wayne Counties. Underlie New Milford red sh. and overlie Chemung sh. Form basal div. of Catskill fm. Well exposed along Jefferson Branch R. R. above Starucca Bridge, also near mouth of Starucca Creek. [In 1882 (2d Pa. Geol. Surv. Rept. G_6) I. C. White gave thickness of *Starrucca shales and sss.* in Pike and Monroe Counties as 600 ft., and stated that they may be = upper part of Chemung fm. instead of Catskill.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, p. 1206). [See 1935 entry under *Delaware River flags.* Willard drops this name, stating it is only upper part of Trimmers Rock ss., the type loc. of which is in Perry Co.]

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 591). Beneath New Milford fm. in Susquehanna Co. is the fully marine Chemung, the Cayuta fm., the designation being extended upward to include Starrucca sh. of I. C. White, which writer does not differentiate from rest of Chemung.

In some early repts spelled *Starucca.* The spelling adopted by U. S. Geog. Bd. is *Starrucca.*

Starrucca sandstone.

Upper Devonian: Northeastern Pennsylvania.

C. S. Prosser, 1894 (U. S. G. S. Bull. 120, p. 78). *Starucca ss.*—Greenish gray massive sss., 600 ft. thick, underlying New Milford sh. and overlying Chemung of I. C. White in eastern Pa.

Occupies same interval as Starucca sh. of I. White. (The approved spelling is *Starrucca.*)

Starucca shale and sandstone.

Upper Devonian: Northeastern Pennsylvania.

See *Starrucca,* the spelling approved by U. S. Geog. Bd.

†State line serpentine.

Pre-Cambrian: Southeastern Pennsylvania and northeastern Maryland. (See F. D. Chester, 1889, 2d Pa. Geol. Surv. Ann. Rept. 1887, pp. 93–105.) Named for fact it occurs fully 16 mi. along bdy. btw. Pa. and Md. Is later than Glenarm series.

Staten Island serpentine.

Pre-Cambrian (?): Southeastern New York (Staten Island).

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). *Staten Island serpentine* clearly intrusive into Fordham gneiss, Inwood ls., and Manhattan schist.

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). *Staten Island or Hoboken serpentine.*—An intrusive which forms the elevated portion of Staten Island and the Knob at Castle Point, in Hoboken. In all cases it is probably more closely associated with Manhattan schist [pre-Camb.] than with any other important fm. Age undet.

State Quarry limestone.

Upper Devonian: Central eastern Iowa.

S. Calvin, 1897 (Iowa Acad. Sci., Proc., vol. 4, pp. 16–21). *State Quarry ls.*—Light-gray fossiliferous lss., 0 to 40 ft. thick, uncon. overlying Cedar Valley ls. in Johnson Co. Included in Upper Dev.

Regarded by some authors as contemp. in whole or part with Lime Creek sh., but E. O. Ulrich (1911) says it is much younger than Lime Creek sh. and of Cheming and Portage age.

Named for State quarry (or North Bend quarries), Penn Twp, Johnson Co.

†State Road conglomerate.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 257). One of cgls. at base of Mesnard qtzite is especially interesting, in that it was the first in which the clear evidence of uncon. was found. This contact is N. of Mud Lake and along an old road known as the State road, and the cgl. has sometimes been called "State Road cgl."

Staunton formation.

Pennsylvanian: Southwestern Indiana.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, chart and pp. 408, 525, 529). *Staunton fm.*—Name proposed for interval btw. top of coal No. 4 and top of coal No. 2 of Ind. Formerly included in Brazil fm. Rests discon. on Brazil fm. as here restricted and is discon. overlain by Petersburg fm. as here expanded. Of Allegheny age.

Named for Staunton, Clay Co.

Stayton lavas.

Miocene: Northwestern Oregon and central northern Oregon (Cascade Mountains region).

T. P. Thayer, 1933 (Pan-Am. Geol., vol. 59, No. 4, p. 317). *Stayton lavas.*—Basaltic, 400± ft. thick, correlated with Miocene Columbia basalts. Form Salem Hills, SW. of Salem, Oreg. Lie on eroded surface of gently folded Illahe fm. (lower-middle Olig.). To E. the lavas flatten and form the shallow Stayton Basin, about 12 mi. wide. East of the basin they rise gently into the Cascades, with conspicuous dip slopes, disappear under the conformably overlying *Fern Ridge tuffs*, and rest uncon. on Mehama volcanics.

Steamboat limestone.

Middle (?) Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 37 and passim). *Steamboat ls.*—At type loc. (on E. and N. sides of Steamboat Mtn) can be divided into 3 natural zones (descending): (1) Extremely massive tan-gray thick-bedded crumbly ls. with much yellow clay disseminated throughout, 40 ft.; (2) interbedded green-gray micaceous calc. sandy shales and tan argill. gray-weathering lss. with much buff clay in flakes, bands, and nodules, the upper 22 ft. composed solely of green calc. platy sh., 115 ft.; (3) thick-bedded massive gray and tan-gray fine-grained ls. with nodules and flakes of buff clay, 70 ft. Underlies Pagoda oolite and overlies Dearborn ls.

Steamboat Mountain type (of diorite porphyry).

Name applied by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, p. 515, 1900) to the rock that "forms the great laccolith of Steamboat Mtn," Little Belt Mtns, central southern Mont.

Stearns shale. (In Council Grove group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 230, 233, 234, 235, 237). *Stearns sh.*, in Garrison sh. memb. of Council Grove fm., consists of (descending): (1) Grayish calc. sh., 1½ to 2 ft.; (2) bluish-gray argill. crumbly sh., 4 to 6 ft.; (3) chocolate or reddish crumbly argill. sh., 5 to 8 ft.; (4) light-gray limy, loosely indurated sh., 2+ ft. Total thickness 14 to 18 ft. Overlies Morrill ls. and underlies Eiss ls. Named for exposure S. of Stearns School, NE. of Humboldt, Nebr.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 18). *Stearns sh.* is 17 to 18 ft. thick in Nebr. and about 8 ft. in southern Kans. Section at type loc. is now obscured, but the sh. is typically exposed along a N.-S. road 6 mi. S. and ½ mi. E. of Humboldt, Nebr.

G. E. Condra and R. C. Moore in 1932 included this sh. in the Garrison, but Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 7) treated it as distinct fm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

Steele shale. (Of Montana group.)

Upper Cretaceous (Pierre): Eastern and central Wyoming.

In April 1909 the names to be used in U. S. G. S. Laramie-Sherman folio (No. 173), by N. H. Darton and C. E. Siebenthal, were given consideration by Com. on Geol. Names of U. S. Geol. Survey. The Cret. rocks as mapped in the western or Laramie quad. of this folio were divided by the authors into (descending): (1) An upper ss. of Pierre age, (2) a sh. of Pierre age, (3) the Niobrara ls., (4) the Benton sh., and (5) the Cloverly fm. Other Survey geologists, who had for several years worked in the coal fields of adjacent areas in southern and central Wyo., were satisfied that the upper ss. of Pierre age in Laramie Basin represented Mesaverde fm. of adjacent areas to W., and they had for some time had in contemplation the introduction of a suitable Wyo. name for the underlying sh. of Pierre age. They at this time presented for it the name *Steele sh.*, from Fort Steele, in the adjacent county (Carbon) on the W. The correlation of the rocks of Pierre age in Laramie quad. with Mesaverde fm. and the proposed Steele sh. to the W. was considered acceptable to all these workers, including Mr. Darton. The Laramie-Sherman folio was the first of these repts to be published (1910). Therefore in it occurs the following original definition of Steele sh.: The *Steele sh.* consists of about 3,000 ft. of dark sh. with some thin beds of ss. and numerous nodular concretions, mostly sandy. Believed to represent Steele sh., whose type loc. is Fort Steele, on North Platte River. Grades into overlying Mesaverde fm. and rests on Niobrara ls. Is basal fm. of Montana group in this area.

The Steele sh. in its type region was described by C. F. Bowen (U. S. G. S. P. P. 108, 1918, p. 229) as consisting of 4,000± ft. of dark-gray fossiliferous marine sh. with intercalated beds of ss. and shaly ss., some of which form conspicuous ledges near top of fm.; the shale containing concretions of calc. ss., dark ls., and white calcite. Underlies Mesaverde fm. and overlies Niobrara fm.

Subsequently (1920) Mesaverde fossils were obtained from thick sandy beds that were included in upper part of Steele sh. as mapped in Laramie Basin. The division line btw. Mesaverde fm. and Steele sh. in that area is therefore now placed somewhat lower than in 1910.

Steele Valley granodiorite.

Late Jurassic (?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, map, pp. 491, 502). Late Jurassic (?) intrusive occurring in Steele Valley, S. part of Perris-Elsinore area, Riverside Co.

Steens basalt.

See under *Steens Mtn basalt.*

Steens Mountain formation.

Pliocene: Southeastern Oregon (Steens Mountain).

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Steens Mtn fm.*—Basalt and rhyolite dikes, 10 to more than 50 ft. thick, typically exposed on Steens Mtn, Harney Co.

†Steens Mountain basalt.

Miocene: Southeastern Oregon (Steens Mountain).

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, pp. 7–130, 101). *Steens Mtn basalt.*—Extensive series of thin flows of light-gray holocrystalline olivine basalt, 3,000+ ft. thick. Overlies Steens Mtn andesitic series. In general the evidence indicates this basalt is definitely younger than Columbia River flows and occurred either late in Mio. or early in Plio. Exposed almost continuously for 100 mi. on E. scarp of Steens and Pueblo Mtns.

The U. S. Geol. Survey has shortened this name to *Steens basalt*, which it classifies as Mio.

Steens Mountain andesitic series.

Tertiary (late): Southeastern Oregon (Steens Mountain).

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, pp. 7–130, 74). *Steens Mtn andesitic series.*—To N. of Alvord Creek, on E. slope of Steens Mtn, it consists of (descending): (1) Upper andesitic series accompanied by extensive breccias; (2) great andesite flow, 500 to 900± ft.; (3) thin bed of coarse andesitic tuffs, 10 to 20 ft.; (4) basic andesitic flow, very like that 100 ft. below top of underlying Alvord Creek beds, 200+ ft. Underlies *Steens Mtn basalt*. [Appears to be regarded as late Mio. or early Plio.]

Steep Rock series (or group).

Pre-Cambrian (lower Huronian): Ontario.

H. L. Smyth, 1891 (Am. Jour. Sci., 3d, vol. 42, pp. 319–331).

Steep Rock Lake series.

Pre-Cambrian: Ontario.

J. E. Gill and J. E. Hawley, 1931 (Jour. Geol., vol. 39, p. 656).

See *Steep Rock series*.

Stehekin physiographic stage.

Recent: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. P. 19). Type loc. Stehekin sources and valley.

Steilacoom gravel.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Steilacoom fm.*—Chiefly coarse gravel, sometimes washed clean, elsewhere mingled with coarse sand, usually stratified or cross stratified. Type, the Steilacoom Plains, which extend for many mi. S. and SW. from Tacoma. G. O. Smith, my associate, describes the deposits, in ms., as of glacial origin and a peculiar type of washed plains, which was submerged during retreat of the ice. Writer agrees with this conception.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54). *Steilacoom gravels* differ from Gale sands in their prevailing coarseness.

Stein sand.

A subsurface sand in Chester group (Miss.) of Marion Co. Ill.

Stellarton formation.

Carboniferous: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 211).

Stennett limestone. (In Shawnee formation.)

Pennsylvanian: Southwestern Iowa.

S. W. Beyer and I. A. Williams, 1907 (Iowa Geol. Surv. vol. 17, p. 480). A sixth ls. horizon far above the strata of the Bethany may for present purposes be designated *Stennett ls*. It is typically developed at Stennett, Montgomery Co., and is believed to be present in adjoining counties.

G. L. Smith, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 276). The Mo. Geol. Surv. has correlated Forbes ls. with Deer Creek ls. of Kans., and uses this term for Forbes ls. As Iowa outcrops of this ls. are upwards of 100 mi. distant from type section of Forbes ls., it is by no means certain they represent same horizon. Under these circumstances, the Mo. Geol. Surv. having abandoned use of term Forbes, it is proposed that this ls. be named *Stennett ls*. Until the different fms. of Iowa have been actually traced in the field to those of Kans. it is preferable that they be designated by local names rather than by those of fms. several hundred mi. distant.

Stensgar dolomite member.

Paleozoic: Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 57; map). *Stensgar dol. memb. of Deer Trail argillite.*—Dolomitic ls., typically slightly banded to massive grayish-white to pure-white crystalline ls. containing large and varying quantities of mag. carbonate. In some places the rock becomes an impure magnesite. The dolomitic phases are usually pinkish, bluish, and reddish gray, depending on iron content. Lies in apparent conformity on Deer Trail argillite and is overlain by beds of Deer Trail argillite. [Type loc. not stated, but map shows it occurs near Stensgar Mtn.]

Stephen formation.

Middle Cambrian: British Columbia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 198). The Camb. strata of Mount Stephen, near Field, along line of Canadian Pacific Ry. are highly fossiliferous, and that locality proves to be one of best in world for collecting Neo-Camb. trilobites, which occur at about 11,000 ft. altitude. The designation *Stephen fm.* is suggested for the trilobitic beds of sh. and ls. with *Ogygopsis klotzi, Zacanthoides spinosus, Ptychoparia cordillerae* and associated fauna.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 2, 3). *Stephen fm.*—Bluish-gray and greenish-gray ls. and sh. band about 2,700 ft. up above r. r. track on N. and E. sides of Mount Stephen, above Field, on Canadian Pacific Ry. B. C. The lss. and the shales are calc. and siliceous. Thickness in Mount Bosworth section 640 ft.; on Mount Stephen 562 ft., with 150 ft. of local development of *Ogygopsis* shales at summit. Middle Camb. fossils; *Ogygopsis* fauna of Mount Stephen and fauna below in the thin-bedded dark bluish-gray ls. Underlies Eldon fm. and overlies Cathedral fm.

Stephens lime.

A subsurface unit, of Penn. age, in Fisher Co., north-central Tex., lying at 3,000 ft. depth.

Stephensian series.

Cambrian: Alberta.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 289). Shales and lss., aggregating 775 ft. in thickness, underlying Eldonian series and overlying Cathedralian series. [Apparently same as *Stephen fm.*]

†Stephensport bed. (In Chester group.)

Mississippian: Northwestern Kentucky and southwestern Indiana.

A. F. Foerste, 1910 (Ky. Geol. Surv. Rept. Prog. 1908 and 1909, p. 84). *Stephensport bed.*—Chiefly two ls. horizons, separated by an intermediate clay horizon, which near middle may be replaced by shaly or even by massive ss. layers. Thickness 96 ft. Underlies Tar Springs ss. and overlies Garfield ss. in Meade and Breckinridge Counties.

This name has also been proposed in a broader sense, for beds extending from top of Glen Dean ls. to base of Cypress ss. (See separate item.)

Named for Stephensport, Breckinridge Co., Ky.

Stephensport (broad usage). (In Chester group.)

Mississippian: Southern Indiana and Illinois and western Kentucky.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 514, footnote). *Stephensport* suggested to Professor Weller in 1920 for the middle Chester, including all rocks btw. top of Glen Dean ls. and base of Cypress ss., but Weller preferred to use *middle Chester* for the present.

Derivation of name not stated, but probably Stephensport, Breckinridge Co., Ky.

Stepovak series.

Eocene: Southwestern Alaska (Stepovak Bay, Alaska Peninsula).

C. Palache, 1904 (Harriman Alaska Expedition, vol. 4, p. 74). *Stepovak series.*—Marine sediments occupying most of area studied about Chicagof Cove, Stepovak

Bay, and containing abundant lower Eo. fossils. Folded and faulted. Upper beds are soft shales, sss., and grits, with some thin beds of ls. and some chert bands. Lower part consists of coarse breccias or aggls. and fine tuffs of igneous material.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, p. 240). Stepovak series of Palache is probably older than Kenai series.

Steptoean series.

A term applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, p. 78), to uppermost part of Pogonip ls. of Nev. Named for development in Egan Mtns, which face Steptoe Valley, NE. Nev.

Sterling granite gneiss.

Late Carboniferous or post-Carboniferous: Eastern Connecticut and western Rhode Island.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 131–134–136, 152, 154, 155, and map). *Sterling granite gneiss.*—Made up of two distinct types—a porphyritic gneiss with abundance of biotite along foliation planes, and an aplite or a granite gneiss practically free from mica. The porphyritic type is always highly gneissoid and the phenocrysts, which are of pink feldspar, are drawn out into lenticular forms. The aplitic type is probably a later intrusion than the porphyritic and normal types. General color of the granite gneiss is pink to red, although in some regions, where exposed in fresh cuts and quarries, it is light to medium gray. It is the "red Westerly" granite of the trade, and is quarried at Westerly, R. I. Intrudes Putman gneiss and is intruded by pegmatites and by Westerly granite (the "gray Westerly" of the trade). Covers most of Sterling Twp, Conn.

See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 23–24, 35–38, 119–135, and map).

Sterling Station iron ore.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). A 4-inch seam of ore 8 ft. above principal ore bed (Furnaceville) at Sterling Station [Cayuga Co.]. Not known to outcrop elsewhere, but appears in several wells. Underlies true [restricted] Sodus sh. [Lies in lower part of Clinton fm.]

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., p. 347), placed *Sterling Station ore* in lower part of Sodus sh., with a thin ls. separating it from underlying Bear Creek sh. This is position assigned to this ore by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10).

Steussy shale member (of Millsap Lake formation).

Pennsylvanian: North-central Texas.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 106, 107), from ms. of rept. by G. Scott and J. M. Armstrong, on geol. of Parker Co. (See under *Millsap Lake fm.*) Type loc. not stated.

Stevens series.

Paleozoic (?): Northeastern Washington (Stevens County).

C. E. Weaver, 1920 (Wash. Geol. Surv. Bull. 20, p. 49, map). *Stevens series.*—The metamorphosed sed. rocks of Stevens Co., which are divided into 11 apparently conformable members (descending): Mission argillites (including Northport ls.), 12,000± ft.; Clugston ls., 1,200± ft.; Colville qtzite, 5,000± ft.; Old Dominion ls., 1,500± ft.; Chewelah argillite, 4,000± ft.; Addy qtzite, 8,000± ft.; Deer Trail argillite (including Stensgar dol. memb.), 3,000± ft.; Eagle Mtn qtzite, 1,200± ft.; and Deer Lake argillite, 4,000± ft. Also includes the following additional named units, the relations of which to one another remain undetermined: Deep Lake argillite, 2,500± ft.; Republican Creek ls., 1,200± ft.; Lead Point argillite, 2,200± ft.; Red Top ls., 1,000± ft.; Fish Creek argillite, 1,500± ft.; Cedar Creek argillite, 2,500± ft.; and Boundary argillite, 4,000± ft. The series has been invaded and in many places greatly disturbed by batholithic masses of granite, syenite, and granodiorite. Is entirely unfossiliferous. The middle and lower members may represent middle and lower part of Paleozoic; the upper members are=Pend Oreille group of B. C. and possibly are upper Paleozoic. [On p. 114 author says upper part of Stevens series may be Mesozoic.]

Stevens Creek slates.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1908 (Repts and resolutions of General Assembly of S. C., regular sess. commencing Jan. 14, 1908, vol. 1, pp. 648–651; also S. C. Geol. Surv., ser. 4, Bull. 2, pp. 414–417, 1908). *Steven's Creek slates.*—Slates heretofore designated "Clay Slates," in which schistosity and slaty cleavage are highly developed. These slates were derived from basic igneous porphyries. Sericite schists and quartz monzonite schists are also included but chiefly along the boundaries.

Probably named for exposures on Stevens Creek, Edgefield Co.

Stevens Creek limestone. (In Borden group.)

Mississippian: Southeastern Indiana.

C. A. Malott, 1922 (Ind. Dept. Cons. Pub. 21, pt. 2, p. 193), in a section across Mitchell plain and Norman and Crawford uplands shows *Stevens Creek ls. lentil in Borden series* as exposed in middle of the Borden in Stevens Creek and in Brummets Creek, Norman upland, Monroe Co.

P. B. Stockdale, 1928 (Ohio Acad. Sci. Proc., vol. 8, pt. 4, p. 177). In vicinity of Borden the Borden group consists of (descending): Alternating layers of ss. and sandy sh., 40 ft.; lenticular ls. up to 5 ft. thick, named *Steven's Creek ls.* by C. A. Malott; massive ss., 100 ft.; sandy sh., 250 ft.; and pure sh., 150 ft.

P. B. Stockdale, 1930 (Ind. Acad. Sci. Proc., vol. 39, pp. 213–214). *Floyds Knob fm.*—Study of Borden rocks throughout unglaciated area of southern Ind. and incidental observation in adjacent parts of Ky. revealed a persistent unit in upper part of Borden group which has served as vital key to subdividing the rocks and to properly associating uppermost Borden fms. with overlying Harrodsburg and Salem lss. The name *Floyds Knob fm.* is being suggested for this fm. It exhibits several lithologic facies, the most common being ls. that is itself of differing traits from place to place. For this ls. facies the name *Goss Mill ls. facies* is being suggested. Thickness is commonly 3 to 4 ft., but at a few places it is as much as 8 ft. or more. Various Ind. workers have referred to the different ls. facies of Floyds Knob fm. as "Stevens Creek ls.," although the name has never been formally proposed in the literature. Preemption of the term by *Stevens Creek slates* of S. C. and confusion in interpretation of different beds which have been referred to same horizon in N. part of unglaciated area preclude continuation of "Stevens Creek." Floyds Knob fm. will be fully described in rept. for publication by Ind. Dept. Cons., Div. of Geol.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 54, 77, 194, 195, 215, 263, etc.). The ls. here named *Floyds Knob fm.* is an excellent key fm. It has often been spoken of as the "Stevens Creek ls." by Ind. workers, although the name has never been definitely proposed. No name has been specifically proposed in the literature for Floyds Knob fm. Most early Ind. workers entirely overlooked the fm.; some described it as merely a local lenticular occurrence of ls. within the "Knobstone ss." Among several students of Ind. geology the Floyds Knob fm. has been referred to as the "Stevens Creek ls.," as an outcome of usage begun by Malott, who suspected the significance and extent of the fm. The only published mention of this term, however, is in connection with a diagram showing a section across Monroe Co., where the bed is labeled *Stevens Creek ls. lentil* (Malott, 1922, p. 193). Glen Lee accepted Malott's designation by referring to it in his unpublished rept. as "Stephen's Creek ls." (Lee, 1924, p. 72 [of unpublished thesis]). In earlier times Ind. Univ. geologists, particularly Cumings and Beede, often spoke of the "Stobo lens," located in SE¼ sec. 33, T. 9 N., R. 1 E., and NE¼ sec. 4, T. 8 N., R. 1 E., near the old Stobo post office, 6½ mi. E. of Bloomington, and suspected the ls. as probably having a widespread distribution. However, the ls. quarry near old Stobo is in a crinoid bioherm, the bottom of the quarry being at a stratigraphic position some 25 to 30 ft. higher than the horizon, which is extensively traceable farther S. If it were entirely acceptable the writer would welcome the adoption of Malott's term "Stevens Creek" for the name of the fm. The term, however, is preempted. In 1908 Sloan applied "Steven's Creek slates" to an Archean deposit in S. C. Continuous field tracing has disclosed a number of points against desirability of *Stevens Creek*. The name was selected from a stream tributary to Salt Creek, flowing S. across west-center T. 9 N., R. 1 E., into north-center T. 8 N., R. 1 E., Monroe Co. Along much of valley of this stream the stratigraphy at and above horizon of Floyds Knob fm. is complicated and confusing. In many places, as at Stobo, crinoidal beds in bioherms occur quite far above horizon in question. At other places no definite ls. bed exists, but a zone of shaly, cherty rock, in some places calc., extending at places many ft. up into Edwardsville fm. is present. The name *Stevens Creek ls.* has been applied to a hard brown siliceous ls. bed, 2 to 5 ft. thick, which lies 25 ft. above base of true Floyds Knob fm., which farther S. has also been referred to as *Stevens Creek ls.* Both Floyds Knob ls. and the calc. memb. 25 ft. higher crop out in several places in Brown Co., to E. The upper bed, which is common to valley of Stevens Creek, is of much more limited and uncertain areal extent than the lower ls. bed to the S. The name *Stevens Creek ls.* is therefore abandoned, and replaced by *Floyds Knob fm.*, selected from a locality in which there is no possible confusion.

Stevenson limestone.

Carboniferous: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 47, 50). Included in Redtop fm.

Stewart andesites.

Devonian: New Brunswick.

W. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 477).

Stewart sand.

A subsurface sand in Kootenai fm. of Cutbank dist., Glacier Co., NW. Mont. According to J. G. Bartram (Geol. of nat. gas, A. A. P. G., 1935, pp. 257, 267) this sand is now called *Sunburst sand.*

Stewarts Landing facies.

Name applied by P. B. Stockdale (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 228, etc., 1931) to a lithologic development of his Edwardsville fm. in a part of southern Ind. and Jefferson Co., Ky.

†Stewartsville group.

Eocene: Western California.

B. L. Clark, 1918 (Geol. Soc. Am. Bull., vol. 29, p. 94).

Synonym of *Meganos*; printed through inadvertence.

Stewartville dolomite.

Middle Ordovician: Southeastern Minnesota, northeastern Iowa, and northwestern Illinois.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27). *Stewartville dol.* (*Maclurea bed*).—Uncon. overlies Prosser ls. and is uncon. overlain by Wykoff ls.=part of upper part of Galena dol.

R. S. Bassler, 1911 (U. S. Nat. Mus. Bull. 77, pp. 25–27). *Stewartville dol.*—Porous soft yellowish dol. and mottled mag. ls. (*Maclurea* bed) containing the *Maclurina manitobensis* fauna, 0 to 100 ft. thick; underlain by 0 to 20 ft. of unfossiliferous sandy mudstone. Overlies Prosser ls. Is top fm. of Trenton group.

Probably named for exposures at or near Stewartville, Olmsted Co., Minn.

A. C. Trowbridge, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 27). *Stewartville div.* of Galena dol. can be seen in Jo Daviess Co., Ill.

Stiles phyllite.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 400). *Stiles phyllite.*—Almost wholly sl. or phyllite, with fairly numerous thin beds of qtzite. Whole fm., including qtzite beds, has rather plain greenish aspect due to secondary chlorite. Weathers greenish gray or whitish gray. Much quartz in thin lenses and veins, especially in its eastern areas, where it is most metamorphosed. Occupies broad band along E. side of Taconic Range, curving westward and southwestward around end of the range. Thickness estimated at 400 or 500 ft. at N., and possibly twice that along E. side of range. Named for occurrence at Stiles Mtn [4 mi. SW. of Brandon, in Brandon quad.]. Underlies Hubbardton sl. and is rather sharply distinct from underlying Brezee phyllite.

†Stillwater sandstone. (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio.

J. S. Newberry, 1874 (Ohio Geol. Surv. vol. 2, pl. opp. p. 81, p. 131). *Stillwater ss.*—Consists of ss., often cgl., 0 to 50 ft. thick, near base of Lower Barren Measures. Underlain by gray sh. and overlain by red and gray shales.

Same as Buffalo ss. memb. of Conemaugh fm.

Named for Big Stillwater Creek, Tuscarawas Co.

Stillwater formation.

Permian: Central and northern Oklahoma.

C. N. Gould, 1901 (Kans. Acad. Sci. Trans., vol. 17, p. 181). *Stillwater ss.*—Several hundred ft. of gray and brown sss. and shales below the Harper or Cimarron series. May eventually be proved to be but a southern continuation of the Sumner.

F. L. Aurin, H. G. Officer, and C. N. Gould, 1926 (A. A. P. G. Bull., vol. 10, pp. 786-799). *Stillwater fm.*—A series of red and gray sss. and red shales exposed in a zone extending N. and S. across east-central Okla. Ranges in thickness from 540 ft. in southern Kans. and northern Okla. to probably 800 ft. in east-central Okla. Occupies strat. interval btw. top of Herington ls. of Kans., or its southern equiv., and base of Cottonwood ls., or its southern equiv., thus corresponding to most of Marion fm. and all of Chase and Council Grove groups of Kans. Is basal fm. of Enid group. The Kans. subdivisions begin to lose their identity in region of Arkansas River in southern Osage, NE. Noble, and Pawnee Counties, Okla. By the time the color-change line has been reached the lss. are thinning rapidly and are being replaced by sss., while the shales begin to change their color from gray to red. Still farther S. the lss. disappear and entire fm. consists of alternating beds of red shales and red and gray sss. This is typical Stillwater, as exposed at Stillwater, Payne Co.

Stillwater formation.

Oligocene or Miocene: Southeastern Alaska (Controller Bay region).

G. C. Martin, 1908 (U. S. G. S. Bull. 335, pp. 24, 30). *Stillwater fm.*—Sh. and ss., without characteristic beds, so far as known. Thickness 1,000± ft. Underlies Kushtaka fm., probably conformably, and overlies Katalla fm. Occupies entire valley of Stillwater Creek and extends for some distance up valleys of Trout and Clear creeks.

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, p. 771). Little seems to be known regarding Stillwater fm. of Martin, which occurs to N. of Bering Lake.

Stillwater complex.

Pre-Cambrian: Montana.

J. W. Peoples, 1933 (Pan-Am. Geol., vol. 60, p. 152). In the pre-Camb. *Stillwater complex* of Mont. the rock facies consist of a norite (interpreted as a basal chill facies) on S. adjoined successively on N. by ultrabasic rocks 2,500 ft. thick, and then by banded noritic anorthositic facies. By analogy with *Bushveld complex* this may be interpreted as gravity stratification. Overlain uncon. by Camb. sediments. [Definitions of *Stillwater* and *Bushveld* are incomplete.]

Stine shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, pp. 83, 84, 89). *Stine sh.*—Blue, gray, and reddish sh. and 2 or 3 ls. seams, the lower one about 1 ft. thick, somewhat aren. and forming rounded blocks. Thickness 7 to 18 ft. in Nebr. and 12 to 14 ft. in NE. Kans. The sh. below the ls. layer is very fossiliferous. Underlies Houchen Creek ls. and overlies Americus ls. Included in Elmdale sh. Named for exposures in slopes S. of Stine, Nemaha Co., Nebr.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), gave the following as correct strat. succession of subdivisions of this Admire sh. (descending): Oaks sh., Houchen Creek ls., Stine sh., Five Point ls., West Branch sh., Falls City ls., Hawxby sh., Aspinwall ls., and Towle sh. This classification not only transfers Houchen Creek ls. and Stine sh. from Elmdale sh. to Admire sh., but changes name of the ls. underlying Stine sh. to Five Point ls.

G. E. Condra, 1935. (See under *Hamlin sh.*)

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 50), adopted this name as defined by Condra and assigned the bed to Perm.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Stirling quartzite.

Lower Cambrian: Southeastern Nevada.

T. B. Nolan, 1928 (Am. Jour. Sci., 5th, vol. 17, pp. 461–472). *Stirling qtzite.*—Largely thick-bedded pink and gray qtzite containing local lenses of pebbles (chiefly of white vein quartz but with smaller proportion of red jasper); in many places interbedded with thin zones of sl. or mica schist. Thickness 3,700 ft. Grades into overlying Wood Canyon fm. and rests on Johnnie fm. Named for exposures on Mount Stirling, about 5 mi. E. of Johnnie mine, Spring Mtns, Clark Co.

Stissing dolomite.

Middle (?) and Lower Cambrian: Southeastern New York (Dutchess County).

C. D. Walcott, 1891 (U. S. G. S. Bull. 81, p. 360). [In this table Walcott mentions, among the Middle Camb. (Acadian) rocks:] "Limestones of Dutchess County, New York (*Stissing*), and central portions of Tennessee and Alabama sections (Coosa)."

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 26). *Stissing ls.* (*1891 Walcott*).—The name is from Stissing Mtn, in northern Dutchess Co. The beds to which this name is applied overlie *Olenellus* beds and contain fauna which is correlated by Walcott with Middle Cambric of Rocky Mtn province. It therefore represents the *Paradoxides* horizon but is without the *Paradoxides* of Atlantic sections.

E. B. Knopf, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 429–458). *Stissing dol.*—Consists of (descending): (1) Fine-grained sparkling gray dol. that contains considerable black chert and several fossil species; (2) shales and shaly dol., 40 ft.; (3) 60 ft. of heavy-bedded fine-grained white dol. with some sericite developed on bedding planes and joint planes, and 2 species of fossils. Overlies, probably discon., basal ("Poughquag") qtzite on S. and E. slopes of Stissing Mtn. Discon. underlies Hoyt dol. Total thickness 200± ft. Of Lower and Middle (?) Camb. age.

†Stissing quartzite.

Cambrian (?): Eastern New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, chart), showed *Stissing qtzite* as underlying *Potsdam ss. and sh.* and overlying *Georgia slates*, and in table on p. 9 he showed it as underlying *Georgia slates*, and as being basal fm. of Camb. In both table and chart included in Lower Camb. Is probably same as Cheshire (†Poughquag) qtzite, of Lower Camb. age, which is present on S. and E. slopes of Stissing Mtn, Dutchess Co.

Above is only record of *Stissing qtzite.*

Stobo limestone lens. (In Borden group.)

Mississippian: Southwestern Indiana (Monroe County).

A. B. Reagan, 1904 (Ind. Acad. Sci. Proc. 1903, p. 214). *Stobo ls. lens.*—On the whole the Knobstone fm. is nonfossiliferous. At intervals, however, as at Stobo post office [Monroe Co.], there are intercalated lenticular beds of ls. and calc. septaria with rich faunas, which consist of (descending): (1) Hard rough gray crinoidal ls., 1 ft.; (2) hard gray ls. with few fossils, 15 ft.; (3) hard gray ls. with rusty particles and crinoid stems, 5 ft.; (4) soft blue sandy sh., 10+ ft. Lies 90 to 99 ft. below top of Knobstone fm.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 194, 263, 265, etc.). [Abandons *Stobo ls.* and renames it *Floyds Knob ls.*] In earlier times Ind. Univ. geologists, particularly Cumings and Beede, often spoke of the "Stobo lens" located in SE¼ sec. 33, T. 9 N., R. 1 E., and NE¼ sec. 4, T. 8 N., R. 1 E., near old Stobo post office, 6½ mi. E. of Bloomington, and suspected the ls. as probably of widespread distribution. They generally considered it as correlative of the ls. fm. under question [Floyds Knob ls.] found farther S. and at other places in Monroe Co. However, the ls. quarry near old Stobo is in a crinoid bioherm, the bottom of quarry being some 25 to 30 ft. higher than the horizon which is extensively traceable farther S. Along hillsides and in ravines on W. side of Salt Creek valley, in N. center sec. 15 and SW¼ sec. 10, T. 8 N., R. 1 E., 2 to 2½ mi. SE. of old Stobo post office, the Floyds Knob fm. is represented by the usual calc. shaly zone, buff at weathered exposures, some 5 ft. thick, with Cutright ss. memb. of the Edwardsville a few ft. above. [On p. 265 he gives a section "slightly W. of old Stobo post office" in which thickness of Floyds Knob fm. is given as 15 ft. See also under *Stevens Creek ls.*]

Stockbridge limestone.

Cambrian and Ordovician: Western Massachusetts and Connecticut, southwestern Vermont, and eastern New York.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. of 2d dist., pp. 135–164). A coarse granular ls. of various colors, which I have denominated the *Stockbridge ls.*, taking its name from a well-known locality, one which has furnished to different parts of the Union a large proportion of the white and clouded marbles which have been so extensively employed for building and other purposes in construction. I have applied this name to all those varieties of ls. which are associated with those masses that are usually known in market as the Stockbridge marbles. Is second bed of ls. in Taconic system, being separated from underlying first bed of ls. by mag. sl. and from overlying third bed of ls. by granular quartz rock.

J. D. Dana, 1872 (Am. Jour. Sci., 3d, vol. 3, pp. 179–186, 250–256). *Stockbridge ls.*, the great metamorphic ls. of Green Mtn range. Is same as the Eolian of Vt. and extends southward and somewhat westward through Salisbury, Conn., and Dover and Pawling in Dutchess Co., N. Y., and continues for 7 or 8 mi. S. of Pawling. [Casually calls it *Pawling ls.* and *Poughquag ls.*] Generally admitted to be Lower Sil. and to represent more or less of time from Calciferous to Trenton periods. Chazy is probably present in it. It alternates with and is overlain by aren. mica schist. Is uncon. underlain by the qtzite of Green Mtn region [casually called *Green Mtn qtzite* and *Poughquag qtzite*].

T. N. Dale, 1891 (Am. Geol., vol. 8, pp. 1–7). *Stockbridge ls.* consists of 1,200 to 1,400 ft. of crystalline ls., in places a dol., quartzose or micaceous, more rarely feldspathic, rarely fossiliferous. In Mount Greylock, Mass., underlies Berkshire schist and overlies Vermont fm. (qtzite).

T. N. Dale, 1893 (U. S. G. S. 13th Ann. Rept., pt. 2, pp. 301–340). In Rensselaer grit plateau of eastern N. Y. the *Stockbridge ls.* conformably underlies Berkshire schist and is 1,000 to 1,400 ft. thick. Upper part is now generally admitted to be of Trenton, Chazy, and Calciferous age, while at least 470 ft. of lower part is Camb.

F. J. H. Merrill, 1901 (geol. map of N. Y.). [The "Cambro-Silurian metamorphosed crystalline ls." of SE. N. Y. is called *Stockbridge ls.* on map; and in accompanying N. Y. State Mus. Bull. 56, table opposite p. 34, 1901, the *Stockbridge ls.* of the map is shown to be=Trenton ls., Chazy ls., Beekmantown, Potsdam and Acadian.]

F. J. H. Merrill, 1904 (N. Y. State Geol. 23d Ann. Rept., pp. 195–198 and map; also N. Y. State Mus. 57th Ann. Rept.). The rocks of Beekman and Pawling Twps. Dutchess Co., N. Y. are mapped as (descending) Hudson schist, *Stockbridge ls.*, and Poughquag qtzite.

See also under *Barnegat ls.* and †*Poughquag ls.*

The present definition of Stockbridge ls. is a fm. of metamorphosed lss., underlying Berkshire (†Hudson) schist, overlying Cheshire (†Poughquag) qtzite, and comprising the metamorphosed equivalents of lss. of Mohawk and Champlain Valleys that range in age from Lower Camb. to Trenton, both inclusive. (See also †*Eolian ls.* and *Dorset ls.*, names that have been applied in SW. Vt.)

Named for prominent development and quarries around Stockbridge and West Stockbridge, in western Mass.

Stockholm band.

Name applied by A. C. Spencer, 1908 (U. S. G. S. Franklin Furnace folio, No. 161), to a part of Pochuck gneiss in Stockholm area of this quad.

Stockton limestone. (In Kanawha formation.)
Stockton cement bed.

Pennsylvanian: Southern West Virginia.

See under *Cannelton ls.* (1885).

Stockton formation. (In Newark group.)

Upper Triassic: New Jersey and southeastern Pennsylvania.

H. B. Kümmel, 1897 (N. J. Geol. Surv. Ann. Rept. State Geol. 1896, pp. 35–40, and Jour. Geol., vol. 5, pp. 543–544). *Stockton series.*—Interbedded coarse, more or less disintegrated arkose cgls.; yellow micaceous, feldspathic sss.; qtzite cgls.; brown-red sss. or freestones; and soft red argill. shales. The cgls. and yellow sss. prevail near bottom and the brown-red sss. near top. Thickness 2,300 to 6,700± ft. Underlies Lockatong series [fm.] and uncon. overlies older crystalline rocks. Is basal fm. of Newark system [group]. Exposed in quarries near Stockton [Hunterdon Co.], N. J.

Stockton shale. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, pp. 326–327). The plants of *Stockton fossiliferous sh.*, the roof sh. of Stockton coal in Kanawha Valley, are pronounced by D. White to belong to Allegheny fm. and to a position not higher than Clarion group. Writer, however, correlates Stockton sh. with Uffington sh. [For many years the Stockton coal and overlying sh., 4 to 50 ft. thick, have been included in Kanawha fm. in all repts of W. Va. Geol. Surv., their strat. position being given as beneath Kanawha black flint. According to D. White (Geol. Soc. Am. Bull., vol. 2, pp. 168–9) the Stockton coal lies 30 to 50 ft. beneath Black flint. The Stockton coal was so named because it was mined by Mr. Stockton.]

Stockton slate. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, pp. 152, 409–410). *Stockton sl., also Cannelton (Stockton) sh.*—Black sl., 15 ft. thick, with marine fossils, underlying Stockton ls. and overlying 2 ft. of black sl. containing fossil plants, or, where that is absent, resting on a coal bed.

Stockwether limestone member (of Pueblo formation).

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 417). *Stockwether bed.*—Mostly hard, rather brittle, rough-weathering gray, containing yellowish or light-colored chert nodules. Thickness 15 to 25 ft. Memb. of Cisco div. Overlies Coon Mtn bed and is separated from overlying Camp Colorado ls. by bed No. 13 (40 to 75 ft. of clay, mostly reddish).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 172, 174, and charts). *Stockwether ls. memb. of Pueblo fm.*—Overlies Camp Creek sh. memb. of Pueblo fm. and is separated from overlying Camp Colorado ls. memb. of Pueblo by sh. bed No. 13 of Drake. The Coon Mtn bed of Drake is largely Cretaceous. Named for Stockwether ranch, on Bull Creek, Coleman Co.

Wallace Lee and C. O. Nickell (ms. ready for publication by Tex. Geol. Survey) define *Stockwether ls. memb. of Pueblo fm.* as overlying Coon Mtn ss. memb., which rests on Camp Creek sh. memb. of Pueblo fm. This is approved definition of U. S. Geol. Survey.

†Stokes sandstone. (In Cheyenne sandstone.)

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 367). *Stokes ss.*—Leaf-bearing beds, comprising upper part of Elk Creek beds and consisting of a few ft. of more constantly aren. and consolidated sediments than lower part (Lanphier beds) of Elk Creek beds. Underlain by Lanphier beds and overlain by Champion shell bed.

Named for Stokes Draw, which proceeds from foot of Stokes Hill and S. of Lanphier Draw, in SE. corner of Kiowa Co.

This name was discarded by U. S. Geol. Survey in 1921, the beds being a local development of Cheyenne ss. and considered to be without strat. value.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, p. 13), in summarizing Cragin's classification of Cheyenne ss., used *Stokes Hill ss.* (instead of *Stokes ss.*) for the upper part of Cragin's Elk Creek beds, and described the *Stokes Hill ss.* as a yellow medium-grained ss., a few ft. thick, that "was named from Stokes or Black Hill, a few mi. W. of Sun City."

Stokes sand.

A subsurface sand in top of Kansas City group in Eldorado oil field, Kans. Is correlated with Layton sand to S.

Stokes Hill sandstone.

Lower Cretaceous (Comanche series): Central southern Kansas. See 1924 entry under †*Stokes ss.*

Stollmeyer oil zone.

Stollmeyer Cruse shale.

Tertiary: Trinidad.

G. A. Macready, 1920 (Am. Inst. Min. and Met. Engrs. Trans. [preprint 1017], p. 9).

Stonebreaker limestone member (of Buck Creek formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

K. C. Heald, 1918 (U. S. G. S. Bull. 686K, pp. 130–131). *Stonebreaker ls.*—A series of thin lss. with intervening shales. The lss. are hard, tough, and sparingly fossiliferous. Weathered surface is light gray with many blotches of limonite yellow. Thickness 16 ft. In SE. corner of T. 27 N., R. 7 E., it lies 250± ft. below Foraker ls. The ls. has been more fully described by writer in U. S. G. S. Bull. 691C, 1918.

K. C. Heald, 1918 (U. S. G. S. Bull. 691C, pp. 61–64). *Stonebreaker ls.*, the highest prominent ls. above the "red lime" in NW. part of Pawhuska quad., lies 45± ft. below top of ss. B, the interval being filled with sh. with 2 or 3 thin beds of ls. The Stonebreaker is 2 to 16 ft. thick. Fresh surface is dark blue to light gray, with ocher-yellow limonite stains. Weathered surface is strongly stained with limonite, giving it a dirty-yellow blotched appearance. In NW. part of area there appears to be one bed, but in S. part, to W. of Parsons Switch, there are two beds, with an intermediate sh., all aggregating 12 ft. Named for Stonebreaker ranch [Pawhuska quad.], where it is well exposed.

H. T. Beckwith, 1928 (Okla. Geol. Surv. Bull. 40T). *Stonebreaker ls. memb. of Buck Creek fm.* lies 80 to 90 ft. below top of the Buck Creek in Osage Co., and higher than *Cryptozoon*-bearing ls. memb. It is 4 to 16 ft. thick in N. part of county and 50 or more in S. part of county. As it increases in thickness to S. it changes in appearance and character to some extent. In N. part of county it consists of one to three light- to dark-gray beds separated by rather thin sh. intervals. In S. part of county it consists of three distinct beds separated by a greater thickness of sandy sh. and sh. with some persistent ledges of ss.; some lss. are 10 ft. or more thick, are usually of lighter color, weather out differently, and are softer; the middle bed is thickest.

Stone City beds. (In Claiborne group.)

Eocene: Eastern Texas (Burleson, Brazos, and Leon Counties).

H. B. Stenzel, 1935 (Univ. Tex. Bull. 3501, pp. 267–279). *Crockett fm.* restricted to beds discon. above the marine Moseley ls., and the 85 ft. of underlying fossiliferous, partly marine beds down to top of Sparta sand in Stone City section, Burleson Co., are here named *Stone City beds*. They include Moseley ls. at top and Eaton lentil (marine) of Renick, and interfinger with underlying Sparta sand. How far they can be traced depends on detailed mapping. They have already been traced through Burleson, Brazos, and Leon Counties to Trinity River.

Stone Corral.

Permian: Central Kansas uplift.

E. A. Koester, 1935 (A. A. P. G. Bull., vol. 19, No. 10, p. 1410), used *Stone Corral* in table, where it is placed in lower part of Cimarron, but whether it is at base is not shown. No explanation of meaning of name is given.

Stonefort limestone member (of Tradewater formation).

Pennsylvanian: Southeastern Illinois (Saline and Williamson Counties).

L. G. Henbest, 1928 (Jour. Pal., vol. 2, pp. 70–71). *Stonefort ls. memb. of Tradewater fm.*—A fossiliferous ls., 2 to 3 ft. thick, lying 100± ft. below No. 2 coal (at base of Carbondale fm.), and 50± ft. above Bald Knob coal, in Saline and Williamson Counties, Ill., and probably extending into Ky. Fossils listed.

Named for exposures near Stonefort P. O. and station, Saline Co., Ill.

Stoneham oil sand.

Drillers' term for an oil sand forming basal memb. of Warren oil sand group in western Pa., which is Fourth sand at Stoneham, Warren Co. (See J. F. Carll, 1880, 2d Pa. Geol. Surv. Rept. I₃, p. 161. He also called it *Stoneham ss.*)

Stonehenge limestone member (of Beekmantown limestone).

Lower Ordovician: Central and central southern Pennsylvania, western Maryland, and northwestern Virginia.

G. W. Stose, 1908 (Jour. Geol., vol. 16, p. 703). Near base of Beekmantown ls. siliceous banded beds and large "edgewise" cgl. closely resembling underlying Conococheague ls. have been separated as a transition phase under name *Stonehenge memb. of the Beekmantown.*

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170). Thickness of *Stonehenge ls. memb. of Beekmantown ls.* is 485 ft. Exposed at Stonehenge, Franklin Co., Pa. Basal memb. of Beekmantown ls.

In central Pa. (Bellefonte and Hollidaysburg regions) the Beekmantown is treated as a *group*, divided (descending) into Bellefonte dol., Axemann ls., Nittany dol., and Stonehenge ls., the latter 0 to 702 ft. thick, and resting on Larke dol. and on Mines dol.

Stonehouse formation.

Silurian: Nova Scotia.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 203).

Stoner limestone. (In Stanton limestone.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 26, 27, 31, 33, 34, 36, 37). *Louisville ls.* is preoccupied hence *Stoner ls.* is proposed for this unit to include also Kiewitz sh. and so-called Du Bois ls. Thickness 14 to 16 ft. 8 in. Type loc. on Stoner farm, located NW. of South Bend, Cass Co., Nebr. Underlies Rock Lake sh. and overlies Eudora sh.

R. C. Moore does not use this name in Kans. See 1936 entry under *Olathe ls.*

Stones River group (also **Stones River limestone**).

Lower Ordovician (Chazy): Tennessee, northeastern Mississippi, western Virginia, western Maryland, northeastern West Virginia, and southern Pennsylvania.

J. M. Safford, 1851 (Am. Jour. Sci., 2d, vol. 12, pp. 353, 354–356). *Stones River group.*—Fossiliferous lss., 240 to 260 ft. thick, divided for convenience into three members, named (ascending) *Stones River beds, Lower Lebanon* [Lebanon of later repts] *ls.*, and *Upper Lebanon* [Carters] *ls.* The basal or Stones River beds are 75 ft. thick, blue and brownish-blue lss., mostly fine-grained and thick-bedded, some strata abounding in dark flinty layers. Lower Lebanon ls., 50 to 60 ft. thick, highly fossiliferous thin-bedded sky-blue lss., coarsely crystalline and abounding in calc. remains, sometimes separated by seams of argill. matter; grades into Upper Lebanon ls., which consists of 110 to 130 ft. of grayish, sometimes brownish, and blue thick-bedded lss., becoming thin-bedded and interstratified with occasional seams of clay in upper 15 or 20 ft. Underlies Nashville group. Oldest rocks in Middle Tenn.

Is of Chazy age. In central Tenn. now includes (descending) Lebanon, Ridley, Pierce, and Murfreesboro lss. The Lowville age of "Upper

Lebanon" or Carters ls. has been established by R. S. Bassler, E. O. Ulrich, and C. Butts, and that fm. is now excluded from Stones River group. In eastern Tenn. and western Va. the Stones River group is now divided by E. O. Ulrich and C. Butts into (descending) Lenoir ls., Mosheim ls., and Murfreesboro ls. Where not divided the Stones River rocks are called *Stones River ls.*

Named for exposures on Stone River, vicinity of Nashville, Tenn. Although the river is now called *Stone River*, the name of the deposits is firmly entrenched in the literature as *Stones River.*

†Stones River beds.

A name applied by Safford in 1851 to the part of Stones River group underlying Lebanon ls. and later subdivided into Ridley, Pierce, and Murfreesboro lss. See under *Stones River group.*

Stone's Switch sand.

Eocene (Jackson): Southeastern Texas (McMullen to Gonzales Counties).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1302, 1314, etc.). *Stone's Switch sand.*—Massive indurated qtzitic ss., 12 to 20 ft. thick, in Whitsett fm. as here defined. Name suggested by Sam Houston, who has traced it from King's Hills, McMullen Co., to E. part of Gonzales Co., where it is covered by overlap of Catahoula fm. Is quarried about 3 mi. S. of Campbellton, on J. Bowers survey. A railroad switch at this quarry was named Stone's Switch. Lies stratigraphically above Falls City sh. and below Dubose sands and clays, all zones in Whitsett fm.

Stonewall limestone.

Silurian: Manitoba.

E. M. Kindle, 1914 (Canada Geol. Surv. Summ. Rept. 1912, p. 249).

Stonewall quartz diorite.

Jurassic: Southern California (Cuyamaca region, San Diego County).

F. S. Hudson, 1922 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 13, No. 6, pp. 181, 191–193, map). *Stonewall quartz diorite.*—Named after Stonewall Peak, which is composed of this rock, which intrudes Julian schist.

Stonington gneiss.

Pre-Pennsylvanian: Southeastern Connecticut.

L. H. Martin, 1925 (Conn. Geol. and Nat. Hist. Surv. Bull. 33). *Stonington gneiss.*—Oldest igneous rock of Stonington region, because it is cut by all others. Is pre-Penn. and younger than the pre-Camb. schists.

Stonington beds.

Upper Ordovician (Richmond): Northern Michigan (Delta County).

R. C. Hussey, 1926 (Mich. Univ. Mus. Geol. Contr., vol. 2, No. 8, pp. 113–150). *Stonington beds.*—Middle division of Upper Ordovician Richmond fm. of Mich. Divided into Ogontz memb. above and Bay de Noc memb. below, both of which outcrop 1 mi. N. of Stonington P. O., on E. side of Little Bay de Noc. Rests discon. on Bill's Creek beds and is overlain by Big Hill beds.

Stony Brook beds. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7, pp. 68–73, 216–217). *Stony Brook beds.*—A series of olive-green sandy shales and shaly sss. filled with typical Chemung fossils. Occur in upper part of Chemung. Finely exposed at cutting along road where it crosses Stony Brook, Orange Twp, Columbia Co., and where it is 50 ft. thick.

Stonybrook quartzite.

Pre-Cambrian: Eastern Massachusetts (Boston Basin).

Walter E. Hobbs, 1899 (Am. Geol., vol. 23, p. 110). *Stonybrook qtzite,* 500± ft. thick. Becomes exceedingly fine-grained in upper part, and it may yet be found necessary to separate this portion as a siliceous mag. sl. Grades into overlying Kendall Green sl. Rests on Archean granite. Named for locality where best exposed [Stonybrook, Middlesex Co.].

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the rocks at and around Stonybrook as Westboro qtzite.

Stony Creek granite gneiss.

Pre-Triassic: Central southern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 147, 152, and map). *Stony Creek granite gneiss.*—Medium- to coarse-grained rock, composed largely of flesh-colored to pink orthoclase crystals, with subordinate white albite, small gray quartz grains, muscovite, and biotite. Is cut by Westerly granite and intrudes Mamacoke gneiss.

Named for occurrence at Stony Creek, a town in Branford Twp.

Stony Gap sandstone member (of Hinton formation).

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 298, 371). *Stony Gap ss.*—Light gray or white, massive, coarse, extremely hard and quartzitic, but without pebbles. Thickness 35 to 120 ft. Underlies Lower Bellepoint sh. Is basal memb. of Hinton group [fm.]. Replaces Hinton ss. of Stevenson, which conflicts with Hinton group [fm.]. Type loc. at village of Stony Gap, Mercer Co., on both sides of Bluefield-Princeton road. Can be traced through Tazewell, Russell, Scott, Wise, and Lee Counties, Va., to Cumberland Gap.

Stony Hills formation.

Permian: Southern Kansas and western Oklahoma.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 358, 363). *Stony Hills fm.*—Name suggested as more appropriate, for reasons stated, than Dog Creek fm. or sh., which in central Okla. becomes laminated with dolomites, which form a considerable part of its thickness, a large body of dol., called Chapman dol., forming its upper memb.

Same as Dog Creek sh., older name.

Named for Stony Hills, E. of Watonga, Blaine Co., Okla.

Stony Lonesome bed.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 334, 337–339). Further confusion has resulted from identification of that "Berea" bed (of Stony Lonesome, E. of Warren) by Ver Wiebe (and by Butts) with "Venango first oil sand." The Venango first sand is Woodcock ss. and not Berea (nor yet the Corry). Caster agrees with others in thinking the *Stony Lonesome bed* continuous with Pithole grit, the Corry ss., and, finally, with true Berea grit of Ohio, a correlation which writer formerly accepted without question, having seen no faunal lists. The Stony Lonesome bed rests (nearly) upon Knapp cgl., while the Pithole and Corry beds lie at different (sh.) intervals above the correlative Cussewago ss. [He listed the "fauna of the thin Stony Lonesome ('Berea') bed, Ver Wiebe's 'Venango first oil sand,' that rests almost directly upon Knapp cgl. in Warren region and may, indeed, be but the topmost stratum of Knapp fm."] Referred to Upper Dev.

G. H. Chadwick, 1935 (letter dated Dec. 11). *Stony Lonesome* has no standing. It was simply a convenience.

Stony Mountain formation.

Ordovician: Manitoba.

D. B. Dowling, 1901 (Canada Geol. Surv. Ann. Rept., n. s., vol. 11, p. 46F). *Stony Mtn fm.*, Ord., Canada.

Many subsequent Canada Geol. Surv. Repts, by Dowling, Malcolm, Wallace, and others, assign *Stony Mtn fm.* (and *Stony Mtn group*) to Ord.

A. K. Miller, 1930 (Am. Jour. Sci., 5th, vol. 20, p. 211), correlated Stony Mtn fm. of Manitoba with upper part of Bighorn dol., of Richmond age.

Stony Mountain shales.

Devonian: Manitoba.

R. C. Wallace, 1925 (Geological fms. of Manitoba, Nat. Hist. Soc. of Manitoba, p. 18), as listed by J. M. Nickles, assigned *Stony Mtn shales* of Manitoba to Devonian.

Stony Mountain limestone.

A. F. Foerste and T. E. Savage, 1927 (Denison Univ. Bull., Sci. Lab. Jour., vol. 22, p. 7), as listed by J. M. Nickles, assigned *Stony Mtn. ls.* of Manitoba to Ord.

Stony Point shale.

Middle (?) Ordovician: Northeastern New York and western Vermont (northern part of Champlain Basin).

R. Ruedemann, 1921 (N. Y. State Mus. Bull. 227, 228, pp. 112, 115–116). There is but one outcrop of sh. btw. Willsboro Point and Canadian bdy line, that at Stony Point, 1½ mi. S. of Rouses Point [Clinton Co.]. Fossils indicate it is older than Utica sh. and probably of late Trenton age. The black Ord. so-called "Utica" shales of Champlain Basin consist in the S. entirely of Canajoharie sh., and in the N. prevailingly of Stony Point sh. In the middle they may meet, the Stony Point sh. resting on Canajoharie sh. on Grand Isle and in Vt. portion of northern part of basin, while on N. Y. side the Canajoharie sh. is replaced by Cumberland Head sh., which places itself btw. lower div. of true Trenton ls. and the black Stony Point sh.

Storm King granite.

Pre-Cambrian: Southeastern New York (Putnam and Orange Counties).

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 364 and 377). *Storm King granite* has large development in Storm King [Putnam and Orange Counties] and Crows Nest Mtns and in Breakneck Ridge along N. border of the Highlands. Is intrusive into Fordham gneiss. Assigned to Pre-cambric.

C. P. Berkey, 1911 (N. Y. State Mus. Bull. 146). *Storm King Mtn gneissoid granite* (also *Storm King gneissoid granite*).—Is a rather acid coarse-grained reddish granite with considerable gneissoid structure. Constitutes whole of Storm King Mtn and larger part of Crows Nest on W. side of the Hudson; also forms chief rock of Bull Hill and Breakneck Ridge.

C. P. Berkey and Marion Rice, 1921 (N. Y. State Mus. Bull. 225, 226, map and passim). *Storm King granite.*—Medium- to coarse-grained, rather dark-colored, slightly greenish and sometimes greasy looking, with marked but crude gneissoid structure. Feldspars gray or red, quartz gray, and there is a strong black streaking of hornblende or augite. Biotite not abundant. Garnet in marginal portions. Intrusive into Grenville series.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this granite as of post-Glenarm pre-Camb. age.

Storm King Mountain gneissoid granite.

See under *Storm King granite.*

Stormville conglomerate.

Lower Devonian: Northeastern Pennsylvania (Monroe County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 76, 132–133). *Stormville cgl.*—A calcareo-siliceous fossiliferous bed containing many quartz pebbles; 15 ft. thick. Underlies Stormville shales and overlies Stormville ls. in vicinity of Stormville, Monroe Co. All included in Lower Helderberg.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7), extended this name to several counties to NW. of Pike and Monroe Counties, and gave thickness of 4 to 7 ft.

Stormville hydraulic cement bed.

Stormville water lime.

Lower Devonian: Northeastern Pennsylvania.

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 136–137). *Stormville hydraulic cement bed* (also *Stormville water lime*).—A bed of water lime, usually pale buff, 5 to 10 ft. thick. Breaks with peculiar earthy fracture characteristic of hydraulic lss. No fossils. Underlies Stormville ls. and overlies Decker Ferry ls.

Stormville limestone.

Lower Devonian: Northeastern Pennsylvania (Monroe County).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 76, 133–135). *Stormville ls.*—Cherty, sandy massive lss., very fossiliferous, usually of gray color; 75 to 100 ft. thick. Underlies Stormville cgl. and overlies Stormville hydraulic cement bed. All included in Lower Helderberg.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7), extended this name to several counties NW. of Pike and Monroe Counties and gave thickness of 100 to 150 ft.

Stormville shale.

Lower Devonian: Northeastern Pennsylvania (Pike and Monroe Counties).

I. C. White, 1882 (2d Pa. Geol. Surv. Rept. G_6, pp. 76, 131–132). *Stormville shales.*—Limy fossiliferous ash-colored, often cherty shales, with a massive cherty ls. 10 ft. thick at base. Thickness 160 ft. Top fm. of Lower Helderberg in section from N. line of Monroe Co. to Delaware Water Gap. Underlies Oriskany ss. and overlies Stormville cgl. Well exposed in S. face of Walpack ridge just N. of village of Stormville, Monroe Co.

I. C. White, 1883 (2d Pa. Geol. Surv. Rept. G_7), extended this name to several counties to NW. of Pike and Monroe Counties, and gave thickness of 2 to 125 ft. In 1885 (2d Pa. Geol. Surv. Rept. T_3) White carried name *Stormville shales* over into Huntingdon Co., and applied it to 200 to 250 ft. of "dark-gray and black limy shales, with some sandy shales in places," underlying Oriskany ss. and overlying Lewistown ls. In U. S. G. S. Hollidaysburg-Huntingdon folio (No. 227) these beds are designated *Shriver ls.* and the overlying ss. is called *Ridgeley ss.*, the two composing the Oriskany group of that area.

Named for exposures at Stormville, Monroe Co.

Stormville sandstone.

Lower Devonian: Northeastern Pennsylvania (Monroe and Pike Counties) and northern New Jersey.

S. Weller, 1900 (N. J. Geol. Surv. Ann. Rept. State Geol. 1899, pp. 3–46), described *Stormville ss.* of Walpack Ridge, Sussex Co., N. J., and stated that it is intercalated btw. Coeymans and New Scotland lss. Also that, according to 2d Pa. Geol. Surv. Rept. G_6, pp. 132, 133, Stormville ss. becomes more and more conspicuous to S. and gradually replaces remaining members of New Scotland beds and superjacent strata.

Appears to be same as Stormville cgl. of 2d Pa. Geol. Surv. Rept. G_6, 1882, pp. 132–133.

Storrs tongue (of Star Point sandstone).

Upper Cretaceous: Central eastern Utah (Book Cliffs).

F. R. Clark, 1928 (U. S. G. S. Bull. 793). *Storrs tongue.*—Thick-bedded and thin-bedded ss. and sandy sh., 0–15 ft. thick, extending laterally from main mass of Star Point ss. into beds of marine Mancos sh. Lies lower than Spring Canyon tongue of Star Point ss. and higher than Panther tongue of Star Point ss. Forms prominent cliff at Storrs, Castlegate quad., Carbon Co.

Stovall limestone. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 49). *Stovall ls.*—Basal memb. of Winfield fm. Dark gray, granular, and quite fossiliferous. Is cherty from Nebr. to N. of Winfield, Kans., in a thickness increasing southward from 2± ft. to 4 ft. or more. It is noncherty at Winfield, beyond which it soon thins out southward, not reaching Arkansas City, Kans. We have followed it from Winfield, Kans., to Odell and Krider, Nebr. Overlies Gage sh. memb. of Doyle fm. and underlies Grant sh. memb. of Winfield fm. Type loc. in bluffs of Doyle Creek Valley SE. of Stovall elevator and farm, 7 mi. SW. of Florence, Kans.

Straight Cliffs sandstone.

Upper Cretaceous (uppermost Colorado): Central southern Utah (Kaiparowits Plateau).

H. E. Gregory and R. C. Moore, 1931 (U. S. G. S. P. P. 164). *Straight Cliffs ss.*—Very massive beds of light-yellowish or buff-brown fine- to medium-grained ss. Most of the hard massive beds are 3 to 10 ft. thick, but some exceed 60 ft. In several parts of Kaiparowits Plateau region contains workable beds of coal. In some districts thin streaks of carbonaceous sh. and poor coal occur almost from bottom to top of fm., but in other districts there is no coal. The chief coal zone is in middle third of fm., where beds 15 to 20 ft. thick occur. Thickness 900 to 1,250 ft. Conformably overlies Tropic sh. and conformably underlies Wahweap ss. The long line of nearly rectilinear cliffs fronting toward Escalante Valley is made by this fm. and suggests the name *Straight Cliffs*, which has been applied to it.

Straight Ridge sandstone member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221). Resistant ss., 50 to 100 ft. thick, underlying Straight Ridge coal in Coosa coal field. Is a memb. of Pottsville fm. Lies 800± ft. above Wolf Ridge ss. memb. of Pottsville. Named for fact it forms Straight Ridge, which extends along W. side and S. end of Yellowleaf Basin, in Vandiver quad.

Stranger formation.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Stranger ss. and sh.* (new name), underlies Haskell ls. and uncon. overlies Lansing group redefined. Included in Douglas group redefined.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 93, 96). [See under *Douglas fm.*, Moore, 1932. On p. 46 *Stranger fm.* is described as consisting of 15+ ft. of buff soft cross-bedded ss. underlain by 1 ft. of brown ls. cgl. On p. 49 a thickness of 80 ft. is assigned to Stranger fm., the lower 40 ft. being massive buff cross-bedded soft ss. and the upper 40 ft. sh., ss., and coal beds.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 79–80). At base of Virgil series is fm. here called *Stranger fm.*, after Stranger Creek, near Tonganoxie, Kans.; typically exposed along E. side of sec. 3, T. 12 S., R. 21 E. It appears to be series of more or less disconnected channel deposits of ss. and sandy sh. extending from Leavenworth, Kans., S. into Okla. It is proposed to place upper limit of the Stranger at base of the thin ls. that underlies Lawrence sh. at Lawrence, Kans. This ls. has for many years been incorrectly called *Iatan ls.* It was later named *Haskell ls.* by Moore. Hinds and Greene (1915) showed true Iatan is a much older ls. From 8 to 10 ft. below Haskell ls. is Sibley coal. The marine sh. separating Haskell ls. and this coal has been named *Vinland sh.* by J. M. Patterson, in unpublished thesis. The dominantly sandy and nonmarine beds from top of Sibley coal to base of Stranger fm. were termed *Tonganoxie* by Patterson. The Stranger fm. is uncon. on various parts of Pedee and Lansing groups.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 147). *Stranger fm.* as first defined embraced nonmarine channel ss. at base of Virgil series and shaly beds up to base of Haskell ls. This div. is not a natural one. Upper bdy was arbitrarily selected. A more desirable top bdy is hiatus at base of Ireland ss. Detailed observations show this uncon. is commonly, if not invariably, at or near top of Haskell ls. in NE. Kans., so that redefinition of Lawrence sh. at Lawrence, Kans., is not necessary. In southern Kans. the marine Robbins sh. occurs btw. Haskell ls. and uncon. at base of Ireland ss., and Lawrence sh. is restricted to beds above this uncon. Newell is author of name.

Stratford formation.

Pennsylvanian: Central southern Oklahoma.

G. D. Morgan, 1924 (Bureau of Geol. [Okla.] Bull. 2, pp. 137–140, pls. 3, 27, and map). *Stratford fm.*—At base is a series of lss., which constitute Hart ls. memb. Above this memb. is an undet. thickness largely composed of dark-colored shales. No suitable upper limit for Stratford fm. occurs in Stonewall quad., and since the region farther W. has not been investigated, none is here suggested. About

400 ft. of fm. is exposed in Stonewall quad. The shales contain a few sss., some of which are arkosic. Overlies Vanoss fm. Believed to underlie Konawa fm., but latter may prove to be in part=Stratford fm. Is part of Pontotoc terrane [group]. Included in Permian, but NE. from the point at which Stratford fm. is thought to be overlapped by Konawa fm. the Penn.-Perm. line is taken to be represented by base of Konawa fm.

Named for exposures at and around Stratford, Garvin Co.

Straven conglomerate member (of Pottsville formation).

Pennsylvanian: Central Alabama.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221). A very coarse cgl., 40 ft. thick, in upper part of Pottsville fm. in Cahaba coal field. Rests on Thompson coal. Named for Straven, Shelby Co., in Montevallo quad.

Straven coal group.

Pennsylvanian: Central Alabama.

A group of three coal beds in Pottsville fm. of Cahaba coal field, the lowest bed lying 940± ft. above Thompson coal, and the three beds occurring within a vertical section of 100± ft. May be=Dogwood coal group. Includes Upper Straven, Middle Straven, and Lower Straven coals.

Straw Hollow diorite.

Late Carboniferous or post-Carboniferous: Northeastern Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 219-220 and map). *Straw Hollow diorite.*—The rock of the great dike at type loc. at Straw Hollow, in Northboro, is porphyritic and contains saussuritized plagioclase phenocrysts nearly an in. long. Some other masses of rock are mapped with Straw Hollow diorite.

Strawn formation (also **group**).

Pennsylvanian (Allegheny): Central and northern Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvi). *Milburn-Strawn series.*—Alternating clays and shales and thin-bedded lss., with fire clay and coal, overlying Richland-Gordon sss. and underlying Brownwood-Ranger series.

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361-398). *Strawn div.*—Shales, sss., and cgls., 3,000 ft. thick, uncon. overlying Millsap div. and underlying Canyon div. Top of coal No. 1, when present, is base.

In 1893 (Tex. Geol. Surv. 4th Ann. Rept. pt. 1) Cummins and N. F. Drake transferred "Millsap div." to the Strawn, and stated that it rested uncon. on Bend div. The U. S. Geol. Survey abandoned "Millsap" (conflict) in 1912, and has since included these beds in the Strawn, as have nearly all geologists since 1893. F. B. Plummer, however, in 1919 (A. A. P. G. Bull., vol. 3, pp. 132-145) excluded †Millsap from the Strawn and stated (under heading *Millsap div.*): Although in 1912 the Tex. Geol. Surv. dropped name Millsap for the lower series of lss. and shales beneath the typical Strawn sands and cgls., it now seems best to restore this name, as the 3 lower lss. are found to contain a fauna quite different from overlying Strawn beds.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 18-42, and Univ. Tex. Bull. 2132), divided *Strawn group* into Mineral Wells fm. (above) and Millsap fm. (below, including all beds beneath coal No. 1), but stated that fauna of latter beds, although not large, appears to be more closely related to that of Bend group than to that of Mineral Wells fm., and is sufficiently distinct to justify recognition of Millsap as a distinct fm. of Strawn group. R. C. Moore, 1929 (A. A. P. G. Bull., vol. 13, p. 888), continued to recognize Millsap as a distinct fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 105, 109), revised the definition of the Strawn by including in it, at the top, the Capps ls., and he divided it into Mineral Wells fm. restricted, Garner fm., and Millsap Lake fm. (=†Millsap of previous repts). This definition was adopted by U. S. Geol. Survey in 1935.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501), drew top of Strawn at *base* of Capps ls. and Rochelle cgl., both of which they included in Graford fm.

As now generally recognized the Strawn group underlies Canyon group and uncon. overlies Smithwick sh., and it is now classified by U. S. Geol. Survey as of Allegheny age.

Named for Strawn, Palo Pinto Co.

†Strawn limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 110). *Strawn ls.*—Ls., 6 ft. thick, in sh. interval btw. Burlington or Garnett ls. and Wyckoff ls. in section along Neosho River from Indian Territory to White City, Kans.

Preoccupied. Replaced by *Deer Creek ls.*, according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13), but according to R. C. Moore (Kans. Geol. Surv. Bull. 22, 1936, p. 172) this ls. is same as Lecompton ls.

Named for Strawn, Coffey Co.

Street Road limestone.

Cambrian: Southeastern Pennsylvania.

T. D. Rand, 1900 (Phila. Acad. Nat. Sci. Proc. 1900, pt. 1). *Street Road ls.* is Camb. according to Mr. Walcott.

Streetsville member.

Upper Ordovician (Richmond): Ontario.

W. S. Dyer, 1925 (Ont. Dept. Mines 32d Ann. Rept., pt. 7, p. 122).

Strelna formation.

Mississippian: Southeastern Alaska (Copper River region).

F. H. Moffit and J. B. Mertie, Jr., 1923 (U. S. G. S. Bull. 745, pp. 18–19, 21–28, table opp. p. 28, map). *Strelna fm.*—Basal fm. in Kotsina-Kuskulana dist. Is a complex of bedded lavas and tuffs intercalated with sed. beds and cut by basic intrusives. The rocks are chiefly stratified tuff beds and dense fine-grained basalt, with minor chert, argillite, sh., and ls. Thickness 7,000 to 8,000, possibly 10,000 ft. Underlies Nikolai greenstone [Permian], probably conformably. Named for occurrence in valley of Strelna Creek. The poorly preserved fossils indicate Miss. age, according to G. H. Girty, and suggest correlation with Lisburne ls.

Strickler limestone. (In Sumner group.)

Permian: Northeastern Kansas.

R. C. Moore, 1936. [See under *Donegal ls.*]

†Stringtown shale.

Lower and Middle (?) Ordovician: Southeastern Oklahoma (Atoka, Latimer, and Pushmataha Counties).

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Stringtown sh.*—Upper part black fissile cherty sh.; lower part greenish fissile friable shales with occasional inclusions of calc. cone-in-cone and ironstone concretions. Thickness 600 ft. Underlies Talihina chert. Base not defined. [In Ark. the name has been used in a restricted sense.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 677). *Stringtown sh.* contains Normanskill fossils at 3 horizons. [U. S. Geol. Survey classifies Normanskill as of Chazy and Middle (?) Ord. age.]

B. F. Wallis, 1915 (Okla. Geol. Surv. Bull. 23, pp. 23–31). Talihina chert and most of Stringtown sh. were deposited in Ouachita Mtns while Viola ls. was being deposited in Arbuckle Mtns. Basal part of Stringtown is of Black River age and corresponds to upper part of Simpson fm.

C. W. Shannon and L. E. Trout, 1915 (Okla. Geol. Surv. Bull. 19, pt. 1, pp. 131–133). *Stringtown sh.* contains Upper Ord. fossils [?] in upper part. [On p. 429 of pt. 2 of Bull. 19 Shannon shows basal part of Stringtown sh. to be of Black River age.]

H. D. Miser, 1918 (U. S. G. S. Bull. 660, p. 67). The use of *Stringtown sh.* has been discontinued in this area [Caddo Gap and DeQueen quads., Ark.-Okla.] because the beds to which it has been applied do not form a mappable unit distinct from rest of sh. above Blakely ss.; because the graptolites supposed to be characteristic of it have apparently been found well down in underlying sh.; and because, according to E. O. Ulrich, the limits and character of Stringtown sh. at type loc. in Okla. are in doubt. With recognition of Blakely ss. as distinct fm., and failure to separate the Stringtown, it became necessary to give a new name (Womble sh.) to whole interval btw. Blakely ss. [below] and Bigfork chert [above].

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 34). *Stringtown sh.* is Lower Ord. and correlates with upper part of Simpson fm., Womble and Blakely sss., and St. Peter ("Burgen") ss.

H. D. Miser, 1926 (Okla. geol. map), placed Stringtown sh. opposite Womble schistose ss., Blakely ss., Mazarn sh., and St. Peter ("Burgen") ss.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45). *Stringtown or Womble sh.* underlies Bigfork chert, overlies Blakely ss., and is of basal Black River and upper Chazy (Blount) age.

The U. S. Geol. Survey has now replaced this name with *Womble sh.*, which affords a better type loc. and which contains in its upper part beds similar, lithologically and faunally, to Stringtown sh. (See paper by T. A. Hendricks, M. M. Knechtel, and J. Bridge, in A. A. P. G. Bull., vol. 21, No. 1, 1937, pp. 1–29.)

Named for Stringtown, Atoka Co.

Striped Peak formation.

Pre-Cambrian (Belt series): Northeastern Idaho and northwestern Montana (Coeur d'Alene district and Cabinet Mountains).

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277–285). *Striped Peak fm.*—Siliceous sss., generally flaggy to shaly; mostly green and purple; ripple marks, sun cracks, etc. Thickness 1,000+ ft. Upper Algonkian fm. in Coeur d'Alene dist. Overlies Wallace fm. Largest areas occur near Striped Peak, Idaho, whence the name. Description of general geology of region is based almost wholly on work of F. C. Calkins.

Strites Pond formation.

Upper Cambrian: Quebec.

Name applied by H. W. McGerrigle (17th Rept. Vt. State Geol., pp. 182, 185, 1931) to A_2 of Logan's section of Philipsburg series of Quebec. McGerrigle mapped his *Strites Pond fm.* in small area in N. part of St. Albans quad., NW. Vt., stating that it extended about 4 mi. into that State. Logan described A_2 as consisting of 100 ft. of white and dove-gray pure compact lss. McGerrigle gave thickness as 400 ft. (See 1931 entry under *Philipsburg series.*) T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 6), classified this fm. as Ord., but paleontologists of U. S. Geol. Survey draw top of Camb. at top of this fm.

†Stromatopora beds.

A paleontologic name applied in some reports to Manlius ls. of N. Y.

†Strong flint. (In Chase group.)

Permian: Central Kansas.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 771–786, 799). *Strong flint.*—Two beds of light-gray ls. containing an abundance of flint in layers, separated by 18 ft. of massive light-gray or whitish ls. Total thickness 35 to 45 ft. Basal memb. of Chase fm. Overlain by shales in Chase fm. and underlain by Neosho fm.

Said to be same as Wreford ls., older name.

Named for Strong, Chase Co.

†Strong City beds.

Permian: Central Kansas.

L. C. Wooster, 1905 (The Carbf. rock system of eastern Kans.). *Strong City beds.*—Includes Strong flints or Wreford ls. and underlying Crusher Hill alternating shales and lss. Overlie Elmdale beds and underlie Cedar Point or Matfield shales. Elmdale beds as here used extends from top of Americus ls. to 12 ft. above Cottonwood ls., or to what appears to be top of Florena sh. memb. of Garrison fm.

Probably named for Strong, Chase Co.

Stuart shale.

Pennsylvanian: Central southern, central, and central eastern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Stuart sh.*—Blue and black clay sh., 90 to 280 ft. thick, with 10 to 50 ft. of ss. near center. Underlies Senora fm. and overlies Thurman ss.

Named for Stuart, Hughes Co., which is located on outcrop of fm.

Stull shale. (In Kanwaka shale.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). *Stull sh.* applied to top memb. of Kanwaka sh. in eastern Kans. Overlies Clay Creek ls. [Derivation of name not stated. On p. 52 *Stull sh.* is described as 26 ft. thick, of which upper 5 ft. consists of dark-bluish and yellow sh., clay, and sand, the middle 11 ft. of light yellowish-brown soft, partly cross-bedded ss., and the lower 10 ft. of bluish to yellowish sh., clay, and micaceous sand.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 171), more fully described this sh.; gave its thickness as 30± ft. near Stull and 45 ft. near Atchison; and stated type loc. is SE. cor. sec. 26, T. 12 S., R. 18 E., near village of Stull, Douglas Co., Kans.

Stump sandstone.

Upper Jurassic: Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98, pp. 76, 81). *Stump ss.*—Mainly thin-bedded gray to greenish-gray fine-grained sss. that weather into platy fragments about 1 in. thick. Near base are some beds of compact calc. ss., locally 6 ft. thick. At base is bed of grit or coarse-grained ss. containing marine Jurassic fossils. The Stump is usually resistant to weathering. Thickness 200 to 600 ft. Underlies Gannett group (Cret.?) and overlies Preuss ss. (Jurassic). Named for Stump Peak, at head of north fork of Stump Creek, about center of T. 6 S., R. 45 E. Boise meridian.

Stuntz conglomerate member (of Knife Lake slate).

Pre-Cambrian (pre-Huronian): Northeastern Minnesota (Vermilion district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept., p. 350). *Stuntz cgl., porodyte and porphyrel.*—Is older than Ogishke cgl. Named for exposures in vicinity of Stuntz Bay of Vermilion Lake.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 129, 131). The porphyry cgl. phase of Ogishke cgl. is confined mainly to area about Stuntz Bay. In the past it has been known as "Stuntz" cgl.

†Stuntz Island agglomerate.

A term applied by N. H. Winchell and H. V. Winchell in 1890 (Minn. Geol. Nat. Hist. Surv. Bull. 6) to a facies of Ogishke cgl.

Sturgeon quartzite.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Crystal Falls and other districts).

H. L. Smyth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 105+). *Sturgeon qtzite.*—Mainly coarse vitreous qtzite, of light-gray color. Also includes sheared qtzites or micaceous quartz schists. Thickness probably 430 to 500 ft. Underlies Randville dol. Is lowest memb. of Algonkian and rests on Archean granites and gneisses. Named for exposures along Sturgeon River.

Sturgis moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Sturgis, St. Joseph Co.

Sturm limestone. (In Lawrence shale.)

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 6, 33). *Sturm ls.*—Light-colored bluish impure ls. that weathers into nodular pellet-like forms. Thickness 6± ft. Is in Andrew (Lawrence) sh. Lies 4 ft. above Nebawka ls. and 6 ft. below Oreapolis ls. Exposed along North Branch of Weeping Water Creek btw. 2 and 4 mi. N. of Nebawka, with several good exposures near Sturm's school house, sec. 12, T. 10 N., R. 12 E. It is in bed of Weeping Water Creek 2 mi. W.-NW. of Nebawka, where it is marked by a ford in the creek.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 34), stated that Nehawka ls. is Iatan ls., but no mention is made of Sturm ls., and the name appears to have been dropped from the list of geol. units in Nebr. If Nehawka ls. is Iatan ls., the Sturm ls. is a bed in Lawrence sh.

Stuver series.

Mississippian: Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 240). *Stuver series.*—Chiefly hard flinty cgl. and qtzite, some sl. and sh. Exposed thickness 2,000 ft. Underlies Lisburne series (Dev.), and therefore tentatively assigned to pre-Dev.

Named for Mount Stuver, E. of Anaktuvuk River. Is now considered to be a part of Noatak fm. (Miss.).

†Styliola limestone.

†Styliolina limestone.

Paleontologic names applied in some early repts to ls. later named *Genundewa.*

sub-Aftonian drift (Pleistocene).

A name that has sometimes been applied to the oldest or Nebraskan glacial drift, because it underlies the Aftonian interglacial deposits.

sub-Blairsville red shale member (of Chemung formation).

Upper Devonian: Western Pennsylvania.

M. R. Campbell, 1904 (U. S. G. S. Latrobe folio, No. 110). *Sub-Blairsville sh. memb. of Chemung fm.*—Red sh. and ss., 320 to 450 ft. thick, lying on mass of sh. and ss. assigned to Chemung fm. Is 930 to 1,070 ft. below top of Pocono ss. and separated from the higher red sh. of the Pocono (Patton sh. memb.) by a variable mass of sh. and ss. The sub-Blairsville bed is not known at surface W. of Allegheny Front but presumably underlies entire region.

Named for occurrence in wells in vicinity of Blairsville, Indiana Co.

†sub-Carboniferous.

A name applied in many early repts to *Mississippian series.* As first used (by D. D. Owen) it included beds extending to base of Sil. lss. In some early repts called "Subcarboniferous."

†sub-Clarksville sand.

Upper Cretaceous (Gulf series): Southwestern Arkansas and northeastern Texas.

A. C. Veatch, 1906 (U. S. G. S. P. P. 46, pp. 24–25, and table opp. p. 16). *Sub-Clarksville sand.*—Sand bed which in Clarksville and Paris wells occurs near base of Brownstown (Taylor) fm. and to E. is found at top of Bingen sand. Does not outcrop in southern Ark. except as it may be represented as littoral deposits in upper part of Bingen sand. Thickness 50 to 100 ft.

Formerly considered to be same as Blossom sand but now considered by L. W. Stephenson to be probably older and of Eagle Ford or Woodbine age. Named for development in wells at Clarksville, Red River Co., Tex.

Subconglomerate measures.

A descriptive term applied in early Pa. Geol. Surv. repts. to the Miss. rocks of western Pa.

†sub-Olean conglomerate.

Devonian or Carboniferous: Southwestern New York and northwestern Pennsylvania.

C. A. Ashburner, 1880 (2d Pa. Geol. Surv. Rept. G_4, pp. 104–105). *Sub-Olean cgl. and ss. (Middle Pocono, No. X).*—Thickness 60 ft. Older than Olean cgl. (basal bed of Pottsville cgl.), and separated from it by 70 ft. of shales and sss.

Replaced by Knapp fm.

Sucarnoochee clay. (In Midway group.)

Eocene (lower): Southwestern Alabama.

E. A. Smith, 1892 (Sketch of geol. of Ala., pam. of 36 pp., Birmingham, Ala., Roberts & Son). *Sucarnochee clay* (also *Sucarnochee or Black Bluff group*).—Series of black clays, 100 ft. thick, well exposed at Black Bluff, on Sucarnochee River [Creek], and therefore called by latter name. Underlies Naheola series and overlies Clayton or Rutledge ls.

In present classification is middle fm. of Midway group, underlying Naheola fm. and overlying Clayton fm. Is same as Porters Creek clay, and of marine origin.

Named for exposures on Sucarnoochee Creek (the spelling adopted by U. S. Geog. Bd.) at Black Bluff, Sumter Co.

†Sudburian.

†Sudbury series.

Synonymous terms applied by A. P. Coleman to post-Laurentian rocks that form lower part of Huronian series (broad sense in which Huronian has been used by U. S. Geol. Survey for many years). For definition see U. S. G. S. Bull. 769, pp. 125–127.

Sudbury marble.

Lower Ordovician (Chazy): Southwestern Vermont (Rutland County).

Used in commercial sense as far back as 1861 (A. D. Hager, Rept. Geol. Vt., vol. 2).

A. Wing, 1877 (Am. Jour. Sci., 3d, vol. 13, pp. 334–347, 404–419). *Sudbury ls.* [heading] of western Vt. contains Trenton fossils. [He also said †Sparry ls. is of Trenton age.]

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 368). *Sudbury marble.*—For most part snow white, but contains a few beds of fine cream-colored dol. Outcrops in town of Sudbury, at NW. end of Taconic Range. No fossils, but appears to be of Chazy age. Rests on Beekmantown ls. and underlies ls. of Trenton age, being only separated from the latter by a heavy bed of gray dol.

Sudbury norite.

Pre-Cambrian: Ontario.

W. G. Miller, 1913 (12th Int. Geol. Cong. Guidebook 7, p. 7).

†Suffolk porphyry.

See *Praysville porphyry*.

Sugar Creek shale. (In Bethany Falls limestone.)

Pennsylvanian: Vicinity of Kansas City, Mo.-Kans.

C. O. Dunbar and G. E. Condra, 1932 (Nebr. Geol. Surv. Bull. 5, 2d ser., p. 17). published a table (table C) listing in one column "current nomenclature" in vicinity of Kansas City, and in the opp. column "Revised correlation by R. C. Moore, 1931," which showed Bethany Falls ls. of "current nomenclature" divided by R. C. Moore's "revised classification" into (descending) Swope ls., *Sugar Creek sh.*, and Middle Creek ls.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). introduced *Swope fm.* to include all beds from top of Bethany Falls ls. (restriction of R. C. Moore's 1931 definition) "to base of Schubert Creek ls. (called 'Hertha' by Hinds and Greene)." His restricted Bethany Falls ls. occupied position of Swope ls. of his 1931 classification, and the sh. separating this ls. from underlying Middle Creek ls. he named *Hushpuckney sh.*, and apparently abandoned his Sugar Creek sh.

Sugar Hill quartz monzonite.

Late Devonian or late Carboniferous: Northwestern New Hampshire (Moosilauke quadrangle).

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., Moosilauke map, p. 28). *Sugar Hill quartz monzonite.*—Medium-grained, pink, locally gneissic; late Dev. or late Carbf. Assigned to New Hampshire magma series. [Mapped on Ore Hill, 2± mi. SE. of Sugar Hill.]

Sugarloaf arkose. (In Newark group.)

Upper Triassic: Central Massachusetts and Connecticut.

B. K. Emerson, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 452). *Sugarloaf arkose*, or the feldspathic ss. and cgl. (shoreward rocks) of the Triassic of Mass. Thickness 700 to 3,000 ft.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; see also U. S. G. S. Mon. 29). [See 1898 entry under *Longmeadow ss.*]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 91–100). *Sugarloaf arkose.*—Coarse buff to pale-red ss., which in many places becomes so coarse that it can be called a cgl. Made up largely of debris of the granite and coarse pegmatite veins of high ground on W. or of Amherst-Leverett region on E. In central part of Mass. it extends from Conn. River westward, including the isolated area in Amherst village, and farther S. it occupies whole width of plain W. of Holyoke Range. All except possibly basal part is synchronous with Mount Toby cgl. to E. Is basal fm. of Newark group to W. Underlies Longmeadow ss. Talcott diabase of Conn. was deposited in early part of Sugarloaf time. Named for occurrence at Sugarloaf Mtn.

Sugarloaf sandstone.

Lower Cambrian: Central northern Maryland (Frederick County).

C. R. Keyes, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 306, 320–322). *Sugarloaf ss.* of Sugarloaf Mtn, Md., is seemingly identical with Catoctin ss.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Rept., vol. 1, p. 165). In Md. hills of qtzite appear, and at last a bold high ridge of qtzite called Sugarloaf Mtn. The *Sugarloaf ss.* (*qtzite*) is described as an unmistakable sedimentary rock. To E. of Sugarloaf is the great phyllite country of alternate belts of hydro-mica and chlorite sl., and these seem to be of later age than Sugarloaf ss., which is correlated with Chikis qtzite.

Sugarloaf metaquartzite.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 620, 623, 635). *Sugarloaf metaqtzite.*—Chiefly dense fine-grained vitreous metaqtzite of extreme purity and dull-white color, and without partings. Some parts characterized by distinctly bluish color quite unlike that of any other terrane in dist. Another common color is brownish white. Near top a few thin beds of fine cgl. of well-worn quartz pebbles in a matrix partly cemented with crystalline hematite. Thickness exposed varies from thin wedge to 1,900 ft. Underlies Nash marble series, but contact not seen. Conformably overlies Lookout schist. Exposed on NE. side of Sugarloaf Peak and elsewhere. Assigned to early Algonkian.

Sugar Loaf dacites.

Devonian: New Brunswick.

M. V. Howard, 1926 (Geol. Soc. Am. Bull., vol. 37, p. 484).

Sugar Loaf basalt.

Latest Pleistocene or Recent: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Sugar Loaf volcanics.*—Columnar-jointed basalt, nodular basalt, vesicular spatter, *aa* clinker, etc., erupted from Sugar Loaf Crater. Included in uppermost part of Honolulu volcanic series [q. v.]. Occurs at Honolulu.

Sugar Run sand.

Drillers' name for a subsurface sand in Bradford dist., NW. Pa., lying btw. Bradford First and Bradford Second sands and 525 ft. above Bradford Third sand.

†Suisun marble.

Age (?): Western California (Solano County).

J. D. Whitney, 1865 (Calif. Geol. Surv. vol. 1, p. 104). North of Suisun commences another series of hills, which has received the name "Pelevo Hills," at their SE. end, but which extend NW. and become merged in the chain known as "Vacca Mtns," the name given to the ridges here bounding Sacramento Valley on W. side. The Pelevo Hills are made up of Cret. strata. The well-known "Suisun marble" occurs in these sss., and is evidently a deposit from calc. springs. It is a deep brownish-yellow color with banded structure.

A local deposit of travertine of unknown age, according to F. L. Ransome.

Suitcase sand.

A subsurface sand, of Penn. age, 0 to 200 (?) ft. thick, in Burbank field, central northern Okla., that is correlated with part of Ochelata fm. It lies lower than Tonkawa sand and higher than Layton sand.

Sujeh formation.

Pre-Cambrian: British Columbia.

S. J. Schofield, 1915 (Canada Geol. Surv. Mem. 76, p. 33). Included in Purcell series.

Sukonk beds.

A misprint (on p. 382 of U. S. G. S. Bull. 191) for *Seekonk beds*.

Sukunka member.

Upper Cretaceous: British Columbia.

E. M. Spieker, 1922 (A. A. P. G. Bull., vol. 6, No. 2, pp. 112–126). Included in Dunvegan fm.

Sullivan formation.

Upper Cambrian: Alberta and British Columbia.

C. D. Walcott, 1920 (Smithsonian Misc. Coll., vol. 72, No. 1, p. 15). *Sullivan fm.*, Camb., Alberta. [Walcott fully defined this fm. in Smithsonian Misc. Coll., vol. 67, No. 8, p. 461, Mar. 5, 1923, when he assigned it to Upper Camb. Thickness 1,440 ft. Underlies Lyell fm. and overlies Arctomys fm.]

†Sullivanian series.

Cambrian: Alberta.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, pp. 285, 288). *Sullivanian series.*—In descending order: Oolites, 335–350 ft. thick; lss. or dol. 325–600 ft. thick; and shales (Bosworth?), 1,100–1,200 ft. thick. [On p. 288 the shales are excluded from Sullivanian series, under name "Bosworthian series."] Lies stratigraphically and uncon. below Sawbackian series and above Bosworthian series in Banff, Alberta. Of late Cambric age. Includes Paget oolites (above) and Thompson dolomites (below).

Sulphur Canyon sandstone bed. (In Price River formation.)

Upper Cretaceous: Central eastern Utah (Book Cliffs).

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). *Sulphur Canyon ss. bed.*—Massive to medium-bedded ledge-making ss., buff to gray except for a white upper part. Weathers into blocky forms due to joints. Thickness 0 to 25 ft. Included in Neslen coal-bearing memb. of Price River fm. in E. part of Book Cliffs field. Lies 15± ft. above Thompsons Canyon ss. bed, and 0 to 14± ft. below Chesterfield coal zone. Is older than Bluecastle ss. bed to W. Named for Sulphur Canyon, T. 9 S., R. 100 W., Utah. Traced from Buck Canyon to Colo. line.

†Sulphur Creek group.

Upper Cretaceous (Colorado): Southwestern Wyoming, northwestern Colorado, and northeastern Utah (Uinta Mountains region).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 50, 154). *Sulphur Creek group.*—Black shales, occasionally friable sss., with carbonaceous shales and lignitic coal. Thickness 2,000 ft. In hills near Hilliard, Wyo., Sulphur Creek cuts through them for several miles. Underlies Salt Wells group and overlies Henrys Fork group.

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Sulphur Creek group of Powell as=lower part of Hilliard fm. and of Niobrara and Benton age.

Sulphur Springs formation. (In Kinderhook group.)

Mississippian: Central eastern Missouri and southwestern Illinois.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 110). *Sulphur Springs fm.*—Basal fm. of Kinderhook group in area about Glen Park and Sulphur Springs, Mo. Consists of Bushberg ss. memb. (10 ft. thick) at top; Glen Park ls. memb. (oolitic ls. 5 ft. thick) in middle; and, at base, 0 to 15 ft. of sh. of either earliest Kinderhook or Dev. age. Underlain by Grand Tower ls.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 29), showed *Sulphur Springs fm.* uncon. below Fern Glen fm. and in places resting on Louisiana ls.

M. E. Wilson, 1922 (Mo. Bur. Geol. and Mines vol. 16, 2d ser.). Glen Park ls. memb. of Sulphur Springs fm. is correlated by Weller with upper part of Louisiana ls.

R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser., pp. 133–136, 140). *Sulphur Springs fm.* is exposed only in Ste. Genevieve and Jefferson Counties, Mo. The lower sh. memb. has not been definitely recognized except at Sulphur Springs. Fauna of Bushberg ss. memb. is essentially same as fauna of Glen Park ls. memb. The Glen Park ls. uncon. overlies Louisiana ls. in Calhoun Co., Ill. The Louisiana contains no species in common with the Glen Park. The Fern Glen fm. discon. overlies the Sulphur Springs. Lithologically and stratigraphically the Sulphur Springs fm. is closely related to Sylamore ss. of central and SW. Mo. and northern Ark., and may be correlated with it as a homotaxial equivalent. [In chart on p. 282 he showed Sulphur Springs fm. as younger than Louisiana ls. This chart showed following downward succession in Jersey and Calhoun Counties, SW. Ill.: Hannibal fm., Glen Park ls., Louisiana ls., Saverton sh., Grassy Creek sh., Dev.; and he gave same succession for western Ill. and NE. Mo. in Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, p. 245. In southern Ill. and SE. Mo. he showed (9th Conf., p. 245) Glen Park uncon. below Fern Glen and uncon. above Chattanooga. Ulrich applied *Glen Park ls. memb.* to 5 ft. of oolitic ls., which appears to be a smaller unit than Glen Park of Moore.]

S. Weller and S. St. Clair, 1928 (Mo. Bur. Geol. and Mines vol. 22, 2d ser., pp. 155–161, 165, 301). In Ste. Genevieve Co., Mo., the *Sulphur Springs fm.* is uncon. overlain by Fern Glen fm. It is everywhere uncon. underlain by Ord. It now occurs in patches only. The upper black sh. memb., 0 to 10 ft. thick, is similar lithologically to Chattanooga sh. The only fossil it contains is *Sporangites*, similar to those in the Chattanooga, but Sulphur Springs fm. is probably younger than typical manifestation of this fm. On basis of fauna at Hamburg, Ill., the Glen Park ls. has been correlated with some portion (upper part) of Louisiana ls., and this correlation may be accepted as including the whole of Sulphur Springs fm.

Named for exposures at Sulphur Springs, Jefferson Co., Mo.

Sultan limestone.

Devonian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 13, etc.). *Sultan ls.*—Lithologically divided into 3 members (descending): (1) Crystal Pass ls. memb., 150 to 260 ft.; (2) Valentine ls. memb., 75 to 380 ft.; (3) Ironside dol. memb., 5 to 125 ft. Most of fossils [listed] came from lower memb.; but some from middle memb.; no fossils in upper memb. According to E. Kirk the fossils are late Middle Dev. or early Upper Dev. Is overlain by Monte Cristo ls. (Miss.) and underlain by Goodsprings dol. (Dev.? to Upper Camb.). Well exposed in neighborhood of Sultan mine, Goodsprings quad. [Mr. Hewett sent an advance copy of his Goodsprings section and of the names he proposed to apply to the fms. to W. S. Glock, who in 1929 (Am. Jour. Sci., 5th, vol. 17, pp. 326 to 339) described the *Sultan ls.* in east-central part of Spring Mtn Range, Goodsprings quad.]

Sumas diorite.

Jurassic (?): Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines, Mem. 38, map 17, 1912). [Mapped *Sumas diorite* on NW. shore of Sumas Lake, which lies W. of 122° and N. of Int. Bdy.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 526). *Sumas granite* and *Sumas diorite* compose part of Sumas Mtn [B. C.(?)]. The diorite is the older. Both are Jurassic (?). May be contemp. with Custer granite gneiss.

Sumas granite.

See 1913 entry under *Sumas diorite*.

Summer formation.

Recent: Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Summer fm.*—Varying thickness of sands and gravels, occurring as alluvial fans, etc. Type loc. on E. side of Summer Lake, Lake Co.

†Summerfield limestone. (In Conemaugh formation.)

Pennsylvanian: Eastern Ohio.

D. D. Condit, 1912 (Ohio Geol. Surv., 4th ser., Bull. 17, pp. 20, 23). *Summerfield ls.*—Nonmarine ls., 50 to 65 ft. below Pittsburg coal. Usually consists of soft gray, buff, or brownish amorphous ls. interbedded with clay. Probably = Lower Pittsburg ls. of Pa. and W. Va. Over much of southern Jefferson Co. the ls. is replaced by ss. or cgl. Included in Conemaugh fm.

Same as Lower Pittsburgh ls. memb., older name.

Named for Summerfield, Noble Co.

Summerhill sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania (Cambria County).

C. Butts, 1905 (U. S. G. S. Ebensburg folio, No. 133). *Summerhill ss.*—Generally laminated, but in places partly heavy bedded. Outcrops in bold ledge, about 50 ft. thick, high in bluff E. of Summerhill [Cambria Co.]. The Catholic Church at Wilmore is built on this ss. Varies in thickness from 30 to 60 ft. Included in Conemaugh fm. Its top is about 60 ft. below Wilmore ss. and it lies about 100 ft. above Ebensburg [Morgantown] ss.

Summerville formation. (In San Rafael group.)

Upper Jurassic: Southeastern Utah and southwestern Colorado.

J. Gilluly and J. B. Reeside, Jr., 1926 (U. S. G. S. Press Bull. 6064, March 30, 1926). [Name adopted at joint conference of J. Gilluly, J. B. Reeside, Jr., R. C. Moore, and H. E. Gregory, from area specially studied by Messrs. Gilluly and Reeside.] *Summerville fm.*—Thin-bedded chocolate-colored sss., earthy red-brown ss. and shales, some gyp., and in some sections a little ls. Thickness 125 to 331 ft. Top fm. of San Rafael group. Conformably overlies Curtis fm. and uncon. underlies Morrison fm.

Named for exposures at Summerville Point, just SE. of head of Summerville Wash, in N. end of San Rafael Swell, SE. Utah.

For additional details see U. S. G. S. P. P. 150, 1928 (by J. Gilluly and J. B. Reeside, Jr.), and U. S. G. S. P. P. 183, 1936 (by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.).

†Summit limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania (Lawrence and Beaver Counties).

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_5, pp. 25–26). *Summit ls.*—Slaty and slab-like ls. 5 ft. thick. Separated from underlying Brush Creek coal by 3 ft. of fire clay. Underlying beds concealed for 50 ft., down to Upper Freeport coal. Named for Summit cut on P. F. W. & C. R. R. in NW. part of Beaver Co.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2, p. 320). *Brush Creek (Summit) ls.*—Slaty dove-colored ls. charged with calcite. Underlies Brush Creek fire clay. Occurs in high knobs of Perry Twp, Lawrence Co.

Now considered same as Mahoning ls., the older name.

Summit limestone. (In Cherokee shale.)

Pennsylvanian: Northeastern Missouri.

W J McGee, 1892 (St. Louis Acad. Sci. Trans., vol. 5, p. 331). *Summit ls.*, 2 ft. thick, occurs at top of Lower Coal Measures in Macon Co. Separated from underlying Summit coal by 3 ft. of sh. or clay. Overlain by drift.

†Summit series. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania (Clarion County).

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. vol. 3, pt. 2, p. 2377). In northern part of Clarion Co. the Clarion group is the "Summit series."

Summit type (of granite).

Pre-Cambrian: Eastern Colorado (Pikes Peak).

E. B. Mathews, 1900 (Jour. Geol., vol. 8, pp. 214–240). *Summit type of granite* shows very constant texture closely allied to that of granite porphyry. Confined to small area about Summit and down W. slope of highest part of Pikes Peak. Is younger than Pikes Peak type and older than Cripple Creek type.

Summit series.

A term applied by R. A. Daly (Canada Dept. Int., Rept. Chief Ast. 1910, vol. 2, pp. 47, 141, 178, 194, 1913) to rocks of the Selkirk Range, southern British Columbia, at 49th par., which he correlated with the pre-Camb. Belt series of Mont. and Idaho and with "a vast thickness of conformably overlying strata which may represent the whole Paleozoic succession up to and including the Sil." "Named for Summit Creek, Selkirk Mtns, along which a great part of the series is exposed." Divided into (descending): Lone Star fm., 2,000 ft.; Beehive fm., 7,000 ft.; Ripple fm., 1,650 ft.; Dewdney fm., 2,000 ft.; Wolf fm., 2,900 ft.; Monk fm., 5,500± ft.; Irene volcanics, 6,000 ft.; and Irene cgl., 5,000± ft. He correlated (p. 178) his Lone Star fm. with fms. in Idaho and Mont. which are of both Camb. and pre-Camb. age. But the rocks appear to belong chiefly if not wholly to Belt series of U. S. Geol. Survey.

†Summitville andesite. (Of Potosi volcanic series.)

Miocene: Southwestern Colorado.

E. S. Larsen, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 35–38). *Summitville andesite.*—Augite andesite flows and interbedded breccias and aggls. of like material. Thickness, 2,400+ ft. Included in Potosi volcanic series of Platoro-Summitville quad. Probably belongs to *Sheep Mtn fm.* Underlies Alboroto fm. and overlies Treasure Mtn latite. Named for extensive development in vicinity of Summitville, Rio Grande Co.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718), gave thickness of this andesite as 3,000+ ft. in Platoro-Summitville dist. and reported its absence in Creede dist.

Later work by E. S. Larsen proved that the rocks around Summitville underlie, instead of overlie, Treasure Mtn latite, and that they belong to Conejos andesite. He therefore abandoned "Summitville," and applied *Sheep Mtn andesite* to the rocks underlying Alboroto quartz latite and overlying Treasure Mtn latite.

Summum sandstone. (In Carbondale formation.)

See under *Marietta.*

Summum cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to middle part of Carbondale fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated, but there is a village of that name in Fulton Co., Ill.

Sumner group.

Permian: Eastern Kansas and northern Oklahoma.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 9, 48). *Sumner div.*—Largely shales, but with some interbedded lss. Thickness 600 to 800 ft. Upper div. of Big Blue series. Divided into Wellington shales above and Geuda salt measures below. Overlies Chase lss. and underlies, probably uncon., Cimarron series.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, pp. 703–737). *Sumner stage* includes Wellington shales above and Marion fm. below, and rests on Winfield fm.

This definition was adopted by E. Haworth and J. Bennett in 1908 (Kans. Univ. Geol. Surv., vol. 9). J. W. Beede, 1909 (Jour. Geol., vol. 17, pp. 710–729), divided the Perm. rocks above Winfield ls. into Wellington stage above and Marion stage below, and included Luta ls. in his Marion stage.

R. C. Moore and W. P. Haynes, 1917 (Kans. Geol. Surv. Bull. 3), and R. C. Moore 1920 (Kans. Geol. Surv. Bull. 6, pt. 2), used *Big Blue group* to include Wellington fm. at top and Cottonwood ls. at base.

The U. S. Geol. Survey adopted *Sumner group* in 1910, to include Wellington fm. at top and Luta ls. at base, and this definition has since been followed generally. But R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), excluded Luta ls. from Sumner group and transferred it to Chase group. This modification has not been considered by U. S. Geol. Survey for its publications.

Named for Sumner Co., Kans.

†Sumpter epoch.

†Sumter epoch.

Pliocene and Miocene: Eastern South Carolina.

J. D. Dana, 1863 (Man. Geol., pp. 506, 511, 522, 798). *Sumter epoch.*—Includes Plio. and Mio. deposits of S. C. [which are now divided into several fms.].

The name has also been spelled *Sumpter*.

Named for development in Sumter dist., Sumter Co.

†Sunbeam monzonite.

Tertiary (post-Eocene): Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pls. 75, 77, pp. 644, 656–657). [*Sunbeam monzonite* as mapped included two types of rocks—a monzonite and a monzonite porphyry—which were mapped separately in U. S. G. S. P. P. 107, 1919.]

Named for Sunbeam mine.

Sunburst sand.

A subsurface gray ss., 5 to 50 ft. thick, forming basal part of Kootenai fm. (Lower Cret.) in Kevin-Sunburst oil field of Toole Co., central northern Mont. Lies at depth of about 1,550 ft.

Sunbury shale.

Mississippian: Ohio and northeastern Kentucky.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, pp. 216, 220). *Sunbury black sl.*—Black bituminous sh., 10 to 15 ft. thick, overlying Sunbury Calciferous Sandrock, 90 to 100 ft. thick, and underlying Raccoon shales [Cuyahoga fm.]. Included in Waverly group.

Underlies Cuyahoga fm. and overlies Berea ss., according to definition in use for many years.

Named for Sunbury, Delaware Co., Ohio.

†Sunbury Calciferous sandrock.

Mississippian and Devonian (?): Central Ohio.

L. E. Hicks, 1878 (Am. Jour. Sci., 3d, vol. 16, pp. 216, 220–222). *Sunbury Calciferous Sandrock.*—Shaly ss., compact ss. (somewhat calc.), and at bottom a few ft. of alternating shales and siliceous lss. Thickness 90 to 100 ft. Underlain by Huron sh. and overlain by Sunbury black sl. Near junction with underlying Huron sh. is stratum of calciferous sandrock, lying in huge rough concretionary masses, underlain by blue shales interstratified with thin layers of siliceous ls., the lowest of which rests directly on Huron sh. Included in Waverly group. [As thus defined includes equivalents of Berea ss., Bedford sh., Cleveland sh., and Chagrin sh. (?).]

Named for Sunbury, Delaware Co.

†Sun City marble.

Popular name for Medicine Lodge gyp. where quarried at Sun City, Barber Co., Kans.

Sundance formation.

Upper Jurassic: Southwestern South Dakota, Wyoming (widespread except southwestern Wyoming), central southern Montana (Stillwater to Rosebud Counties region), northwestern Nebraska, and central northern Colorado (as far S. as Loveland).

N. H. Darton, 1899 (Geol. Soc. Am. Bull., vol. 10, pp. 387–393). *Sundance fm.*—Green shales and thin-bedded sss., 60 to 400 ft. thick, underlying Unkpapa ss. and uncon. overlying Spearfish fm. (Red beds) in Black Hills. Marine Jurassic fossils abundant.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 520). *Sundance fm.* consists of dark-drab or green shales and buff or reddish sss. alternating, with 25 ft. of massive red ss. at base.

N. H. Darton and C. C. O'Harra, 1909 (U. S. G. S. Belle Fourche folio, No. 164, p. 3). Type loc. of *Sundance fm.* is above Sundance, not far SE. of Belle Fourche quad., S. Dak.

Sunday quartzite.

Pre-Cambrian (lower Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic district).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pp. 225, 227, chart opp. p. 598, 605). *Sunday qtzite.*—Mainly qtzite, at least 150 ft. thick, with basal cgl. from a few in. to 10 ft. thick. Grades into overlying Bad River ls. Rests uncon. on Archean. May be same as Mesnard qtzite of Marquette dist. Named for two exposures E. of Sunday Lake, one a short distance E. of Little Presque Isle River and the other near Newport mine.

†Sunday Lake quartzite.

A name applied in some repts to *Sunday qtzite* of Penokee-Gogebic dist., Mich.

Sunderland formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

G. B. Shattuck, 1901 (Johns Hopkins Univ. Circ., vol. 20, No. 152, pp. 73–75). *Sunderland fm.*—Ice-borne boulders, gravel, sand, and loam, which change their mutual distribution both vertically and horizontally, after manner of shore deposits. They are frequently much altered and decayed and have been derived from fms. occurring in immediate vicinity, as well as from those found far W. in the mtns. In southern Md. the base of Sunderland terrace lies at about 90 ft., but rises gradually toward NW., until at Charlotte Hall (St. Marys Co., Md.) the surface of the bench is at 170 ft. Is next younger than Lafayette fm. and uncon. underlies Wicomico fm. Is extensively developed throughout Prince George's, Charles, St. Marys, and Calvert Counties, and numerous outliers exist on other parts of western shore from Herring Bay to Elkton, but continuity of fm. in this part of Md. has been destroyed. It is developed as an unmistakable terrane butting up against Piedmont Plateau or lapping around edges of the Lafayette. The scarp line at Charlotte Hall is part of the ancient sea cliff of Sunderland sea. Is basal fm. of Columbia group. The name is derived from hamlet of Sunderland, on the divide, in Calvert Co.

G. B. Shattuck, 1902 (Md. Geol. Surv. Cecil Co. Rept., p. 170). *Sunderland fm.* is a wave-built terrace, composed of clay, loam, sand, and gravel, 0 to 90 ft. thick. Base lies at about 90 ft. and upper limit at 160 to 180 ft.

M. R. Campbell, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 825–852). *Sunderland fm.* is not marine, but consists of two different fluviatile deposits, one deposited by Patuxent River and the other by Potomac River, and the two are not of same age. The hamlet of Sunderland is within the area deposited by Patuxent River. The name Sunderland should be abandoned as a fm. name.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 19), proposed to limit Wicomico to 95-foot level, *Sunderland* to 160-ft. level, Coharie to 215-foot level, and Brandywine to 270-ft. level. Later (16th Int. Geol. Cong. Guidebooks 5 and 12, 1932) Cooke fixed elev. of Sunderland fm. at 170 ft. The terrace fms. of Columbia group (including the Sunderland) now recognized by Cooke from Del. to southern Ga., and probably into Fla., are enumerated herein under *Columbia group*. Cooke regards all the fms. as chiefly marine terrace deposits.

Sunlight intrusives.

Miocene: Yellowstone National Park, Wyoming.

A. Hague et al., 1899 (U. S. G. S. Absaroka folio, No. 52) and 1904 (U. S. G. S. Mon. 32, Atlas). Cuts the early basic breccia.

Sunloch metagabbro.

Tertiary: British Columbia.

V. Dolmage, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 25).

Sunnybrook sand.

An oil-bearing sand in base of Hermitage fm. (of early Trenton age) of western Tenn., is known as *Lower Sunnybrook sand*, and a sand of Upper Ord. age is designated *Upper Sunnybrook sand*. The same names are used for two creviced lss. in Lexington fm. (of Trenton age) in Wayne Co., Ky.

Sunnyside limestone.

Carboniferous or Triassic: British Columbia.

C. Camsell, 1910 (Canada Geol. Surv. Mem. 2, pp. 47, 54). Assigned to Carbf. Included in Nickel Plate fm.

H. S. Bostock, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. A, pp. 207, 208). *Sunnyside ls.* assigned to Triassic.

†Sunrise series.

†Sunrise group.

Paleozoic and Mesozoic: Southern Alaska.

W. C. Mendenhall, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 305–307). About min. dist. of Turnagain Arm and vicinity, of which Sunrise City is center, is a series of metamorphic gold-bearing rocks to which name *Sunrise series* has been given. Wherever examined they consist of interbedded fine blue-black slates and dark-gray arkoses. Intruded by dikes. Outcrop all about W. waters of Prince William Sound, wherever the shores were examined. No fossils. Tentatively referred to upper Paleozoic.

Detailed mapping of type region showed that the rocks above described in this rapid reconn. rept included Paleozoic and Mesozoic beds, one more or less definite unit being of Upper Cret. age.

Sunrise formation.

Lower Jurassic: Southwestern Nevada (Tonopah and Hawthorne quadrangles).

S. W. Muller and H. G. Ferguson, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 241–252). *Sunrise fm.*—Shales, lss., and sss. of Lower Jurassic age, conformably underlying Dunlap fm. (Lower Jurassic) and conformably overlying Gabbs fm. (Upper Triassic). Thickness 0 to 1,200± ft. Named for Sunrise Flat, in Gabbs Valley Range. Type section is in upper part of New York Canyon, W. of Sunrise Flat.

Sunrise Springs series.

Tertiary or Pleistocene: Northeastern Arizona.

See 1932 entry under *Bidahochi fm.*

Sunset division. (In Arnheim formation.)

Upper Ordovician: Southwestern Ohio and north-central Kentucky.

A. F. Foerste, 1910 (Denison Univ. Sci. Lab. Bull. 16, p. 18). *Sunset div.*—Lower div. of Arnheim bed. On E. side of Cincinnati geanticline it is terminated by a layer containing *Platystrophia ponderosa*. Southward in Ky. this horizon consists of comparatively unfossiliferous argill. lss. containing comparatively few specimens of *Platystrophia*. Included in Richmond. Thickness 16 ft. Underlies Oregonia div. of Arnheim and overlies Mount Auburn beds (top div. of Maysville).

A. F. Foerste, 1912 (Ohio Nat., vol. 12, pp. 429–452). *Sunset div.* of Arnheim fm. differs lithologically from overlying Oregonia div. of Arnheim. Is included in Richmond only for reason that southward in Ky. it represents a period of diastrophic movement and is regarded as inaugurating a new period of sedimentation rather than closing a former period.

Named for Sunset, Fleming Co., Ky.

Sunset sandstone.

Lower Cretaceous: Alberta.

J. MacVicar, 1924 (Canada Geol. Surv. Summ. Rept. 1923, pt. B, p. 34). Assigned to Cret.

J. A. Allan and R. L. Rutherford, 1934 (Alberta Research Council Rept. 30, p. 32). Assigned to Lower Cret.

Sunshine Peak rhyolite.

Miocene: Southwestern Colorado (San Cristobal quadrangle).

E. S. Larsen, 1935 (U. S. G. S. Bull. 843). A local volcano poured out a considerable amount of this rhyolite on an irregular surface of Silverton volcanic series in NW. part of San Cristobal quad. and adjoining part of Uncompahgre quad. Named for exposures on Sunshine Peak, San Cristobal quad. Partly intrudes and partly uncon. overlies Picayune volcanic group. Confined to area about 12 mi. across. Has a uniform and distinctive character; is commonly dense, nearly white to quaker drab. Its intrusive portions carry many large inclusions of Picayune volcanic group. Assigned to Mio.

Supai formation. (Of Aubrey group.)

Permian and Pennsylvanian (?): Northern Arizona, southern Utah, southeastern Nevada.

N. H. Darton, 1910 (U. S. G. S. Bull. 435, pp. 21, 22, 25). *Supai fm.*—Name proposed for the red sss. and shales that constitute lower part of Aubrey group in northern Ariz. and form a definite strat. unit over wide area. In previous repts these rocks, together with the overlying gray ss. (herein named *Coconino ss.*), have usually been referred to as the "Aubrey ss. series." They are, however, distinct from the gray ss. throughout northern Ariz., but their separation from underlying Redwall ls. is not everywhere as clear as could be desired. Named for conspicuous exposures at Supai village, on Cataract Creek, northern Ariz. In Cataract Canyon and the side canyons near Supai settlement the fm. appears to be 1,400± ft. thick. At top are 400 ft. of red shales, in part sandy, with thin red ss. layers. The lower memb., about 1,000 ft. thick, consists of red sss. varying from coarse to fine and from slabby to cross-bedded, lying on about 75 ft. of red shales and soft red sss. Next below is Redwall ls., of which upper part is soft and contains some sh. partings. In Gilbert's section at mouth of Grand Canyon he included in top of Redwall ls. 510 ft. of alternating ss. and ls. which I believe belong to Supai fm.

L. F. Noble, 1922 (U. S. G. S. P. P. 131B, p. 64), removed from top of Supai fm. 267 to 317 ft. of deep brick-red sandy shales and fine-grained friable sss. (which he stated are uncon. on the underlying beds of the Supai) and named them *Hermit sh.* According to present definitions, therefore, the Supai fm. (restricted) is separated from overlying Coconino ss. by Hermit sh. In this same publication (pp. 54–60) Noble added to base of the Supai 200 to 510± ft. of red sandy sh., purplish and gray ls. with red chert, and reddish to buff calc. ss., of Penn. age, which Gilbert, Walcott, Darton, and other earlier writers had included in Redwall ls., but which Darton had suggested properly belong to Supai fm. Noble reported a probable uncon. btw. the Penn. and Miss. beds. Noble's definition is present approved definition of U. S. Geol. Survey.

In parts of southern Utah the gray Coconino ss. greatly thickens and occupies the time interval of a large part of the red Supai fm. See under *Coconino ss.* The Supai fm. as identified in SW. Utah and SE. Nev. probably includes the time equiv. of Hermit sh.

This fm. is now classified as Perm. and Penn. (?), because of its contained fossil plants, all of which were classified by D. White as of Perm. age. There is, however, a possibility some beds of Penn. age may be present in its basal part in some areas.

Supaian series.

A term employed by C. [R.] Keyes to designate the *Supai fm.* and supposedly contemp. deposits.

Superior amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Bohemian Range group, and is probably=Baltic amygdaloid. The mineralized part is the Superior lode. Named for occurrence in Superior mine, Houghton Co.

Superior flow.

Includes Superior amygdaloid and the underlying trap.

Superior sandstone.

An abbreviated form of *Lake Superior ss.* that is used by some geologists.

Superior drift.

A name that has been applied to red drift of Superior lobe of Labrador ice sheet (Wisconsin stage of Pleist.) in Superior Basin, Lake Superior region.

Superioran period.

Term introduced by C. [R.] Keyes. Same as his *Superioric period.*

Superioric period.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). Latest period of Proterozoic era in Lake Superior region. Includes Keweenawan lavas, Animikian slates, and the erosion interval separating them.

Superior West amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Bohemian Range group. Is first amygdaloid above or to W. of the Superior amygdaloid in Superior mine, Houghton Co. The mineralized part is the Superior West lode.

Superior West flow.

Includes Superior West amygdaloid and the underlying trap.

†Superjacent series.

A descriptive term used in a titular sense in folios and other early repts on Gold Belt region of northern Calif., to include the Cret., Tert., and Quat. deposits, in contradistinction to †Bedrock series, a term applied to underlying Jurassic, Triassic, and Carbf. fms.

Sur series.

Pre-Franciscan (possibly pre-Cambrian): Southern California (Southern Coast Ranges).

P. D. Trask, 1926 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 16, No. 6). *Sur series.*—The term *Santa Lucia series* was first applied to the crystalline complex of Santa Lucia Range by J. P. Smith in 1909 (Sci., n. s., vol. 30, p. 347). [Name used but not defined in publication cited.] The name *Santa Lucia*, however, had been previously applied by Lawson (1893) to the granite at N. end of Santa Lucia Range. It is very evident that the crystalline schists comprise a sed. series deposited prior to intrusion of the quartz diorite. At present both a series of sediments and the granite which intrudes them bear the same name. A new name should be applied to the schists, since, by priority, *Santa Lucia* should be given to the granite and quartz diorite. The name *Sur series* is proposed as a comprehensive name for the schist series of Southern Coast Ranges, which is particularly well developed along Sur River. Age unknown. No fossils have yet been found in this series. It is intruded by Santa Lucia quartz diorite, of pre-Chico age. It consists chiefly of sed. rocks now metamorphosed into qtzites, marbles, mica schists, paragneisses, and in part into injection gneiss. It includes the crystalline lss. that have been named *Gabilan ls.*

Surber sand.

A subsurface sand, of Penn. age, in Stephens Co., southern Okla., lying at 1,700 ft. depth in Empire pool, the Nigh sand lying at 1,600 ft. and the Cantrell at 1,800 ft.

Suretka conglomerate.

Tertiary: Costa Rica.

E. W. Berry, 1921 (U. S. Nat. Mus. Proc., vol. 59, p. 169).

†Surgent series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 106, 131–134, 272+, and vol. 2, p. 753) for Clinton "group" of N. Y. Divided into (descending) *Surgent red marl*, *Surgent upper ore sh.*, *Surgent ore ss.*, *Surgent lower ore sh.*, *Surgent upper sl.*, *Surgent iron ss.*, and *Surgent lower sl.*

Surprise formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930 (Econ. Geol., vol. 25, pp. 309–311 and map). *Surprise fm.*—A series of predominantly fine-textured flaggy or slaty rocks which occupy an irregular strip of country on W. side of Panamint Range. Prevailing rock types are cgl.-schist, actinolite schist, ottrelite schist, quartz-sericite schist, sl., phyllite, quartz-biotite-tourmaline schist, metamorphosed sss. and grits and a few beds of brown ls., and there exist all gradations and combinations of these rocks. Though bedding is not often seen, it is frequently suggested, and there can be no doubt as to sed. origin. Overlies Marvel dolomitic ls., usually with gradation from true ls. to true schist for a distance of 5 to 30 ft. Underlies Sour Dough dolomitic ls. (basal fm. of Telescope group) with noncon. Exposed along Surprise Canyon, S. part of Panamint Range. Assigned to lower Paleozoic (?).

F. M. Murphy, 1933 (Calif. State Div. Mines Rept. 28 of State Min., July–Oct. 1932, pp. 329–356). [Repeats 1930 definition, including (on p. 349 and on map) statement that Surprise fm. is separated from Telescope group by a noncon.; but in columnar section (on p. 336) he shows Surprise fm. as conformable with overlying Telescope group and the noncon. as in midst of Surprise fm. Gives rather detailed description of lithology.]

Sushitna slates.

Same as Susitna sl., the approved spelling.

Susitna slate.

Cretaceous and Jurassic (?): Southern Alaska (Cook Inlet region).

G. H. Eldridge, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 14–20, map). *Sushitna slates.*—Slates and schists, essentially qtzitic, varying from fine homogeneous rock to one of granular texture. Exposed up Sushitna River for 50± mi., from 15± mi. above mouth of the Chulitna to considerable distance above mouth of Indian Creek. [Thickness and age not given.]

The age of this fm. is now considered to be Cret. and Jurassic (?), and the river is now spelled *Susitna*.

Suslota limestone.

Carboniferous (upper): Central eastern Alaska (Mentasta Mountain region).

W. C. Mendenhall and F. C. Schrader, 1903 (U. S. G. S. P. P. 15, pp. 46–47). *Suslota series or Upper Carbf. ls.*—[In text called *Suslota ls.*] Medium- to heavy-bedded ls. intruded by igneous rocks. Occurs W. of Suslota Pass, where it plays prominent part in make-up of mtns.

†Susquehanna mica schist.

Pre-Cambrian: Northern Maryland.

W. B. Clark, E. B. Mathews, and E. W. Berry, 1918 (Md. Geol. Surv. vol. 10, table on p. 69). [Assigned to Camb.; not described.]

Same as Wissahickon fm. (pre-Camb.), according to E. B. Knopf (personal statement June 1922).

Susquehanna series.

G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108), proposed *Susquehanna series* as a geographic name for Upper Dev. series, to include Catskill to Tully, both inclusive.

Sutherland schistose complex.

Carboniferous (?): Southern British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, map 9, 118° to 118°30'). *Sutherland schists.*—Phyllite, garnetiferous, epidotic, and actinolitic schists, etc.; Paleozoic (?). [Mapped on and around Sutherland Creek, B. C.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2). *Sutherland schistose complex.*—An intensely deformed series of lss., qtzites, and schists, sectioned by the railway line E. of Christina Lake. The oldest rocks are highly crystalline schists of sed. origin. With these are associated many irregular bands of gneissic gabbroid rocks, amphibolites, and sheared hornblende porphyrites; all greatly altered basic intrusives. Structurally characterized by utter confusion. No fossils. Possibly Carbf.

Sutherland oil sand.

A subsurface sand in lower part of Penn. section of Graham field, in NW. part of Carter Co., southern Okla., about 165 ft. below Bennett oil sand and 250 to 350 ft. above Smith sand. Thickness 20 to 40 ft.

Sutherland Falls marble.

Commercial name for a marble of Lower Ord. age in Rutland Co., SW. Vt. Mentioned, as a quarry term, as far back as 1861 (Rept. geol. Vt., vol. 2). Its outcrops are shown by G. W. Bain, 16th Int. Geol. Cong. Guidebook 1, 1933, fig. 19, p. 86. E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assign it to Chazy epoch. Sutherland Falls, on Otter Creek, at Proctor, drop 122 ft. Village of Proctor was known as Sutherland Falls until 1884, when it was incorporated as Proctor.

Sutter formation.

Eocene (?): Northern California (Marysville Buttes region, Sutter County).

R. E. Dickerson, 1916 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 9, pp. 404–406). *Sutter fm.*—Chiefly rhyolitic ash, rhyolitic tuff-breccia, thin flows of rhyolite, and cgl. containing rhyolitic and quartz pebbles. Thickness 500 to 600 ft. Rests with marked uncon. on Chico and on Tejon. Overlain uncon. by lava flows and mud flows that consist of andesitic material. Included in upper part of Ione fm. as mapped in Marysville folio of U. S. Geol. Survey, which also included Tejon and Chico rocks. Named for occurrence in Sutter Co., in what is now known as Marysville Buttes (formerly Sutter Buttes).

Howel Williams, 1929 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 112, 129+). *Sutter fm.*—Predominantly washed rhyolite tuffs below and andesite tuffs above, admixed with sands, clays, and gravels. Thickness 500 to 1,000+ ft.

Overlies Butte gravels and is overlain, with erosion uncon., by intrusive andesite porphyry. Assigned to Mio. and Plio (?). Dickerson's original description of Sutter beds calls for drastic revision. Essentially the Sutter fm. is detrital equiv. of the Tert. rhyolitic and andesidc deposits of Sierra Nevada, admixed with sediments that are the equivalents in age of the 6 auriferous gravels of the intervolcanic period of the Sierra. Although the Sierra was unquestionably the chief source of the Sutter beds, it is likely that part of the sediments was also derived from the Coast Ranges. Its volcanic materials appear to be entirely pyroclastic and free from lava flows, and there is nothing in the fm. to suggest a derivation from local vents, as Dickerson has supposed. The most notable and persistent feature of Sutter fm. is the regularity and prominence of its banding. Most complete and typical section is along West Butte Pass, adjacent to road bridge that lies due S. of South Butte.

W. Stalder, 1932 (A. A. P. G. Bull., vol. 16, No. 4, pp. 361–364). *Sutter fm.*, consisting of 1,000 or more ft. of sss., gravels, and clays, is probably Mio. or Plio.

†Sutton gneiss.

Pre-Cambrian: Central southern Massachusetts and northwestern Rhode Island.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*Sutton gneiss* is shown in strat. table of Worcester Co., Mass., as underlying Grafton qtzite and cgl. and overlying Northbridge gneiss.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped this rock as Northbridge granite gneiss and abandoned "Sutton gneiss," because, as stated in personal communication, Northbridge was better established and afforded a better type loc., Northbridge being in midst of the fm.

Named for exposures E. of Sutton, Worcester Co., Mass.

Sutton formation.

Jurassic and Triassic (?): British Columbia.

C. H. Clapp and J. A. Allan, 1911 (Canada Geol. Surv. map 17A), and C. H. Clapp, 1912 (Canada Geol. Surv. Mem. 13, p. 61).

Sutton limestone. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1917 (W. Va. Geol. Surv. Rept. Braxton and Clay Counties, p. 218). *Sutton ls.*—Calc. stratum, dark gray on fresh fracture, weathers yellowish gray; somewhat siliceous; 0 to 3 ft. thick. Lies 0 to 24 ft. below Upper Mahoning ss. and 0 to 15 ft. above Middle Mahoning ss. Exposed just E. of B. & O. R. R. station at Sutton, Braxton Co.

Sutton schists.

Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

Sutton Island series.

Cambrian or pre-Cambrian(?): Southeastern Maine (Mount Desert Island region).

N. S. Shaler, 1889 (U. S. G. S. 8th Ann. Rept., pt. 2, pp. 1037, 1041–1043, 1061, and map). *Sutton Island series.*—Highly metamorphosed dark-greenish and grayish thick flaggy clay slates, with qtzites, bedded felsites, and associated traps. This so-called series cannot be proved to be a continuous section. It consists of two divided portions, that which is found on Sutton's Island and that which appears on Cranberry Islands. Resembles similar deposits on Campobello and Deer Islands, in Passamaquoddy Bay. [See †*Campobello series.*] Is mapped across S. part of Mount Desert Island and on Sutton Island. No trace of fossils. The Sutton's Island group of rocks, though containing an abundance of volcanic material, shows no trace of the volcanic breccias which abound in the Cranberry series. Assigned to Camb. or pre-Camb. Named for development on Sutton Island, S. of Mount Desert Island.

On 1933 geol. map of Maine, by A. Keith, the rocks of Sutton Island appear to be mapped as "igneous, mainly Carbf."

Sutton Mountain series.

Sutton Mountain gneiss.

Pre-Cambrian: Southern Quebec and northwestern Vermont.

J. A. Dresser, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 210). *Sutton Mtn series*, pre-Camb., Quebec.

R. Harvie, Jr., 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 288). *Sutton Mtn series*, pre-Camb., Quebec.

S. B. Keith and G. W. Bain, 1932 (Econ. Geol., vol. 27, p. 174). *Sutton Mtn gneiss*, pre-Camb., occurs in Green Mtn geanticline, Vt. Light gray; distinct banded structure; greatly contorted locally.

Suwanee basalt flow.

See under *Laguna basalt flow*.

Suwannee limestone. (Of Vicksburg group.)

Oligocene (middle): Eastern Florida and south-central Georgia (Lowndes and Brooks Counties).

C. W. Cooke and W. C. Mansfield, 1936 (Geol. Soc. Am. Proc. 1935, pp. 71–72). *Suwannee ls.* is proposed for yellowish ls. typically exposed along Suwannee River in Fla., from Ellaville, where it uncon. overlies white ls. containing Vicksburg (Olig.) fossils, almost to White Springs, near which it lies uncon. below Hawthorn fm. (Mio.). Another large area of the ls., centering near Brooksville, Hernando Co., lies btw. Ocala ls. (Eo.) on N., and Tampa ls. (Mio.) on S. Most writers have regarded this ls. as part of Tampa ls. Writers think it is of late Vicksburg age and correlate it tentatively with Flint River fm. of Ga. and Chickasawhay marl memb. of Byram marl of Miss.

Swaggart sand.

A subsurface sand, of Penn. age, in central northern Okla., which is correlated with Tonkawa sand and with lower part of Nelagoney fm.

Swakane gneiss.

Pre-Ordovician: Central Washington (Entiat Mountains).

A. C. Waters, 1932 (Jour. Geol., vol. 40, No. 7, pp. 603–633). *Swakane gneiss.*—A complex of remarkably foliated, highly metamorphic rocks, in part sed. and in part igneous. Biotite gneiss predominates, but the fm. also includes granodiorite gneiss, amphibolite, amphibolite schist, marble, mica schist, and masses of serpentine. The most widespread sed. rock is a series of marble lenses and associated lime-silicate rocks which occur for most part in NW. cor. of area. Associated with the marble are belts of gneiss that show by their mineralogical composition that they are of sed. origin. Finest occurrence of Swakane gneiss is along canyon of Swakane Creek, for which it is named. Is oldest fm. in Entiat Mtns. Overlain uncon. by Swauk fm. (early Eo.) and intruded by Chelan batholith (probably late Jurassic). Peshastin fm. outcrops a few mi. SW. of this area. Warren S. Smith (Jour. Geol., vol. 24, 1916) correlates the Peshastin with a series of sed. rocks in Skykomish Basin to W. that contains definite Trenton fossils. On basis of comparative metamorphism the Swakane gneiss is therefore pre-Ord.

†Swallow limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, pp. 104–105). *Swallow ls.*—First ls. system underlying Oswego ls., being a thin bed exposed about 7 mi. below Oswego. Named by Dr. Newlin on account of its having been described by Prof. Swallow in 1854. Included in Cherokee shales, unless it should prove to be more extensive in Cherokee Co. than now seems probable, in which case the term *Cherokee sh.* should be applied only to shales below Swallow ls.

Not a geographic name. The beds are included in Cherokee sh.

Swallow belt, terrane, or formations.

C. [R.] Keyes, 1933 (Pan-Am. Geol., vol. 59, pp. 132–135). *Permian* is inappropriate term for the Carbonic red-beds of Great Plains. For the miscellaneous collection of sediments or terranes now being called *Permian*, some such title as *Swallow* [nongeographic] *belt, terrane, or fms.*, or *Dumble beds* [nongeographic], might be adopted with great advantage. "Such course does not imply necessarily definite correlation, or specific geologic age, but merely pertains to the broad body of strata which pioneer who first brought the fms. as a whole into the attention of geologists." [Also uses *Swallowal or Dumblal group of strata* or *terrane*, pp. 135, 140.]

Swan Creek phosphate.

Upper Devonian or Mississippian: Western Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 136, 137, 138, 142). *Swan Creek phosphate.*—The phosphate rock of Swan Creek, Totty's Bend, and other localities in Lewis and Hickman Counties, Tenn., where it ranges in thickness from 10 to 50 in. or more; outside of this area it ranges from 1 in. to 10 in. One variety is dark bluish gray, fine-grained, weathering yellowish gray and then looking like ss. Another variety is lighter-colored and coarser and abounds in small spiral shells and other minute fossils. Sometimes it disintegrates and forms a white claylike substance. Contains very little ls. matter. Is closely associated with Hardin ss. and often apparently becomes the Hardin ss. Overlies Hardin ss. and underlies Dev. Chattanooga sh. [according to pp. 104 and 136].

The Hardin ss. is treated as a memb. of Chattanooga sh. According to E. O. Ulrich and C. W. Hayes (U. S. G. S. Columbia folio, No. 95) this phosphatic band is to SW. replaced by Hardin ss. memb.

Named for Swan Creek, Lewis and Hickman Counties.

Swan Creek limestone.

Upper Ordovician: Western Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 43-44). *Swan Creek ls.*—Cross-bedded, nearly unfossiliferous Ord. ls. in Tenn. River Valley. About 56 ft. thick. Of Lorraine age. Underlies Warren [Arnheim] ls. and overlies richly fossiliferous Lorraine ls. containing *Platystrophia lynx*.

Named for Swan Creek, Hickman Co.

Swan Creek sandstone.

Mississippian: Southwestern Illinois (Union County).

E. O. Ulrich, 1923 (Geol. Soc. Am. Bull., vol. 33, p. 831), stated that *Swan Creek ss.* was a field name applied by him to 20 ft. of ss. overlying the *Talarocrinus*-bearing zone in upper part of Ste. Genevieve ls. and corresponding to "some part of the Shetlerville." Exposed along Swan Creek, 1½ to 2½ mi. E. of Anna, Union Co.

Swandyke hornblende gneiss.

Pre-Cambrian: Central Colorado.

T. S. Lovering, 1935 (U. S. G. S. P. P. 178). *Swandyke hornblende gneiss.*—Chiefly hornblende gneiss, but subordinate quartz-biotite schists and gneisses and injection gneiss are common. Is a highly metamorphosed igneous rock intermediate btw. diorite and gabbro. In this quad. [Montezuma] it forms a thick sill-like mass in Idaho Springs fm., with which it is essentially conformable, in most places gradational, but areal relations shown on map suggest a large laccolithic mass or a thick surface flow intercalated in Idaho Springs fm.

On 1935 Colo. geol. map this fm. was included in Gunnison River series (comprising the oldest exposed rocks in Colo.) and assigned to *pre-Camb.*, the terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey.

Swan Island moraine.

Pleistocene (Wisconsin): Southwestern Maine.

G. H. Stone, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 380). *Swan Island moraine.*—Probably a terminal moraine. Named for occurrence on Swan Island, in Kennebec River, S. of Richmond, Sagadahoc Co.

Swan Peak quartzite.

Lower Ordovician: Northeastern Utah and southeastern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 407, 409). *Swan Peak qtzite.*—Fine-textured gray qtzite, 500 ft. thick. Chazy (?) fauna. Underlies (uncon.?) Fish Haven dol. and overlies Garden City ls.

Named for Swan Peak, Rich Co., Utah.

See also under †*Geneva qtzite.*

†Swan Pond granite.

Late Carboniferous or post-Carboniferous: Northeastern Massachusetts.

J. H. Sears, 1905 (Phys. geog., geol., min., and pal. of Essex Co., Mass., p. 141). Granite locally known as "Swan Pond granite," having its greatest development on shore of this pond.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the granite around Swan Pond as Andover granite.

Swan River beds.

Upper Cretaceous: Manitoba (Winnipeg region).

W. A. Johnston, 1934 (Canada Dept. Mines, Geol. Surv. Mem. 174, p. 12).

Swansea rhyolite.

Tertiary (late?): Central northern Utah (Tintic district).

G. W. Tower, Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, map). [Exposed in Swansea and South Swansea mines.]

†Swanton slate.

A name that has been loosely applied (J. B. Perry, Boston Soc. Nat. Hist. Proc., vol. 11, pp. 347+, 1868) to slates of Trenton, Upper Camb., and Lower Camb. ages, in NW. Vt. In 1869 (Am. Jour. Sci., 2d, vol. 47, pp. 341+) Perry used the term *Black slates or Swanton group*, 10,000–15,000 ft. thick; includes thin beds of ss. and ls. C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 176–178), stated that Trenton ls. rests uncon. on *Swanton slates* at Highgate Springs, NW. Vt.

†Swanton marble.

A name applied in 5th Rept. Vt. State Geol., p. 133, 1906, to the Winooski marble at Swanton, Vt.

†Swanton conglomerate.

Lower Ordovician to Lower Cambrian: Northwestern Vermont (Franklin County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 118–126). *Swanton cgl.*—Largely coarse ls. cgl., with many beds of calc. gray ss., some calc. qtzite, and subordinate layers of dark-gray sl. The cgl. forms lenses of all sizes up to 30 ft. in thickness and ¾ mi. long. As a rule the rock consists of bluish-gray ls. matrix embedded with pebbles and great boulders of blue ls.; there are also many pebbles and boulders of fine white or bluish-white marble, gray calc. ss., sandy ls., gray dol., and a peculiar tough dark-gray dol. that weathers reddish brown; also a few small bits of black chert and pebbles of dark sl. The beds of this fm. begin about 8 mi. nearly S. of St. Albans and appear at many localities northward to and across Canada border. It is well shown in E. part of Swanton Twp. for which it is named. It is not continuous but forms disconnected lenses at base of Georgia sl., in which it was originally included. These lenses are common in towns of St. Albans, Swanton, and Highgate, and unusually good exposures occur about 1 mi. W. of Georgia Center. Heretofore included in Georgia sl., but notable aspect of the cgl. and its taxonomic value justify treating it as a distinct fm. It is separated from overlying Georgia sl. by a great uncon., and also from underlying Highgate sl. by a great uncon.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 377–379), divided the rocks of the central sequence of NW. Vt. into (descending): Georgia sl. (of

Beekmantown age); Corliss cgl. (of Beekmantown age); uncon.; Highgate sl. (of Upper Camb. age); Mill River cgl. (of Upper Camb. age); and several older fms. "In the original description of this region by writer the very strong resemblance of Mill River and Corliss cgls. led to their description as one fm.—the 'Swanton cgl.' Later detailed mapping and study showed that there were 2 cgls. and that the Mill River—the older one—was placed by thrust faulting S. of Highgate Center in position of the Corliss on top of Highgate sl., thus causing the confusion of the two." [The name *Swanton cgl.* has therefore been abandoned.]

Swarbrick formation.

Cambrian: Central Nevada (Tybo district).

H. G. Ferguson, 1933 (Nev. Univ. Bull., vol. 27, No. 3, pp. 13–25). *Swarbrick fm.*—Largely thin-bedded gray chert interbedded with thin bands of bluish gray ls., the lss. increasing toward top. Near top some sh. is interbedded with the chert. The uppermost chert horizons were included in this fm., so that as mapped the uppermost 200 or 300 ft. is in places dominantly sh. containing more or less chert. Thickness 2,500 to 3,000+ ft. Base not exposed. Oldest fm. in Tybo dist. Grades into overlying Tybo sh. No fossils. Forms hanging wall of ore-bearing fissure in Swarbrick prospect, in E. part of Tybo dist.

†Swartwood Tropidoleptus zone.

Term applied by H. S. Williams (Sci., n. s., vol. 24, pp. 365–372, 1906) to *Tropidoleptus* zone No. 3 of Cayuta sh. memb. of Chemung fm. in Ithaca region, N. Y., because of outcrop SW. of Swartwood.

The U. S. Geol. Survey does not apply geographic names to faunal zones, and Williams therefore withdrew the geographic name from his ms. of U. S. G. S. Watkins Glen-Catatonk folio, No. 169, 1909.

Swasey formation.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 11). *Swasey fm.*—Bluish-gray oolitic and aren. lss. with some calc. and argill. shales. Thickness 238 ft. Overlies Dome fm. and underlies Wheeler fm. Type loc. is slopes of Swasey Peak.

Swastika sand (Archer County, Texas).

Same as Gose sand, both subsurface.

Swatara iron sandstone. (In Clinton formation.)

Silurian (Niagaran): Southeastern Pennsylvania (Lebanon County).

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 637, 638). *Swatara iron ss.*—Very massive iron ss., 120 ft. thick, lying 511 to 631 ft. above base of Rose Hill fm. (lower Clinton) in section E. of Swatara Creek, Swatara Gap, 11 mi. NW. of Lebanon, Pa. Overlain by 200± ft. of younger beds of Rose Hill fm. Lies lower in Rose Hill fm. than Center iron ss., whose base is 96 ft. below top of the Rose Hill.

Swauk formation.

Eocene: Central and central northern Washington.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137). *Swauk ss.*—About Camas Land, to E. of Wenache Mtns and in Valley of Wenache in vicinity of Mission, Leavenworth, etc., consists largely of thick-bedded nearly white impure ss. with minor amounts of sandy sh. To S. of Wenache Mtns, in region drained by North and Middle Forks of Teanaway River and Swauk Creek, the fm. consists largely of thin-bedded yellowish arkose ss. and yellowish sandy sh. with 200 ft. of coarse cgl. at base. All deposited in a single Tert. lake or estuary. Thickness 6,000 to 8,000 ft. Fossil plants assigned to Eo. by F. H. Knowlton. Named for Swauk mining dist. [SW. of Camas Land], where it occurs. Is conformably overlain by Columbia [River] lava, and rests uncon. on schists, greenstones, serpentine, etc.

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Swauk fm.* underlies Teanaway basalt with slight uncon.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Swauk fm.* was named for Swauk Creek, also for occurrence in Swauk mining dist.

Swearinger slate.

Upper Triassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Swearinger sl.*—Dark calc. slates with thin blue lss. and some siliceous layers. Thickness 200 ft. Includes *Halobia* bed, *Rhabdoceras* bed, and *Monotis* bed [zone of *Pseudomonotis subcircularis*]. Rests directly and uncon. on Carbf. Robinson fm. Believed to underlie Hosselkus ls.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Swearinger sl.*—Chiefly dark slaty sh., sometimes more or less calc. and at other times decidedly siliceous, but the thin beds of ls. or chert form only a small portion of whole mass. In the side of the sl. adjoining Hosselkus ls. thin lenticular beds of ls. become more abundant. They are generally dark, with irregular cherty or sandy layers, and are fossiliferous. Thickness 200 ft. Is underlain (not overlain, as originally supposed) by Hosselkus ls., with which it is conformable, but in places it rests on the older Robinson fm. Is overlapped by Trail fm. [Is approx = Brock sh.]

Named for fact that it occurs just above Swearinger's house, on N. side of Genesee Valley, Plumas Co.

Swede Pond quartzite.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199). *Swede Pond qtzite.*—Usually vitreous qtzite. Thickness 400 ft. Included in Grenville series. Where "soaked" by Laurentian granite it is called *Swede Pond gneiss* and *syntectic Swede Pond gneiss*. Is separated from overlying Catamount schist by 20 ft. of unnamed sandy ls. Overlies Paxon ls. Type loc. is Swede Pond, Hague Twp, Warren Co. On George W. Smith property, S. of Clintonville, it is divisible into Upper Swede Pond qtzite, 350 ft. thick, and Lower Swede Pond qtzite, 50 ft. thick, the two separated by Trout Pond ls., 50 ft. thick.

Swede Pond gneiss.

See under *Swede Pond qtzite.*

Sweeney sand.

Drillers' term for a sand in Gaines oil region, Tioga Co., northern Pa. Included in †Blossburg fm., a part of the Chemung. (See M. L. Fuller, U. S. G. S. 22d Ann. Rept., pt. 3, p. 593, 1902.)

†Sweetland shale.

An abbreviated form of *Sweetland Creek sh.* that is used by some geologists.

Sweetland Creek shale.

Upper Devonian or Mississippian: Southeastern Iowa and western Illinois (?).

J. A. Udden, 1899 (Jour. Geol., vol. 7, pp. 65–78). *Sweetland Creek beds.*—Olive-gray sh. with green bands, 0–48 ft. thick, uncon. overlying Cedar Valley ls. and uncon. underlying Coal Measures. Correlated with Dev. Black sh. of Interior.

Regarded by some geologists as contemp. in whole or part with Lime Creek sh., and by other geologists as younger than Lime Creek, also as possibly an outlier of basal Kinderhook. E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22), definitely classified it as post-Dev.; S. Weller (1920) suggested it is all Miss.; Van Tuyl (1925) suggested it is basal Kinderhook; T. E. Savage (1935) stated it is "considered by most geologists to be early Miss.;" R. C. Moore (1935) included it in Kinderhook group, and correlated it with Saverton and Grassy Creek shales of Mo.

Named for exposures on Sweetland Creek, Muscatine Co., Iowa. Some authors have extended this name into western Ill.

Sweetsburg slate.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Sweetwater group.

Oligocene: Central Wyoming (Sweetwater Valley).

F. V. Hayden, 1871 (U. S. Geol. Surv. Terr. 4th Ann. Rept., p. 29). Fresh-water lake beds that cover entire Sweetwater Valley may be called *Sweetwater group*. Identical with upper part of Wind River deposits. Uncon. overlain by Plio. marls and sands.

F. M. Endlich, 1879 (U. S. Geol. and Geog. Surv. Terr. 11th Ann. Rept., pp. 110, 154–156). *Sweetwater group*.—Local deposit, in Sweetwater dist., consisting of brown indurated shales and marls, some sss. and cgl. near base. Thickness 1,200 to 1,400 ft. Assigned to Mio. Underlies Plio. Niobrara group and uncon. overlies Bridger group. Occurs all along Sweetwater River and continues N. to the hills opposite Seminoe Pass.

N. H. Darton, 1908 (Geol. Soc. Am. Bull., vol. 19, btw. pp. 403 and 463). Sweetwater fm. of Hayden Survey overlies Wasatch in Sweetwater Plateau. Strongly suggests the White River, into which it appears to merge in high plateau W. of Alcova. [On pl. 22 he mapped *Sweetwater fm.* over part of central Wyo.]

W. Granger, 1910 (Am. Mus. Nat. Hist. Bull., vol. 28, p. 241, footnote). Sweetwater of Hayden Survey is probably same as *Titanotherium* beds [Chadron fm., the lower part of White River group, Olig.].

The beds covering a large area along and adjacent to Sweetwater River were mapped as *White River group (Olig.)* on 1924 geol. map of Wyo.

Sweetwater dolomite.

Permian: Central northern Texas (Fisher and Nolan Counties).

A. M. Lloyd and W. C. Thompson, 1929 (A. A. P. G. Bull., vol. 13, p. 953, pl. 10). *Sweetwater dol.*—Thin, persistent dol., in places fine-grained and sandy and in places coarsely crystalline; 1 to 3 ft. thick. Strikes N. 30° W. through city of Sweetwater, and is named after its outcrop there. Directly underlies the Triassic in SW. Fisher Co. and northern Nolan Co.

M. G. Cheney, 1929 (Univ. Tex. Bull. 2913, p. 26), replaced this (preoccupied) name with *Claytonville dol.*, which E. H. Sellards (Univ. Tex. Bull. 3232, p. 167, 1933) also adopted, instead of Sweetwater (preoccupied), and included it in Peacock fm.

Sweetwater member.

Oligocene: Western Wyoming (Wind River Range).

C. M. Bauer, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 665–695). *Sweetwater memb. of White River group*.—Uncon. on Uinta fm., from head of Sand Draw SW. to S. end of Wind River Range, is a boulder bed, from a few ft. to 150 ft. thick, for most part unstratified and poorly sorted. One lens, 50 to 85 ft. thick, extending from Wagonbed Spring SW. for 2± mi., shows no sorting of material and no stratification. Base is visible all the way. Blocks of ss., cgl., tuff, and porphyry up to 10 or 12 ft. diam. are enclosed in matrix of finer material containing chert, granite, and schist pebbles. To NE. the boulders are smaller—3 to 4 ft. From head of Sand Draw toward SW. end of outcrop, granites, gneisses, and schists predominate. In high bluff NW. of Lone Butte the lower 20 to 40 ft. of the memb. consists almost wholly of well-rounded boulders of qtzite, schist, gneiss, and granite, 6 to 18 in. diam., and upper 30 to 60 ft. contains much fine material without stratification or sorting and a scattering of boulders (mostly of red and gray porphyries) from few in. to 2 or 3 ft. diam. Uplift, causing increased erosion, talus slides, and flood wash, accompanied by volcanism, is believed to have been responsible for formation of Sweetwater memb. From Wagonbed Spring SW. for nearly 1½ mi. the memb. is mainly aggl., standing up in cliff 65 to 85 ft. high. Along Sweetwater rim the memb. is overlain by consolidated gravel and sand beds of fluviatile origin, from a few ft. to 20 or 30 ft. thick, and belonging to White River group. The Sweetwater memb. is believed to be initial stage of White River group. [In table on p. 669 this memb. is placed below Brule and Chadron fms. of White River group (Olig.).] The boulder bed described in this paper as *Sweetwater memb. of White River group* is widespread. It occurs along Sweetwater escarpment from Lander-Rawlins road as far E. as Alcova, a distance of 80 mi. Writer believes it correlates with boulder bed on Green Mtn, S. of Sweetwater River, and it may correlate with Bishop cgl. of SW. Wyo.

Swenson gypsum member.

Permian: Central northern Texas (Stonewall and adjacent counties).

L. T. Patton, 1930 (Univ. Tex. Bull. 3027, pp. 45+). *Swenson gyp. memb.*—Basal memb. of Peacock fm. Named for exposures near town of Swenson, Stonewall Co. Forms prominent escarpment extending from S. border of county to near Swenson, where escarpment dies down and the gyp. bed disappears. On N. side of Salt Fork River a prominent gyp. bed appears that is correlated with Swenson gyp., although it is not believed that the two beds are continuous across area btw. Swenson and Salt Fork River. Believed that the two basins were separated by a bar at time of deposition of the gyp. beds. In many places the Swenson consists of two beds of gyp., each 5± ft. thick, separated by 5± ft. of sh. About 100 ft. above Swenson gyp. there occurs another rather prominent gyp. bed which may be called Oriana gyp. The Swenson is good key horizon in this and adjacent counties.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 168). *Swenson gyp. of Patton* is apparently same as Childress dol. and gyp. and is discarded. [On pp. 168 and 179 the Swenson gyp. is included in Peacock fm. and the Childress dol. and gyp. in underlying Blaine fm.]

Swenson sand.

A subsurface sand, of Penn. age, in central northern Okla., that has been correlated with Fort Scott ls. (Oswego lime) and also with Marland sand (Dev. or Miss.?). Named for Gus Swenson farm, Kay Co.

Swift Current beds.

Middle Ordovician: Ontario (Manitoulin Island).

A. F. Foerste, 1912 (Ohio Nat., vol. 13, pp. 38–39). *Swift Current beds.*—Chiefly whitish and reddish lss. containing fossils of Leray age. Thickness probably 50 ft. Rest on red clay shales of Lowville age, also, in places, on Huronian qtzites; are overlain by Cloche Island beds. Named for occurrence at Swift Current, the locality at which the railroad passes from the peninsula over the Cloche Island.

Swift Current formation.

Eocene: Saskatchewan.

F. H. McLearn et al., 1934 (Canada Geol. Surv. Summ. Rept. 1933, pt. B, p. 33).

Swift Water formation.

Probably Cambrian: Northwestern New Hampshire (Ammonoosuc region).

C. H. Hitchcock, 1874 (Am. Jour. Sci., 3d, vol. 7, pp. 468–476). *Swift Water series.*—Qtzites, sss., actinolite schist, hornblende schist, white mica schist, black sl. Thickness 2,500 to 4,400 ft. Seems to be more nearly related to overlying Helderberg series than any of other fms. [Name here used in paper describing region from Swiftwater and Woodville on S. to N. of Littleton, all in Grafton Co.]

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2, pp. 465, 658–675). *Swift Water series* assigned to lower part of Upper Huronian; placed below Lisbon group (also Upper Huronian) and above hornblende schist, basal Upper Huronian.

C. H. Hitchcock, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 461–482). *Lisbon-Swiftwater complex* may be Ord. In the State rept. the local name "Lisbon" was applied to the green schists and "Swiftwater" to an indefinite group of mica schists, slates, and cgls., both making parts of one whole. For convenience the double name may be used. The Lisbon rocks are green chloritic schists and sss., igneous diorites, granites, and protogenes, hydromica schists, qtzites, lss., cgls., etc. The Swiftwater rocks are mica schists, qtzites, hornblende schists, slates, argillitic and sericitic schists, and obscure cgls. The two groups were separated on published map, but further explorations indicate none of these rocks are restricted to any particular horizon. The Swiftwater series seems to underlie the other.

C. H. Hitchcock, 1905 (Geol. Littleton, N. H., Univ. Press, Cambridge), assigned *Swift Water schist series* to Sil. and the Lisbon to Lower Sil. or Camb.

F. H. Lahee, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 231–250). *Swiftwater series* is supposed to be = Lyman schists and associated rocks.

C. P. Ross, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 267–302). *Swift Water fm.*—Oldest fm. in Ammonoosuc mining dist. Is certainly pre-upper Sil. and probably Camb. Principally metamorphosed sss. and cgls., light or whitish; at one place a bed of black phyllite at top. Dips under Lisbon fm., of Camb. or Ord. age. Hitchcock's original distinction btw. the predominantly whitish Swift Water strata and the greenish Lisbon beds is adopted. No fossils. Surrounds village of Swift Water, Grafton Co.

M. Billings, 1933 (Am. Jour. Sci., 5th, vol. 25, p. 149), divided the rocks of Littleton and Moosilauke quads into *Littleton fm.* (Lower Dev.); *Fitch fm.* (middle Sil.); and 3 pre-Sil. fms., called (descending) *West Bath sl., Swiftwater-Lyman fm.*, and *Lisbon qtzite.* None of these fms. were described.

M. Billings, 1934 (Sci., vol. 79, pp. 55–56, Jan. 19, and Am. Jour. Sci., 5th, vol. 28, pp. 412–422, Dec.), divided the rocks of Littleton and Moosilauke quads into (descending) Littleton fm. (Lower Dev.); Fitch fm. (middle Sil.); Clough cgl. (Lower Sil.?); and 3 fms. of pre-Sil. (Upper Ord.?) age (descending), Partridge sl., Ammonoosuc volcanics, and Albee qtzite, thus dropping *Lisbon, Lyman*, and *Swift Water* from the nomenclature. The U. S. Geol. Survey has not yet had occasion to consider this revised classification.

Switchback limestone.

Upper or Middle Cambrian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 5, 39, and passim). *Switchback ls.*—In most places slightly calc., argill. fine-grained sandy gray to brown-gray dol. In Nannie Creek Basin region it consists of platy buff-gray siliceous dol., which gives ringing sound when struck. In other places, notably at type loc. near Pentagon Mtn, it consists of 100 ft. of massive, thick-bedded cream-gray sandy argill. mag. ls. underlain by 6 ft. of green-gray sh, and shaly ls. Minimum thickness of 20 ft. is in Dearborn region. Underlies Devils Glen dol. and overlies Gordon Mtn ls. Type loc. is upper-middle part of the cliffs which form E. side of peak 1 mi. S. 48° E. of Pentagon Mtn, in NE¼ sec. 23, T. 25 N., R. 12 W. Named for Switchback Pass, about ¼ mi. S. of these cliffs.

Swope limestone.

Swope formation.

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southeastern Nebraska.

C. O. Dunbar and G. E. Condra, 1932 (Nebr. Geol. Surv. Bull. 5, 2d ser., p. 17 and table C). Revised correlation by R. C. Moore, 1931 [unpublished?], divides Bethany Falls ls. in vicinity of Kansas City into (descending) *Swope ls.*, Sugar Creek sh., and Middle Creek ls.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). The beds from top of Bethany Falls ls. down to base of Schubert Creek ls. (which overlies Ladore sh. [restricted], clearly represent a single sedimentation cycle and are here named *Swope fm.* They are divided into (descending): Bethany Falls ls. [restriction of R. C. Moore's 1931 definition and replaces *Swope ls.* of his 1931 list of names], *Hushpuckney sh.* [=Sugar Creek sh.], *Middle Creek ls., Elm Branch sh., Sniabar ls., Mound City sh., Critzer ls., Tennison Creek sh.*, and *Schubert Creek ls.* (called "Hertha" by Hinds and Greene). [Derivation of names not stated.]

J. M. Jewett, 1932 (p. 100 of book cited above). Base of *Swope fm.* is variable, since the lower ls. members are less persistent than Bethany Falls ls., the upper memb. In all cases Swope fm. includes strata from top of Bethany Falls ls. as defined in repts of Mo. Geol. Surv. down to base of lowest lens of ls., which is a few ft. below the Bethany Falls and which is persistent over several mi. This excludes blue flaggy ls. beds which are present a few ft. below Swope fm. in southern Linn and northern Bourbon Counties.

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21, pp. 26–29). *Swope ls.* is proposed by Moore and Newell for the persistent lss. and thin shales from top of Ladore sh. [restricted] to top of Bethany Falls ls. In Johnson and Miami Counties, NE. Kans., divided into (ascending) Middle Creek ls., Hushpuckney sh., and Bethany Falls ls. [On p. 26 he also stated that Ladore sh. of southern Kans. may include representatives of Middle Creek ls. and Hushpuckney sh. Named for Swope Park, Kansas City, Mo.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 37). Definition of *Swope fm.* is modified to exclude beds below Middle Creek ls., because nowhere else in Missouri series has a well-defined "lower" ls. (in terms of Shawnee cycle) been found. [On p. 78 Moore stated Swope ls. of his 1932 definition (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook) includes beds classed in his 1936 paper as Hertha ls., Ladore sh., and Bethany Falls ls.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

POLITECHNIKA GDAŃSKA ZAKŁAD GEOLOGII

Sybille tongue (of Phosphoria formation).

Permian: Central southern Wyoming (Laramie Basin).

H. D. Thomas, 1934 (A. A. P. G. Bull., vol. 18, No. 12, p. 1664). *Sybille tongue of Phosphoria fm.*—Fossiliferous ss., 21 ft. thick, lying in midst of Satanka sh., being 184 ft. above base of Satanka sh. and a similar distance below top of the Satanka. Its upper part is a massive medium-grained mottled pink and buff ss. containing great quantity of cylindrical gray chert nodules. This grades down and becomes a thin-bedded limy ss. containing maroon chert laminae and small angular gray-chert masses. Type loc. around Sybille anticline near Sybille Springs, in Laramie Basin. Seems to be absent in S. part of Laramie Basin. To N. and W. becomes more limy.

Sycamore sand. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Central Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 141, 142). *Sycamore sands.*—At base cgl. of well-rounded pebbles of Paleozoic ls., quartz, chert, granite, and schist, embedded in ferruginous yellow and red gritty sand; passes upward into angular cross-bedded sand, which becomes finer toward top until it reaches condition known as "pack sand." Thickness 50 ft. Basal memb. of Travis Peak fm. in Burnet Co. Underlies Cow Creek beds and overlies Carbf.

Named for exposures on Sycamore Creek, Burnet Co.

Sycamore limestone.

Mississippian (Kinderhook): Central southern Oklahoma (Arbuckle Mountains).

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Sycamore ls.*—Dense, even-textured bluish ls., which weathers to yellowish hues and is hard and tough. Thickness 0 to 160 ft. Overlies Woodford chert and underlies Caney sh. Increases in thickness to W.

According to E. O. Ulrich, C. Schuchert, and R. C. Moore the Sycamore fauna is of Kinderhook age.

Named for Sycamore Creek, Johnston Co., which crosses its outcrop in T. 3 S., R. 4 E.

Sycamore sandstone.

See *Sycamore Creek ss.*, Upper Dev., Ariz. Also see 1936 entry under *Jerome fm.*

Sycamore Creek sandstone.

Upper Devonian: Northeastern and central Arizona.

C. Lausen and E. D. Wilson, 1925 (Univ. Ariz., Ariz. Bur. Mines Bull. 120, pp. 7, 12–13). *Sycamore Creek ss.*—Name proposed by A. A. Stoyanow in unpublished ms. The fm. is generally dull reddish brown in color, although some buff-colored beds are present. Is made up of a coarse quartz sand cemented chiefly by oxides of iron and carbonate of lime. Cross-bedding is locally common, and then the stratification is not well defined. Traversed by numerous joints. Pebbly layers common. Is conformably overlain by thin-bedded flaggy lss. containing fossils identified by Stoyanow as Upper Dev. Occurs as isolated remnants S. and SE. of Payson, while to N. is a large area partly overlain by Redwall ls. Upper part has been largely removed by erosion, and where overlain by Redwall ls. [Miss.] the thickness is seldom over 150 ft. Contains fossil fishes identified by Stoyanow as undoubtedly Upper Dev. Rests uncon. on pre-Camb. diorite and in places on older rocks. On recent map of Ariz. is classified as Tapeats ss. (Upper Camb.).

A. A. Stoyanow, 1926 (Am. Jour. Sci., 5th, vol. 12, pp. 311–315). *Sycamore Creek fm.*—Three cliff-forming sss., separated by beds of reddish mottled ss., pink-white quartzitic ss., and compact pink ss.; some beds of gray ls. Thickness 125 to 324 ft. Best exposed at Sycamore Creek, a tributary of East Verde River. Assigned to Dev. Overlain by Dev. ls. Rests on granite.

In 1936 Stoyanow gave further description of this unit and changed its name to *Sycamore ss. memb. of Jerome fm.*, as explained under 1936 entry under *Jerome fm.*

Sykes sand.

A subsurface sand, of earliest Penn. or late Miss. age, in central Okla., which is correlated with basal part of Cromwell sand. According to Okla. Geol. Surv. Bull. 40Q. p. 180, 1928, the Sykes sand is of Penn. age and correlates with a part of Dutcher sand series.

Sykesville granite.

Pre-Cambrian: Northern Maryland (Carroll County).

A. I. Jonas, 1928 (Md. Geol. Surv. Carroll Co. geol. map). *Sykesville granite*, schistose biotite-quartz monzonite, of pre-Camb. age.

Sylacauga marble member (of Talladega slate).

Paleozoic or pre-Cambrian: Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 51). *Sylacauga marble memb. of Talladega sl.*—Fine-grained white or cream-tinted translucent rock, more or less clouded with green, due to layers of green phyllite. No dol. beds observed within the marble, but it undoubtedly is closely associated with large thicknesses of dol., which is believed to be of much later age than the marble. No fossils. Thickness at least 500 ft. Is in lower part of Talladega sl., probably 4,500± ft. above base. Overlain and underlain by phyllite, and is believed by Prouty to be same as Sawyer ls. memb. Prouty described the marble in Ala. Geol. Surv. Bull. 18, 1916, but did not apply name to it. He expressed opinion the marble is of various ages, from Upper Camb. (Conasauga) to Ord. (Chickamauga). Present writer believes it is all of same age and that it all lies in Talladega sl.

Named for exposures and quarries around Sylacauga, Talladega Co.

Sylamore sandstone member (of Chattanooga shale).

Devonian (?): Northern Arkansas, southwestern Missouri, and eastern Oklahoma.

R. A. F. Penrose, Jr., 1891 (Ark. Geol. Surv. Ann. Rept. 1890, vol. 1, pp. 113, 114). *Sylamore ss.*, proposed by J. C. Branner, in unpublished rept. for yellow, brown, or gray earthy ss., often containing green or black shaly layers, and sometimes merging into beds of same material. Frequently much iron-stained and sometimes contains small flat ferruginous concretions. Of irregular distribution. Thickness 0 to 30 or 40 ft. Supposed by Dr. Williams to be="Black sh." of Tenn. and elsewhere in Mississippi Basin. Underlies Boone chert and overlies St. Clair ls.

For many years the name *Sylamore fm.* was in some repts on Ark. geology used as defined above; in other repts it was said to underlie †Eureka sh., and in still other repts it was said to overlie †Eureka sh., the relations being confused by the fact that where "the ss. was present the overlying sh. seemed to be absent," and where "the sh. was present the ss. seemed to be absent," so that many repts stated that the ss. seemed to replace the sh. In 1905 (U. S. G. S. Fayetteville folio, No. 119) G. I. Adams and E. O. Ulrich defined *Sylamore ss. memb.* as basal memb. of Chattanooga sh., and as consisting of 0 to 75 ft. of white to light-brown friable ss. in massive beds, locally conglomeratic, with chert, ls., and phosphatic pebbles, and as overlain by 30 to 70 ft. of black carbonaceous fissile sh. forming the upper memb. of Chattanooga sh. They stated that the ss. is the ss. present at type loc. of †Key ss. and that the sh. is the sh. exposed at Noel, the type loc. of †Noel sh. Since 1905 the Sylamore has usually been described either as the basal memb. of Chattanooga sh. or as underlying †Eureka sh.

E. T. McKnight, 1935 (U. S. G. S. Bull. 853), described a ss. (0 to 18 ft. thick) underlying St. Joe ls. memb. of Boone fm. in Yellville quad., which he stated has been widely called *Sylamore ss.* in repts on northern Ark. but which he treated as basal memb. of Boone fm., because it appeared to be of Osage age. He stated: What Sylamore is at type loc. is unknown, as type loc. has not been visited for 40 yrs, when its strat. relations were uncertain. He also expressed belief that Sylamore of literature is "simply the basal ss. of an overlapping series of strata and that its age varies in different places."

Named for exposures on Sylamore Creek, Stone Co., central northern Ark.

Sylvan intrusives.

Late Tertiary: Yellowstone National Park.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Nat. Park folio, No. 30). *Sylvan intrusives*.—Dike rocks varying from diorite to granite porphyry, breaking through late basic breccia near Sylvan Pass. Assigned to Neocene.

Sylvan shale.

Upper Ordovician (Richmond): Central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Sylvan sh.*—Soft greenish fissile sh., 50 ft. thick; increases to W., in Arbuckle Mtns, to nearly 300 ft. Underlies Hunton ls. and overlies Viola ls.

That the fm. is of Richmond age seems to be generally accepted.

Named for exposures near former village of Sylvan Johnston Co.

Sylvania sandstone.

Lower Devonian (Helderberg): Northwestern Ohio, Michigan, and western Ontario.

E. Orton, 1888 (Ohio Geol. Surv., vol. 6, pp. 4, 18). *Sylvania ss.*—Extremely pure glass sand, 20 or more ft. thick, in Lucas and Wood Counties, Ohio, and adjacent territory, also probably Monroe Co., Mich. Occurs in midst of Lower Helderberg or Waterlime, nearly or quite 200 ft. below Corniferous ls.

For many years Sylvania ss. was treated as middle part of †Monroe fm, all of which was supposed to be of Sil. age, but Sylvania ss. and overlying "Upper Monroe" are now classified by most if not all geologists as Lower Dev. (Helderbergian), and Sylvania ss. is now treated as a distinct fm., uncon. underlying Detroit River dol. and uncon. overlying Bass Islands dol. (Sil.). However, J. E. Carman, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 260, 264), states Sylvania ss. is conformable with overlying beds.

J. E. Carman, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 2, pp. 264–265). *Sylvania ss.* includes 2 phases, (1) a probably eolian deposit which has great development in SE. Mich. and is only slightly developed in NW. Ohio; (2) a reworked and water-laid phase, which is dominant type in NW. Ohio and which may show all gradations to pure dol. The water-laid phase grades conformably into overlying Detroit River dol., contains fossils of either Amherstberg or Lucas age, and is of different age at different places, being the marginal part of an encroaching sea. The eolian phase may represent not only Sylvania stage proper but also such part of Detroit River stage as is not here represented by marine deposits. Assigned to Dev. In spite of variable age relations of this ss. it is believed *Sylvania ss.* should be continued as the name of a lithologic unit in NW. Ohio.

Named for Sylvania, Lucas Co., Ohio.

Syracuse serpentine.

G. H. Williams, 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 533–534), described *Syracuse serpentine* in James Street Hill, Syracuse, N. Y.

Syracuse salt member (of Salina formation).

Silurian (late): Western to east-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, pp. 18–19 and chart). *Syracuse salt* underlies Camillus sh. and overlies Verona sh. Included in Salina beds.

In later repts thicknesses of 35 to 300 ft. are given for this memb., which is stated to consist of alternating beds of rock salt and sh. underlying the Camillus and overlying the Vernon. (D. H. Newland and H. Leighton, N. Y. State Mus. Bull. 143, pp. 18–23, 1910.)

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 52). *Syracuse salt*.—While no outcrops of rock salt are known, this term is used to indicate the horizon of the salt beds as determined by the wells and shafts which penetrate the beds of rock salt [at Syracuse, N. Y.].

Is middle memb. of Salina fm.

Syrena formation. (Of Magdalena group.)

Pennsylvanian: Southwestern New Mexico (Santa Rita district).

A. C. Spencer and S. Paige, 1935 (U. S. G. S. Bull. 859). *Syrena fm.*—Lower memb. consists of 100 to 130 ft. of sh., with thin beds of ls. in lower part; upper memb. consists of 260 ft. of alternating ls. and sh. The lower memb. is locally called *Mountain Home sh.* by geologists of mining companies, in their company repts, and the upper memb. is called by them *Don ls.* Upper fm. of Magdalena group. The Syrena is overlain by Abo redbeds and underlain by Oswaldo fm. Named for Syrena patented mining claim 1± mi. S. of Hanover P. O.

Tabera formation.

Oligocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Table Creek shale. (In Wabaunsee group.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, eastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 80). *Table Creek sh.*—Largely bluish gray and argill. to sandy; top part very sandy in Kans. Thickness in Nebr., Mo., and Iowa 25 to 45 ft.; increases to 50 ft. in Kans. S. of Kansas River. Nyman coal, in top part, persists in Iowa, Mo., Nebr., and at places in Kans. Named for outcrops on Table Creek at Nebraska City, Nebr. Underlies Dover ls. and overlies Maple Hill ls., all included in McKissick Grove sh. memb. of Wabaunsee fm.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 94, 96). Condra's name *Table Creek sh.*, which includes Nyman coal, is restricted to the sh. btw. the Jim Creek ls. above and Dover lss. below, and the sh. beneath the Dover (which formed basal part of Table Creek sh. as originally defined) is here named *French sh.* [On p. 58 thickness of Table Creek sh. restricted is given as 54 ft.]

R. C. Moore and G. E. Condra, Oct. 1932 (Revised classification chart of Kans. and Nebr.), transposed the names *French sh.* and *Table Creek sh. restricted*, by applying former name to the sh. *overlying* Dover ls. and the latter name to the sh. *underlying* Dover ls.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 10). *Table Creek sh.*, top memb. of McKissick sh. fm., underlies Dover ls. fm. and overlies Maple Hill ls. memb. of McKissick sh. fm.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), discarded McKissick Grove sh. and treated its subdivisions as fms. in Wabaunsee group. He stated (p. 239) that ls. called Jim Creek ls. in Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, 1932, is not true Jim Creek ls. but the younger Nebraska City ls. The Table Creek sh. as defined in 1932 rept therefore extended up to base of Nebraska City ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Table Head series.

Middle Ordovician: Newfoundland.

C. Schuchert and C. O. Dunbar, 1934 (Geol. Soc. Am. Mem. 1, pp. 63, 99).

†Table Mountain sandstone.

Permian: Central southern Oklahoma (Garvin County).

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324 to 341). The most eastern exposure of Duncan ss. is on Table Mtn, in western Garvin Co., from which the name "Table Mountain ss." has been applied locally to this fm.

There is no other record of this name. Gould did not include it in his list of geologic names of Okla. (Okla. Geol. Surv. Bull. 35, Sept. 1925).

Table Mountain andesite.

Name applied by H. Williams (Calif. Univ. Dept. Geol. Sci. Bull., vol. 21, No. 8, 1932, diagram on p. 311) to the rocks shown as composing Table Mtn, NW. of Lassen Peak, Calif.

Table Mountain **formation**.

Late Tertiary or early Quaternary: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, p. 138, map). *Table Mtn fm.*—Moderately consolidated deposits of yellowish to reddish-brown gravels and sands of late Tert. or early Quat. age. Thickness 50 to 100 or more ft. Finely exposed in Table Mtn, 4 mi. NE. of Jacumba, southern Peninsular Range. Underlie Jacumba volcanics.

Table Rock granite.

Carboniferous (?): Northwestern South Carolina.

E. Sloan, 1907 (Summary of mineral resources of S. C., pp. 7, 8). [Name mentioned but fm. not defined.]

E. Sloan, 1908 (Catalogue of mineral localities of S. C.: S. C. Geol. Surv., ser. 4, Bull. 2, pp. 185, 411, 423, 425–426). *Table Rock granite.*—An intrusive granite, typically exhibited at Table Rock Mtn, and constituting predominant rock in portion of this zone NE. of Keowee River. It is a muscovite-bearing biotite granite which is not generally highly schistose, although in some of its probable exposures this feature is well developed. It comprises a medium fine-grained "pepper and salt" granite, varying to a coarse-grained gneissoid. While many exposures of Table Rock granite exhibit but slightly developed schistosity, it encloses areas of Carolina gneiss and Roan gneiss which are highly schistose and therefore assumedly much older; and while it appears in Saluda zone and in Chatooga zone, or on both sides of the Cambrian lss. and schists, it has not been observed breaking through the latter, yet in many of its aspects this Table Rock granite is quite fresh enough to represent a post-Carbf. intrusion. Therefore in so much as Carolina gneiss and Roan gneiss are prominently exhibited in Saluda zone the latter is placed with the Archean rocks, but in so much as the Table Rock intrusive granite is predominant rock over a large area, the Saluda zone is assigned to Archean with this qualification.

Named for development at Table Rock Mtn, Pickens Co.

Table Rock sandstone.

Upper Devonian: Western New York (Genesee River region).

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 2, pp. 96–98). [See under *Letchworth sh.* J. Hall (1840 Rept. N. Y. Geol. Surv., p. 391, and 1843 Rept.) mentioned a thin ss. that formed the *table rock* at top of lower Portage Falls, but he did not name the ss., and Chadwick's appears to be the original use of this name.]

†Tachatna series.

See *Takotna fm.*

Tackawasick limestone.

Middle Ordovician (Trenton): Eastern New York (Capital district).

R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, pp. 410, 414). *Tackawasick ls.*—Narrow band of Trenton shaly ls. found near E. edge of area in only a few outcrops. It appears as a band btw. Lower Camb. and Upper Dev. rocks (Rensselaer grits) and has evidently been overthrust far out of place. [On p. 414 he shows it as in part underlying Snake Hill sh. (of Trenton age) and in part equiv. to lower beds of the Snake Hill; and as uncon. overlying Rysedorph cgl.]

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, p. 115). *Tackawasick ls. and sh.*—Occurs in E. trough of Capital dist., underlying Snake Hill sh. and overlying Rysedorph cgl. [On p. 25 he placed Rysedorph cgl. above Tackawasick.]

Tacoma delta.

Pleistocene: Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Tacoma delta.*—A complex mass of gravels exhibiting plunge structure and faults, forming a voluminous delta underlying city of Tacoma. A portion of the structure belongs to Vashon epoch; another part underlies Vashon till and probably was formed during Puyallup interglacial epoch. [Some geologists consider this epoch to be glacial.] The delta is attributed to outflow from a lake that covered Stellacoom plains as the ice retreated.

†Taconian.

Alternative name applied in some early repts to *†Taconic system*. Later C. Schuchert (Textbook of geol., 2d ed., vol. 2, p. 187, 1924) applied the name to the Lower Camb. (Waucoban) epoch, and used "Taconian series" to cover the Lower Camb. rocks of eastern North America. (See U. S. G. S. Bull. 769, p. 101.)

Taconian disturbance.

A term applied by C. Schuchert and C. O. Dunbar (Textbook geol., pt. 2, p. 65, 1933) to diastrophic movements of late Ord. and earliest Sil. time.

†Taconic slate.

Ordovician: New York.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. of 2d dist., pp. 135–164). A sl. which I have named *Taconic sl.*, and which is found at W. base of Taconic Range. It lies adjacent to the Lorrain or Hudson River shales, some varieties of which it resembles. Is dark sl., passing into light blue, often stained brown. It contains more alumina and less magnesia than the magnesian slates.

In early repts variously assigned to Sil., to Camb., and to pre-Camb.

†Taconic system.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. 2d dist., pp. 135–164, 429). "A group or system of rocks which belong evidently to a position between the primary of the Atlantic ranges of mountains and the New York system." [For fuller definition see book cited above or U. S. G. S. Bull. 769, pp. 101–102, 1925. Includes rocks ranging in age from Upper Ord. to Lower Camb.]

In early repts variously assigned to Camb., to Sil., and to pre-Camb.

Taconic limestone.

See 1862 entry under *†Eolian ls.*

Taconic revolution.

A period of uplift and folding extending from Lower Camb. to Upper Ord., during which low mtns were thrown up from Va. to Newfoundland. Named for Taconic Mtns, eastern N. Y.

Taft granite.

Probably Cretaceous: Yosemite National Park, California.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 122, map). Nonporphyritic biotite granite, of even, medium-coarse grain. Consists chiefly of white feldspar and smoky gray quartz in grains mostly about 5 mm diam. Younger than El Capitan granite.

Named for fact it composes Taft Point.

Taft sandstone member (of Boggy shale).

Pennsylvanian: Eastern Oklahoma (Muskogee County).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Taft ss. memb. of Boggy sh.*—Massive gray to light-brown ss.; small pebbles of quartz in T. 14 N. and large pebbles of ss., sh., and quartz in SW. corner of T. 15 N. The cgl. was not found N. of Arkansas River and hence may represent a shore phase of the memb. Thickness 50± ft. Lies 80 to 150 ft. above Inola ls. memb. of Boggy sh. Named for exposures S. of Taft, sec. 19, T. 15 N., R. 17 E.

Taggard limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450, 476). *Taggard ls.*—White, medium soft, pure, nearly always oolitic, 5 to 16 ft. thick. Few marine fossils. Underlies Upper Taggard sh. and overlies Lower Taggard sh.; all members of Greenbrier series [ls.]. Type loc. on Taggard Branch of Indian Creek, Monroe Co. Also observed in Mercer Co. To NE. it occurs at intervals in Greenbrier Valley as far N. as head of Tygart Valley River, in Randolph Co., W. Va. Was traced as far S. as Washington Co., Va.

Taggard shales. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450, 476–479). *Upper Taggard sh.*—Red sh.; 0 to 15 ft. thick; with marine fossils; underlying Pickaway ls. and overlying Taggard ls. *Lower Taggard sh.*—Red or sandy sh.; 5 to 20 ft. thick; underlying Taggard ls. and overlying Patton ls. All members of Greenbrier series [ls.]. Type loc. of *Upper Taggard sh.* in road just N. of Taggard Branch of Indian Creek, 2.8 mi. SE. of Union, Monroe Co. Type loc. of *Lower Taggard sh.* on Taggard Branch of Indian Creek 2.8 mi. SE. of Union. Can be traced NE. to Pocahontas Co., but does not appear to be present in Mercer Co.

Tagish series.

Age (?): British Columbia (Windy Arm district).

R. G. McConnell, 1905 (Canada Geol. Surv. Summ. Rept. 1905, pp. 27–28).

Tah formation.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 335, 339).

†Tahkandit series.

Permian and Pennsylvanian (?): Yukon River region, Alaska.

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 169–174). *Tahkandit series.*—White or gray lss. alternating with carbonaceous shales and sometimes with cgls. Overlies Rampart series and underlies Mission Creek series. An erosion interval in some part of Tahkandit series is suspected. Probably includes rocks of Upper Carbf. to Dev. age.

This unit as defined included lss. of Perm. age (to which name *Tahkandit* was later restricted) and Nation River fm., of Penn. (?) age.

Tahkandit limestone.

Permian: Northeastern Alaska (Eagle-Circle district).

J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 816, p. 121). *Tahkandit ls.*—Essentially cream-colored to white massive ls. with some beds of cgl., ss., and sh. in lower half. Thickness 527 ft. Type loc. along the Yukon just above mouth of Nation River (the old Indian name for which is Tahkandit), where a belt of the rocks crosses the Yukon, trending NE. Conformably overlies Nation River fm. and underlies Upper Triassic rocks with, it is believed, uncon. but without apparent angular discordance.

Is upper part of Spurr's Tahkandit series.

Tahoe glacial stage.

Pleistocene: Sierra Nevada, California.

E. Blackwelder, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865–922). *Tahoe stage.*—Next to youngest glacial stage, represented by till on E. slope of Sierra Nevada. Named for Lake Tahoe, along W. shore of which several large glaciers of this stage descended from Sierra Nevada and built strong moraines, but Lake Tahoe itself is not of glacial origin. Correlated with Iowan stage.

Takotna formation.

Middle Devonian: Southern Alaska (Kuskokwim region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 157–159, 179). *Tachatna series.*—Gray lss., generally thin-bedded and fissile, limy carbonaceous and chloritic slates, and occasional generally fine-grained arkoses; considerably folded; frequent quartz veins. Extends from some distance below junction of Kuskokwim with East Fork down to junction of Tachatna [Takotna] River, and from the Tachatna to below Vinasale. Fossils pronounced by Schuchert to indicate probable Middle Dev. age. Uncon. underlies Holiknuk series.

Taku group.

Devonian (?): British Columbia.

D. D. Cairnes, 1911 (Canada Geol. Surv. Summ. Rept. 1910, p. 32).

Talbot formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

G. B. Shattuck, 1901 (Johns Hopkins Univ. Circ. vol. 20, No. 152, pp. 73–75). *Talbot fm.*—Is developed as a bench of variable width around edges of Wicomico terrace, and frequently separated from it in many places by a low scarp line. Occasionally this scarp, which is the ancient sea cliff of Talbot sea, attains height of 30 to 40 ft., notably in Kent Co., Md., but there are places where the scarp seems to be entirely lacking, and it is probable that in these places it has been destroyed. Carries same sort of detritus as underlying Wicomico and Sunderland fms., but possesses a greater proportion of loam and a smaller proportion of decayed materials, and contains numerous lenses of greenish-blue clay, which frequently carry plant remains and are regarded as swamp deposits, formed in mouths of ponded streams and buried by advancing beach of Talbot sea. Base of Talbot terrace is irregular, sometimes lying above tide and sometimes below, but the top, where it borders its sea cliff, is usually limited by the 45- or 50-foot contour. Is top fm. of Columbia group. Overlies Wicomico fm. uncon. Named for Talbot Co., E. shore of Md.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 21). *Talbot fm.* is here restricted to the deposits on 42-foot level, which are same as typical "Chowan" fm., here abandoned. Pamlico fm. is here extended northward and applied to the deposits on the 25-foot level, which have heretofore been included in Talbot fm. [This is present accepted definition of U. S. Geol. Survey.]

The terrace fms. of Columbia group (including the Talbot) now recognized by Cooke from Del. to southern Ga. and probably into Fla., are enumerated herein under *Columbia group.*

Talcott diabase. (In Newark group.)

Upper Triassic: Central Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50, and U. S. G. S. Mon. 29, p. 476). *Talcott diabase*, the "anterior sheet" of Percival. Extends across Conn.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 91–92, 264). After a considerable accumulation of coarse sediments, forming the base of Sugarloaf arkose across bottom of the valley, a bed of lava was poured out on them which "barely enters Mass. [?] from the south" and is called *Talcott diabase*, from its occurrence at Talcott, Conn. It is important in its extension across Conn., "but it barely crosses the State and ends in Suffield, Conn."

Talcott shale. (In Bluefield formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 300, 418). *Talcott sh.*—Gray and sandy, 10 to 25 ft. thick, with marine fossils. Underlies Droop ss. and overlies Ada sh.; all members of Bluefield group [fm.]. Type loc. on S. side of Greenbrier River 0.6 mi. SE. of Talcott, Summers Co. Also observed in Monroe Co. and should be present in Mercer Co.

Talford schist.

Lower Devonian (?): Northwestern New Hampshire (Franconia quadrangle).

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., pp. 8, 13, etc.). *Talford schist* (from a brook by that name in S. part of quad.) is proposed for the schists exposed in a long, discontinuous belt, extending from Mount Hale to Russell Crag. Only few exposures on Talford Brook itself. The schists are gray quartz-mica schists and mica schists, with garnet or sillimanite in some instances. The fm. is precisely like Littleton fm. in Mount Moosilauke area, which suggests the two may be same, but lacking conclusive proof it seems better for present to establish a separate fm. for the schists in Franconia quad. and to assign them doubtfully to lower Dev. They are older than Moat volcanics, from which they are separated by a pronounced uncon.

†Talihina chert.

Ordovician, Silurian, and Devonian: Southeastern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Talihina chert.*—Upper memb. consists of blue, greenish, and white stratified flint and chert 300 ft. thick; middle memb. consists of cherty and clay shales 300 ft. thick; lower memb. consists of 300 ft. of black, bluish, and white stratified flint, chert, and cherty sh., with thin lentils of blue ls. Thickness of fm. 1,200± ft. Underlies Standley sh. and overlies Stringtown sh.

B. F. Wallis, 1915 (Okla. Geol. Surv. Bull. 23, p. 32), restricted Talihina chert to beds of pre-Richmond age, and designated the overlying beds "Unnamed chert of Upper Silurian age."

Named for exposures in Potato Hills, SW. of Talihina, Le Flore Co., where the rocks named "Talihina chert" were in 1929 (Okla. Geol. Surv. Bull. 50, p. 19) divided by H. D. Miser into following mapped fms. (descending): Arkansas novaculite, Missouri Mtn sh., Polk Creek sh., and Bigfork chert.

Talisman quartzite.

Pennsylvanian (?): Southwestern Utah (southeast and northeast of Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Talisman qtzite.*—Fine-grained pink qtzite, 400 ft. thick, underlying Elephant ls. (conformably to N., but uncon. suggested to S.) and overlying (apparently conformably) Topache ls. Type loc. Talisman mine, SE. of Frisco dist.

Talkeetna formation.

Lower Jurassic: Central southern Alaska (Cook Inlet region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 218, 219). The Lower Jurassic rocks of Matanuska Valley and Talkeetna Mtns are here named *Talkeetna fm.* They consist of 3,000± ft. of lava, aggl., breccia, and tuff, interbedded with lesser volumes of ss. and sh. containing fossil plants and marine invertebrates. Chiefly waterlaid volcanics, deposited mostly or wholly in marine waters. Overlain (conformably?) by Tuxedni ss. (Middle Jurassic). Basal contact and underlying rocks not exposed. Are a very prominent strat. and structural element in geol. of E. part of Talkeetna Mtns and of Matanuska Valley. It is possible the fm. may contain more than one strat. unit and that plants and marine shells are not of same age. The plants are oldest Jurassic known in N. Am., according to F. H. Knowlton; the invertebrates suggest Lower Jurassic, according to T. W. Stanton.

Talladega slate.

Pre-Cambrian (?) to Carboniferous: Eastern Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.; no description). [*Talladega (Ocoee) group* is used in table for rocks btw. Ladiga (Potsdam) ss. above and Archean crystalline schists below.]

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala., with explanatory chart). *Talladega (Ocoee, Algonkian)*: Classification uncertain. Probably in part Camb. Unknown thickness of qtzites and congls; argill. or clayey shales, usually partly crystalline; hard greenish sandy shales. Imperfectly crystalline. Overlain by Chilhowee (Weisner) ss., and underlain by Archean crystalline schists.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 49–61). *Talladega sl.*—Occupies belt 6 to 10 mi. or more wide, extending NE. from Chilton and Shelby Counties to State line in Cleburne Co. On SE. is bounded for most of distance by schistose or locally massive greenstone—the Hillabee chlorite schist. On NW. is bounded by several Paleozoic fms. up to Floyd sh. (Miss.). Thickness possibly 30,000 ft. Much the greater part consists either of sl. or sericite phyllite interbedded with minor beds of cgl., ss., ls., marble, dol., chert, graphitic phyllite, and quartz schist. Includes Sawyer ls. memb. (about 4,500 ft. above base), Sylacauga marble memb. (about 4,500 ft. above base, and probably same as Sawyer ls. memb.), Brewer phyllite memb. (lies a few ft. above Sawyer ls. memb.), ferruginous ss. memb. (lies 1,000± ft. above the Brewer), Jumbo dol. memb. (lies several thousand ft. above ferruginous ss. memb.), Cheaha ss. memb. (lies higher than Brewer memb.), Butting Ram ss. memb. (probably same as Cheaha ss.). Assigned to Algonkian (?) and Paleozoic. It seems safe to say it is composed of the shoreward clastic deposits accumulated at intervals during whole time that the predominantly calc. Paleozoic rocks were being deposited in the open sea to westward.

See C. F. Park, Jr., 1935 entry under *Erin sh.*

G. W. Crickmay, 1936 (Geol. Soc. Am. Proc. 1935, p. 72). It is concluded weight of evidence favors a pre-Camb. age for *Talladega series*.

Named for exposures on Talladega Creek, Talladega Co.

Tallahatta formation. (Of Claiborne group.)

Eocene (middle): Southern Alabama, Mississippi, and western Georgia.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 344 and chart opp. p. 334). Name suggested by E. A. Smith. *Tallahatta or Orangeburg fm.*—Hitherto known as the Buhrstone, a local term used for the rough siliceous rocks belonging to Lower Eocene of the Carolinas, Ga., Ala., etc., adopted by Lyell in 1845 (Quart. Jour. Geol. Soc. London, vol. 1, p. 435) for a fm. which he regarded as newer than the white ls. [Vicksburg group]. Buhrstone had been used by Finch and others as early as 1823 (Am. Jour. Sci., 1st ser., vol. 7, p. 38), but the term is of a colloquial rather than a distinctive character. Owing to very great objections to these qualitative mineralogical terms as names for fms., and loose way in which present one has been used in the literature, it has been thought best to propose a geographical name for the original group. The name selected is that of Orangeburg dist. of S. C., the typical loc. of the Buhrstone, as defined by Tuomey (Geol. S. C., 1848, p. 149), in correcting Lyell's stratigraphy. It was in Orangeburg dist. that Tuomey found the fossils which fixed the horizon, and also the thickest and finest exposures. For the exposures of nearly same age, but of different fauna and lithologic character, in Ala., Prof. E. A. Smith suggests *Tallahatta*, from the local name of the hills containing them.

Basal fm. of Claiborne group. Underlies Lisbon fm. and overlies Hatchetigbee fm., of Wilcox group.

Named for development in Tallahatta Hills, Choctaw Co., Ala.

Tallery limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 341). *Tallery ls.*—Yellow shaly and impure calc. bed, 0 to 2 ft. thick, with marine fossils. Underlies Tallery ss. and overlies Upper Tallery sh. All members of Hinton group [fm.]. Type loc. on Tallery Mtn road SE. of True, Summers Co., W. Va. Also observed in Tazewell Co., Va.

Tallery sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 296, 340). *Tallery ss.*—Usually green and shaly, but sometimes massive; 10 to 25 ft. thick. Underlies Lower Fivemile sh. and overlies Tallery ls. All members of Hinton group [fm.]. Type loc. on Tallery Mtn, Summers County, W. Va. Quarried near Athens, Mercer Co., W. Va., and also observed in Tazewell Co., Va.

Tallery shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe and Summers Counties, pp. 296, 342–343). *Upper Tallery sh.*—Usually greenish yellow and slightly calc. deposit, with marine and occasional plant fossils; 10 to 23 ft. thick; underlies Tallery ls. and overlies Tallery coal. *Lower Tallery sh.*—A red and variegated or green and sandy deposit, 25 to 38 ft. thick, underlying Tallery coal and overlying Low Gap ss. All members of Hinton group [fm.]. Type loc. same as Tallery ls. Also observed in Tazewell Co., Va.

Tallulah Falls quartzite.

Basal Cambrian or pre-Cambrian: Northeastern Georgia.

S. L. Galpin, 1915 (Ga. Geol. Surv. Bull. 30, p. 119). *Tallulah Falls qtzite.*—Qtzite, found in Rabun and Habersham Counties in vicinity of cataracts from which the name is taken. In Habersham Co. the rock is mainly a medium-grained qtzite containing some muscovite (sericitic), less biotite, and at times garnet and feldspar. Occasionally the percentage of feldspar rises until the rock bears more resemblance to granite than to qtzite. The qtzite appears to pass conformably into micaceous schists, although there has been considerable intrusion of igneous material near the transition zone. Probably thins rapidly to W. and SW. Probably later than Roan gneiss.

Named for development in vicinity of Tallulah Falls, Rabun Co.

Taloga formation. (In Cimarron group.)

Permian: Western Oklahoma and southern Kansas.

F. W. Cragin, 1897 (Am. Geol., vol. 19, pp. 362–363). *Taloga fm.*—Name proposed to include all of Kiger div. above Day Creek dol., the persistence of Hackberry shales and Big Basin ss. in central Okla. being doubtful, and younger rocks of Kiger div. being present farther W.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, pp. 703–737), used this name as defined by Cragin, as did E. Haworth and J. Bennett, 1908 (Univ. Geol. Surv. Kans., vol. 9). R. C. Moore and W. P. Haynes, however, discarded the name (Kans. Geol. Surv. Bull. 3, 1917), and used *Greer fm.* to include Big Basin ss. and Hackberry sh. of Cragin, as did R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2). There is no other record of *Taloga fm.*, and †Greer fm. was discarded in 1924 by its author.

Named for Taloga, Dewey Co., Okla.

Talon formation.

Devonian(?): Quebec.

J. A. Dresser, 1912 (Canada Geol. Surv. Mem. 35, p. 29).

Talpa limestone. (In Clyde formation.)

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 428). *Talpa bed.*—Nearly all ls., mostly hard and massive, of gray, bluish, and yellowish colors and rather uneven texture. Fossiliferous. Thickness 200 to 300 ft. Memb. of Albany div. Underlies Paint Rock bed and overlies Grape Creek bed.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, p. 36), redefined Paintrock by removing from its base 70 ft. of beds, which they transferred to *Talpa fm.* They gave thickness of Talpa as 400 ft. (See 1918 entry under *Paint Rock bed.*)

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 197–198). *Talpa ls.* is top memb. of Clyde fm. (of Wichita group). Overlies Grape Creek sh. and ls. bed.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 169). Talpa ls. of Drake is top bed of Clyde fm.

Named for Talpa, Coleman Co.

Tamabra.

Cretaceous: Mexico.

J. A. Villatoro, 1932 (Bol. petróleo, vol. 34, Nos. 4–6).

Tamaha sandstone member (of Savanna sandstone).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Tamaha ss. memb.*—Basal memb. of Savanna ss. Thin-bedded, slabby ss.; rarely massive; bedding regular; fine to medium texture; brown; sometimes greenish, brown, and gray; weathers dark brown; much mica and many dark argill. streaks; ripple marks. Thickness in Muskogee-Porum area 10 to 20 ft. Separated from younger Keota ss. memb. by 60 to 70 ft. of sh. Named for exposures at Tamaha, Haskell Co.

Tamán beds.

Jurassic: Mexico.

A. Heim, 1926 (Eclogae geol. Helvetiae, vol. 20, p. 84).

Tamana series.

Tertiary: Trinidad.

G. P. Wall and J. G. Sawkins, 1860 (Geol. of Trinidad, pp. 39–41).

Tamarack formation.

Term applied by O. H. Hershey (Am. Geol., vol. 27, p. 226, 1901) to the gabbro in Klamath Mtn region of northern Calif., which he assigned to pre-Cret.

Tamasopo series.

Lower Cretaceous: Northeastern Mexico.

E. A. Trager, 1926 (A. A. P. G. Bull., vol. 10, No. 7, pp. 671–675, 688). Author proposes that name *Tamasopo series* be applied to that part of Lower Cret. section which includes the two important producing horizons. This series may be divided into two parts: (1) The upper part, which is the Lower Cret. producing horizon in Northern dist., is named the *Tamaulipas* [ls.]. Tamaulipas has been proposed because of its typical exposures in the State of Tamaulipas. (2) The lower part, which is the producing horizon in the South fields and which is typically exposed at El Abra, for which the term "El Abra" is proposed. The exact relationship btw. the producing horizon of the South fields and that of Panuco field, both of which have been termed Tamasopo, is not known. The top of the Tamasopo of the South fields is very badly eroded, and it is thought the Tamaulipas of Panuco dist. uncon. overlies the Tamasopo of the South fields. In outcrop the Tamaulipas is a thin-bedded to massive white to gray, finely crystalline ls. which has been accorded thicknesses of more than 3,000 ft. This ls. underlies a large part of Mexico and is easily distinguished by its physical properties combined with its abundant fauna. It is in part, if not entirely, Lower Cret. If the determination of the presence of Jurassic is correct, then the Tamaulipas ls. is considerably less than 3,000 to 5,000 ft. thick within Panuco dist., as has been previously inferred from outcrop data. The Tamaulipas ls. has heretofore been called "Tamasopo ls.," but that name is a "misnomer." The Tamaulipas ls. is overlain by Upper Cret. San Felipe (San Juan) fm.

†Tamasopo limestone.

Lower Cretaceous: Northeastern Mexico.

Replaced by Tamaulipas ls., as explained under *Tamasopo series*.

Tamaulipas limestone.

Lower Cretaceous (Comanche series): Northeastern Mexico.

See *San Tamaulipas fm.*, also definition under *Tamasopo series*.

Tamesi formation.

Cretaceous: Mexico.

E. T. Dumble and E. R. Applin, 1924 (Pan-Am. Geol., vol. 41, p. 340).

Tamihy series.

Cretaceous (?): Southwestern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines, Mem. 38, map 16, 121°30′ to 122°). *Tamihy series.*—Cgl., green and black sss., and gray shales. Mapped along Tamihy Creek, B. C. and Wash.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 518). *Tamihy series.*—Heterogeneous mass of gray cgl., black qtzitic ss., dark-gray paper shales, gray grit, and green sss. in rapid alternation. Thickness 2,500± ft. Occurs 2 mi. down Tamihy Creek. Assigned to Cret. (?). Seems to lie uncon. on Carbf.

Tampa limestone.

Miocene (lower): Central and northern Florida and southern Georgia.

L. C. Johnson, 1888 (Am. Jour. Sci., 3d, vol. 36, p. 235). The southern lakes, like Thonotosassa and Topoptaliga, have for their bed another phase or stage of the Mio., which for convenience may be called *Tampa fm.*, constituting so thick a layer that the influence of the underlying Eocene is not felt. The same is true of Tampa and Hillsborough Bays. [According to Dall (p. 335 of book cited below) the beds referred to are=part of Tampa ls. of Dall.]

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 112, 113, 117–119, 157, 158, 335). *Tampa ls.*, [also *Tampa beds*], which appears obscurely at Ballast Point and with clearness at other localities, overlying the *Orthaulax* bed, was first clearly described [but not named] by Allen in 1846. He observes: "The first layer of solid rock beneath the soil is a stratum of ls.; it is hard and white, has an earthy texture, and appears to have resulted from comminuted and decomposed shells. The surface of this rock is exposed in several places in vicinity of Fort Brooke; about 2 mi. N., near Hillsboro River; 4 mi. W., on shore of the bay; and 6 or 7 mi. E., in banks of a small stream." This rock I have named *Tampa ls.* It overlies *Orthaulax* bed and underlies Alum Bluff beds. Included in *Tampa group*. Thickness 25 to 30 ft. The chert of Hillsboro River is only a cherty phase of Tampa ls.

G. C. Matson and F. G. Clapp, 1909 (Fla. Geol. Surv. 2d Ann. Rept.). *Tampa fm.* as here defined consists of 0 to 130 ft. of yellow to gray lss., locally cherty, and greenish clay, and it includes (descending): Greenish-gray clay, 15 ft. [now assigned to Alum Bluff group]; "Cerithium rock" (formerly called "Tampa ls."), 40 ft.; "silex bed" (formerly called "Tampa silex bed"), 4 to 10 ft.; ls. similar to "Cerithium rock," 6 ft.; greenish clay, like top bed, 41 to 64 ft. It underlies Alum Bluff group, and is regarded as contemp. with Chattahoochee fm.

C. W. Cooke and S. Mossom, 1929 (Fla. Geol. Surv. 20th Ann. Rept). Name changed to *Tampa ls.*, because fm. is chiefly ls., and redefined so as to include the contemp. "Chattahoochee fm." Early observers attempted to discriminate btw. the "silex bed" (also called "*Orthaulax pugnax* zone" by Dall), the "Tampa ls.," and the "Cerithium rock." Latterly the tendency has been to regard these supposed separate entities as merely different facies or parts of a single fm. The *Orthaulax pugnax* zone lies near top of the fm.

Named for exposures at Tampa, where it underlies the town, and at other places around Tampa Bay.

†Tampa group (broad sense).

Miocene (lower and middle): Northern and southern Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 112–113, 157, 335). The Mio. rocks of Fla. above those forming Chattahoochee group and below the upper fossiliferous bed at Alum Bluff I include in the group which, from their oldest known typical exposure, I name the *Tampa group*. This may be divided into three sets of beds: (1) The Chipola beds (including Sopchoppy ls., *Orthaulax* bed, Bailey's "infusorial earth," the White Beach sandrock, and Chipola marl (or lower bed at Alum Bluff); (2) the Tampa beds (including Tampa ls.); and (3) Alum Bluff beds, or unfossiliferous sand and clay strata intervening btw. Chipola marl and the upper fossiliferous bed at Alum Bluff.

Name abandoned for *Tampa fm.* in narrow sense, which was later changed to *Tampa ls.*

Named for exposures on Tampa Bay.

†Tampa silex bed.

Miocene (lower): Central Florida.

Term used in some early repts to designate the very fossiliferous siliceous bed, 4 to 10 ft. thick, characterized by *Orthaulax pugnax* and included in middle part of Tampa ls. Has also been called *Orthaulax bed*. Contains in abundance the mineral silica (silex), "the most abundant constituent of the earth's crust."

Named for exposures at Tampa.

Tampanogos shales.

See *Timpanogos shales*.

†Tanana schist.

Pre-Cambrian: Eastern Alaska (along Tanana River).

A. H. Brooks, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 468–469, 478, 483). *Tanana schists*, pre-Sil., widely distributed on Tanana River, much less metamorphosed than the gneisses.

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, p. 60), discarded this name for *Birch Creek schist*, the older term.

Taneha sand.

A subsurface sand, of early Penn. (Cherokee) age, in Okla., 0 to 60± ft. thick, lying lower than Bartlesville sand, higher than Burgess sand, and correlated with Tucker and Booch sands. Type region is Rogers and Tulsa Counties.

Taneum andesite.

Miocene: Central Washington (Mount Stuart quadrangle).

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Taneum andesite.*—Hypersthene andesite, including tuffs and tuff-breccias, as well as loose-textured lavas. Thickness 200 to 300 ft. Exposed over several sq. mi. on south branch of Taneum Creek. Of Mio. age.

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139), gave thickness of *Taneum andesite* as 0 to 1,000 ft.

E. J. Saunders, 1914 (Wash. Geol. Surv. Bull. 9), gave thickness of *Taneum andesite* in Kittitas Co. as 300 to 1,500 ft.

Taneytown facies.

Upper Triassic: Maryland.

G. E. Dorsey, 1919 (Geol. Soc. Am. Bull., vol. 30, pp. 155–156). *Taneytown facies.*—Easternmost facies of Newark system in Md. Consists of (1) gray, pink, and red highly arkosic sss., in places very micaceous, underlain by (2) "Potomac marble" (coarse quartz cgl. or ls. cgl.).

Probably named for occurrence at or near Taneytown, Carroll Co.

Taninul limestone.

Upper Cretaceous: Mexico.

J. E. Brantly, 1924 (A. A. P. G. Bull., vol. 8, No. 1, p. 24).

Tank volcanics.

Quaternary(?): Southern California (Kern County).

A. C. Lawson, 1906 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 431–462). *Tank volcanics.*—Andesitic lava flows and tuffs, best exposed in vicinity of railway tank 2 mi. below Tehachapi station, on Tehachapi Creek. Older than Cable fm. and younger than Atlas fm.

Tank Hill limestone.

Lower Ordovician (Chazy): Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171). *Tank Hill ls.*—Lower part is gray fine-grained thin-bedded lss. containing some conglomeratic beds; upper part is thicker-bedded lss. and makes a line of high cliffs a little below Eureka qtzite; upper 50 ft. is shaly ls. and sandy sh. Total thickness 450 ft. Fossils [listed] are of Chazy age, according to E. Kirk. Is in fault relation to underlying Yellow Hill ls., and conformably overlain by Eureka qtzite. Named for exposures on W. face of Tank Hill, in Ely Springs Range.

Tanlajas formation.

Eocene: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, pp. 129, 134). Assigned to Tert.

W. A. Ver Wiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 485). Assigned to Eo.

Tanner shale.

Lower Triassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 338). *Tanner shales* is name assigned to basal sh. beds of Moenkopian series outcropping at Tanner's Crossing of Little Colorado River. Thickness 100 ft.

†Tanners Hill red. (In Conewango formation.)

Devonian or Carboniferous: Northwestern Pennsylvania.

Name locally applied (J. F. Carll, 2d Pa. Geol. Survey Rept. I, 1875) to bed of red sh., 15 to 20 ft. thick, lying about 100 ft. above base of Conewango fm. in Warren Co., Pa. Is exposed on Tanner's Hill, Warren Co., according to F. A. Randall (2d Pa. Geol. Surv. Rept. I₄, p. 297, 1883).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 67). In Warren, Pa., region near top of Ellicott sh. memb. of Chadakoin stage is a bright-red paint-rock layer, the so-called "*Tanner's Hill red*" *band* much mentioned in Pa. repts. A red layer 2 or 3 ft. thick occurs beneath Panama cgl. in Wrightsville and Lottsville region, just W. of Warren, Pa. This is presumably Tanners Hill red band. [On pp. 78–79:] At Warren, Pa., Panama cgl. is believed to be represented by the micaceous sparsely pebbled flags immediately above "Tanner's Hill red" band.

Tanner's Hill quarry rock. (In Conewango formation.)

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

F. A. Randall, 1883 (2d Pa. Geol. Surv. Rept. I_4, pp. 297, 304–308, and well sections by J. F. Carll in same rept). *Tanner's Hill quarry rock.*—Yellowish ss., partly massive, partly false-bedded, 14 ft. thick. Is quarried in Tanners Hill section, Warren Co. Lies 151 ft. above Tanners Hill red [sh.].

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 86). In Warren area the Bimber Run cgl. memb. has been variously known, but chiefly as the *"Tanner's Hill quarry rock."*

Tantalus conglomerate.

Jurassic or Cretaceous: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Mem. 5, p. 35).

Tantalus basalt.

Latest Pleistocene or Recent: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Tantalus volcanics.*—Basalt, clinker, balls, etc., overlying black ash ("black sand") and erupted from Tantalus cone. Included in uppermost part of Honolulu volcanic series [q. v.]. Occurs at Honolulu.

Tantoyuca formation.

Eocene: Mexico.

W. A. Ver Wiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 487).

Taosan series.

A term introduced by C. [R.] Keyes to cover the oldest pre-Camb. rocks of N. Mex. Named for Taos Co. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 11.)

Tapeats sandstone. (Of Tonto group.)

Middle Cambrian: Northern Arizona (Grand Canyon).

L. F. Noble, 1914 (U. S. G. S. Bull. 549). *Tapeats ss.*—Brown slabby, cross-bedded ss.; basal part contains lenses of cgl. having rounded pebbles. Thickness 0 to 285 ft. Is basal fm. of Tonto group. Rests, with great visible angular uncon., on Dox ss., top fm. of Unkar group (Algonkian), and, in places, upon the still older Vishnu schist (Archean). Conformably overlain by Bright Angel sh. Named for Tapeats Creek, below mouth of which, just N. of Shinumo quad., the bed of Colorado River lies within this ss.

Tappan moraine.

Pleistocene (Wisconsin stage): Southeastern New York (Rockland County).

J. B. Woodworth, 1905 (N. Y. State Mus. Bull. 84, pp. 93–94, pl. 2). Named for development at Tappan, Rockland Co.

Tar sands.

Upper Cretaceous: Canada.

R. G. McConnell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 32D to 36D, 53D, 58D to 59D). Exact syn. Dakota.

Tarkio limestone member (of Wabaunsee formation).

Pennsylvanian: Southwestern Iowa, northwestern Missouri, eastern Kansas, and southeastern Nebraska.

S. Calvin, 1901 (Iowa Geol. Surv. vol. 11, pp. 420, 422, 430–437). *Tarkio ls.*—Ls., 27 ft. thick, interbedded with thin sh. beds, and lying about 125 ft. above Nodaway coal. Constitutes second and last assemblage of lss. in Page Co., Iowa.

G. L. Smith, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 77–90, 273–282). *Tarkio ls.*—Yellow, blue, gray, and brown ls. and gray calc. sh., 6 to 12 ft. thick. Underlies McKissick's Grove shales and overlies City Bluffs sh.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 9–18), divided the rocks btw. McKissick Grove shales above and City Bluffs shales below into (descending): Tarkio ls., 12± ft.; sh., 30 to 40 ft.; Preston ls., 2½ to 3 ft.; sh., 17 to 21 ft.; Fargo ls., 11 ft.; sh., 30 to 32 ft.; Burlingame ls., 5 ft. 2 in.; sh., 8 to 12 ft.; Rulo ls., 1 ft. 4 in. They described *Tarkio ls.* as consisting of (descending): ls., 4 ft.; sh., 3 ft. 11 in.; ls., 6 in.; sh., 6 in.; ls., 6 in; sh., 16 in.; ls., 6 to 11 in.

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13, 2d ser.). *Tarkio ls.* is basal memb. of Wabaunsee fm. and same as "Barclay" ls. and "Wyckoff" ls., and Greene has little doubt it is same as Burlingame ls.

J. L. Tilton, 1924 (Iowa Geol. Surv. vol. 29, pp. 230–264), divided the Wabaunsee of SW. Iowa into (descending): McKissick Grove sh., 91 to 93 ft.; *Tarkio ls.* (restricted), 4 ft.; sh. and soft ls., 12 ft.; Preston ls., 1 to 2 ft.; and included the Rulo, Burlingame, and Fargo lss. of Nebr. in Scranton sh.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 57, 90). *Tarkio ls.* is not same as Burlingame ls. but lies 80 to 100 ft. above Burlingame ls. It belongs to Wabaunsee fm. Lies 25 ft. higher than Emporia ls. It overlies Willard sh. memb. and underlies Pierson Point sh., the basal bed of McKissick Grove sh. [This is definition of Tarkio ls. adopted by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr., by Condra in his 1935 rept, and by Moore in his 1936 rept. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 229, 230). S. Calvin (Iowa Geol. Surv. vol. 11) applied *Tarkio* to rocks on Tarkio Creek, N. of Coin, Page Co., Iowa. Condra, who has carefully studied type Tarkio, concludes the beds named Tarkio by Calvin are unquestionably = beds that have been called Emporia in Kans. Hinds and Greene (1915) misidentified Burlingame ls. as Tarkio ls. Since usage of past 20 years has led to application of *Tarkio* to a ls. that is not recognized at the locality on Tarkio Creek, N. of Coin, Iowa, and since it is desirable to use *Tarkio* in its currently understood sense, the exposures of the Tarkio on Mill Creek, SW. of Maplehill, Kans., may appropriately be chosen as a new "type loc." This procedure may at first seem anomalous, but it is theoretically and practically in accord with principles of good stratigraphy. We follow the principle of usage in accepting *Tarkio* for the ls. thus designated by Condra and Bengston (1915). Thickness in vicinity of Maplehill 1–10± ft. Can be traced from Nebr. southward to northern Lyon Co., Kans., but no outcrops identifiable as Tarkio have been found farther S.

Tarouba shale.

Eocene: Trinidad.

G. A. Waring, 1926 (Johns Hopkins Univ. Studies in geol., No. 7, p. 43).

Tarrant formation.

Upper Cretaceous (Gulf series): Eastern Texas (Trinity and Brazos River regions).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 239, 270, 425). *Tarrant fm.* (from W. L. Moreman's unpublished description).—Type loc., 1 mi. E. of Tarrant station, Tarrant Co., at crossing of St. Louis, San Francisco & Texas Railway over a tributary of Bear Creek. Typical thickness 15 ft. Consists of gray and brownish-gray sandy clay and intermittent thin brownish ls. strata and calc. concretions. The basal stratum, which uncon. overlies Woodbine sand, is a phosphatic pebble cgl. 1 to 6 in. thick. The top is a parting of limonitic material less than 1 in. thick. Underlies Britton fm. Is = basal part of Eagle Ford.

Tarryall formation.

Carboniferous and Triassic (?): Central Colorado (South Park region).

G. A. Muilenburg, 1925 (Colo. Geol. Surv. Bull. 31, pp. 12–25). [*Tarryall fm.* on map, *Tarryall series* in heading on p. 23, which includes *Upper Tarryall fm.* and *Lower Tarryall fm.*]. *Upper Tarryall fm.* consists of 6,000± ft. of bright-red ss. and variegated shales at top, becoming darker and more chocolate-colored at base, also gray sss. with pebbly streaks. *Lower Tarryall fm.* consists of 3,000 to 5,000± ft. of gray to reddish gritty ss. and interbedded sh., with pebbly and conglomeratic streaks. Difficult to separate from Upper Tarryall fm. The Upper Tarryall fm. is = Wyoming fm., and Lower Tarryall fm. is same as Maroon fm. Assigned to Penn. If Morrison fm. is present it has not been separated from Upper Tarryall fm. Exposed in and around Tarryall Creek, Park Co.

Tar Springs sandstone. (Of Chester group.)

Mississippian: Western Kentucky, southern Illinois, and southwestern Indiana.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, p. 174 and pl. showing geol. section of Hancock, Breckinridge, and Mead[e] Counties, Ky.) and 1857 (Ky. Geol. Surv. vol. 2, pp. 85–88). *Tar Spring and Shot Pouch ss.*—Sub-Carbf. ss., 50 to 70 ft. thick, forming cliff at the Tar Spring, Breckinridge Co., Ky. Overlies Upper Pentremital and Archimedes ls. and is separated from overlying Millstone grit by more than 258 ft. of shales, with interbedded thin lss. and at base a soft ss. Occupies same geologic horizon as *Rock House ss.* on head of Shotpouch Creek.

A. D. Brokaw, 1916 (Ill. Geol. Surv. Extr. from Bull. 35), defined *Tar Springs ss.* of SE. Ill. (parts of Saline, Williamson, Pope, and Johnson Counties) as consisting of 150± ft. of yellowish-brown ss., reddish in places, with locally a sh. above the middle; underlying Menard fm. and overlying Sloans Valley fm. In Breckinridge Co., Ky., it contains tar springs. [†*Sloans Valley* was later discarded for *Glen Dean ls.*]

C. Butts, 1917 (Ky. Geol. Surv., Miss. fms of western Ky, p. 112). *Tar Springs ss.* of Breckinridge Co., Ky., underlies Buffalo Wallow fm. and overlies Glen Dean ls. [The Buffalo Wallow is=Clore, Palestine, Menard, Waltersburg, and Vienna fms. of western Ky. and SW. Ill.]

S. Weller, 1920 (Ill. Geol. Surv. Bull. 41). In Pope and Johnson Counties, Ill., *Tar Springs ss.* underlies Vienna ls. and overlies Glen Dean ls., and Waltersburg ss. separates Vienna ls. from overlying Menard ls.

At one time Tar Springs ss. was believed to be same as †Big Clifty ss., but latter is now known to be same as the older Cypress ss.

Named for Tar Springs, 3 mi. S. of Cloverport, Breckinridge Co., Ky.

Taseko formation.

Oligocene (?): British Columbia.

J. D. MacKenzie, 1921 (Canada Geol. Surv. Summ. Rept. 1920, pt. A, pp. 52, 77).

†Tassajara lake (?) bed. [U. S. Geographic Board has adopted spelling Tassajero.]

Pliocene probably: Western California (Alameda County).

J. G. Cooper, 1894 (Calif. Acad. Sci. Proc., 2d ser., vol. 4, p. 170). *Tassajara lake (?) bed.*—Along a small branch of Walnut Creek, in Alameda Co., N. of Livermore, is a deposit which contains chiefly living species, and was formerly called *Quat.*, but one extinct species has been described from there, and its high elevation, nearly corresponding with Contra Costa lake bed, makes it probable it may better be called *Plio.* [Fossils listed.]

Probably named for exposures on Tassajero Creek, Alameda Co.

Tassajero formation.

Pliocene or Pleistocene: Berkeley Hills, California.

B. L. Clark, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 151). Moraga fault shows conclusively that Moraga series and Orinda and Siesta fms. are cut off at the fault, and that the continental deposits to E. of fault are younger than any on W. side of the fault. All of these rocks, which are so well exposed on W. side of Moraga fault, are buried beneath these later sediments on E. side. The continental beds on E. side of the fault have thickness of over 4,000 ft. They contain no lavas, and tuff beds are lacking except in lowest portion of section exposed in an anticline W. of town of Lafayette. A sliver block along Las Trampas fault, which is on SW. side of Lafayette, exposed vesicular lavas which undoubtedly underlie this section of later Plio. deposits E. of Moraga fault. Vertebrate fossils of Orinda and Siestan fms. of Berkeley Hills area place the fms. in Lower Plio. A limb bone of *Equus* was obtained in the series E. of Moraga fault. This places these beds either as Upper Plio. or Lower Pleist. The name *Tassajero fm.* is proposed for this series of deposits. Type section is on SW. side of Mount Diablo where it is crossed by Tassajero Creek. It is probable Tassajero fm. includes beds of Middle and Upper Plio. and Lower Pleist. age.

†Tatalina group.

Lower Ordovician, possibly Cambrian, and (chiefly) pre-Cambrian: Northeastern Alaska (Yukon-Tanana region).

L. M. Prindle, 1913 (U. S. G. S. Bull. 525, pp. 37-38). *Tatalina group*.—An aggregate of feldspathic fragmental rocks, including cgls., sss., and graywackes, interbedded with argillites which are in places altered to phyllites; considerable chert. As mapped [in Fairbanks quad.] includes some ls. which may or may not be an integral part of the group. In White Mtns region [in Fairbanks quad.] includes considerable greenstone in form of ancient tuffs and lavas lithologically similar to the rocks described as undiff. greenstones but older than most of them. The group is typically exposed in valley of Tatalina River. Thickness probably several thousand ft. Rests uncon. on Birch Creek schist, and in White Mtns is overlain by ls. ranging in age from Ord. to Dev. Fossils indicate upper part of group is Ord. Lower part may be Camb., but provisionally the group is referred to Ord.

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). Upper part of Tatalina group of Prindle is Middle Ord. and is here named *Fossil Creek volcanics*. Major part of group is pre-Camb., but it includes some Lower Ord. and possibly some Camb. It is here included in assemblage mapped as "undiff. pre-Middle Ord. rocks," which appear to be contemp. with part of Tindir group of pre-Camb. and Lower Camb. (?) age. Tatalina group is therefore abandoned.

Tatay limestone.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 334, 338).

Tate member. (In McMillan formation.)

Upper Ordovician: Central Kentucky to southwestern Ohio.

A. F. Foerste, 1906 (Ky. Geol. Surv. Bull. 7, pp. 19, 212). *Tate layer* belongs in upper half of Fairmount bed.

A. F. Foerste, 1912 (Denison Univ. Sci. Lab. Bull. 17, pp. 18, 23, 49). *Tate memb.*—Important, practically unfossiliferous argill. section, 0 to 30 ft. thick, occurring btw. Fairview and McMillan divisions of the Maysville. [In table on p. 23 and on p. 18 *Tate memb.* is included in McMillan fm.] Traceable from Casey and Boyle Counties in central Ky. to Adams Co., Ohio.

A. F. Foerste, 1924 (Canada Dept. Mines, Geol. Surv., Mem. 138, No. 121 geol. ser., p. 30, chart opp. p. 58). *Bellevue (Tate)* underlies Corryville and overlies Fairmount. Writer has assumed that Tate memb. corresponds to Bellevue.

Derivation of name not stated.

Tatei formation.

Cambrian: British Columbia.

L. D. Burling, 1922 (Geol. Soc. Am. Bull., vol. 33, p. 109).

Tatina group.

Ordovician and Silurian (?): Central southern Alaska (Mount McKinley region).

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, pp. 55, 69-73, map). *Tatina group*.—Sediments, dominantly calc. but including considerable argill. and some aren. material, which form oldest known Paleozoic terrane of Mount McKinley region. Consist of blue lss. interbedded with black carbonaceous argillites and thin-bedded siliceous lss. and calc. slates, along N. front of Alaska Range. Ord. fossils in argillites in lower part. Upper part may be post-Ord. Thickness 4,000 to 5,000+ ft. Type exposures in upper basin of Tatina River, formerly called Rohn River. Exposed on the river and traced to East Fork of the Toklat. Without doubt older than Tonzona group.

†Tatman formation.

Eocene (middle?): Northern Wyoming (Bighorn Basin).

W. J. Sinclair and W. Granger, 1912 (Am. Mus. Nat. Hist. Bull., vol. 31, pp. 60-62). *Tatman fm.*—Yellowish shales, yellow-brown and gray sss., and much lignite. Thickness 0 to 600 ft. Except a few scraps of bone no vertebrate fossils found. Invertebrate fossils suggest probably Eo., possibly Bridger. Named for Tatman Mtn. Not found N. of Gray Bull River. Lies conformably on Lost Cabin fm. (of Wind River group), and is overlain by *post-Tatman andesitic gravels* [apparently *Tatman Mtn gravels* of their 1911 rept].

Tatman Mountain gravels.

Oligocene (?): Northern Wyoming (Bighorn Basin).

W. J. Sinclair and W. Granger, 1911 (Am. Mus. Nat. Hist. Bull., vol. 30, pp. 88, 105–111). *Tatman Mtn gravels*, 30 to 60 ft. thick, of Olig. (?) age (no fossils). On Tatman Mtn overlie beds that may correspond to Uinta and Bridger fms. (Eo.). These gravels are fragments of a fm. now almost entirely destroyed by erosion.

Tatonduk shales.

Ordovician: Canada (Yukon).

L. D. Burling, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 128).

Tatums sand.

A subsurface sand, of Penn. age, in Tatums pool, Carter Co., Okla., lying at depths of 1,200 to 2,800 ft. in the producing area. Thickness 125 ft. (See A. A. P. G. Bull., vol. 19, No. 3, 1935, pp. 401–411.)

Taunton clays.

Name applied by J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, p. 986), in heading, to Pleist. clays occurring near Taunton, Mass., which were worked for brick.

Tawas moraine.

Pleistocene (Wisconsin stage): Northeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Included in Port Huron morainic system. Named for Tawas, Iosco Co.

Taylor marl.

Upper Cretaceous (Gulf series): Central and eastern Texas.

R. T. Hill, 1892 (Artesian Invest. Final Rept., pt. 3, p. 73, 52d Cong., 1st sess., S. Ex. Doc. 41, pt. 3). *Taylor or Exogyra ponderosa marls.*—Chalky clays, 1,200 ft. thick, characterized by *Exogyra ponderosa*. Overlie Austin-Dallas chalk and underlie Uppermost or Glauconitic div. (Navarro fm.) of Cret.

Named for Taylor Prairie, central Tex.

Taylor meta-andesite.

Mississippian: Northern California (Taylorsville region).

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Taylor meta-andesite.*—Green, in places slaty meta-andesite, more than 1,000 ft. thick. Occurs as lava flows, tuffs, and volcanic cgl. Conformably overlies Arlington fm. and conformably underlies Shoofly fm.

Named for exposures around Taylor Rock, Taylorsville region.

Taylor sandstone. (In Greene formation.)

Permian: Northern West Virginia and southwestern Pennsylvania.

R. V. Hennen, 1909 (W. Va. Geol. Surv. Rept. Marshall, Wetzel, and Tyler Counties, p. 173). *Taylor ss.*, 20 to 165 ft. thick, lies 100 to 150 ft. below Gilmore ls. and higher in section than Nineveh ss. Named for Taylor Twp, Greene Co., Pa.

In some subsequent repts of W. Va. Geol. Surv. the name *Taylor ss.* has been applied to a ss. lying btw. *Upper* and *Middle Rockport lss.* and in other repts to a ss. lying btw. *Middle* and *Lower Rockport lss.*

Taylor Branch limestone.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

See under *South Fork ls.*

Taylors Ridge.

A name applied (in table and without definition) by G. Little (Hdb. of Ga., Com. of Agric., 1876, p. 40) to the representative of Medina epoch in Ga. Placed above "Cincinnati shales" and below "Fossiliferous Iron, of Clinton epoch."

Taylorsville formation.

Devonian: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Taylor[s]ville slates,* 1,800 ft. thick. Older than Arlington beds and younger than Montgomery ls.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Taylorsville fm.*—Chiefly slates and thin-bedded sss., among which there are numerous small layers of fine black chert or occasional less regular masses of red chert, but at base there is locally a fine greenish-gray cgl. with indistinct pebbles, and near middle well-defined beds of light-colored qtzite. Thickness 1,800 ft. Rests with probable uncon. on Montgomery ls. Is older than Arlington fm., from which it is separated by granite. Fossils not distinctive, but fm. is believed to be Dev.

Named for exposures on E. face of spur above the ls. about 1 mi. S. of Taylorsville, Plumas Co.

Taylortown limestone. (In Washington formation.)

Permian: Southwestern Pennsylvania (western part of Washington County).

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, p. 2577). *Taylortown ls.*—Compact, massive ls., 10 to 20 ft. thick. Lies 2 to 10 ft. below Little Washington coal at all exposures in western Washington Co. Overlies Taylortown (Waynesburg "B" coal of Rept. K). [Probably named for *Taylorstown* or *Taylorstown Station*, Washington Co.,]

Taylorville slates.

See *Taylorsville fm.*

Tazewell substage.

Pleistocene: Mississippi Valley.

See under *Mankato substage* and *Wisconsin stage.*

Tazewell loess.

Pleistocene: Iowa and Illinois.

See 1933 entry under *Wisconsin stage.*

Tazin series.

Pre-Cambrian: Alberta and Northwest Territories.

C. Camsell, 1915 (Canada Geol. Surv. Summ. Rept. 1914, pp. 58, 59) and 1916 (Canada Geol. Surv. Mem. 84, p. 25).

Teanaway basalt.

Eocene: Central Washington (Mount Stuart and Snoqualmie quadrangles).

G. O. Smith and B. Willis, 1901 (Am. Inst. Min. Engrs. Trans., vol. 30, p. 359). *Teanaway basalt.*—Older than Roslyn ss. and younger than Swauk ss.; all of Eo. age.

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Teanaway basalt* underlies Roslyn fm. and rests with slight uncon. on Swauk fm.

G. O. Smith, 1904 (U. S. G. S. Mount Stuart folio, No. 106). *Teanaway basalt* is a series of lava flows with interbedded tuffs; the basalt is black and very compact. Conformably underlies Roslyn ss. (Eo.) and rests uncon. on Swauk fm. (Eo.).

G. O. Smith and F. C. Calkins, 1906 (U. S. G. S. Snoqualmie folio, No. 139), gave thickness as 500 to 6,000 ft.

Teapot sandstone member (of Mesaverde formation).

Upper Cretaceous: Eastern Wyoming.

V. H. Barnett, 1915 (U. S. G. S. Bull. 581, p. 113). [See 1915 entry under †*Little Pine Ridge ss.*]

Teapot Mountain porphyry.

Early Tertiary (?): Central Arizona (Ray district).

F. L. Ransome, 1919 (U. S. G. S. P. P. 115, p. 126, pl. 45). Of the two varieties of quartz monzonite porphyry in Ray dist. the Granite Mtn porphyry occurs almost wholly in S. half of dist., while *Teapot Mtn porphyry* is characteristic of N. half. Both are intrusive. Largest exposure of Teapot Mtn porphyry is on ridge S. of Teapot Mtn and W. of the metallized schist area.

Teay formation.

Pleistocene: Southwestern West Virginia.

M. R. Campbell, 1900 (U. S. G. S. Huntington folio, No. 69). *Teay fm.*—Gravel, sand, and finely laminated clay deposited by ancient Kanawha River. Thickness 0 to 60 ft. Forms floor of Teay Valley, Cabell Co.

Tecovas formation. (In Dockum group.)

Triassic (Upper?): Panhandle of Texas.

C. N. Gould, 1907 (U. S. G. S. W. S. P. 191, pp. 20–29). *Tecovas fm.*—Largely shales. Lower part more or less sandy sh., chiefly maroon, lavender, yellow, and white; upper part dark-red or magenta sh. Thickness 90 to 220 ft. Lower fm. of Dockum group. Uncon. overlies Quartermaster fm. and underlies Trujillo fm.

Named for exposures on Tecovas Creek, Potter Co.

Tecuja beds.

See *Tecuya beds.*

Tecumseh shale. (In Shawnee group, Kansas.)

Tecumseh shale member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 28). *Tecumseh sh.*—Fine-textured olive-colored shales, containing many ferruginous concretions and occasional beds of soft shaly ss. Thickness 75 ft. Basal part of Upper Coal Measures in Shawnee Co., Kans. Underlies Calhoun [Deer Creek] ls.

The present generally accepted definition treats Tecumseh sh. of Mo. as a memb. of Shawnee fm., overlying Lecompton ls. memb. and underlying Deer Creek ls. memb. In Kans. the Shawnee is treated as a group and the Tecumseh sh. as a fm. G. E. Condra and R. C. Moore have divided Tecumseh sh. into 3 members (descending)—Rakes Creek sh., Ost ls., and Kenosha sh.; and Moore stated (1936) that to N. the upper bdy of their Rakes Creek sh. extends up to base of Rock Bluff ls. of Condra. (See 1936 entry under *Rakes Creek sh.*)

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Named for exposures at Tecumseh, Shawnee Co., Kans.

Tecuya beds.

Miocene (lower): Southern California (San Joaquin Valley).

C. Stock, 1920 (Calif. Univ. Pub. Dept. Geol. Bull., vol. 12, No. 4). *Tecuya beds.*—Land-laid beds in which red sss. and shales are most striking lithologic members, but lavas and tuffs are also present. Rests uncon. on Tejon fm. in immediate vicinity of Tecuja [Tecuya] Canyon, in lower part of San Joaquin Valley, and is overlain, without evidence of uncon., by Monterey marine deposits, presumably with Vaqueros fauna. The beds may be contemp. with part of Sespe fm. or may belong to Monterey series.

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 586–614, and Proc. First Pan-Pacific Sci. Conf., pt. 3, pp. 801–818). The *Tecuja beds* are continental deposits intercalated in marine Vaqueros group, and it seems to writer they are lower Mio., rather than upper Olig.

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169), included *Tecuya* in Mio. but showed it as older than Vaqueros ss.

Tegucigalpa.

Upper Triassic: Honduras.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 356).

Tehachapi marble.

Southern California (Kern County).

H. G. Hanks, 1886 (Calif. State Min. Bur. 6th Ann. Rept. State Min. pt. 1, p. 23). *Tehachapi marble.*—A large deposit of yellow brecciated marble situated ½ mi. from town of Tehachapi, Kern Co., on road to Caliente, also 9 mi. W. of Tehachapi, in Bright's Valley.

Tehachapi formation.

Quaternary (?): Southern California (Kern County).

A. C. Lawson, 1906 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, pp. 431–462). *Tehachapi fm.*—A great body of post-lacustrine coarse alluvium in fresh, undecomposed condition, only slightly cemented. Thickness 250 ft. Younger than Cable fm.

Probably named for occurrence near town of Tehachapi and in Tehachapi Creek Valley, Kern Co.

Tehama formation.

Pliocene: Northern California (Tehama County).

R. D. Russell and V. L. Vander Hoof, 1931 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 2, pp. 11–21). *Tehama fm.*—Name proposed by Mr. Russell. Consists of 2,000± ft. of massive pale greenish-gray to pale-buff sandy clays, which are usually tuffaceous. Intercalations of sand and gravel, often strongly cross-bedded, are present throughout. A massive coarse-grained pumice tuff memb. (for which C. A. Anderson and R. D. Russell propose name *Nomlaki tuff memb.*) occurs near base. This same tuff memb. occurs near base of Tuscan fm., so that the two fms. must be in part contemp., and they in fact interfinger, but their conditions of deposition are in general dissimilar. The Tehama consists of flood-plain deposits laid down on a comparatively low-lying land surface, while the Tuscan is largely composed of aggls., presumably mud flows. The Tuscan fm. is almost exclusively andesitic material derived from old volcanoes in Lassen region; the Tehama, with exception of Nomlaki tuff memb., contains only a very subordinate amount of volcanic debris. The Tuscan fm. extends along E. border of Sacramento Valley from Pentz northward almost to Pit River and E. into Lassen Peak region. The Tehama fm. occurs on W. side of Sacramento Valley. The Tehama fm. lies, with uncon. and overlap, on Cretaceous Chico-Shasta series, and is overlain discon., and locally with angular uncon., by Red Bluff fm. (Pleist.). Named for outcrops in Tehama Co. Strat. evidence indicates Tehama and Tuscan fms. are probably Plio. Vertebrate evidence (from above Nomlaki tuff memb.) indicates that both are Upper Middle to Upper Plio.

Tehuacana member (of Kincaid formation).

Eocene (lower): Eastern Texas.

G. D. Harris, 1896 (Bulls. Am. Pal., vol. 1, No. 4, pp. 129, 155). In vicinity of Tehuacana, Limestone Co., the ls. beds of the Midway aggregate at least 40 ft. They are overlain by yellowish and bluish, slightly argill. sandy layers, which so far as observed are unfossiliferous. West of the College, say ½ mi., yellowish calc. sands occur 45 ft. or more below base of the ls. (p. 129). [In correlation table on p. 155 Harris placed *Tehuacana ls.* in middle Midway, and showed it as overlain by upper Midway sands to S. of Tehuacana and as underlain by lower Midway boulder clay to N. of Tehuacana, and he called the *upper Midway* the *Wills Point clays and sand*, which is a restriction of *Wills Point* as used by others.]

F. B. and H. J. Plummer, 1928 (Pan-Am. Geol., vol. 49, p. 297), divided Midway into an upper zone of sandy clays and silts containing large concretionary masses, a middle zone of dark-gray clays, and a basal zone of yellowish or buff-gray clays and glauconitic sands, and stated "that the lowest and middle divisions are in some places separated by a ls. lentil known as the *Tehuacana ls.*, and in other places by a layer of glauconitic sand."

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 496, 532, 535, 536, 539, 541, 542, 544, 545, 553). *Tehuacana ls. lentil.*—Top part of Pisgah memb. of Kincaid fm. Proposed by Harris (1896) for the Midway ls. at Tehuacana. Consists of 4 to 50 ft. of coquina, oolite, compact indurated shell marl and ls. Extends through Limestone, Navarro, and Kaufman Counties. Type loc. is the abandoned quarry at Tehuacana, Limestone Co. Underlies Wills Point fm. [restricted].

J. Gardner, 1935 (Univ. Tex. Bull. 3301, pp. 22–26), excluded these beds from Pisgah memb. and treated them as a distinct memb., called *Tehuacana memb. of Kincaid fm.*, which she described as consisting of calc. glauconitic sands, characteristically indurated with a calc. cement, the heavy glauconitic, highly fossiliferous, loosely indurated sands with or without phosphatic nodules, and all other equiv. deposits btw. top of Pisgah memb. (restricted) and base of Wills Point fm. The name Tehuacana "ls." commonly applied to this unit is largely a misnomer, although it does contain intercalated sandy ls. lenses. Lower part of the Tehuacana is typically exposed along W. face of scarp on which town of Tehuacana stands. The higher horizons are best represented in the quarry ½ mi. E. of the town. About 72 ft. of section are included in the Tehuacana outcrops. About 20 ft. above base is oyster bed, and 10 ft. higher is another oyster bed. Max. thickness of outcrop is less than 100 ft., but indicated thickness in well logs approximates 200 ft.

†Tehuacana formation. (Broad usage.)

Eocene (lower): Eastern Texas.

Julia Gardner, 1932 (Prel. ed. geol. map of Tex.), applied *Tehuacana fm.* to lower part of Midway group and restricted *Wills Point fm.* to upper part of Midway group.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 532–533). The name *Tehuacana* was given by Harris to designate the Midway ls. at Tehuacana, and is now in good usage among geologists for this ls. lentil. Miss Gardner selected Tehuacana Bluff (the steep hill just W. of town of Tehuacana, Limestone Co.) as typical of *Tehuacana fm.* as used in prel. ed. of Tex. geol. map for all Midway deposits beneath Wills Point fm. [restricted], and this is best possible type loc. for basal Midway div. The name *Tehuacana* being in good standing among geologists for the ls. lentil, it seems best to apply a new name to the basal fm. of Midway group, in order to avoid confusion. Julia Gardner has proposed for it the name *Kincaid fm.*

Tejon formation.

Eocene (upper): Western California.

W. M. Gabb, 1869 (Calif. Geol. Surv. Pal., vol. 2, p. xiii, as reported by J. D. Whitney from unpublished paper by Gabb, and footnote by Gabb on p. 129). Div. B of Cret. of previous Calif. repts is here named *Tejon group*, from locality where it is most strongly developed. This div. of the Cret. is peculiar to Calif. Is found most extensively developed in vicinity of Fort Tejon and about Martinez. From latter locality it forms an almost continuous belt in the Coast Ranges to Marsh's, 15 mi. E. of Monte Diablo, where it sinks under San Joaquin plain. It was also discovered at various points in E. face of same range as far S. as New Idria, and in summer of 1866, by Mr. Gabb, in Mendocino Co., near Round Valley, the latter locality being most northern point at which it is as yet known. Is the only coal-producing fm. in Calif. Contains a large and highly characteristic series of fossils, the larger part peculiar to itself, while a considerable precentage is found extending below into the next [Martinez] group, and several species still farther down into Chico group. [On p. 147 Gabb mentioned "beds intermediate btw. Tejon group and Martinez group W. of town of Martinez," but no such beds are mentioned in connection with definitions of Tejon or Martinez.]

In 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 94, 281) the name *Tejon fm.* was restricted by B. L. Clark to upper part of the Tejon of previous usage, or to the beds containing a "typical Tejon fauna," the uncon. underlying beds being named *Meganos group*. The U. S. Geol. Survey uses the restricted definition of Tejon fm. The Eo. age of Tejon fm. has long been recognized.

See also under *Domengine fm.*

Named for occurrence in vicinity of Fort Tejon, Kern Co.

Tekonsha moraine.

Pleistocene (Wisconsin stage): Southern Michigan. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for Tekonsha, Calhoun Co.

Telegraph Creek formation. (Of Montana group.)

Upper Cretaceous: Central southern Montana (Stillwater to Rosebud Counties region).

W. T. Thom, Jr., July 6, 1922 (U. S. G. S. Bull. 736B, p. 38). *Telegraph Creek fm.*—Yellow sandy sh. parted in middle by a thin bed of concretionary ss., which caps an escarpment. Less prominent layers of concretionary ss. occur in upper half of fm. Thickness 320 ft. Underlies Virgelle ss. memb. of Eagle ss. and overlies Niobrara sh. Fossils predominantly Montana types. They include several sp. found in Eagle ss., mingled with forms usually found in Niobrara sh., of latest Colorado age. Typically developed at head of Telegraph Creek, T. 2 S., Rs. 28 and 29 E., Crow Indian Res.

†Telegraph Hill sandstone. (In Franciscan group.)

Jurassic(?): Western California (San Francisco).

R. Crandall, 1907 (Am. Phil. Soc. Proc., vol. 46, pp. 3-58). *Telegraph Hill ss.*—Sss. and shales very similar to the older San Bruno ss. of the Franciscan. Thickness 800 to 1,000 ft. Is topmost fm. of Franciscan or Golden Gate series. At the Potrero the fm. rests on the jaspers of the Franciscan, which overlie San Bruno ss. Named for exposures at Telegraph Hill, San Francisco.

A. C. Lawson (U. S. G. S. San Francisco folio, No. 193, 1914) mapped this ss. as *Marin ss.*

Telescope group.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930 (Econ. Geol., vol. 25, p. 311 and map). *Telescope group.*—Consists of 7 mapped units (descending): *Redlands dolomitic ls., Radcliff fm., Sentinel dol., Wildrose fm., Mountain Girl cgl.-qtzite, Middle Park fm.,* and *Sour Dough dolomitic ls.* The Mountain Girl cgl.-qtzite overlies Middle Park fm. with discon.(?), and the Sour Dough ls. noncon. overlies Surprise fm. The names of these fms. are derived from geographic terms used in this [southern] part of Panamint Range. The rocks have nearly all been metamorphosed to some degree. In absence of diagnostic paleontologic evidence the age of all fms. is open to question. Tentative assignment to Lower Paleozoic has been made largely on lithologic grounds. The rocks are undeformed.

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July-Oct. 1932, pp. 329-356), redefined *Telescope group*, by including at top a newly named fm. (Hanaupah fm.) 1,500± ft. thick. The fm. overlying Telescope group is in this publication named *Death Valley fm.* It also is assigned to lower Paleozoic (?). Appears to be named for Telescope Peak, S. part of Panamint Range, on and around which the fms. of the group are mapped.

Tellera (also Tellara) limestone.

Pennsylvanian (?): Central northern New Mexico (Sandia Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257-259; Conspectus of geol. fms. of N. Mex., pp. 3, 11). [*Tellera* on p. 3; *Tellara lss.* on p. 11.] Uppermost gray ls. memb. of Maderan series, exposed on E. flank of Sandia Range. Thickness 300 ft. [Derivation of name not given.]

Tellico sandstone. (In Blount group.)

Lower Ordovician (Chazyan): Southeastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 4). *Tellico ss.*—Bluish-gray and gray calc. sss. and sandy shales closely interbedded. Weathers to porous sandy rock with strong red color. Southeast of Bays Mtn is 800 to 900 ft. thick and overlies Athens sh. and underlies Sevier sh.; NW. of Bays Mtn is 250 to 500 ft. thick and overlies Chickamauga ls. and underlies Sevier sh.

According to C. Butts and E. O. Ulrich is of Chazy age. Is considered by A. Keith to be strat. equiv. of Moccasin ls. of E. Tenn., but according to C. Butts and E. O. Ulrich the Moccasin of E. Tenn. is all of Black River age, and typical Moccasin of SW. Va. is a facies of lower or Lowville part of the Black River.

Named for exposures in cut on Tellico River, Monroe Co., Tenn.

Tellowa formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Tellowa fm.*—Interbedded ss. and sh. with one large and several small coal seams, composing all Carbf. rocks of Tazewell area that overlie Sequoyah fm. Thickness 500 ft. Is similar in composition to Sequoyah fm., but carries some larger coal seams. [Type loc. not stated and unknown.]

Telluride conglomerate.

Oligocene(?): Southwestern Colorado.

W. Cross, 1901 (U. S. G. S. Bull. 182, pp. 29-39). *Telluride cgl.*—Cgl. free from volcanic material but containing pebbles of very hard sed. rocks of Mesozoic and

Paleozoic age and of schists, granites, and Algonkian qtzites. Thickness in Silverton quad. 1,000 ft. Overlies Dolores fm. uncon. and uncon. underlies San Juan series of igneous rocks. In previous rept called San Miguel cgl., but that name is preoccupied. Named for exposures about town of Telluride and throughout Telluride quad.

Temapache limestone.

Oligocene: Mexico.

E. T. Dumble, 1918 (Calif. Acad. Sci. Proc., 4th ser., vol. 8, p. 146). Assigned to Tert.

W. A. Ver Wiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 494). *Temapache beds* assigned to Olig.

Temblor formation.

Miocene (middle): Southern California (Kern County).

F. M. Anderson 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, pp. 168–187). *Temblor beds.*—The entire series of Mio. sands and shales below Monterey shales in Mount Diablo Range. Thickness 1,500 ft. Include (descending):

"Button beds," 100 ft. (sandy beds characterized by great numbers of small discoidal sea urchins, *Astrodapsis*).

Siliceous and clay shales with interstratified ss., 600 ft.

Sss. with numerous fossil species, 800 ft.

Rest uncon. on Domijean sands. In some places there is distinct overlapping of Monterey shales beyond borders of Temblor beds. [Fossils listed.]

F. M. Anderson, 1908 (Calif. Acad. Sci. Proc., 4th ser., vol. 3, pp. 1–40). *Temblor beds.*—Calc. beds, clay sh., sands, and gravels, with a pebbly cgl. at base and containing typical lower Mio. fossils. Thickness 450 to 550 ft. The "Reef bed" of former rept [which was included in †Coalinga beds] is properly a part of Temblor beds. Rest uncon. on Olig.(?) organic shales, which in former rept were thought to be Mio. and were called *Monterey shales*, and which overlie Domijean sands. Strat. and faunally "Vaqueros ss." agrees with Temblor beds and is without doubt to be correlated with the Temblor of Mount Diablo Range.

J. P. Smith, 1910 (Jour. Geol., vol. 18, No. 3). *Temblor ss.*—Type Temblor is younger than type Vaqueros, and carries fauna like that of *Ocoya Creek beds*. The Temblor fauna carries *Turritella ocoyana* and other fossils, while the older or type Vaqueros is characterized by *Turritella inezana* fauna. True Vaqueros is absent in Coalinga region, the type section of the Temblor, and true Temblor is absent in Salinas Valley, the type region of the Vaqueros. True Temblor underlies the diatomaceous Monterey sh.

F. M. Anderson, 1911 (Calif. Acad. Sci. Proc., 4th ser., vol. 3, pp. 17+). *Temblor group.*—[Describes these deposits in Kern River region and the part of Mount Diablo Range that is locally known as "Temblor Mtns."] Chiefly marine, but locally contains a fresh-water or brackish-water facies. Thickness ranges up to 1,760 ft. Correlates with *Ocoya Creek beds*. If Monterey is present it cannot be separated from Temblor group. The more shaly part is nearest the base, and the beds become coarser toward top, though clays are distributed throughout the column. Called "Vaqueros" by Arnold and others. Uncon. underlies Kern River group and rests uncon. on granite.

F. M. Anderson and Bruce Martin, 1914 (Calif. Acad. Sci. Proc., 4th ser., vol. 4, pp. 31–51). *Temblor (Vaqueros) beds.*—[Gives details of the beds.] Thickness 500 to 2,500 ft. in Temblor Basin and San Juan dist. Uncon. underlies Monterey sh. and uncon. overlies granite. It has yet to be shown that the so-called Vaqueros beds of Salinas Valley are older in time than the Temblor deposits at base of Mio. in the Great Valley.

B. L. Clark, 1921 (Jour. Geol., vol. 29, pp. 586–614). The Monterey series contains two fairly distinct but closely related faunas, the upper the *Temblor group* or *Turritella ocoyana* zone, the lower the *Vaqueros group* or *Turritella inezana* zone. A very large percentage of Vaqueros species is common to the Temblor. The marine Temblor includes the middle Mio. land fm. locally known as the *Big Blue*. The Temblor group corresponds to "Salinas sh." and "Monterey sh." of other repts, but is older than Maricopa sh. and Briones ss. In most places it uncon. overlies Vaqueros group and uncon. underlies Santa Margarita fm.

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). Faunas of Vaqueros and Temblor horizons have always been found in same sequence, and though they are very different they occur in similar facies of deposition (arkosic sss.). To N. the Temblor is conformable on underlying Vaqueros; in southern Calif. there is well-marked uncon. btw. them.

The present generally accepted definition of Temblor fm. applies the name to the deposits that include the *Turritella ocoyana* zone, of middle Mio. age and younger than Vaqueros fm. (*Turritella inezana* zone), of late lower Mio. age. H. G. Schenck, however (A. A. P. G. Bull., vol. 19, No. 4, pp. 521–534, 1935), considers lower part of type Temblor is = upper part of Vaqueros at its type loc.

Named for exposures on Temblor ranch, in McKittrick dist., Kern Co.

Temecula Canyon granite.

Age(?): California.

W. A. Goodyear, 1889 (Calif. State Min. Bur. 9th Ann. Rept., p. 149).

Temescal formation.

Recent: Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Temescal fm.*—Secondary alluvium derived from main alluvial embankment of San Antonio fm. in course of its degradation, and consisting of same kind of material, namely, fragments of Mesozoic and Tert. rocks. Thickness varies up to 13 ft. Rests uncon. on marine Merritt sand, of Pleist. age. Named for development along Temescal Creek, Alameda Co.

Temescal porphyry.

Late Jurassic(?): Southern California (Riverside County).

P. H. Dudley, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 223). *Temescal porphyry.*—Extensive dacite porphyry in part of Riverside Co. btw. towns of Riverside and San Jacinto and Corona and Elsinore. Younger than Elsinore series and older than Alberhill clays (Eocene). [Dudley gave full description in Calif. Jour. Mines and Geol., vol. 31, No. 4, 1935, pp. 491, 496–500 (and map), and assigned it to late Jurassic(?).]

†Temiscamian series.

†Temiscaming series.

Variants of †Timiskamian series.

Temiscouata group.

Silurian (Niagaran): Quebec.

H. W. McGerrigle, 1934 (Quebec Bur. Mines Ann. Rept. 1933, pt. D, p. 116).

Temperance River group.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 14, pp. 143–146). *Temperance River group.*—Succession of very distinctly and thinly bedded fine-grained diabases and melaphyrs, with strongly developed amygdaloids, and several seams of detrital matter, in shape of red shaly ss. and cgl., one ss. exceeding 200 ft. thick; toward base some layers of dense ashbed diabase and diabase porphyrite. Thickness 2,500 to 3,000 ft. Overlies Beaver Bay group. Included in Keweenawan series. Mapped along Temperance River.

Temperance River member.

Pre-Cambrian (Keweenawan): Northeastern Minnesota.

A. H. Elftman, 1898 (Am. Geol., vol. 21, pp. 90–109, 175–188). *Temperance River memb.* of Keweenawan series includes greater part of Agate Bay group, the eastern end of Duluth group, and all of Temperance River group of Irving. It consists of (1) diabase and diabase porphyrite with interbedded sss.; (2) basic and intermediate surface flows with interbedded sss.; and (3) 100+ ft. of cgl. and qtzite at base. Rests uncon. on *Red Rock memb.*, which was named for its persistent red color and which consists of intrusives and equivalent effusives, associated with St. Louis River gabbro and parts of Lester River and Beaver Bay groups of Irving.

Temple Bar conglomerate.

Pleistocene (early): Northwestern Arizona.

W. T. Lee, 1908 (U. S. G. S. Bull. 352, p. 17). *Temple Bar cgl.*—Sand and gravel having wide distribution in western Ariz., in the Colorado and other valleys of that region, filling low places generally to an altitude of 3,000 ft. or more. Typically exposed near mouth of Virgin River at Temple Bar [NW. corner of Mohave Co.], where it consists of slightly consolidated sand and gravel exposed in nearly perpendicular cliffs, in which are included sheets of basalt. Where exposed along Colorado River it is evidently a river deposit, but it merges laterally into deposits of angular mtn wash in some places and possibly into lacustrine deposits in others. Rests uncon. on Greggs breccia and older fms. and is apparently = in age to the widespread detrital accumulation filling the low places of the Southwest generally and forming the desert plains of Ariz. and parts of southern Calif. No fossils, and at present no means of definitely correlating with other fms. In composition, geologic and physiographic relations, and general appearance is similar to Gila cgl., but greater part of Temple Bar cgl. is usually not so well consolidated as Gila cgl., although in places, especially where the older portions are exposed, it is as firmly cemented. Assigned to early Pleist.

Some geologists think this deposit may include some Plio., as does the Gila cgl.

Temple Butte limestone.

Devonian (Upper ?): Northern Arizona (Grand Canyon).

C. D. Walcott, 1889 (Geol. Soc. Am. Bull., vol. 1, p. 50). *Temple Butte ls.*, 0 to 94 ft. thick, of Dev. age. Underlies Redwall ls. (Carbf.) and overlies Tonto in Grand Canyon of the Colorado but is in places entirely absent, either through erosion or nondeposition, and where absent Redwall ls. rests on Tonto group.

N. H. Darton, 1910 (U. S. G. S. Bull. 435). *Temple Butte ls.*—Purple and cream-colored ls. and ss., 0 to 100 ft. thick.

Named for Temple Butte, 3 mi. S. of junction of Little Colorado River with Colorado River.

Tempoal shale.

Eocene: Mexico.

E. T. Dumble and E. R. Applin, 1924 (Pan-Am. Geol., vol. 41, June, pp. 336, 338).

Tenejapa formation.

Tertiary: Mexico.

W. A. Ver Wiebe, 1925 (Pan-Am. Geol., vol. 44, p. 134).

Tenistipa limestone.

Cretaceous (?): Mexico.

A. Heim, 1926 (Eclogae geol. Helvetiae, vol. 20, p. 86).

Tenley formation.

Pliocene (?): District of Columbia.

C. K. Wentworth, 1930 (Va. Geol. Surv. Bull. 32, p. 37). Term *Brandywine fm.* as defined by W. B. Clark in 1915 includes a considerable part of the terrace surface deposits formerly called *Lafayette* in Wash. region. It has become apparent, however, that other parts of former Lafayette fm. could not be included in Brandywine of Clark. As result of field studies in 1921 and 1922 writer divided [unpublished?] former Lafayette fm. of Wash. region into (1) an older and higher terrace and gravel fm., the *Tenley fm.*, from Tenleytown, D. C., and (2) a younger and lower terrace and gravel fm., the Brandywine of Clark. As the Tenley terrace is not preserved on the Coastal Plain in Wash. area it will not be described in this rept.

Foregoing is only known use of *Tenley fm.* Whether the deposit corresponds to Bryn Mawr gravel is a debated point.

Tenmile granite.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Tenmile granite.*—Pink and gray biotite granite. Intrudes Archean schists, but does not intrude the Algonkian rocks. Named for Tenmile Creek, which enters Animas River SE. of Snowdon Peak.

Was assigned to Algonkian by E. S. Larsen in U. S. G. S. Bull. 843, 1933. The terms "Algonkian system" and "Archean system" were discarded by

U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

†Tenmile sands.

Pleistocene: Southern South Carolina (Charleston County).

E. Sloan 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 20). While these white clays [Hampton] accumulated in good bodies in elevated spots, along a favored zone, the argill. silts which were deposited more southerly appear in places interbedded in thin seams with fine varicolored sands, aggregating from 20 to 40 ft. in thickness. This appears to have been associated with the formation of an outer reef, barrier, or ridge, designated *Ten Mile sands*, on seaward slope of which the marine Pleist. deposited. The Ten Mile sands include a capping of reddish loam, which probably represented the terminal expression of the Hampton red clays. Very fine grained pure-white eolian sands accumulated over the Ten Mile sands. Is a fresh-water deposit.

C. W. Cooke (personal communication, 1935). The beds described are a facies of Talbot fm.

Named for exposures at Ten Mile Hill, on Charleston-Lanes Railway (A. C. L. R. R.) and at Ten Mile Hill, on Charleston-Branchville Railway (S. C. R. R.), Charleston Co.

Tenmile limestone. (In Greene formation.)

Permian: Southwestern Pennsylvania (Washington and Greene Counties).

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 97, 105). *Ten-mile ls.*—Lies in interval btw. Pursley coal and Boyd coal, and near base of Greene fm. Is No. VII of vol. K. Lies 14 to 40 ft. above Upper Washington ls. and 19 to 35 ft. below Rogersville ls. Is thick in Washington Co. but rarely more than 3 ft. thick in Greene Co. Is usually earthy.

Tenmile River beds.

Pennsylvanian: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 164–173). The Rhode Island Coal Measures E. of Providence and Seekonk Rivers as far as E. bank of Tenmile River afford characteristic exposures of slightly altered ss., pebbly beds, and shales. Coal has been found in bed of Tenmile River [Mass.]. These strata may for reference be denoted *Tenmile River beds.* Belong relatively high in the Coal Measures, but may = upper part of Cranston beds of R. I. Lie 1,000 ft. lower stratigraphically than Seekonk beds.

†Tennessee sandstone.

Pennsylvanian: Western Arkansas coal field.

A. J. Collier, 1907 (U. S. G. S. Bull. 326, p. 19). Lower ss. memb. of Fort Smith fm. is typically exposed in Tennessee Ridge, Sebastian Co., and from this occurrence has been locally called "Tennessee ss." It is 20 to 50 ft. thick, hard, flaggy, and ripple-marked.

Tennessee marble.

Commercial term for Holston ls. of Tenn., which is largely of red color.

†Tennesseean system.

E. O. Ulrich, 1905 (U. S. G. S. P. P. 36, table on p. 24), divided the Miss. rocks of Ky.-Ill. fluorite dist. into 2 major divisions (the rank of which was not indicated). The upper, designated *Tennesseean*, included the Chester and Meramec groups (the latter including Warsaw), and the lower, designated *Waverlyan*, included Osage and Kinderhook groups. He stated that he would explain his classification in a paper in preparation.

S. Weller, 1907 (Ill. Geol. Surv. Bull. 6, p. 23), quoted Ulrich's 1905 table and stated: The 2 major divisions of the Miss. made by Ulrich, the Waverlyan and the Tennesseean, are of doubtful utility, in Ill. at least; if they are to be retained at all the dividing line btw. them, as also the line btw. the Osage group and the Meramec group, should be shifted so as to include Warsaw fm. in the Osage.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 581–582), used *Tennesseean system* and *Waverlyan system*, to include the rocks designated by those names in his 1905 publication, and explained why he regarded the assemblages as "systems." His quoted explanation is also published in U. S. G. S. Bull. 769, 1925.

S. Weller, 1920 (Jour. Geol., vol. 28, pp. 415–416). There is no basis for recognition of so-called *Waverlyan* and *Tennesseean* as systems.

†Tennessee River group.

See †*Harpeth and Tennessee River group.*

Tennessee River gravels.

Pleistocene: Western Kentucky.

R. H. Loughridge, 1888 (Ky. Geol. Surv. Rept. Jackson's Purchase region). *Tennessee River gravel*, basal Quaternary fm. Overlies Lagrange group.

F. J. Fohs, 1907 (Ky. Geol. Surv. Bull. 9, p. 67). *Tennessee River gravels.*—White gravels and clay, 20 to 110 ft. thick, composing lower part of Lafayette fm. Underlies Paducah fm. (upper part of Lafayette) and overlies Penn.

Probably named for exposures along Tennessee River.

†Tennesseic.

A variant of †Tennesseean system.

Tennison Creek shale.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 90, 97). [See under *Swope fm.*]

J. M. Jewett, 1932 (pp. 90, 100, 103 of book cited above). *Tennison Creek sh.* is proposed for the strata overlying Schubert Creek ls. and underlying Critzer ls., all members of Swope fm. Tennison Creek sh. is generally less than 5 ft. thick, yellow, locally fossiliferous, and contains local thin ls. beds; is quite dark in a few places. Named for Tennison Creek, in W. part of Bourbon Co.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 80), discarded *Tennison Creek sh.* It appears to be included in his Bourbon fm., as he stated Critzer ls. occurs near top of that unit.

Tensleep sandstone.

Pennsylvanian: Wyoming (rather widespread).

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, pp. 394–401). *Tensleep ss.*—White ss., 50 to 200 ft. thick. Underlies Chugwater fm. and overlies Amsden fm. Named for exposures in walls of lower canyon of Tensleep Creek.

†Tentaculite limestone.

Silurian (Cayugan): New York.

W. W. Mather, 1840 (N. Y. Geol. Surv. 4th Rept., pp. 237–238). Underlies Pentamerus ls. [Coeymans ls.] and overlies Water lss. [Rondout ls.].

Paleontologic name (from *Tentaculites*) for ls. later named *Manlius ls.*

tepee zone.

A zone, 500± ft. thick, in Pierre sh. of eastern Colo. that is characterized by hard calc. concretions which form "tepee buttes." These "tepee buttes" occur at horizons in the Pierre varying from 750 to 1,300 ft. above its base.

Tepetate formation.

Tertiary: Mexico (Lower California).

A. Heim, 1922 (Geol. Mag., vol. 59, p. 534).

Tequepis sandstone.

Miocene: Southern California (Santa Barbara County).

R. N. Nelson, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 166–167). *Tequepis ss.*—Top fm. of Monterey series in upper Santa Ynez River region. Is younger than Salinas sh., and uncon. below Fernando Plio.

R. N. Nelson, 1925 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 15, No. 10). *Tequepis ss.*—Fine-grained light-gray feldspathic and tuffaceous sss., in places interbedded with thin layers of brown bituminous sh., and with 100 ft. of diatomaceous sh. at top. Characterized by abundance of brown fish scales. Max. thickness 1,000 ft.

The massive cream-gray tuff that overlies Salinas sh. of N. side of Santa Ynez River ½ mi. E. of Redrock Canyon is considered to be part of Tequepis ss. The Tequepis is a unit of rather limited extent, overlying Salinas sh. in W. part of the dist. along Santa Ynez River. Is top fm. of Monterey group, which is uncon. overlain by Fernando Plio. Named for development on Tequepis rancho.

Terlingua clay.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 33–41). *Terlingua beds.*—Yellowish-white indurated stratified chalk, gradually changing upward to impure gray marl, which becomes less and less calc. until it is a true clay; the uppermost clays contain some thin layers of concretionary ls. and calc. sss. Thickness 1,250 ft. Grade upward into Rattlesnake beds [Aguja fm. of present nomenclature] and grade downward into Boquillas flags. Correspond to Austin chalk and Taylor marls of Austin region.

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 271, 472), restricted Terlingua to the equiv. of Austin chalk, and called the overlying beds *Taylor marl* and the underlying beds *Boquillas.*

The U. S. Geol. Survey at present uses the name as defined by Udden, but calls the fm. *Terlingua clay.*

Named for exposures along Terlingua Creek, Brewster Co., in Terlingua quad.

Terra Blanca formation.

Quaternary: Panhandle of Texas (northern part).

R. T. Hill, 1890 (Am. Geol., vol. 5, p. 69). The bottom of great valley of Canadian River through the Staked Plains, which for convenience I here term the Older valley of the Canadian, is but slightly concave, almost a plain itself, and covered with an extensive detrital fm. of calc. pan, accompanied by siliceous pebbles, much worn and rounded. For this fm. I have proposed the name *Terra-Blanca,* used by Mexican inhabitants of the valley. Overlies Red Beds.

Terra Cotta series.

Devonian(?), Silurian, and Ordovician: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 156–157, 180). *Terra Cotta series.*—Heavy-bedded impure lss., slates, and arkoses, with probably some volcanic rocks; heavily folded and cut by intrusives. Conformably underlie Tordrillo series. May be of same age as Skwentna series (Jurassic?), but differs lithologically. [Named for Terra Cotta Mtns.]

The rocks of area described include Ord., Sil., and Dev.(?) beds.

Terra Nova.

A time term for middle part of Lower Camb. Introduced by C. D. Walcott in 1888 (Nature, vol. 38, p. 551) and assigned to basal part of Lower Camb. Later (Am. Jour. Sci., 3d, vol. 37, p. 383, 1889) assigned by him to middle part of Lower Camb., and still later (Walcott, U. S. G. S. 10th Ann. Rept., p. 548, 1890) replaced by *Placentia.*

Terranovan.

Pre-Cambrian and later: Newfoundland and New Hampshire.

T. S. Hunt, 1870 (Am. Jour. Sci., 2d, vol. 50, p. 87). From these investigations of Mr. Alex. Murray we learn that btw. the Laurentian and the Quebec group there exists several thousand ft. of strata, including soft bluish-gray mica slates and micaceous lss. belonging to Potsdam group, besides a great mass of whitish granitoid mica slates, whose relation to the Potsdam is still uncertain. To the whole of these we may perhaps give the provisional name of *Terranovan series,* in allusion to the name Newfoundland.

T. S. Hunt, 1871 (Am. Jour. Sci., 3d, vol. 1, p. 182). The series of micaceous schists with interstratified gneisses which I have elsewhere (this Jour., July 1870, p. 87) designated *Terranovan series* (the White Mtn series) are, in present state of knowledge, supposed to be newer than Huronian, to which I refer the crystalline schists with associated serpentines and diorites of Green Mtns.

T. S. Hunt, 1872 (Am. Ass. Adv. Sci. Proc. 20th meeting, p. 32). The peculiar gneisses and mica schists of White Mtn series appear to be developed to great extent in Newfoundland, which has led me to propose for them the name *Terranovan system*.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 218). T. S. Hunt (Am. Jour. Sci., 3d, vol. 1, 1870, p. 87) gave name *Terranovan* to the strata btw. Laurentian gneisses and the fossiliferous Camb. strata. Later (Chem. and geol. essays, 1875, p. 194) he restricted the name to the gneissic series and did not consider the upper series. *Avalon* is now proposed for the fms. btw. basal beds of Camb. and the Archean gneisses of Newfoundland. Type loc. is Avalon Peninsula.

Terra nova is Latin for *Newfoundland*.

Terry limestone. (In Hinton formation.)

Mississippian: Southern West Virginia.

C. E. Krebs and D. D. Teets, Jr., 1916 (W. Va. Geol. Surv. Rept. Raleigh and western Mercer and Summers Counties, p. 69). *Terry ls.*—Gray ls., with marine fossils, 1 ft. thick at Terry, Raleigh Co., where it lies 346 ft. below top of Mauch Chunk sh. and is underlain by an undet. thickness of Mauch Chunk strata.

R. V. Hennen and D. D. Teets, Jr., 1919 (W. Va. Geol. Surv. Rept. Fayette Co., pp. 113, 335). *Terry ls.* lies 10 to 14 ft. below Princeton cgl., the intervening beds being gray sh. [later named Terry sh.]. Author believes *Terry ls.* is same as Upper Hinton ls. of Krebs.

Terry sandstone member (of Pierre shale).

Upper Cretaceous: Central northern Colorado (Larimer County).

M. W. Ball, 1924 (A. A. P. G. Bull., vol. 8, No. 1, pp. 81–87). *Terry ss.* was named and mapped [unpublished repts] by A. T. Schwennensen, E. W. Krampert, and C. H. Henley. It is 16 ft. thick, lies 604 ft. below Rocky Ridge ss. and 383 ft. above Hygiene ss. Forms part of the island in Terry Lake and also helps to form two of the promontories jutting into the lake. [See 1924 entry under *Hygiene ss.*]

K. F. Mather, J. Gilluly, and R. G. Lusk, 1928 (U. S. G. S. Bull. 796B). *Terry ss. memb. of Pierre sh.* is 0 to 20 ft. thick, lies 200 to 400 ft. above Hygiene ss. and 300 to 600 ft. below Rocky Ridge ss. Closely resembles Hygiene ss. but is much thinner and not nearly so persistent along the strike of the beds.

Terry shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Tazewell County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 295, 330). *Terry sh.*—Greenish-brown sandy sh. with occasional lentils of coal and streaks of red sh. Contains plants. Thickness 10 to 50 ft. Top memb. of Hinton group [fm.]. Overlies Terry ls. and underlies Princeton cgl. or ss. Named for association with Terry ls. Observed in Mercer and Summers Counties, W. Va., and in Tazewell Co., Va.

Tertiary period (or system).

The time (and the rocks) of the older period of Cenozoic era, following the Cretaceous system and preceding the Quaternary system. For definition see U. S. G. S. Bull. 769, pp. 49–56. Also see under †*Primitive*.

Tertic.

A variant of Tertiary employed by some geologists.

Tesnus formation.

Pennsylvanian: Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 45). *Tesnus fm.*—Consists of ss., sh., chert, and a few lenticular layers of cgl., with, at base, Rough Creek sh. memb. Thickness of fm. 3,370 ft. Underlies Dimple fm. and uncon. overlies Santiago chert (Miss. ?). Named by Baker.

C. Schuchert, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 383–400). It is generally held that the local *Tesnus* and *Dimple* fms. are older than and uncon. underlie *Gaptank fm.*, but there is no convincing evidence this is so, and it may well be that the first-named fms. are only a nearer-shore phase, to SE., of the Gaptank. The Tesnus has almost no fossils, while those of the Dimple do not indicate more than Penn. time. Fossils collected by Baker and Bowman in lss. supposed to be of Dimple age I believe belong to Gaptank fm. The Gaptank fossils indicate the time to be at least = Canyon and lower Cisco. The Tesnus may = Strawn, or even Strawn and Bend.

but fossils must be found before definite correlations can be made. The *Dimple* may be of Strawn age. The Haymond is at best but part of the Tesnus.

P. B. and R. E. King, 1928 (Univ. Tex. Bull. 2801). Gaptank fm. grades into underlying Haymond fm., which clearly overlies and grades into Dimple fm., which in turn overlies and grades into Tesnus fm.

Named for exposures at and around Tesnus, Brewster Co.

Tessey limestone.

Permian: Western Texas (Brewster County).

J. A. Udden, 1917 (Univ. Tex. Bull. 1753, p. 53). *Tessey fm.*—Mostly unstratified dolomitic rock, quite like Vidrio in general appearance. In places has well-marked bedding planes and in places is brecciated. Considerable part of rock is only slightly dolomitic; some of fm. is finely oolitic and in thin sections showed shreds of Bryozoa and a few minute Foraminifera. In its upper part near mouth of canyon one layer is entirely calc. and contains abundant *Fusulina*. Thickness 1,400 ft. Uncon. overlain by Comanchean Cret. Grades into underlying Gilliam fm. Named for post office once located about 2 mi. N. of mouth of Gilliam Canyon but now defunct.

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 73–84). The strata overlying Word fm. and underlying Bissett fm. in Glass Mtns are herein referred to *Capitan fm.* They were originally divided by Udden into 3 units (descending)—*Tessey, Gilliam*, and *Vidrio fms.* They were subdivided along Gilliland Canyon, where they are separable into massive dol. below (Vidrio), thin-bedded dol. in middle (Gilliam), and massive dol. above (Tessey). The work of R. E. King and writer has shown that the 3 subdivisions established by Udden are local phases of the interfingering of different facies. The natural units in W. part of Glass Mtns do not correspond in age to those in the E., and neither those in E. or W. have any more than a local significance. For this reason it is here proposed to use the general term *Capitan fm.* for these rocks, and to reduce the Vidrio, Gilliam, and Tessey to the rank of members of this fm. Tessey memb. is 100 to 1,050 ft. thick; Gilliam memb. is 500 to 873 ft. thick; and Vidrio memb. is 600 to 1,200 ft. thick. In W. part of Glass Mtns the equivalents of Tessey memb. and upper part of Gilliam memb. appear to have been removed by erosion, and the upper massive memb. of Capitan fm., 215 to 800 ft. thick, is believed to correspond to lower part of Gilliam and upper part of Vidrio. Beneath this upper memb is *Altuda memb.*, consisting of 450 ft. of thin-bedded brown dolomitic ls., sandy ls., and siliceous sh., which merges into massive dol. a short distance E. of Old Blue Mtn, and is not represented as such in Gilliland Canyon. Beneath the Altuda lies the lower massive memb. of Capitan fm., 85 to 300 ft. thick.

P. B. King, 1933 (Historical geol. of R. C. Moore, p. 325), substituted *Glass Mtns fm.* for the rocks to which he in 1931 applied the name *Capitan* fm., and called the subdivisions *Tessey massive ls. memb., Gilliam thin-bedded ls. memb., Vidrio massive ls. memb.*, and *Altuda siliceous sh. memb.*

The name *Glass Mtns* being preoccupied, and the deposits designated by that name being the southern extension of Capitan ls., they are designated by latter name by U. S. Geol. Survey. (See P. B. King, 1934, Geol. Soc. Am. Bull., vol. 45, pp. 697–798.)

The Survey's present approved definition of *Tessey ls.* treats the beds as a distinct fm., instead of including them in Capitan ls. (See U. S. G. S. P. P. 187, by P. B. King, in press.)

Tetagouche series.

Ordovician: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 28).

Tetelna volcanics.

Carboniferous: Southeastern Alaska (central Copper River region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 36, map). *Tetelna volcanics.*—Intrusive diorites, andesitic lavas, diabase dikes, some altered sediments, and porous greenish qtzite. [Derivation of name not stated, and map shows no geographic feature of that name, but the fm. is mapped along Indian Creek, the Indian name of which is Tetelna.]

Teton formation.

Triassic and Permian: Yellowstone National Park, Wyoming.

W. H. Weed, 1896 (U. S. G. S. Yellowstone Park folio, No. 30). *Teton fm.*—Top memb. a ss., generally bright yellow, with red weathered surface; next below is a red aren. sh., which rests on gray and greenish calc. shales, often micaceous; basal memb. is ss., usually of dull-brown color and more or less calc., characterized by rods and rolls of white chert and carrying interbedded gray lss. containing linguloid shells. Overlain by Ellis fm. and underlain by Quadrant qtzite. Named for Teton Range [to SW. of Yel. Park]. Is thinner at N. end of Teton Range and in Gallatin Range (in NW. corner of park, where it is 200 ft. thick) than in Snake River region (in southern part of park), where it is 400 ft. thick.

Tetrazoic.

A time (life) term applied by E. Hitchcock (Geol. Vt., 1861, vol. 1, p. 19) to Cret. system.

Tetro limestone.

Mississippian: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Tetro ls.*—Hard fine-grained blue cherty ls., 355 ft. thick, underlying Humbug ls. and overlying 160 ft. of carbonaceous sh. or shaly ls., in Tintic dist.

This ls. forms a part of Pine Canyon ls. It was evidently named for Tetro mine.

Teutonic limestone.

Middle Cambrian: Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Teutonic ls.*—Descending: (1) Dark-gray finely banded argill. ls., cross-bedded in upper part, weathering light gray, 114 ft.; (2) dark-blue ls. with countless veinlets, 77 ft.; (3) fault breccia, 30 ft.; (4) dark bluish-gray ls. with countless veinlets, 170 ft.; (5) dark bluish-gray ls., thinly bedded, ribboned, or mottled with bands or small blotches of yellowish-brown argill. material, 175 ft. Total 566 ft. Underlies Dagmar ls. and overlies Ophir fm. Named for Teutonic Ridge.

Texado group.

Age (?): British Columbia.

O. E. Le Roy, 1908 (Canada Dept. Mines Geol. Surv. Branch Pub. 996, p. 12). Devono-Carbf.

J. G. McConnell, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 70), Triassic (?), and 1914 (Mem. 58, p. 21), Jurassic (?); E. M. J. Burwash, 1918 (Geol. of Vancouver and vicinity), Carbf.; C. O. Swanson, 1925 (Canada Geol. Surv. Summ. Rept. 1924, pt. A, p. 109), Jurassic (?).

†Texan system.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lvii, 276–282). *Texan system.*—At base sandy shales and mica schists (Mason series); in middle qtzites and sss. (Llano series, restricted sense); at top shaly beds and marble (Packsaddle series). Uncon. underlies Camb. and overlies Archean group. Assigned to Eparchean group. Covers period marked by great eruptions of igneous matter, intrusive and extrusive.

Conflicts with Llano series, older name.

Named for State of Texas.

†Texana limestone.

Paleontologic name applied in some early repts to Walnut clay (Lower Cret.) of Tex.

Texas Creek granodiorite.

Jurassic or Cretaceous: Southeastern Alaska (Hyder district).

A. F. Buddington, 1929 (U. S. G. S. Bull. 807, pp. 22–27, 58–60, maps, etc.). The porphyritic granodiorite composing the Texas Creek batholith and forming basal part of the Coast Range intrusives. Named for occurrence along Texas Creek.

Texhoma-Gose sand.

See *Gose sand*.

Texhoman series.

Name introduced by C. R. Keyes to include the late Tert. deposits of Kans. (See Iowa Acad. Sci. Proc., vol. 22, 1915, p. 255.)

†Texian system.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 562-563, 658-659). *Texian or Algonkian system*. Includes Mason, Llano [narrow usage], and Packsaddle series.

Same as Texan system of Comstock and Dumble 1890, and same as Llano series of present usage.

Texon sand.

A subsurface oil-producing zone in Clear Fork fm. of Big Lake dist., N. of town of Texon, Reagan Co., Tex. Lies 50 to 100 ft. below Big Lake lime, and 2,845 to 3,137 ft. below surface.

Thane volcanic group.

Lower or Middle Jurassic (?): Southeastern Alaska (Juneau region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 247, 251-252, chart opp. p. 270). *Thane volcanic group*.—In descending order, melaphyre tuff, ls., and interbedded tuff and sl., probably 5,000± ft. thick. Underlain, apparently conformably, by Gastineau volcanic group (Upper Triassic). Believed to be directly overlain by Treadwell sl. (Upper Jurassic?), but Gastineau Channel separates the 2 fms. No fossils. Tentatively referred to Lower or Middle Jurassic.

The settlement of Thane, on Gastineau Channel, lies in midst of these rocks.

Thanet gabbro.

Pre-Cambrian: Ontario.

F. D. Adams and A. E. Barlow, 1910 (Canada Geol. Surv. Mem. 6, p. 150).

†Thayer shale. (In Kansas City formation.)

Pennsylvanian: Eastern Kansas and northwestern Missouri.

E. Haworth, 1895 (Kans. Univ. Quart., vol. 3, p. 276 and pl. opp. p. 290; Am. Jour. Sci., 3d, vol. 50, p. 459 and pl. opp. p. 466). *Thayer shales*.—Shales and sss., with two or more coals, 20 to 200 ft. thick, underlying Iola ls. and overlying Erie or Triple ls. system.

Same as Chanute sh., broad usage, according to H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13); same as Chanute sh. restricted, according to N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 49). But R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 75), states it is=Fontana-Chanute shales.

Named for exposures at Thayer, Neosho Co., Kans.

Thaynes limestone (also **Thaynes group**).

Lower Triassic: Northeastern Utah, southwestern Wyoming, and southeastern Idaho.

J. M. Boutwell, 1907 (Jour. Geol., vol. 15, pp. 439-458). *Thaynes ls.* (also *Thaynes fm.*).—Essentially a calc fm. Comprises two parts separated by a red-sh. memb., each made up of ls., calc. ss., normal ss., and sh. Most of true lss. are in upper part, and sss. predominate in lower part, though each type is found throughout. A very characteristic rock occurring at many horizons is a dense, homogeneous blue-gray calc. ss., which appears superficially to be a ls. but on exposure loses its low calc. content and becomes a medium fine-grained brown ss. [Detailed section in Park City dist., Utah, given; fossils listed.] Thickness 1,190 ft. Underlies Ankareh sh. (red) and overlies Woodside sh. (red). Named after Thaynes Canyon, whose deep and extended incision affords best exposures of the fm. in Park City dist., Utah.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56, pp. 50+, chart opp. p. 50, map, pl. 3, etc.). *Thaynes fm.*—In SW. Wyo. consists of very fossiliferous gray lss. and thin-bedded yellow sss., containing abundant fauna. Thickness in SW. Wyo. 2,400 to 2,600+ ft. Conformably underlies Nugget fm. and conformably overlies Woodside fm.

J. M. Boutwell, 1912 (U. S. G. S. P. P. 77, p. 55, pls. 2, 5). *Thaynes fm.*—Essentially calc. Comprises two parts separated by a red sh. memb., each made up of ls., calc. ss., normal ss., and sh. Most of true lss. are in upper part and sss. predominate in lower part. A characteristic rock at many horizons is a very fossiliferous dense, homogeneous blue-gray calc. ss. which appears superficially to be a ls. Thickness of fm. in Park City dist., Utah, 1,290± ft.; the upper part 630± ft.; the middle red sh. memb. 115± ft.; and lower part 445± ft. Conformably underlies Ankareh sh. (red) and overlies Woodside sh. (dark red). [Fossils listed.] Extends into Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492). *Thaynes* deposits in Fort Hall Ind. Res., SE. Idaho, become a *group*, divisible into 3 fms., here named (descending) Portneuf ls., 1,500± ft. thick; Fort Hall fm., 800± ft. thick; and Ross [*Ross Fork* now] ls., 1,350± ft. thick.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 35). *Thaynes group* (including Portneuf ls., Fort Hall fm., and Ross ls.) underlies Ankareh ss. and overlies Woodside sh. in Fort Hall Ind. Res., SE. Idaho.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713), replaced *Ankareh ss.*, as used by him in previous repts, with *Timothy ss.*, and explained that the lithologic unit called by him *Thaynes group* in SE. Idaho corresponds to *Thaynes fm.* as used by Veatch in SW. Wyo., and also corresponds to *Thaynes ls.* of Boutwell in Park City dist., Utah, but includes at top lss. that are equiv. in time to basal part of Boutwell's Ankareh sh. of Park City dist., Utah.

Thebes sandstone. (Of Richmond group.)

Upper Ordovician: Southwestern Illinois and southeastern Missouri.

A. H. Worthen, 1866 (Ill. Geol. Surv. vol. 1, p. 139). *Thebes ss.*—Regularly bedded brown ss., sometimes massive; well exposed in bluffs at town of Thebes. Included in Cincinnati group. Separated from overlying Cape Girardeau ls. by brown sandy shales and underlain by 5 ft. of yellowish-brown sh. resting on Trenton ls.

In many subsequent early Ill. and Mo. repts the brown sandy sh. referred to above was included with the ss. under name *Thebes ss. and sh.* and, later, *Thebes fm.* Worthen himself in 1868 (Ill. Geol. Surv. vol. 3, pp. 20-29) used *Thebes ss. and sh.* In 1909, however (Am. Jour. Sci., 4th, vol. 28, p. 515), Savage named the sh. *Orchard Creek sh.*, restricted *Thebes* to the ss., and reported an uncon. btw. the sh. and the ss. The name of the ls. referred to above was many years ago shortened to *Girardeau ls.* The Orchard Creek sh. is now classified as early Sil. and Thebes ss. as Upper Ord. (Richmond). The ls. underlying Thebes ss. has long been known as *Fernvale ls.* The Thebes is contemp. with lower part of Maquoketa sh.

Named for Thebes, Alexander Co., Ill.

The Dalles beds.

The Dalles group.

The Dalles formation.

See *Dalles fm.*

Theresa dolomite.

Upper Cambrian: Central to eastern New York.

H. P. Cushing, 1908 (Geol. Soc. Am. Bull., vol. 19, pp. 159-160). *Theresa fm.*—Somewhat calc. sandy dolomites with interbedded weak sss., especially near base. Thickness 20 to 70 ft. Very closely related to underlying Potsdam ss. and formerly included in Potsdam but here separated as distinct fm. Base drawn at base of first dol. layer. Uncon. overlain by Pamelia ls. (of late Chazy age) in Theresa and Alexandria Bay quads., Jefferson Co. Named for Theresa Twp, in which it is exposed in its entirety.

J. M. Clarke, 1908 (N. Y. State Mus. Bull. 121, pp. 11-13). *Theresa fm.* (*so-called "passage beds"*).—A dol. fm. quite like the rocks which elsewhere immediately overlie

Potsdam ss. around the Adirondacks and which have been regarded and mapped as passage beds into Beekmantown fm. Seems to hold a fauna not before recognized in State. Beekmantown is absent in Theresa and Alexandria quads., and Theresa fm. is uncon. overlain by Pamelia ls. [of Chazy age].

In 1910 (N. Y. State Mus. Bull. 140, pp. 11–12) J. M. Clarke applied *Galway fm.* to passage beds btw. Potsdam ss. [restricted] and Little Falls dol. in Broadalbin quad., Fulton and Saratoga Counties, while on pp. 99 and 127 of same Bull. (140) E. O. Ulrich and H. P. Cushing applied *Theresa fm.* to passage beds btw. Potsdam ss. and Little Falls dol. of Mohawk Valley, which they described as consisting of alternating vitreous ss., calc. ss., and gray, usually somewhat sandy dolomites. In N. Y. State Mus. Bull. 145, 1910, H. P. Cushing applied *Theresa dol.* to beds above Potsdam ss. in Thousand Islands region, which he stated are overlain, everywhere uncon., by Little Falls dol. In 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27) E. O. Ulrich showed *Upper Theresa*, as he called it, as=Tribes Hill ls. and separated from *typical Theresa* by an enormous hiatus representing 5,000 ft. of strata deposited elsewhere. The same year (N. Y. State Mus. Bull. 153, pp. 8–38 and map) W. J. Miller applied *Theresa fm.* to 200 ft. of beds btw. Potsdam ss. and Little Falls dol. in Broadalbin quad., which J. M. Clarke in 1910 called *Galway fm.* In 1914 (N. Y. State Mus. Bull. 169) H. P. Cushing and R. Ruedemann transferred to Theresa fm., under name *Hoyt ls. memb.*, the basal 100 ft. of Little Falls dol., consisting of thick-bedded dol. and ls. with black oolite, which are "now considered a phase of upper part of Theresa fm." In 1916 (N. Y. State Mus. Bull. 191) Cushing included in Theresa fm., toward its top, a ss. to which G. H. Chadwick had in 1915 applied name *Heuvelton (20-foot) ss.* and treated as a fm. distinct from underlying "*Theresa mixed beds or fm. as restricted by Ulrich.*" But Cushing stated: There is some evidence this Heuvelton ss. and some overlying beds, as well as 0 to 40 ft. of beds underlying this ss., will have to be separated from upper part of Theresa fm., but evidence is not yet decisive, and lithologically these beds are much like underlying typical Theresa, although they occupy time interval of Little Falls dol. He also applied *Theresa* to the beds beneath these doubtful strata, and stated they seem to be exact equiv. of typical Theresa of Theresa quad. In 1920 (N. Y. State Mus. Bull. 217, 218) G. H. Chadwick mapped *Heuvelton white ss.* as a distinct fm., but stated that it seems linked stratigraphically with Theresa below, though its few fossils suggest a later age, and that in Canton quad. it is apparent summit of Theresa fm., and not a lentil in Theresa, as Cushing found to W. He assigned Theresa to "Upper Cambrian (Saratogan, Ozarkian of Ulrich)," and gave its thickness as probably btw. 50 and 100 ft. R. Ruedemann, 1929 (Geol. Soc. Am. Bull., vol. 40, No. 2, pp. 412, 414), 1930 (N. Y. State Mus. Bull. 285, p. 27), and 1933 (16th Int. Geol. Cong. Guidebook 1, p. 17) did not exclude *Hoyt ls.* from *Theresa fm.* But W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 191, 239), excluded *Hoyt ls.* from *Theresa fm.* and included it in Little Falls dol.

The U. S. Geol. Survey treats Hoyt ls. as a memb. of Theresa dol. and classifies Theresa and overlying Little Falls dol. as Upper Camb.

Theresa syenite.

Pre-Cambrian: Northeastern New York (Theresa quadrangle).

H. P. Cushing et al., 1910 (N. Y. State Mus. Bull. 145, p. 38, map). *Theresa syenite*, of early pre-Cambric age but younger than Laurentian granite gneiss. A small intrusive mass, less than 2 mi. in length and less than ½ mi. broad, lying S. of Theresa.

Thermopolis shale. (Of Colorado group.)

Upper Cretaceous: Central northern Wyoming and central southern Montana (Stillwater-Rosebud Counties region).

C. T. Lupton, Jan. 21, 1916 (U. S. G. S. Bull. 621, p. 168). *Thermopolis sh.*—A mass of generally shaly rocks, limited below by top of upper ss. bed (Greybull sand of drillers) of Cloverly fm. and above by base of Mowry sh., with both of which fms. it is conformable. Thickness 700± ft. Consists of dark-colored sh. containing one or more lenticular beds of ss., the most persistent of which is the Muddy sand, well known to oil operators, which is 15 to 55 ft. thick and lies 210 to 330 ft. above top of Greybull sand. Named for exposures near town of Thermopolis, Hot Springs Co., Wyo.

D. F. Hewett and C. T. Lupton, 1917 (U. S. G. S. Bull. 656, p. 19). *Thermopolis sh.*—Mainly dark sh., 400 to 800 ft. thick, sandy near its top and base, and containing a persistent bed of ss. near its middle. The sandy beds, 100 ft. or more thick, near base have been termed "rusty beds" by Washburne (U. S. G. S. Bull. 340, p. 350, 1908), [who treated them as basal memb. of Colorado fm. in Bighorn Basin, Wyo.]. Overlies Cloverly fm., of which Greybull ss. is top memb.

In U. S. G. S. P. P. 149, p. 64, 1927, W. T. Lee included in his Greybull ss. the rusty beds described above as basal part of Thermopolis sh. R. S. Knappen and G. F. Moulton, 1931 (U. S. G. S. Bull. 822, pp. 23–28) included the rusty beds in Thermopolis sh. and treated Greybull ss. as top memb. of Cloverly fm. This is present approved definition of Thermopolis sh., except that in Black Hills region the 10 to 50 ft. of dark-gray sh. and sandy sh. to which Collier applied name *Nefsy sh. memb. of Graneros sh.*, and which represents upper part of Thermopolis sh., is now included in Mowry sh., and *Nefsy* has been abandoned. This constitutes a local redefinition of Mowry sh. and Thermopolis sh.

Thessalon group.

Pre-Cambrian (Keewatin): Western Ontario (north shore of Lake Huron).

A. Winchell, 1888 (4th Int. Geol. Cong., London, Am. Comm. Repts, p. A14). *Thessalon red qtzite*, Huronian, Canada.

A. E. Barlow, 1893 (Geol. Soc. Am. Bull., vol. 4, p. 328). *Thessalon schists*, Huronian, Ont.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52). *Thessalon group.*—Greenstones and green schists mapped by Logan and Murray as "Huronian sl." are of Keewatin age.

†Theta subdivision.

A Greek name applied by F. W. Cragin (U. S. G. S. Bull. 266, 1905) to basal 250 ft. of Malone fm. of Malone Mtn, El Paso Co., Tex.

Thetford series.

Age (?): Quebec.

J. A. Dresser, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 188). [Age not assigned.]

R. Harvie, Jr., 1913 (12th Int. Geol. Cong. Guidebook 2, p. 104), assigned to pre-Camb. (?).

J. K. Knox, 1918 (thesis, Univ. Chicago, p. 33), assigned to post-Ord.

Thetis group.

A name applied by A. J. Collier (U. S. G. S. Bull. 259, 1905, p. 179) to a group of coal beds mined at Thetis mine, E. of Cape Lisburne, Alaska, which are now classified by U. S. Geol. Survey as of Upper Cret. age.

Thibert series.

Triassic: British Columbia.

F. A. Kerr, 1926 (Canada Geol. Surv. Summ. Rept. 1925, pt. A, p. 84).

Thiensville formation.

Devonian: Southeastern Wisconsin (Ozaukee and Milwaukee Counties).

E. R. Pohl, 1929 (Pub. Mus. City Milwaukee Bull., vol. 11, pp. 7–8). Milwaukee fm. rests discon. on *Thiensville fm.* (provisional) of Raasch [ms.]. The position of the provisional *Ozaukee* and Thiensville fms. of Raasch[ms.] is to N., about 30 mi. from Milwaukee, occupied by *Lake Church fm.* (provisional of Raasch), but since the types of animal life in either are entirely distinct they must not be considered as equiv. nor are they contemp. Although in no place is the complete section of latter seen, these beds are about 12 ft. thick, and from them have come some of most interesting pelecypods of region. [These fms. are not defined.]

E. R. Pohl, 1930 (Tenn. Acad. Sci. Jour., vol. 5, p. 56), showed Dev. of Wis. as divided into Milwaukee fm., uncon. on *Lake Church fm.*, in turn uncon. on *Ozaukee fm.*, and dropped *Thiensville* from classification. "The Ozaukee and Lake Church fms. are probably previous invasions from same directions." "*Ozaukee* is ms. name of Raasch, who is at present considering the strat. interrelationships of Dev. fms. of Wis."

G. O. Raasch, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 260, 262–264). *Thiensville fm.* (*novum*).—Mainly dol. of dark-chocolate, light-chocolate, or brownish-gray color, which may be massive and vesicular or finely laminated. In general moderately thick-bedded. Ranges from extremely firm and compact to highly porous. Many layers have bituminous odor. Thickness 50–65 ft. Fossils remain largely undescribed. In Ozaukee Co. rests on Lake Church fm. (Dev.), but S. of Ozaukee-Milwaukee Co. line it lies on Sil. Differs distinctly, lithologically and faunally, from Lake Church fm. and from overlying Milwaukee fm. [Middle Dev.]. Has been removed by post-Dev. erosion N. of type loc., which is cut on highway 57, 2 mi. N. of Thiensville, Ozaukee Co. Surface outcrops were formerly generally confused with Niagaran, and in subsurface borings it was formerly confused with the Waubakee.

Thomas clay. (In Conemaugh formation.)

Pennsylvanian: Western Maryland (Georges Creek Basin).

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 7). *Thomas clay* lies short distance below Lower Bakerstown (Thomas) coal in Georges Creek Basin.

Thomas limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 60, 119, pl. 6). *Thomas ls.*—A thin fresh-water ls. Underlies fire clay beneath Lower Bakerstown (Thomas) coal and overlies Pine Creek ls. in Upper Potomac Basin, Md. Named for its position beneath Thomas coal. [On p. 119 it is stated that *Thomas ls.* is thin ls. in fire clay, that it is 10 ft. thick, and that it rests on Buffalo ss.]

Thomas sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland and northeastern West Virginia.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 60, 119, pl. 6). *Thomas ss.*—Rests on Lower Bakerstown (Thomas) coal and lies a short distance below Cambridge red bed in Upper Potomac Basin, Md. Is of variable thickness; 25 ft. thick in Upper Potomac Basin. Is named for its position above Thomas coal.

D. B. Reger, 1924 (W. Va. Geol. Surv. Rept. Mineral and Grant Counties). The name "Thomas" ss. is a misnomer. The ss. that outcrops at Thomas, Tucker Co., W. Va., is Saltsburg ss., which overlies Upper Bakerstown coal. It would have been much better to apply name *Lower Saltsburg ss.* to the ss. that occurs in interval btw. Upper and Lower Bakerstown coals.

Thomas sand.

A subsurface sand, of Penn.(?) age, in central southern Okla., lying lower than Smith sand and correlated with Brown sand. The name has also been applied to a sand in Thomas pool, Kay Co., central northern Okla., lying at 2,055 ft. depth and immediately above Pawhuska lime.

Thomas Hill shale.

Pennsylvanian: Northeastern Missouri.

H. A. Wheeler, 1893 (Mo. Geol. Surv. Sheet Rept. 2 (vol. 9), p. 63). *Thomas Hill shales.*—Three sh. beds, aggregating 50 to 55 ft., btw. Bevier coal below and Summit coal above at Thomas Hill. [As thus described it would include Macon City sh. of C. H. Gordon.]

A part of Cherokee sh.

Named for exposures at Thomas Hill, Randolph Co.

Thomas Hill fire clay.

Under clay of Summit coal, in Cherokee sh. of NE. Mo. Named for Thomas Hill, Randolph Co.

Thomaston granite gneiss.

Ordovician (?): Western and western central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 109-110 and map). *Thomaston granite gneiss.*—A number of masses of gneissoid granite, some of considerable size, one of the larger of which occurs in Thomaston. Foliation unevenly developed, and rock varies from almost massive granite to distinctly schistose phases. Where least metamorphosed, as at Plymouth quarry at Thomaston and at places on Candlewood Mtn, the rock is remarkably white, has medium grain, and is flecked by numerous small scales of mica (biotite). Locally, as in Wilton area, it is distinctly porphyritic, with phenocrysts of microcline. Is of igneous origin. Often occurs as dikes.

H. S. Palmer, 1921 (U. S. G. S. W. S. P. 466, pp. 144, 179). *Thomaston granite gneiss* is later than Hoosac schist.

W. M. Agar, 1934 (Am. Jour. Sci., 5th, vol. 27, pp. 354-373). Age of *Thomaston granite gneiss*, as derived from radioactive minerals in its accompanying pegmatites, is late Ord.

Thomonde beds.

Miocene: Haiti.

W. F. Jones, 1918 (Jour. Geol., vol. 26, p. 736).

Thompson limestone.

Middle Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370-394). *Thompson ls.*—10 to 30 ft. of ls., gray above and red below. Its position everywhere appears to clearly indicate that it lies btw. Mormon and Hardgrave sss.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Thompson ls.*—Gray and red ls. lentils in calc. sh. Thickness 10 to 30 ft. Appears to conformably overlie Mormon ss. Rests on Fant meta-andesite, which in turn is younger than Hardgrave ss.

Named for exposures on Thompson's ranch, on W. slope of Mount Jura, E. of Taylorsville, Plumas Co.

†Thompson slate.

Pre-Cambrian: Minnesota.

See *Thomson sl.* (the correct spelling). N. H. Winchell, in Minn. Geol. and Nat. Hist. Surv. Final Rept., vol. 4, 1899, heading on p. 551, used, evidently inadvertently, *Thompson sl.* for the fm. which on pp. 7, 551, and other pages he spelled *Thomson sl.*, the name of the town for which it was named. Winchell's typographic error on p. 551 was, unfortunately, perpetuated on p. 389 of U. S. G. S. Bull. 191.

Thompson dolomite.

Cambrian: Alberta.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 42, p. 288). *Thompson dol.*—Dolomites, 600 ft. thick, underlying Paget oolites and overlying Bosworthian series. [Apparently the upper dolomitic part of Upper Camb. Bosworth fm.]

Derivation of name not stated.

Thompson red shale.

Middle Jurassic: Northern California (Mount Jura).

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81). [See under *Combe ss.*]

Thompson Canyon sandstone bed. (In Price River formation.)

Upper Cretaceous: Central eastern Utah (Book Cliffs).

D. J. Fisher, 1935 (U. S. G. S. Bull. 852). *Thompson Canyon ss. bed.*—Massive, faintly cross-bedded straw-colored ss. that weathers into rounded surfaces. Thickness 10 to 15 ft. Included in Neslen coal-bearing memb. of Price River fm. Is older than Bluecastle ss. bed to W. and lies about 15 ft. lower than Sulphur Canyon ss. bed to E. Directly overlies Ballard coal zone and lies 0 to 50 ft. below Chesterfield coal zone. Named for Thompson Canyon.

†Thompson Creek beds.

Oligocene (lower): Western central Montana (Broadwater County, Helena-Boulder region).

E. Douglass, 1902 (Am. Phil. Soc. Trans., vol. 20, n. s., pt. 3, pp. 237–245). *Thompson Creek beds*, the White River (Olig.) deposits on Thompson Creek [3 mi.] NW. of Three Forks. Apparently belong to lower White River or *Titanotherium* horizon, but may belong in part to *Oreodon* horizon. Local name given until correlation is established.

H. F. Osborn, 1909 (U. S. G. S. Bull. 361, p. 103). Beds on Thompson Creek, Mont., are lower Olig. *Titanotherium* zone.

Thompson River silts.

Pleistocene: British Columbia.

R. A. Daly, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 166).

†Thomson slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Carlton County) and northwestern Wisconsin.

J. E. Spurr, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 159–166). *Thomson slates (St. Louis slates, Cloquet slates)*.—Schistose or slaty rocks continuously exposed along St. Louis River not far from Duluth, near Thomson, Carlton, and Cloquet, Minn. Have already been called St. Louis, but that name is preoccupied. So *Thomson* (already used [in ms.?] by Prof. N. H. Winchell) is adopted.

N. H. Winchell, 1899 (Minn. Geol. and Nat. Hist. Surv. Final Rept. vol. 4), described this fm. under heading (p. 551) *Thompson sl.*, but on pp. 7, 551, and throughout his rept. he used *Thomson sl.*, the name subsequently used by other geologists and the name of the town in Minn. for which it apparently was named.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, pl. 14), mapped the sl., graywacke, schist, qtzite, and ls. of Carlton, Thomson, and St. Louis River, in St. Louis and Carlton Counties, Minn., as Virginia sl.

Thomson moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Thomson, Carlton Co.

Thorn Creek gas sand.

Drillers' term for a sand in Pocono fm. of Butler Co., Pa., which lies about 100 ft. above Butler 2d sand.

Thorn Hill formation.

Ordovician (Lower): Northeastern Tennessee (Morristown quadrangle).

G. M. Hall and H. C. Amick, 1934 (Tenn. Acad. Sci. Jour., vol. 9, No. 2, pp. 158–161). *Thorn Hill fm.*—Approx. 524 ft. 4 in. of dol. with very subordinate amounts of sh. of different colors. The dol. is in fairly massive beds, some of which contain openings more or less completely filled with dol. crystals. Some beds are cherty. Predominantly light-colored, but some beds are rather dark-hued. Base is marked by a sandy dol. which is very inconspicuous when fresh but which weathers to rusty porous ss. Thorn Hill post office is on the highway about ½ mi. from type exposure. Underlies Mosheim ls. and overlies Forked Deer ls. Is approx.=Cotter fm. of Ozark region. Section studied is along U. S. Highway 25E. btw. Indian Creek and Bean Gap.

Thornton fire clay. (In Conemaugh formation.)

Pennsylvanian: Northern West Virginia, western Maryland, and eastern Ohio.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 322). *Thornton fire clay*.—Lies just under Mahoning coal and occasionally replaces it; overlies Mahoning ls. Thickness 0 to 6 ft. Named for Thornton, Taylor Co., W. Va. [In places he shows 19 ft. of fire clay overlying Lower Mahoning ss. and calls it *Mahoning fire clay*.]

Is a bed in Mahoning ss. memb. of Conemaugh fm.

Thorofare andesite.

Silurian (post-Niagaran): Central southern Maine (Penobscot Bay region).

G. O. Smith, 1896 (Geology of the Fox Islands, Maine, pp. 12, 30–45). *Thoroughfare volcanics.*—Red, gray, and purple volcanic rocks, occupying greater part of two southern peninsulas of North Haven and continuing across the Thoroughfare to NE. shore of Vinal Haven and NW. part of Calderwood's Neck. Consist of lavas and pyroclastics, in approx. following (ascending) succession: (1) Dark-gray pyroxene andesite and andesite porphyry; (2) volcanic cgl., which to S. and W. grades into breccias showing both tuffaceous and flow characters; (3) red basaltic andesites; (4) more acid hornblende andesite; (5) interbedded acid and basic tuffs and amygdaloidal flows; (6) quartz porphyry tuffs and small amounts of quartz porphyry. Conformably underlie Vinalhaven rhyolite.

G. O. Smith, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 7). *Thorofare andesite.*—Name applied to rocks earlier described and mapped as *Thoroughfare volcanics.* Assigned to Sil. Are of post-Niagara age—probably late Sil.

Named for development on shores of Fox Island Thorofare, btw. North Haven and Vinalhaven Islands, Penobscot Bay region.

Thorold sandstone member (of Albion sandstone).

Silurian (early): Western New York and western Ontario.

A. W. Grabau, 1913 (Geol. Soc. Am. Bull., vol. 24, pp. 431, 460–463). [*Thorold ss.* on p. 431; *Thorold qtzite* on p. 460.] The *upper gray* or *Thorold ss.* [the "Grey band" of the Medina] separates the red Medina beds from overlying Clinton. Will be called *Thorold qtzite*, from exposure at Thorold, Ont., on Welland Canal. Is traceable eastward to Rochester and Oswego, occurring everywhere at top of the Medina. Beyond Oswego it is represented by Oneida cgl. Is 10 to 12 ft. thick in western N. Y. but in Nottawassaga Twp, Ont., it is said to be 35 ft. thick. Along Niagara Gorge consists of 7½ ft. of hard, massively bedded, compact quartzose ss. resembling Whirlpool ss. and commonly showing irregular cross-bedding; sometimes a thin basal bed is separated by a few in. of reddish sh. from the main mass. Rests on Medina red sss. and is overlain by Sodus sh. (6 ft. of olive-green to grayish, sometimes purplish-gray sh.) [which he included in the Medina, although it had previously been included in Clinton, and is still included in that fm.].

In Niagara folio (No. 190, 1913) of U. S. Geol. Survey the *Thorold ss.* was treated as topmost memb. of *Albion ss.* (a name suggested by J. M. Clarke to replace "Upper Medina" of the literature), and was described as consisting of 5 ft. of hard gray ss. In 1914 (Sci., n. s., vol. 39, pp. 915–918) E. M. Kindle (author of Paleozoic geology of Niagara folio) objected to *Albion ss.* and advocated Grabau's restricted definition of *Medina* (which applied the name to "Upper Medina" of the literature), and he treated *Thorold ss.* as top memb. of *Medina fm.* and assigned to the Clinton of Niagara Gorge the overlying sh., which he called *Sodus sh.*

In Geol. Soc. Am. Bull., vol. 25, p. 310, 1914, C. Schuchert stated that at Thorold, Ont., the *Thorold memb.* (consisting of 10 ft. of white fine-grained ss.) is overlain by 4 ft. of bluish-green argill. sh., which he included in Medina fm. but excluded from Thorold ss. In his Niagara Gorge section, however, he treated Thorold as top memb. of his Medina fm., and referred to the Clinton the 2½ to 6 ft. of sh. discon. overlying the Thorold and underlying the Wolcott ls., which is "often correlated with Sodus memb. at Rochester" but without anything "of value to support this reference." The same year (Canada Geol. Surv. Summ. Rept. 1913, pp. 179–188) M. Y. Williams treated *Thorold ss.* as top div. of Medina and assigned Sodus sh. to the Clinton.

In 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 4) R. S. Bassler treated Thorold ss. as top memb. of Albion and assigned Sodus to Clinton.

In 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 332, 341, 359, 364, etc.) G. H. Chadwick excluded Thorold ss. from Medina and named the sh. overlying it *Maplewood sh.*, which he showed to be considerably older than Sodus sh., and, although included in Clinton group of Hall, its "strat. relations are with the beds below rather than above it." In 1919 (Canada Geol. Surv. Mem. 111) M. Y. Williams treated Thorold ss. as top memb. of *Medina-Cataract*. In 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 443, 456) E. R. Cumings proposed that Albion ss. be restricted to beds btw. Whirlpool ss. and Thorold ss., and he included Thorold in *Medinan series*, as did A. F. Foerste in 1923 (Denison Univ. Bull., Jour. Sci. Lab., vol. 20, pp. 50–51).

In 1923 (Md. Geol. Surv. Sil. vol., pp. 244, 267, 347) E. O. Ulrich transferred Thorold ss. to Clinton fm. and applied *Albion* to underlying rocks down to base of Whirlpool ss.

In 1924 (Canada Dept. Mines, Geol. Surv. Mem. 138) A. F. Foerste stated that *Thorold ss.* is top *memb.* of Cataract fm. of southern Ontario. But according to C. Schuchert, 1913 (Geol. Soc. Am. Bull., vol. 24), the Cataract fm. corresponds to only lower 50 ft. of the 135 ft. of Albion ss. at Niagara Falls.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 323), treated *Thorold ss.* as basal memb. of Clinton and restricted *Albion* to underlying beds. She listed Thorold as present at Rochester and in west-central N. Y.

G. H. Chadwick, 1935 (A. A. P. G. Bull., vol. 19, No. 5, p. 702), stated the ss. at Rochester that was formerly called Thorold ss. is not true Thorold, but younger and of Clinton age. He has named it *Kodak white ss.*

The U. S. Geol. Survey still classifies Thorold ss. as top memb. of Albion ss.

Thoroughfare andesite.

Silurian: Maine. See *Thorofare andesite*.

Thorp Springs limestone.

Lower Cretaceous (Comanche series): Central northern Texas.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, p. 509). *Thorp Springs ls. subdivision.*—Lies near base of Glen Rose beds. Is one of Caprotina lss. of Shumard. Massive stratum, composed almost exclusively of shells of *Requienia texana* Roemer. Thickness about 20 ft. Outcrops for several miles along bed of river at Granbury and Thorp Springs [Hood Co.] and also in bed of Paluxy at Glen Rose.

Thousand Creek beds.

Pliocene: Northwestern Nevada.

J. C. Merriam, 1910 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 6, No. 2, p. 43). *Thousand Creek beds.*—Sedimentary series whose age and relations to Virgin Valley beds have not been determined. The beds are not a strat. unit and may be partly of age of Virgin Valley beds and partly later.

J. C. Merriam, 1911 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 6, No. 11, p. 210). Thousand Creek fauna assigned to upper part of lower Plio., and Virgin Valley beds assigned to middle Mio.

J. C. Merriam, 1917 (Univ. Calif. Pub., Dept. Geol. Bull., vol. 10, No. 22, p. 428). *Thousand Creek fm.*—Strat. relations of these beds, which occur in valley of Thousand Creek, not yet fully known, but there is every reason to consider them much later than Virgin Valley (middle Mio.). [Fauna listed.] Assigned to Plio.

H. F. Osborn, 1921 (Geol. Soc. Am. Bull., vol. 32, p. 332). *Thousand Creek fm.* of Nev. is middle Plio.

W. D. Matthew, 1924 (Geol. Soc. Am. Bull., vol. 35, opp. p. 746). Mammals of Thousand Creek fm. are late Mio and [or?] early Plio.

Thousand Springs basalt.

Pleistocene: Southern Idaho (Gooding County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, pp. 434–439). *Thousand*

Springs basalt.—A feldspar pahoehoe basalt filling a canyon of Snake River N. of and shallower than present canyon. It is filled with tubes and open contacts. Thickness 100± ft. Older than McKinney basalt and younger than Malad basalt. Thousand Springs, SW. of Wendell, in Gooding Co., issue from this basalt.

Thrall limestone member (of Foraker limestone).

Pennsylvanian: Southeastern Kansas (Butler and Greenwood Counties).

N. W. Bass (Kans. Geol. Surv. Bull. 23, in press). *Thrall ls. memb. of Foraker ls.*—Light-gray ls. that weathers cream-colored and contains specimens of a large fusulinid in abundance. Lowermost 6 in. and uppermost ft. is thin-bedded and inclined to be shaly. Middle 2 to 2½ ft. occurs in 2 or 3 beds that commonly form a prominent ledge and contain a conspicuous layer of chert nodules. Persistent from Elmdale, Kans., into Okla., but in southern Kans. it thickens greatly and appears to coalesce with adjacent beds and thus lose its identity. Thickness, 1 ft. 4 in. near Elmdale, on Cottonwood River; 1½ ft. in Browning oil pool; 3 ft. in W. part of Greenwood Co.; 9± ft. in Sallyards oil field; 13 ft. E. of Beaumont, Kans. Lies 11½ ft. above Americus ls. memb. of Foraker. Named for Thrall post office, Greenwood Co.

Thrall sand.

Drillers' name for a porous soft green altered basic igneous rock called serpentine, which lies in Taylor marl and produces oil at Thrall and Lytton Springs, Tex. Probably younger than Lytton Springs sand.

Threeforks shale (also **Threeforks limestone**).

Upper Devonian: Montana (rather widespread), western Wyoming, southeastern Idaho, northern Utah.

A. C. Peale, 1893 (U. S. G. S. Bull. 110). *Three Forks shales.*—In Three Forks region consists of (descending): (1) Yellow laminated ss., 25 ft.; (2) dark bluish-drab or black argill. lss., 45 ft.; (3) highly fossiliferous green, purple, and black argill. and calc. sh., 70 ft.; (4) grayish-brown compact, close-grained ls., 15 to 20 ft.; (5) reddish and brownish-yellow calc. and argill. shales, 65 ft. Rests on Jefferson ls. and underlies Madison ls.

Named for fine development of fm. at junction of three forks of Missouri River, near Three Forks, Mont. In some areas the fm. becomes so calc. that it is called *Threeforks ls.*

Threemile limestone. (In Chase group.)

Permian: Northeastern Kansas.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12). *Threemile ls.*—Basal memb. of Wreford ls. Underlies Havensville sh. and overlies Speiser sh. of Council Grove group. [Graphic section on p. 12 shows it as consisting of flinty ls. 10 ft. thick. Derivation of name not stated. Replaces Fourmile ls. of Condra and Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 32).]

Three Sisters formation.

Pre-Cambrian: British Columbia.

J. F. Walker, 1934 (Canada Dept. Mines Geol. Surv. Mem. 172, No. 2345, p. 7).

Three Twins member (of Chalk Bluff formation).

Permian: Southeastern New Mexico (Pecos Valley).

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7). North from Little McKittrick to Spencer Draw the top of Carlsbad ls. grades into sss., which in turn are in part displaced by anhydritic sands, sandy redbeds, anhydrites, fine greenish sss., thin greenish-gray sandy shales and dolomitic lss. This sequence of beds is here named *Three Twins memb. of Chalk Bluff fm.*, from Three Twins Hills, where, in Spencer Draw, a partial section is exposed. This member is top part of the fm. It is underlain by Azotea tongue of Carlsbad ls., or, where that is absent, by lithologically similar Seven Rivers memb. The Three Twins and Seven Rivers members represent greater part of Chalk Bluff fm. and are=Carlsbad and Capitan lss. of reef zone.

Thrifty formation. (In Cisco group.)

Pennsylvanian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31, 38). *Thrifty fm.*—Thick shales (less fossiliferous and brighter in color than those of Graham fm.), lss. (thicker and somewhat more massive than those of other divisions of Cisco), some ss., and coal. Breckenridge ls. memb. at top and Avis ss. memb. at base in Brazos River region. Thickness 100 to 125 ft. to S., 150 to 200 ft. to N. Underlies Harpersville fm. and discon. overlies Graham fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), followed above definition.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+). Avis ss. of Brazos River region is same as Parks Mtn ss. of Drake of Colorado River region; and in McCulloch Co. (Colorado River region) this ss. is called *Avis ss.* and treated as basal memb. of Thrifty fm., the underlying Speck Mtn ls. being treated as top of Graham fm.

Wallace Lee and C. O. Nickell (ms. soon to be published as a Univ. Tex. Bull.) followed Plummer and Moore's 1922 definition of Thrifty fm. in Brazos River region, and in Colorado River region included in the Thrifty the Speck Mtn ls. and underlying beds down to base of *Bellerophon* ls. of Drake.

Named for Thrifty, Brown Co., Colorado River region.

Thule formation.

Pre-Cambrian: Greenland.

L. Koch, 1929 (Meddelelser om Grönland, Bd. 73, Afd. 1, No. 1, p. 7).

Thunder Bay limestone.

Middle Devonian: Northeastern Michigan (Thunder Bay).

C. C. Douglass, 1839? (Mich. Leg. H. Doc. 27, btw. pp. 97 and 111). *Thunder Bay ls.*—Beds of ls. and gray clay or sh. containing abundant fossils. Occurs on S. cape of Thunder Bay. Overlain by black bituminous sh. and underlain by black bituminous ls.

Thunder Bay slates.

Pre-Cambrian (upper Huronian): Canada (Thunder Bay, Lake Superior).

R. D. Irving, 1883 (U. S. G. S. 3d Ann. Rept., pl. 3, map). *Animikie or Thunder Bay slates* of north shore, Vermillion Lake iron-bearing series, and iron-bearing rocks of the south shore all included in Huronian.

Thunder Bay series.

Middle Devonian: Northeastern Michigan.

A. W. Grabau, 1902 (Mich. Geol. Surv. Rept. 1901, p. 192). *Thunder Bay series.*—Clay, sh., and lss., 130 ft. thick, overlying Alpena ls. and forming upper shales of Traverse group. Named for exposures on Thunder Bay, at and around Alpena.

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526), restricted *Thunder Bay stage* by removing at top their Squaw Bay ls. (See 1935 entry under *Traverse fm.*)

Thunder Bay shales.

E. R. Pohl, 1930 (Tenn. Acad. Sci. Jour., vol. 5, No. 2, p. 61). I suggest that "Olentangy" be entirely dropped from nomenclature of SW. Ont., and that all beds demonstrably below "Encrinal ls." be known as *Thunder Bay shales.*

Thunderhead conglomerate. (In Chilhowee group.)

Cambrian (Lower): Eastern Tennessee and western North Carolina.

A. Keith, 1895 (U. S. G. S. Knoxville folio, No. 16, p. 2). *Thunderhead cgl.*—Heavy series of cgl., graywacke, and ss., with many small partings of sl. General color gray. Sl. beds black or dark gray when fresh. Thickness believed to be 3,000 ft. Little variety in fm. and no division into beds of distinct character. The coarse beds vary only in proportion of quartz and feldspar. All sl. beds are same in composition. Overlies Cades cgl. and underlies Hazel sl. [This is type area of fm.]

C. W. Hayes, 1895 (U. S. G. S. Cleveland folio, No. 20), applied *Thunderhead* to 3 fms. (descending)—*Thunderhead cgl.*, 300± ft.; *Thunderhead sl.*, 1,500± ft.; *Thunderhead cgl.*, 800–1,000 ft.; the latter fm. resting conformably on Pigeon sl.

Named for development on Thunder Head, Blount Co., Tenn., and Swain Co., N. C.

Thunderhead slate.

See under *Thunderhead cgl.*, C. W. Hayes, 1895.

Thurber sand.

Drillers' name for a gas sand in Strawn fm. of central northern Tex., lying 140 ft. below Thurber coal.

Thurman sandstone.

Pennsylvanian (Allegheny): Eastern and central Oklahoma.

J. A. Taff, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 439). *Thurman ss.*—Brown ss. and shaly beds with, at base, 50 ft. or more of cgl. composed of angular or little-rounded chert fragments in a brown ss. matrix. Thickness 200 ft. Top fm. of Coal Measures. Overlies Boggy sh. [Mapped (pl. 64) as *Shawnee ss.*, but, Shawnee being preoccupied, Thurman ss. is adopted in text.]

Named for former village of Thurman, northern part of Pittsburg Co., (about 6 mi. W. of Indianola), which is near if not on outcrops of the fm.

Thurmond formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

M. R. Campbell, 1902 (U. S. G. S. Raleigh folio, No. 77). *Thurmond fm.*—Prevailingly sandy beds underlying Quinnimont coal (basal bed of Quinnimont fm.) and overlying Bluestone fm. in region E. of Guyandot Basin. Thickness 450 to 725 ft. Is = Pocahontas and Clark fms. combined of southern part of Raleigh quad. The new name Thurmond is introduced, because in area E. of Guyandot Basin the Pocahontas [No. 3] coal (the dividing line btw. Pocahontas and Clark fms.) is not recognized and the fms. cannot be separated. Well exposed at town of Thurmond, Fayette Co.

Tiawah lime.

Pennsylvanian: Northeastern Oklahoma (Rogers County).

S. W. Lohman, 1932 (Summaries and abstracts of technical papers presented before the Tulsa Geol. Soc. 1932, unpaged, paper dated Dec. 19, 1932). *Tiawah lime.*—Above the Red Fork sand, in lower part of Boggy fm., is the Pink lime. Separated from latter by a sandy sh. is an intermittent ls. horizon (upper Pink lime) that is very persistent on outcrop and particularly well developed in hills about town of Tiawah, from which it may take its name.

Tibbit Hill schist.

Pre-Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Tice shale. (Of Monterey group.)

Miocene (middle): Western California (San Francisco region).

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193). *Tice sh.*—Bituminous sh., prevailingly chalky, in some places whitish, in others pinkish or yellowish. A fm. of Monterey group. Overlies Oursan ss. and underlies Hambre ss. Thickness 460 ft. Named for exposures along Tice Creek, in Concord quad.

Tichenor limestone member (of Ludlowville shale).

Middle Devonian: Western to central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 22 and table). In Ontario Co. the succession of Hamilton beds from base up is Shaffer sh. (= Skaneateles sh.), Centerfield ls., Canandaigua sh. (= Ludlowville sh.), Encrinal (Tichenor) ls., and Moscow sh.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). *Tichenor ls.* in Canandaigua and Naples quads. consists of 1 ft. of compact, hard bluish-gray, often crinoidal ls., commonly known as *Encrinal ls.* Underlies Moscow sh. and overlies Canandaigua [Ludlowville] sh. Well exposed at Tichenor Point, on Canandaigua Lake, in Ontario Co.

Subsequent repts up to 1930 continued to apply *Tichenor ls.* to the thin ls. described, which according to D. D. Luther (N. Y. State Mus. Bull. 99, 1906) is persistent for more than 100 mi. E. of Buffalo quad.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 226). *Tichenor memb.* [Redefinition.].—The 1-ft. bed. of ls. at Tichenor type section when traced westward becomes one of a group of several layers of same lithic character and containing a definite fauna, which is a recurrence of that of Centerfield ls. These crinoidal lss. and the associated shales contain same fauna as type Tichenor and the 10 ft. of sh. below it. *It is here proposed to unite the 10 ft. of sh. with the 1-ft. crinoidal bed at Tichenor Point,* under the name *Tichenor,* and to apply this name to these lss. and associated shales as far W. as Lake Erie. West of Bullis Bridge the Tichenor becomes thinner and most of the thin bands disappear. It is only 2½ ft. thick on Cazenovia Creek at Spring Brook and is a single layer of hard crinoidal and pyritiferous ls. 1½ ft. thick on shores of Lake Erie. Grabau proposed *Morse Creek ls.* for this single layer, but there is little advantage in continuing this name in any other than a subsidiary sense, since its relation to the Tichenor is clearly established. The Tichenor does not correlate with the "Encrinal" which forms summit of Ludlowville fm. in Cayuga Lake region [which Cooper calls *Menteth ls.*], as it apparently disappears by becoming shaly E. of Seneca Lake. Localities for examination of the Tichenor are Lake Erie shore btw. Lakewood and Pike Creek; Jacox Run, in Genesee Valley; Murder Creek at Darien; Hills Gulch, 5 mi. S. of Le Roy; Bullis Bridge, 4½ mi. NE. of Spring Brook; Cazenovia Creek at Spring Brook; and Smoke Creek at Windom.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 369, 393), included *Tichenor ls.* in Ludlowville sh. It lies 50 to 75 ft. below Menteth ls. in Ontario Co., but in Erie Co. the Menteth ls. rests on Tichenor ls., through overlap.

The U. S. Geol. Survey treats *Tichenor ls.* as a *memb.* in upper part of Ludlowville sh., and follows the definition of N. Y. State Survey, which does not include in it the underlying 10-ft. bed of sh. which Cooper (1930) included.

Ticholeptus beds.

A paleontologic name applied by E. D. Cope to lower Mio. beds of the Western States containing fossil remains of *Ticholeptus.*

Tickville rhyolite.

Tertiary (Eocene?): Central northern Utah.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, pp. 60–61). *Tickville rhyolite.*—Five small bodies of intrusive rhyolite occurring near Tickville.

Tidioute shale member.

Devonian or Carboniferous: Northwestern Pennsylvania (Crawford County).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, pp. 116–119, table opp. p. 61). *Tidioute sh. memb.*—Olivaceous mica-flecked sh., containing in basal 1 or 2 ft. the famous Echini fossils. Thickness 5 to 23 ft. Is present, but only about 5 ft. thick, at type section of Hayfield sh., which was named for Hayfield Twp. Crawford Co. It rests on Cobham cgl. (Cussewago ss.) and is overlain by Hayfield sh. sensu stricto, which is approx. 20 ft. thick at Tidioute. [The Hayfield sh. of Chadwick was defined as resting on Cussewago ss., so that introduction of *Tidioute sh. memb.* constituted a restriction of Chadwick's Hayfield sh.] Named for excellent exposure along Allegany River at Tidioute and especially for the exposures along State highway through Dennis Run, 1 mi. SW. of Tidioute, which seems to be max. development of the memb. (23 ft.).

Tieton andesite.

Pleistocene: Central Washington (Ellensburg region).

G. O. Smith, 1903 (U. S. G. S. Ellensburg folio, No. 86). *Tieton andesite.*—Flows of lava with associated aggl., occupying old valleys. Flowed down Tieton Cañyon. Near mouth of Tieton River is 200 ft. thick. Of Pleist. age.

†Tiffany beds. (In Wasatch formation.)

Eocene: Southwestern Colorado and northwestern New Mexico.

W. Granger, 1917 (Am. Mus. Nat. Hist. Bull. 37, pp. 826–830). *Tiffany beds.*—These beds—300 ft. or more thick—contain the fauna discovered by Gidley and cannot properly be correlated, on a faunal basis, with any part of Gallina Wasatch.

Gidley says fauna appears to be intermediate btw. Fort Union and Wasatch. To those familiar with our Eocene mammalian faunas the position of this one as intermediate btw. the Torrejon and Wasatch is manifest. This horizon should be specially designated, and writer suggests *Tiffany beds*, after Tiffany station, on Denver & Rio Grande Railway 4 mi. S. of Mason schoolhouse. Possibly the vertical range of fauna characterizing these beds is greater than 300 ft., but fm. is not cut through to its base at Mason schoolhouse or at any other points where fossils were found. Fauna resembles Torrejon more than Wasatch. According to Gardner the beds overlap on Torrejon and Puerco and rest on Animas fm.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, pp. 43–48). "Tiffany beds" are a faunal zone at and near base of Wasatch fm., as they are not different in lithology from the beds above and in fact are separable only by their fauna. This zone has been traced northward from type loc. in sec. 20, T. 33 N., R. 6 W., to S. part of T. 35 N., R. 6 W., and eastward as far as Pagosa Junction. It undoubtedly extends beyond that locality, but how far has not been determined. In all this region it can be identified by its fossils as well as by tracing the beds. Westward from type loc. it has been traced to divide btw. Animas and La Plata Rivers and southward for some miles into New Mexico. It has not yielded fossils W. or S. of its type loc., and identification depended on tracing outcrops and on lithologic comparisons. In S. part of San Juan Basin this faunal zone is apparently absent, and beds with only the typical Wasatch fauna have been observed. Just where btw. northern and southern San Juan Co. this zone wedges out has not been determined. [Fossils listed.] Granger placed "Tiffany beds" in Eocene, but Matthew would put them and underlying Torrejon fm. in Cret.

Tigaraha schist.

Early Paleozoic or older: Northwestern Alaska (Seward Peninsula).

F. H. Moffit, 1913 (U. S. G. S. Bull. 533, pp. 20–23, maps). *Tigaraha schist.*—All that part of Kigluaik group btw. top of ls. of Mount Osborn and base of Nome group. Is brown-weathering biotite schist several thousand ft. thick. Upper part is siliceous graphitic schist, irregular in distribution and thickness. Type loc. includes a sharp peak, near head of Buffalo Creek, which is here named Tigaraha Mtn, *ti-ga-rah-a* being Eskimo word for *pointed*. Assigned to Paleozoic, possibly in part pre-Paleozoic.

Tiger Creek sandstone member (of Bristow formation).

Pennsylvanian: Central Oklahoma (Creek County).

A. E. Fath, 1917 (U. S. G. S. Bull. 661B, pp. 73–74, pl. 5). *Tiger Creek ss.*—Well exposed in S. part of sec. 6, T. 17 N., R. 10 E., on S. side of a small tributary to Tiger Creek, for which it is named. Thickness 20 to 30 ft. Is lowest outcropping bed that overlies the sh., 100 to 130 ft. thick, whose outcrop extends from sec. 4, T. 17 N., R. 10 E., to and beyond sec. 7, T. 16 N., R. 10 E. Its lower 2 or 3 ft. is highly fossiliferous, containing innumerable impressions of *Fusulina*. The ss. as a whole varies greatly in lithologic character. In some places it is light-gray to yellowish-brown friable ss. that cannot be distinguished from other sss. in region. In other places as much as half of it is so calc. that it can be called a ls. In still other places the *Fusulina*-bearing portion is separated from upper portion by as much as 15 ft. of sh. All gradations btw. these various facies are known—from ls. through sandy ls. and limy ss. to common siliceous ss.—and any or all of these facies may be present as layers or lenses in a single exposure. In Hominy quad., to N., this bed lies above Avant ls., according to personal communication of R. H. Wood. At Arkansas River the distance btw. the 2 beds is 60 ft. To S. of Arkansas River both Avant ls. and the sh. that separates the Avant from Tiger Creek ss. decrease in thickness, and near S. bdy of Hominy quad. the Avant ls. is only 1 or 2 ft. thick and Tiger Creek ss. is separated from it by only 3 to 5 ft. of sh. The Avant probably thins out and disappears before reaching Bristow quad.

A. E. Fath, 1925 (U. S. G. S. Bull. 759, pp. 13–15). *Tiger Creek ss.* is basal *memb.* of Bristow fm. and rests on the thick sh. bed that forms upper part of Copan fm. as herein delimited. The Tiger Creek ss. persists from Nowata quad. through Bristow quad.

Tightner formation.

Mississippian: Northern California (Colfax region).

H. G. Ferguson, 1929 (Am. Inst. Min. and Met. Engrs. Tech. Pub. 211, p. 4). *Tightner fm.*—Almost entirely fine-grained greenish hornblende schist with varying amounts of quartz, probably for most part secondary. Near the veins the schist is altered to talc schist. A small amount of quartzose mica schist and rare beds of glistening black sl. are interbedded. Small lenses of coarsely crystalline white ls. occur here and there. Dominantly of volcanic origin. Thickness probably 7,000 ft. Underlies, probably uncon., Kanaka fm., and is believed to overlie Blue Canyon fm., but the two are in fault contact. Named for fact it forms principal wall rock of Tightner mine. Extends from North Yuba to South Yuba.

Tigre limestone.

Oligocene: Panama and Costa Rica.

D. F. McDonald et al., 1919 (A. A. P. G. Bull., vol. 3, p. 364).

Tijeras quartzite.

Pre-Cambrian: New Mexico.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257-259; Conspectus of geol. fms. of N. Mex., pp. 4, 11). *Tijeras qtzites.*—Qtzite beds 250 ft. thick, best exposed in great Tijeras arch of pre-Cambric rocks at S. end of Sandia Range.

Tilden limestone lentil (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 44, map, and sections). *Tilden ls. lentil of Bingham qtzite.*—White or light-colored siliceous marble. Max. thickness 100± ft. [In sections is shown to lie a considerable distance below Phoenix ls. and above Yampa ls., both lentils in Bingham qtzite. Named for Tilden mining claim.]

Tilden formation.

Cambrian: Southwestern Montana (Argenta, Beaverhead County).

P. J. Shenon, 1931 (Mont. Bur. Mines and Geol. Bull. 6). *Tilden fm.*—Chiefly gray to pinkish-gray sandy ls., the more sandy beds near base. Contains ore deposits. Directly overlies Flathead qtzite, without angular contact, and is separated from overlying Ermont fm. (Dev.) by color contrast. Best exposed NW. of Ermont mine, where following section of 421 ft. (descending) was measured: (1) Muddy-colored sandy ls. in beds 1 to 4 ft. thick with 8-in. bed of oolitic ls. 10 ft. above base, 102 ft.; (2) light-gray thin-bedded sandy ls. that weathers buff, 12 ft.; (3) massive crystalline bluish-gray sandy ls., 190 ft.; (4) fine-grained pinkish-gray ls. that weathers tan, 10 ft.; (5) gray sandy ls., 20 ft.; (6) thin-bedded white siliceous ls., 12 ft.; (7) gray sandy ls., with 6 outstanding beds, mostly massive, pebbly ls. at base containing angular quartz fragments, 75 ft. No fossils found. Tentatively assigned to Camb. because occupies about same strat. position as Gallatin fm. of Threeforks region and Silver Hill, Hasmark, and Red Lion fms. of Philipsburg quad., but absence of sh. at top of Flathead qtzite and throughout the Tilden is in marked contrast with those regions. [Derivation of name not stated, and no geographic feature called Tilden is shown on map accompanying rept.]

Tillite Canyon formation.

Age (?): Eastern Greenland.

C. Teichert, 1933 (Meddelelser om Grönland, Bd. 95, No. 1, pp. 74, 79).

Tillman sand lens.

A subsurface sand, of Lower Cret. age and a few ft. to 20 ft. thick, forming top bed of Davis oil and gas horizon in Webster Co., NW. La. Named for lease on which first producing well was drilled. (See under *Davis oil and gas horizon.*) Is said to lie in lower part of Glen Rose fm.

†Timber Belt beds.

Eocene: Eastern Texas.

E. T. Dumble and R. A. F. Penrose, Jr., 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. xxxvi, 17, 22). *Timber Belt or Sabine River beds.*—Siliceous sand and greensand marls, with smaller quantities of white, brown, and black clays and with frequent beds of lignite. Thickness 800 to 1,000 ft. Underlie Fayette beds and overlie Basal clays.

Included Wilcox group, part of Claiborne group, and Jackson of present classification.

Named for great timber region of eastern Tex.

Timber Canyon fanglomerate.

Pleistocene (upper): Southern California (Ventura and Los Angeles Basins).

U. S. Grant, IV, and H. R. Gale, 1931 (San Diego Soc. Nat. Hist. Mem., vol. 1, pp. 37, 38, 63). *Timber Canyon fangl.*—Reddish fangl., of upper Pleist. age, occurring on top of the ridges and beveling the edges of the upturned marine beds W. of Timber Canyon, on N. side of Santa Clara Valley. This deposit was formed at base of Santa Paula Peak. Is present in Ventura and Los Angeles Basins.

†Timber Creek beds.

Eocene: New Jersey.

W. M. Gabb and G. H. Horn, 1862 (Acad. Nat. Sci. Phila. Jour., 2d ser., vol. 5, pp. 111, 135), referred to a part of *middle marl bed*—Rancocas fm. of current nomenclature—exposed on Timber Creek, N. J., as *Timber Creek beds*, but did not define the term.

†Timber Creek group.

Upper Cretaceous (Gulf series): Eastern Texas.

R. T. Hill and C. A. White, 1887 (Phila. Acad. Nat. Sci. Proc. 1887, pp. 40, 44; Am. Jour. Sci., 3d, vol. 33, pp. 296, 298). *Timber Creek group* or *Lower Cross Timbers.*—Fossiliferous coarse-grained friable ferruginous sands alternating with thin seams of yellow clay; contains lignite. Outcrop coextensive with region known as *Lower Cross Timbers*. Uncon. overlies Washita div. of Comanche series and underlies Eagle Ford shales. Same as Dakota ss.

Name replaced by *Woodbine sand*, by R. T. Hill, because, as stated by him, of previous use of Timber Creek beds in N. J. "Timber Creek bed" has also been used for the part of Woodbine sand that was later named *Lewisville*.

†Timber Creek beds.

Upper Cretaceous: Eastern Texas (north of Colorado River).

J. A. Taff, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, p. 285). Dakota sands (Lower Cross Timbers) divided into (descending) *Timber Creek beds*, 50–100 ft.; Dexter sand; and Basal clay, 200+ft.

Timbered Hills group.

Cambrian (Upper): Southern Oklahoma (Arbuckle and Wichita Mountains).

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55–57). *Timbered Hills group* underlies Fort Sill ls. (basal fm. of Arbuckle group) and overlies pre-Camb. Includes (descending) Honey Creek fm., Cap Mtn ss. (=Honey Creek of W. part of mtns), and Reagan ss. [Derivation of name not stated.]

Timber Ridge sand.

A subsurface sand, 10 or more ft. thick, in Muskogee Co., central eastern Okla., which in Timber Ridge pool lies at 1,540 to 1,560 ft. depth, the Muskogee sand lying at 1,480 to 1,510 ft. C. W. Wilson, Jr., says (A. A. P. G. Bull., vol. 19, No. 4, 1935, pp. 505, 515) this sand corresponds to Coata ss. memb. of Atoka fm., and that it is one of the Dutcher sands.

Times porphyry.

Tertiary (middle or late): Northwestern Arizona (Oatman district).

F. L. Ransome, 1923 (U. S. G. S. Bull. 743). Irregular mass of micrographic granite porphyry. Intrudes Alcyone trachyte and Moss porphyry. Exposed in Times Gulch.

†Timiskamian series.

Lower part of Huronian series of U. S. Geol. Survey. See U. S. G. S. Bull. 769, pp. 124–125. Also called "Timiskaming series."

Timiskaming.

Name applied to a glacial lake, of Pleist. age, in Canada, north of Great Lakes region.

Timms Point formation.

Pleistocene: Southern California.

U. S. Grant, IV, and H. R. Gale, Nov. 3, 1931 (San Diego Soc. Nat. Hist. Mem., vol. 1, 1931, pp. 37, 42–43). *Timms Point zone* introduced to replace *Deadman Island "Plio.,"* since Deadman Island no longer exists, having been entirely removed by steam shovels. The beds, predominantly clayey, contain a cold-water fauna, which is correlated with a glacial age and assigned to Pleist. They underlie, apparently conformably, typical San Pedro zone and uncon. overlie Las Posas zone.

A. Clark, Dec. 19, 1931 (San Diego Soc. Nat. Hist. Trans., vol. 7, No. 4, pp. 37, 40). *Timms Point fm.*—Uncemented clayey fine sands and silts, predominantly yellowish, with local finer gray streaks and patches. Exposed thickness 30 ft. Has been called *Santa Barbara, San Diego,* and *Deadman Island Plio.* Lower part at least of Santa Barbara fm. is believed to be older than Timms Point fm., and San Diego fm. is older than Timms Point. Therefore *Timms Point* is proposed for the silts and sands uncon. overlying Mio. sh. and underlying Lower San Pedro sands [shown as absent at Timms Point but present on Deadman Island], with Timms Point the type section. Was considered Plio. by Arnold, but small percentage of extinct species, the presence of a cool-water fauna attributable to a glacial stage, and the very modern aspect of the underlying faunas in vicinity of San Pedro indicate these beds are best considered Pleist. instead of Plio.

D. Cassell and A. J. Tieje, 1933 (Pan-Am. Geol., vol. 59, No. 5, p. 376). Writers regard it significant that Las Posas fm. of Grant and Gale does not appear [in deep well near Ventura] btw. the Timms Point (upper Pico of some authors) and middle Pico beds, and therefore restore it to position first assigned it by Pressler above Timms Point horizon.

U. S. Grant, IV, 1935 (Pan-Am. Geol., vol. 64, No. 1, pp. 73–74). At San Pedro *Timm Point fm.* underlies San Pedro fm. and overlies Lomita fm., all marine Pleist. [Fossils listed.]

Timothy sandstone.

Lower Triassic: Southeastern Idaho.

G. R. Mansfield, 1920 (Am. Jour. Sci. 4th, vol. 50, p. 62; U. S. G. S. Bull. 713, pp. 29, 50). *Timothy ss.*—Somewhat sugary yellowish to grayish ss. in beds 1 to 3 in. thick, weathering pinkish. Thickness 800 ft. Uncon. underlies Higham grit and overlies (uncon. ?) Thaynes group. Previously described as *Ankareh ss.* Named for Timothy Creek, in Lanes Creek and Freedom quads, which cuts the fm.

Timpahutean series.

Timpahuten series.

Terms applied by C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53), 1924 (vol. 41, p. 78), and 1926 (vol. 46), to *Lone Mtn ls.* (Upper Ord. and Sil.) of Nev. and to supposedly contemp. deposits in other States, including Laketown dol. (Sil.) of Utah. "Title is derived from Timpahute Peak, N. of Las Vegas."

Timpanogos shales.

C. [R.] Keyes, 1924 (Pan-Am. Geol. vol. 41, p. 38). *Timpanogos shales,* 2,000 ft. thick, composing Monon series in Utah. Of Early Cambric age. [Derivation of name not stated. On p. 48 it is spelled *Tampanogos.*]

Timpas limestone. (Of Colorado group.)

Upper Cretaceous: Eastern Colorado and northeastern New Mexico.

G. K. Gilbert, 1896 (U. S. G. S. 17th Ann. Rept., pt. 2, p. 566). *Timpas fm.*—Series of lss. and calc. shales of prevailing blue colors. Thickness 175 ft. Lower fm. of Niobrara group. Underlies Apishapa fm. and overlies Carlile sh. (top fm of Benton group). Named for Timpas Creek, which enters Arkansas River below Rocky Ford, Colo.

The Niobrara and Benton are not now treated as groups, the broader term *Colorado group,* which includes them both, being considered the more

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useful group name. Where the Niobrara deposits and Benton deposits are not subdivided they are called *Niobrara ls.* and *Benton sh.*, respectively.

Tinaja granite porphyry.

Age (?) : Mexico.

S. F. Emmons, 1910 (Econ. Geol., vol. 5, p. 327).

Tindir group.

Pre-Cambrian and Lower Cambrian(?): Northeastern Alaska (Yukon-Tanana region).

D. D. Cairnes, 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 185–187). *Tindir group*, Camb. or pre-Camb., Alaska and Yukon. [See also Cairnes, Canada Geol. Surv. Summ. Rept. 1912, p. 11, 1914, and Canada Geol. Surv. Mem. 67, p. 44, 1914.]

J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 816, p. 21), 1932 (U. S. G. S. Bull. 836, p. 369), and 1933 (Wash. Acad. Sci. Jour., vol. 23, No. 8, p. 399). Assigned to pre-Camb. and Lower Camb.(?).

J. B. Mertie, Jr., 1937 (U. S. G. S. Bull. 872). *Tindir group (pre-Camb. and Lower Camb.?)*.—A thick sequence of sed. rocks interbedded with basic lava flows and intruded by igneous rocks. The intrusives, however, are not properly a part of the group. The sediments consist of dol., ls., sh., sl., and qtzite. The igneous rocks are mainly diabase and basalt of greenstone habit, together with an undet. proportion of lavas and tuffaceous beds of hematitic habit. Thickness 19,000+ ft. in Yukon-Tanana region. [Long description.]

Named for exposures along Int. Bdy btw. Tindir, Cathedral, and Harrington Creeks.

Tinkers Falls member.

Upper Devonian: Central New York (Onondaga County).

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 790–806). *Tinkers Falls memb.*—Basal memb. of Tully fm. At type section (in face of Tinkers Falls just under the main overhanging ledge) it consists of 6½ ft. of alternating thin layers of dark calc. sh. and shaly ls. abounding in *Chonetes aurora*. At June's quarry and ravine, not far W. of Tinkers Falls, it is 1½ ft. thick, but E. of type section it thickens to 14± ft. at N. end of Deruyter Reservoir, Cazenovia quad. Can not be traced far W. of type section. Underlies Apulia memb. of Tully and overlies Hamilton.

Tinley Park moraine.

Pleistocene: Northeastern Illinois (Chicago region).

M. M. Leighton and G. E. Ekblaw, 1932 (16th Int. Geol. Cong. Guidebook 26, p. 15). The inner memb. of Valparaiso morainic system W. of Chicago is the well-defined Arlington Heights moraine, which S. of Chicago is known as *Tinley Park moraine*.

†Tintic andesite.

Tertiary: Central northern Utah (Tintic district).

G. W. Tower Jr., and G. O. Smith, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3), mapped the only andesite in Tintic dist. as *Tintic andesite*. A geographic name for the rock is considered unnecessary and *Tintic* conflicts with Tintic qtzite, of same area.

Tintic quartzite.

Lower Cambrian and pre-Cambian (?): Central northern Utah (Tintic district).

G. O. Smith, 1900 (U. S. G. S. Tintic folio, No. 65). *Tintic qtzite.*—Clay slates and qtzites, the qtzites white, weathering brownish red, very pure, compact, and fine-grained, with occasional beds of fine quartz pebbles. Several beds of green, yellow, and red clay slates occur near top. Underlies Mammoth ls. In mapping, the base of lowest bed of ls. was taken as contact btw. the two fms., so that some slates are included in Mammoth ls. Exposed thickness about 7,000 ft., but base not found.

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107), restricted Tintic qtzite to the massive qtzites, and transferred to his overlying Ophir fm. 100 to 190± ft. of sh. or sl.

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which were included in Tintic qtzite as originally defined. This is present approved definition. (See U. S. G. S. P. P. 107, p. 25.)

Exposed in Tintic Canyon and at other places in Tintic dist.

†Tintic slate.

Middle and Lower Cambrian: Central northern Utah (Tintic district).

G. W. Crane, 1915 (Am. Inst. Min. Engrs. Bull. 106, pp. 2149–2151). *Tintic sl.*—Thinly laminated green sl. with intercalated bands of impure gray banded ls. near top and thin bands of brown qtzitic sl. near bottom. Thickness 358 ft. Underlies Golden Ray ls. and overlies Tintic qtzite.

Replaced by *Ophir fm.*, the name *Tintic* being adopted for the qtzite.

Tinton sand member (of Redbank sand).

Upper Cretaceous: Eastern New Jersey (Monmouth County).

S. Weller, 1905 (N. J. Geol. Surv. Ann. Rept. 1904, pp. 147, 154–159, and Jour. Geol., vol. 13, pp. 76, 81). *Tinton beds.*—Hard glauconitic, indurated sand bed, 22 ft. thick. For faunal and strat. reasons it is separated from underlying Red Bank sand and recognized as a distinct fm. Fauna is more closely allied to beds below than to beds above. Underlies Sewell [Hornerstown] marl. Exposed at Tinton Falls. Was included in Red Sand of Cook.

The U. S. Geol. Survey has since 1909 (U. S. G. S. Trenton folio, No. 167) treated Tinton sand as top memb. of Redbank sand, but most repts of N. J. Geol. Surv. still treat it as a distinct fm.

Tioga glacial stage.

Pleistocene: Sierra Nevada, California.

E. Blackwelder, 1931 (Geol. Soc. Am. Bull., vol. 42, pp. 865–922). *Tioga stage.*—Youngest glacial stage on E. slope of Sierra Nevada. Named for fact the glacier depositing the till occupied Tioga Pass, and its lobes descended both SW. and NE. therefrom. Correlated with Wisconsin stage.

Tioga magnafacies.

Devonian or Carboniferous: Central northern Pennsylvania (Tioga-Elkland region).

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 23). Westward the Pocono-like magnafacies (herein termed "*Pocono" magnafacies*) assumes a finer-grained, less well sorted facies of brown (limonitic) weathering qtzitic micaceous ss. usually replete with mud balls and triturated cellulose. This facies occasionally contains brackish-water faunas. In Tioga and Elkland area of Pa. a parvafacies of this magnafacies, which is now known to be of Chautauquan age, was mistaken by M. L. Fuller (U. S. G. S. Elkland-Tioga folio, No. 93, 1903) for Oswayo fm., at top of Conewango series. From this mistaken correlation the eastern development of this magnafacies has ever since been termed the *Oswayo*. For this magnafacies the name *Tioga* is proposed. The Oswayo fm. in Olean, N. Y., area represents the Oswayo *sensu stricto* parvafacies expression of the Tioga magnafacies.

Tiona sand.

Drillers' term. Western Pa. Of Chemung age. Older than Speechley sand and younger than Bradford oil sand group. In W. Va. the name has been applied to a sand higher than Speechley sand.

†Tionesta sandstone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477, 489, 490). *Tionesta ss.*—Massive coarse gray or yellowish rock, sometimes much blotched and streaked with iron peroxide. Thickness 50 to 60 ft. Separated from overlying Brookville coal by 0 to 15 ft. of sl. and sh. and overlies Tionesta group [Mercer sh. memb. of Pottsville fm.]. [As thus defined the name applies to Homewood ss. memb. of Pottsville fm.]

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2, p. 53). *Piedmont (Tionesta) ss.* is=Homewood ss. The name "Tionesta" has in late publications of the survey been replaced by "Piedmont," as the former was considered only a synonym for the Congl., but I think it evident that at *Tionesta* [Forest Co., Pa.], where this stratum got its name, the rock occupies same relation to other members of the series as the one at the top of our section, and that there is no valid reason why it should not retain the original name at least through this region.

Replaced by Homewood ss. memb., the better-established name.

†Tionesta group. (In Pottsville formation.)

Pennsylvanian: Northwestern Pennsylvania.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477). *Tionesta group* underlies Tionesta ss. and overlies Seral cgl. and ss. [evidently Connoquenessing ss.]. Thickness 10 to 100 ft. Includes Mahoning ls. [upper Mercer ls.], Tionesta or Mercer coal, Upper, Middle, and Lower Porter coals, Mercer ls., and other strata.

Corresponds approx. to Mercer sh. memb. of Pottsville fm.

Tionesta series.

Pennsylvanian: Western Pennsylvania.

F. Platt, 1875 (2d Pa. Geol. Surv. Rept. H, pp. 8–9). Hodge [J. T.] in 1839 named and described the *Sharon series* as underneath Cgl. No. XII, from his explorations W. of Allegheny River. Lesley in 1841 [where?] named and described the *Tionesta series* as overlying Cgl. No. XII as he approached the Allegheny River from Potter Co. The Tionesta ss. is Cgl. No. XII, and therefore the *Tionesta series of coal beds* is same as *Sharon series*. It is therefore necessary to expunge the whole Tionesta group, sandrock, and coal beds from Mr. Rogers' column.

The term "Cgl. XII" as used in some early Pa. Geol. Surv. repts. was applied to the upper or Homewood ss. memb. of Pottsville fm. of present nomenclature, and in other repts to all of Pottsville fm. of present usage.

Tionesta iron shales. (In Pottsville formation.)

Pennsylvanian: Northwestern Pennsylvania.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Tionesta iron shales.*—Shales containing iron ore, sometimes in shape of concretions and again as a stratum of calc. ore on top of Upper Mercer ls. Thickness 20 ft. Underlie Tionesta coal, and sometimes separated from underlying Upper Mercer ls. by a thin bed of coal.

Is a part of Mercer sh. memb.

Tionesta clay. (In Pottsville formation.)

Pennsylvanian: Southeastern Ohio (Hocking Valley).

E. Orton, 1884 (Ohio Geol. Surv. vol. 5). *Tionesta clay*, 0 to 5 ft. thick, underlies Tionesta coal and lies 10 ft. above Upper Mercer horizon.

Is a part of Mercer sh. memb.

Tippah sandstone member (of Porters Creek clay).

Eocene (lower): Northeastern Mississippi and southwestern Tennessee.

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 64). *Tippah ss.*—Unconsolidated white and yellow sands, gray in places, with glauconite grains; upper 4 or 5 ft. consists of hard fossiliferous, coarsely grained glauconitic ss. Thickness of fm. 75–100 ft. Overlies Porter's Creek fm. and underlies Ackerman clays. Top fm. of Midway group.

The Tippah ss. has since 1925 been treated as top memb. of Porters Creek clay. (See C. W. Cooke, U. S. G. S. P. P. 140E, 1925, and E. N. Lowe, L. W. Stephenson, and G. A. Waring, U. S. G. S. W. S. P. 576, 1928.) It is not known to extend S. of Tippah Co., Miss.

Named for Tippah Co., Miss., "where it is prominently exposed in broken hills and ridges."

Tipperary erosion surface.

Pleistocene: Northeastern Utah and southwestern Wyoming (Uinta Mountains).

W. H. Bradley, 1936 (U. S. G. S. P. P. 185). Older than Blacks Fork glacial stage. Lies 150 ft. above post-Bear Mtn surface. Named for its largest remnant, Tipperary bench, which lies btw. Smith Fork and Little Dry Creek, Wyo.

Tipton sandstone.

Pre-Cambrian (?): Northwestern Iowa.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 187; Sci., n. s., vol. 40, p. 144). *Tipton terrane.*—Sss., 425 ft. thick, composing basal fm. of Keweenawan series.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, p. 317). The so-called Tipton sss. and shales may eventually prove to be Mid Cambric in age rather [than] pre-Camb.

Derivation of name not stated.

Tipton shale member (also **Tipton tongue**) of Green River formation.

Eocene: Southwestern Wyoming (Sweetwater County) and northwestern Colorado (Moffat County).

A. R. Schultz, 1920 (U. S. G. S. Bull. 702). *Tipton sh. memb. of Green River fm.*—Thin fissile sh. and ss.; pronounced oolitic ls. (in places 20 to 50 ft. thick) near base; also other oolitic and concretionary beds locally resembling huge oyster shells scattered on surface. Thickness 100 to 325 ft. Underlies Cathedral Bluffs red beds memb. of Green River fm. and overlies Wasatch fm. Named for exposures in vicinity of Tipton, a station on Union Pacific R. R. in Sweetwater Co., Wyo. To N. of Tipton station the Tipton sh. has been removed by erosion over greater part of Great Divide Basin.

J. D. Sears, 1924 (U. S. G. S. Bull. 751G). In basin of Vermilion Creek, in NW. Moffat Co., Colo., and southern Sweetwater Co., Wyo., the upper and lower parts of Wasatch fm. are separated by Tipton tongue of Green River fm. This tongue, which is characterized by gray fissile sh. and oil sh., wedges out southward, and the main part of the Wasatch and the upper part (here called Cathedral Bluffs tongue) merge into a continuous fm. comparable to that E. of Godiva Ridge. According to Schultz the Cathedral Bluffs tongue (which he called a memb. of Green River fm.) passes northwestward by lateral variation into typical Green River shales.

Tip Top sand.

Tertiary or older: Western Kentucky (Hardin and Meade Counties).

A. H. Sutton, 1931 (Ky. Geol. Surv., ser. 6, vol. 37, pp. 275, 285). *Tip Top sand* is proposed to designate the small deposit of soft and poorly cemented sand along Dixie Highway about ¼ to ½ mi. NW. of Illinois Central station of Tip Top. The deposit lies partly in Hardin Co. and partly in Meade Co. and covers an area of approx. 40 acres. Color is white, yellowish white, and yellow. Upper part is stained by iron oxides leached from overburden of soil, but lower beds are white except where they have come in contact with surface waters. Consists predominantly of quartz grains with minor amounts of other sediments, chiefly lenses, 2 to 6 in. thick, of yellowish and white clay interbedded with the sand. It is quarried for glass, pottery, and molding sand by Ky. Silica Co. Exact age unknown. Whether it is Tert. or a filling of an earlier sink hole is not settled. It lies on a floor of St. Louis ls. and is about 50 ft. thick.

†Tisbury beds.

†Tisbury gravel.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard, Gay Head, and other localities).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 975–988 and chart). *Tisbury beds.*—A glacial deposit, consisting of rather ferruginous stratified clays and clayey sands occurring at Marthas Vineyard, Gay Head, and other localities. Separated from deposits of last glacial epoch by Vineyard erosion interval, and from underlying interglacial Sankaty beds by Gay Head interval of erosion and folding. Well exposed in Chilmark and West Tisbury [Marthas Vineyard]. *The Mohegan Bluff beds* on Block Island are an extension of this series.

J. B. Woodworth, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 197–212). Thickness of *Tisbury beds* on Marthas Vineyard 150 ft.

A. C. Veatch, 1903 (Jour. Geol., vol. 11, pp. 766–776). The greater part of Manhasset beds of Long Island are regarded as=Tisbury of Woodworth.

M. L. Fuller, 1903 (Am. Geol., vol. 32, pp. 308–311). Manhasset gravel is probably to be correlated with *Tisbury beds* of Marthas Vineyard and Mohegan Bluff beds of Block Island.

A. C. Veatch, 1906 (U. S. G. S. P. P. 44). *Tisbury (Manhasset) gravel* on Long Island varies in thickness from 0 to 250 ft.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). The deposits formerly called "Tisbury beds" by Woodworth are here divided into Manhasset fm. (glacial), Jacob sand (transitional), and Gardiners clay (interglacial), all of which are present on Marthas Vineyard.

Named for exposures at West Tisbury, Marthas Vineyard.

Tishomingo granite.

Pre-Cambrian: Central southern Oklahoma (Arbuckle Mountains).

R. T. Hill, 1891 (Am. Jour. Sci., 3d, vol. 42, p. 118). *Tishomingo granite* lies in heart of Chickasaw Nation, S. of and underlying Wapanucka ls. dist. At its eastern outcrop it is composed of red feldspar, white and black mica, quartz, and hornblende, with numerous pegmatitic veins. In W. part of Chickasaw Nation the feldspar is albite. The granite is intersected by numerous dikes of diabase.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79, p. 2), and 1903 (Tishomingo folio, No. 98, p. 2). *Tishomingo granite.*—Coarse pink or red pegmatitic granite with numerous dikes of basic rocks. Quartz monzonite occurs in intimate relations to the granite and appears as phases of it. In some instances the monzonite occurs with some definition of bdy. Again it blends with the granite gradually.

C. W. Tomlinson, 1928. [See under *Colbert porphyry.*]

Named for Tishomingo, Johnston Co., which is located on the granite.

†Titanotherium beds.

A paleontologic term applied in early repts to Chadron fm. The sss. in upper part of the Chadron have been called "Titanotherium sss."

Titkana limestones.

Cambrian: British Columbia and Alberta.

C. D. Walcott, 1913 (Smithsonian Misc. Coll., vol. 57, No. 12, pp. 334, 337).

Titus Canyon formation.

Oligocene (lower): Southeastern California (Grapevine and Funeral Mountains).

C. Stock and F. D. Bode, 1935 (Nat. Acad. Sci. Proc., vol. 21, No. 1, pp. 571–579, map). *Titus Canyon fm.*—Red and green qtzite cgls., calc. sss., calc. mudstones, algal lss., and tuffaceous sss., with ls. breccia at base. Near middle occurs algal ls. zone, consisting of yellow and blue-gray algal lss. and red or maroon calc. mudstones. All fossils occur below this algal ls. zone. They are lower Olig. Thickness 3,000± ft. Type occurrence in Titus Canyon, near Leadfield, Calif. Thickness near Leadfield 2,200± ft. The fm. dips E.-NE. off E. flank of Grapevine and Funeral Mtns. Rests uncon. on Paleozoic and pre-Paleozoic. Is uncon. overlain by 400 to 500 ft. of lower Mio. (?) cgl. which is interbedded with and lenses upward into rhyolite flows and associated sed. tuffs which attain thickness of 7,000 ft. near Titus Canyon.

Tiverton arkose.

Carboniferous: Southeastern Rhode Island.

A. F. Foerste, 1899 (U. S. G. S. Mon. 33, pp. 378–379). *Tiverton arkose.*—Arkose extending along escarpment from Steep Brook to Tiverton Four Corners [eastern part of Newport Co.]. Exposed at several places in Tiverton. Thickness 100 to 200 ft. Probably same as Natick arkose.

A part of Wamsutta fm. as mapped by B. K. Emerson, U. S. G. S. Bull. 597, 1917.

Tivola tongue (of Ocala limestone).

Eocene (upper): Central Georgia (Houston, Twiggs, and adjacent counties).

C. W. Cooke and H. K. Shearer, 1918 (U. S. G. S. P. P. 120C, pp. 51–56). *Tivola tongue of Ocala ls.*—A bed of bryozoan-bearing ls. typically exposed at quarry of Planters Limestone Co., 2 mi. S. of Tivola, Houston Co., which projects as far N. as Rich Hill, Crawford Co., and intrudes far into the main area of the contemp. Barnwell fm., in which it forms an important horizon marker near the base in Houston, Twiggs, and adjacent counties. It extends laterally into lower part of

Twiggs clay memb. of Barnwell fm. In most places it is underlain by thin sandy beds that are classed with the Barnwell. Its thickness in a few places exceeds 40 ft., but is commonly much thinner. Is of Jackson age.

Tizapan basalt.

Tertiary: Mexico.

R. H. Palmer, 1926 (Pan-Am. Geol., vol. 45, p. 127).

Tlaxcala formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 335).

Toborg sand.

A shallow oil sand of Cret.(?) age, lying at 400 to 425 ft. depth in Yates oil field of Tex.

Toboso conglomerate facies.

Mississippian: Central Ohio.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 667–669). *Toboso cgl. facies of Cuyahoga fm.* in E. part of Licking Co. Largely nonfossiliferous cgls. and sss. with shales in lower part. Thickness 558 ft. Includes (descending): (1) Berne memb., 1 to 2 ft.; (2) Black Hand memb., 100 ft.; (3) sss. and shales, 488 ft.

Includes Cuyahoga fm. and lower part of Black Hand fm.

Probably named for occurrence at Toboso, Licking Co.

†Tobucksy sandstone.

Pennsylvanian: Central eastern Oklahoma.

H. M. Chance, 1890 (Am. Inst. Min. Engrs. Trans., vol. 18, pp. 658, 659). *Tobucksy ss.*—Massive ss., 200 ft. thick, forming basal part of Coal Measures in Choctaw coal field. Underlies Grady [Hartshorne] coal, and overlies shales and sss. probably of Subcarboniferous age.

Same as Hartshorne ss., later but better-established name.

Derivation of name not known.

Toby conglomerate.

Pre-Cambrian: British Columbia.

J. F. Walker, 1926 (Canada Geol. Surv. Mem. 148, p. 13).

Toccoa quartzite.

Basal Cambrian or pre-Cambrian: Northeastern Georgia.

S. L. Galpin, 1915 (Ga. Geol. Surv. Bull. 30, p. 120). *Toccoa qtzite.*—From 2 mi. E. of Ayersville to within about 1½ mi. of Toccoa there are several striking outcrops of qtzite, which usually dip to NW., although in some cases sheeting planes dipping to SE. are so strongly developed that they obscure what appears to be the true bedding of the rock. The fm. seems to pass upward into siliceous and micaceous schists with occasional narrow bands or layers of biotite, or even hornblendic schist. Below the qtzite comes into sharp contact with hornblende schists (Roan). No conclusive evidence obtained to show whether this contact is intrusive. The qtzite shows considerable variation in composition, especially toward a feldspathic phase which bears strong resemblance to an igneous gneiss but which seems to pass gradually into the typical rock.

Named for exposures in a ballast quarry N. of Southern Ry and about 2 mi. W. of Toccoa, Stephens Co.

Tochatwi group.

Pre-Cambrian: Northwest Territories.

C. Lausen, 1929 (Canadian Min. and Met. Bull. 202, p. 386).

Tocito sandstone lentil (of Mancos shale).

Upper Cretaceous: Northwestern New Mexico (San Juan Basin).

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134). On Chaco and San Juan Rivers near the Hogback, NW. N. Mex., a notable bed of coarse brown cross-bedded ss., about 35 ft. thick, occurs 735± ft. above base of Mancos sh. It contains lenses of pebbles of chert and quartz as much as ½ in. diam. and resistant enough to make a cliff. It is known to petroleum geologists as Tocito ss., though sometimes also called by them Frontier ss. In this rept it is called *Tocito ss. lentil of Mancos sh.* Named for outcrops of the ss. near Tocito trading post, San Juan Co., N. Mex. Also outcrops near Beautiful Mtn, about 25 mi. SW. of type loc.

†Tocquan gneiss.

See †*Tucquan gneiss.*

†Todd Valley formation.

Pleistocene: Eastern Nebraska (Saunders County).

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, pp. 324, 349–350). *Todd Valley fm.*—A valley fill of, chiefly, fine sand, becoming coarser near bottom. Consists of fluvioglacial deposits. Occurs in "an old Platte channel" across Saunders Co. from near North Bend to Ashland. Thickness 120 to 190+ ft. Younger than Loveland fm. (of Sangamon age) and older than Peorian loess. Probably formed in late Iowan time. Named for its occurrence in Todd Valley, an old filled Platte River valley.

Todilto limestone member (of Morrison formation).

Upper Jurassic: Northwestern New Mexico and extreme northeastern Arizona.

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380) and 1917 (U. S. G. S. P. P. 93). *Todilto fm.*—Where developed as ls. the fm. is very thin; where developed as calc. sh. it is much thicker. The ls. is dense and gray. Thickness of fm. 3 to 200 ft. Conformably underlies Navajo ss. and conformably overlies Wingate ss. Named for Todilto Park, McKinley Co., N. Mex.

A. A. Baker, C. H. Dane, E. T. McKnight, et al., June 1, 1931 (U. S. G. S. prel. maps showing geol. structure of Valley-Navajo Mtn region, San Juan Co., Utah, and of parts of Grand and San Juan Counties, Utah). *Kayenta fm.* introduced for deposits btw. Navajo ss. (above) and Wingate ss. (below) because field studies of A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., show that Todilto fm. at its type loc. is younger than the beds btw. Navajo ss. and Wingate ss.

According to subsequent studies by Messrs. Reeside, Baker, and Dane the typical Todilto ls. of Todilto Park is basal memb. of Morrison fm. and rests uncon. on Wingate ss.; but in SE. Utah and parts of SW. Colo. the Morrison is separated from the Wingate by several intervening fms., in descending order Summerville, Curtis, Entrada, Carmel, Navajo, and Kayenta. (See U. S. G. S. P. P. 183, 1936, p. 9.)

In some areas the Todilto rocks are chiefly gyp. and are called *Todilto gyp. memb.* In other areas they are of mixed lithology and are called *Todilto memb.*

Todos Santos formation.

Mesozoic: Mexico.

S. F. Emmons and G. P. Merrill, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 514). Cret.; included in Chico [Upper Cret.].

W. A. VerWiebe, 1925 (Pan-Am. Geol., vol. 44, p. 131), assigned this fm. to Triassic and Jurassic.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 329), assigned it to Lower Cret. or older.

Togiak gravels.

Pleistocene: Southwestern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, p. 177). *Togiak gravels*, Pleist., occur along banks of Togiak River and Togiak Lake.

Tohachi shale.

Tertiary (Eocene ?): Northwestern New Mexico and northeastern Arizona.

H. E. Gregory, 1916 (U. S. G. S. W. S. P. 380). *Tohachi sh.*—Dark-brown and white shales and subordinate sss., 200 to 1,100 ft. thick. Overlain, uncon. (?), by Chuska ss. Rests uncon. on Mesaverde and later Cret. fms. Named for Tohachi Indian School, McKinley Co., NW. New Mex., where it is exposed.

Tok sandstone.

Tertiary(?): Eastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 473, 483). *Tok ss.*—Soft, friable yellowish ss., thinly bedded, containing thin beds of fine feldspathic cgl. Thickness 50+ ft. Few plants. Tentatively Tert.(?). Several exposures occur a few mi. below mouth of Tok River.

Tokio formation.

Upper Cretaceous: Southwestern Arkansas and southeastern Oklahoma.

H. D. Miser and A. H. Purdue, 1918 (U. S. G. S. Bull. 690, pp. 19, 24). *Tokio sand memb. of Bingen fm.*—Contains sand and clay, in addition to a basal gravel and 3 higher gravels. The sand is incoherent, firmly packed gray quartz sand in beds some of which are over 30 ft. thick. Conspicuously cross-bedded. Contains disseminated particles of kaolin and a few scattered pebbles. Weathers red and produces a gray sandy soil. Light-colored and dark-colored clays are interbedded with the sand. Some of them contain fossil plants and small quantities of iron pyrites and lignitiferous matter. The light-colored clays are in beds 5 to 6 ft. thick and consist of plastic ball clays and nonplastic kaolins. The memb. is widely distributed W. of Tokio [Hempstead Co., Ark.] and Highland. It comprises upper 100 to 150 ft. of Bingen fm. The underlying part of the Bingen consists of gravels, greenish arkosic sand, red clay, and dark plant-bearing clay. The Tokio memb. is conformably overlain by Brownstown marl.

C. H. Dane (U. S. G. S. Press Bull. 8823, Sept. 10, 1926) and L. W. Stephenson (A. A. P. G. Bull., vol. 11, No. 1, Jan. 1927) divided †Bingen fm. into *Tokio fm.* (above) and Woodbine fm. (below), and discarded Bingen. They also *redefined Tokio* by including in it, at base, a gravel bed 30 to 40 ft. thick, beneath which an uncon. had been discovered. The beds beneath the uncon. and above the Kiamichi clay they identified as Woodbine fm. (See also Dane, Ark. Geol. Surv. Bull. 1, 1929.)

†Tokio sand member.

See explanation under *Tokio fm.*

Tokun formation.

Tertiary (probably Miocene): Southeastern Alaska (Controller Bay region).

G. C. Martin, 1908 (U. S. G. S. Bull. 335, pp. 24, 35). *Tokun fm.*—Lower 2,000± ft. chiefly sandy shales; upper 500 ft. a bed of ss. Conformably overlies Kushtaka fm., the transition apparently representing a change from fresh-water to marine conditions. The Tokun outcrops on both shores of Lake Tokun. [Gives area of occurrence, detailed section, fossils, etc.]

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, p. 771). *Tokun fm.*, which occurs to N. of Bering Lake, closely resembles lower part of Katalla fm. to S. of Bering Lake. Martin thought Katalla fm. was older than Stillwater and Tokun fms., but writer suggests Tokun fm. is = lower part of Katalla fm., which he has named *Split Creek memb.*, and that this is underlain by Kushtaka fm. Katalla fm. is here assigned to upper Olig., on basis of lithologic similarity to fossiliferous beds in Yakataga dist. that are assigned to upper Olig. by B. L. Clark.

Tolay volcanics.

Pliocene (lower): Central western California (Petaluma district).

R. R. Morse and T. L. Bailey, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 10, pp. 1437–1455). *Tolay volcanics.*—A hitherto unrecognized fm. disclosed in core drilling at Petaluma. Includes great thickness of flows, breccias, tuffs, and aggls. Rough review of well samples shows, in general, that the fm. is acidic below, basaltic in middle, andesitic above, and that it terminates with extensive deposits of pyroclastic material, which, at top, are interbedded with lowermost Petaluma shales. [On p. 1443 and elsewhere they seem to include the transition beds in Petaluma fm.] Thickness 4,162+ ft. Upper few hundred ft. appear at surface in small area W. of Tolay Creek, near Lakeville School, Petaluma quad., where they conformably underlie Petaluma fm., believed to be Lower Plio. On this evidence and by inference from relations of rocks in adjoining areas, the Tolay volcanics are assigned to Lower Plio. The Upper Mio. San Pablo strata are unknown at Petaluma. If present they must occur in the unknown interval below Tolay volcanics, where it is possible Monterey also may be represented.

Tolchico shale.

Lower Triassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 338). *Tolchico shales* is name given to 2d sh. memb. of Ward's Moenkopian series, finely displayed around mouth of Canyon Diablo. Thickness 100 ft.

Name probably derived from Tolchico Settlement, The Crossing, Little Colorado River, Coconino Co.

Toledo moraine.

Pleistocene (Wisconsin stage): Northern Ohio. Equivalent to Goodland and Imlay moraines of southern Michigan. Named for Toledo, Ohio. Same as Cleveland moraine.

Toledo formation.

Oligocene: Northwestern Oregon (Lincoln County).

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., Oreg. Bur. Min. and Geol., vol. 3, No. 1). *Toledo div.*—Tuffaceous ss. and shales, green gray on unweathered surfaces, but weathers white, yellow, and red. The ss. is rather thinly bedded, and sandy sh. makes up greater part of series. Thickness 2,800 ft. Underlies Yaquina ss. and overlies Coaledo fm. Type loc. 3 mi. S. of Toledo, Lincoln Co.

W. D. Smith, 1924 (Econ. Geol., vol. 19, p. 458), gave thickness as 3,000 ft.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12). It is possible to divide *Toledo fm.* into at least 2 members, the upper consisting of 1,000± ft. of sss. and the lower 1,200± ft. of concretionary sh. of lower Olig. age, here named *Moody sh.* It is believed there is no angular uncon. btw. Toledo fm. and overlying Yaquina fm.

H. G. Schenck, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 22–31). *Toledo fm.* uncon. overlies Burpee fm.

Tolenas marble.

Probably late Tertiary or Quaternary: Western California.

W. L. Watts, 1890 (Calif. State Min. Bur. 10th Ann. Rept., pp. 668–669). *Tolenas marble.*—Pure waxlike aragonite, the work of springs; quarried at Tolenas Springs, Solano Co.

Toll Pit beds.

Silurian: Southeastern Michigan.

W. H. Sherzer and A. W. Grabau, 1910 (Mich. Geol. Surv. Pub. 2, geol. ser. 1, pp. 47+). *Toll Pit beds.*—At Toll Pit quarry, near Scofield, the upper part of the Sylvania is interstratified with some dolomitic layers carrying Anderdon fauna. Pre-Dundee erosion has carried away all of Monroe beds except this thin layer of Anderdon in the upper Sylvania. Traces of Dundee still remain at this loc.

Tolovana limestone.

Silurian (Niagaran): Northeastern Alaska (Preacher, Tolovana, and Hot Springs districts).

J. B. Mertie, Jr., 1936 (U. S. G. S. Bull. 872). *Tolovana ls.*—Composed entirely of carbonate rocks without any important admixture of argill. or aren. members. Both ls. and dol. are present. In White Mtns these rocks are dark to light gray, crystalline, and weather white, yellowish, or buff. Generally massive. Niagaran (middle Sil.) fossils from lower 500 ft. It is possible uppermost part may be late Sil. Thickness possibly as much as 3,000 ft. Rests with possible discon. on undiff. pre-Middle Ord. rocks and is overlain, probably with great uncon., by Dev. rocks.

Toltec trap.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 21). Then succeed [next above National ss.] various trap belts of which little is known, 1,710 ft. wide. In southern of these belts was worked the Toltec mine, on a large quartzose vein. [Called *Toltec traps* on map, and shown as next below Oneida cgl.]

Tomahawk amygdaloid.

Same as Torch Lake amygdaloid. Derivation of name not known.

Tomales formation.

Upper Pleistocene: Western California (Marin and Sonoma Counties).

R. E. Dickerson, 1922 (Calif. Acad. Sci. Proc., 4th ser., vol. 11, No. 19, with maps). *Tomales fm.*—Largely land or stream-laid deposits, including terrace deposits containing a small but distinctive Pleist. fauna, and also probably material composing alluvial fans. In part of area the fm. consists of lignitic beds overlain by loosely consolidated tan-colored sss. and cgls. (or perhaps fangls. would be a better designation) of lighter color than the tan-colored sss. of Millerton fm. A small estuarine fauna found in upper beds indicates that during part of time the region was occupied by a shallow bay. Rests uncon. (important break) on Millerton fm.

Named for occurrence on NE. side of Tomales Bay, where most of headlands are thinly coated with the loosely consolidated sss. and cgls. of Tomales fm.

Tomales Bay deposits.

Pleistocene: Western California (Marin County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 4, p. 76). *Tomales Bay deposits.*—According to Anderson they consist of coarse arkose detritus with indistinct horizontal stratification. Generally found in the larger depressions of the peninsula. Range in elev. from 500 ft. downward. Form a series of low, broad hills, extending along middle of valley near Olema, and occur at intervals on both shores of Tomales Bay, forming there a system of low bench-like terraces below 200 ft. height. West of main ridge they are found in occasional patches around flanks of hills at head of Drake's Estero and N. of Abbott's Lagoon.

Tombigbee sand member (of Eutaw formation).

Upper Cretaceous: Northeastern Mississippi, western Tennessee, southern Alabama, and western Georgia.

E. W. Hilgard, 1860 (Rept. geol. and agric. Miss., pp. 3, 61, 68–75). *Tombigbee sand group.*—Sharp fine-grained, strongly micaceous fossiliferous sands, laminated when indurate, and cemented by carbonate of lime; usually of greenish tint, but not infrequently gray, bluish, black, yellowish, and sometimes orange red. Clays and noncalc., also nonmicaceous, sands are also found. Thickness 150 to 160± ft. Underlies Rotten ls. group [Selma chalk] and overlies Eutaw group.

J. M. Safford, 1864 (Am. Jour. Sci., 2d, vol. 37, pp. 361–363), suggested that Tombigbee sand of Hilgard "most likely ought to be included in his Eutaw group." But the Tombigbee continued to be treated as a distinct fm. until about 1905, when U. S. Geol. Survey and Miss. Geol. Survey began to include it in Eutaw fm. but continued to define the Tombigbee as including all sands up to base of Selma chalk. In 1911 L. W. Stephenson (Ga. Geol. Surv. Bull. 26, pl. 5) divided the sands that had previously been called *Coffee sand* in Tenn. and *Tombigbee sand* in Miss. into 2 members, the upper being called *Coffee sand memb.* of Eutaw fm. and the lower being called *Tombigbee sand memb.* of the Eutaw. Later (Wash. Acad. Sci. Jour., vol. 7, No. 9, 1917) Stephenson showed that Coffee sand of Miss. grades laterally into lower part of Selma chalk, so that in parts of NE. Miss. the Tombigbee sand is overlain by Selma chalk and in other parts of that area it is overlain by Coffee sand, which is now treated as a distinct fm.

Named for exposures on Tombigbee River near Aberdeen, Monroe Co., and at Plymouth Bluff, Lowndes Co., Miss.

†Tombigbee.

Eocene: Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). The name *Tombigbee (Lignitic)* is applied to the deposits underlying the Buhrstone and including the Hatchetigbee at the top and the Black Bluff [Sucarnoochee clay] at base. [As thus defined it corresponds to Wilcox group and upper fm. of Midway group.]

Preoccupied by Tombigbee sand memb.

†Tombigbee chalk.

Upper Cretaceous: Southwestern Alabama and northeastern Mississippi.

W J McGee, 1890 and 1891 (Am. Jour. Sci., 3d, vol. 40, pp. 25, 30, 31, 1890; U. S. G. S. 12th Ann. Rept., pt. 1, pp. 419, 475), referred to: The peculiar middle Cret. fm. which [E. A.] Smith and [L. C.] Johnson now designate [unpublished] the Tombigbee chalk (the "Rotten ls." of the books).

The only known use of *Tombigbee chalk* by either E. A. Smith or L. C. Johnson is in the table of contents of Ala. Geol. Surv. Bull. 2, 1892, but in the text heading *Tombigbee* does not appear. The name in the table of contents appears to be an oversight. W. H. Dall and G. D. Harris, however, used *Tombigbee chalk* in U. S. G. S. Bull. 84, 1891, p. 166. The name was also used by C. W. Hayes and M. R. Campbell in 1895 (Nat. Geog. Mag., vol. 6, p. 125), but throughout the text they used *Rotten ls.* The name *Tombigbee chalk* conflicts with Tombigbee sand memb., the older name, and was years ago replaced by *Selma chalk*, which also replaces †*Rotten ls.*

Apparently named for development on both sides of Tombigbee River in Greene, Hale, Sumter, and Marengo Counties, Ala., and near Tombigbee River in NE. Miss.

Tombstone sandstone.

Upper Cretaceous: Central southern Montana (Livingston quadrangle).

W. H. Weed, 1893 (U. S. G. S. Bull. 105, pp. 16, 18). *Tombstone sss.*, 150 ft. thick, lie at top of Montana group at Cokedale, 10 mi. W. of Livingston, Mont., and are overlain by massive white bluff sss., 75 ft. thick, which form basal memb. of Laramie fm. They sometimes form bluff exposures but more often weather out in "tombstone ledges."

Tomichi limestone.

Upper, Middle, and Lower Ordovician: Central Colorado (Monarch-Tomichi region).

R. D. Crawford, 1913 (Colo. Geol. Surv. Bull. 4, p. 56). *Tomichi ls.*—In descending order: (1) Argill. ls. and calc. sh., few ft.; (2) ls. which grades into dolomitic ls., with little chert (*Receptaculites oweni* up to 50 ft. and cup corals to top), 100 ft.; (3) very persistent qtzite, 28 to 30 ft., locally called "parting qtzite;" (4) probable uncon.; (5) sandy bed, 15 ft.; (6) cherty bluish-gray mag. ls., 200 to 290 ft. Rests uncon. on Sawatch qtzite. Overlain by Ouray ls. (Miss. and Dev.). Named for Tomichi, Gunnison Co.

Tomifobia slates and limestones.

Ordovician: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, p. 11).

†Tomlinson stage.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

H. M. Chance, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 52). *Tomlinson stage.*—In Indian Territory consists of (descending): 50 ft. of ss.; 320 ft. of shales; 100 ft. of sss.; and 200 ft. of shales with 3 ft. of coal near bottom. Overlies Norristown stage [Hartshorne ss.] and underlies Poteau stage along Choctaw, Oklahoma & Gulf Ry in Indian Territory.

Includes McAlester group and Savanna ss.

Probably named for Tomlinson, Scott Co., Ark.

Tomlinson shale.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Tomlinson sh.*—Sh., 500 to 600 ft. thick, underlying Greenwood ss. and overlying Hartwell ss. All included in Sebastian stage. [The Hartwell ss. is absent in Okla.]

Named for Tomlinson, Scott Co., Ark.

Tomstown dolomite.

Lower Cambrian: Central southern Pennsylvania, western Maryland, and northern Virginia as far south as Massanutten Mountain.

G. W. Stose, 1906 (Jour. Geol., vol. 14, p. 208). *Tomstown ls.*—Drab to white mag. lss. with purer lss. (of mottled dark- and light-gray colors) near base. About

800 ft. thick. Underlies Waynesboro fm. and overlies Antietam ss. Exposed at Tomstown, Franklin Co., Pa.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170), gave thickness as 1,000± ft.

Tonganoxie sandstone.

Pennsylvanian: Northeastern Kansas.

J. M. Jewett and C. C. Williams, May 1, 1935 (Kans. Acad. Sci. Trans., vol. 38, pp. 191–198). *Tonganoxie ss.*—Massive ss. to sandy sh., mostly micaceous, fine-grained, and uniform, usually cross-bedded, brown or gray; 30 ft. thick. Occurs on uplands in extreme W. part of Johnson Co. Included in Stranger fm.

N. D. Newell, May 15, 1935 (Kans. Geol. Surv. Bull. 21, p. 82). The dominantly sandy and nonmarine beds from top of Sibley coal (which lies 8 to 10 ft. below top of Stranger fm.) to base of Stranger fm. were termed *Tonganoxie* by J. M. Patterson, in unpublished thesis, from a town in Leavenworth Co., Kans.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 147, etc.). *Tonganoxie ss.* was erroneously attributed by Newell (Bull. 21) to J. M. Patterson. The name was originated by Moore. Is basal memb. of Stranger fm. Includes heavy cross-bedded channel sss., sandy shales, and several coal beds and extends up to top of Sibley coal. Nearly all of Tonganoxie ss. in Kans. is nonmarine. In much of Douglas, Leavenworth, and Wyandotte Counties it rests uncon. on various parts of Stanton, Weston, and Iatan fm.s. Thickness varies from 3 or 4 ft. near Elk City, Kans., to nearly 100 ft. in E. part of Leavenworth Co. Type loc., area E. of Tonganoxie, Leavenworth Co. Good exposures along U. S. Highway 40 in secs. 26 and 35, T. 11 S., R. 21 E., about 7 mi. E. of Tonganoxie and on Stranger Creek and its tributaries N. of Linwood.

Tongue River member (of Fort Union formation).

Eocene: Northeastern Wyoming; northeastern, southeastern, and central southern Montana; and southwestern North Dakota.

J. A. Taff, 1909 (U. S. G. S. Bull. 341, pp. 129–130). The coal-bearing rocks of Sheridan coal field, Wyo., are divided into 3 coal groups (descending)—Ulm coal group, intermediate coal group [=part at least of Sentinel Butte sh. memb. exclusive of Roland coal], and *Tongue River coal group*. The top bed of Tongue River coal group is Roland coal. It includes also several other coals (Smith, Dietz, Monarch, Carney, and Masters). Is exposed along Tongue River.

W. T. Thom, Jr., and C. E. Dobbin, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 484–499). *Tongue River memb. of Fort Union fm.*—Yellow or light-colored strata containing massive sss. and numerous thick coal beds. Top of memb. is placed beneath bed K of Sidney field, bed F of Sentinel Butte field, and Roland coal of Sheridan field. Base is placed beneath the light-colored coal-bearing rocks which characteristically form a marked clinker-capped escarpment rising above lowlands or badlands developed from the somber Lebo sh., with which it intertongues at the contact. According to interpretation of writers the term *Fort Union fm.* should be restricted to Lebo andesitic (or sh.) memb. and Tongue River memb., although overlying Sentinel Butte sh. is classed as Fort Union (?) by U. S. Geol. Surv. The Tongue River memb. is well exposed along Tongue River btw. Carneyville, Wyo., and Brandenburg, Mont., and along the Yellowstone btw. Burns, Mont., and Buford, (Fort Union), N. Dak., also in Missouri Valley above Fort Clark, N. Dak.

Tonkawa sand.

A subsurface sand of Penn. age and 0 to 700 (?) ft. thick, in central and northern Okla. Correlated with lower part of Nelagoney fm. Lies lower than Endicott sand series and higher than Layton sand and Layton lime.

Tonkawa limes.

Drillers' term for Penn. lss. in Oklahoma City field, central Okla., lying somewhat lower than Tonkawa sand.

Tonkawatla formation.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 123).

Tonoloway limestone. (In Cayuga group.)

Silurian: Central Pennsylvania to western Virginia.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28). *Tonoloway ls.*—Underlies Bossardville ls. and overlies Wills Creek fm. in Pa.-Md.-Va. region.

G. W. Stose, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Tonoloway ls.*—Top fm. of Cayuga group. Consists of 400 ft. of ls. with some sh. Overlies Wills Creek sh. and underlies Helderberg ls.

Named for exposures on lower slopes of Tonoloway Ridge, Washington Co., Md.

Tonopah formation.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1905 (U. S. G. S. P. P. 42, pp. 41+, map). *Tonopah rhyolite-dacite* occupies large part of Tonopah dist. In N. part of area mapped it intrudes the earlier andesite and in many places the later andesite. In S. half of area it contains many inclusions of later andesites, as well as probable earlier andesites, vein quartz, and granitic fragments. It often intrudes or overlies Fraction dacite breccia. Above Fraction dacite breccia proper is a series of coarse pumiceous tuffs which are rudely layered and rarely well stratified and in which Tonopah rhyolite-dacite sheets are often interbedded, with no sign of intrusion. Occasionally also thin sheets of the rhyolite-dacite are found in lower part of overlying Siebert tuffs (lake beds).

T. B. Nolan, 1930 (The underground geology of western part of Tonopah dist.: Univ. Nev. Bull., vol. 24, No. 4, pp. 10–13). The name *Tonopah fm.* is proposed for what has been called "Lower rhyolite" by J. A. Burgess (Econ. Geol., vol. 4, p. 687, 1909). The fm. has also been called "Tonopah rhyolite" or "Tonopah rhyolite-dacite" (J. E. Spurr, U. S. G. S. P. P. 42, p. 41, 1905, and Econ. Geol., vol. 10, p. 745, 1915), and correlated with rhyolite exposed on the surface N. of the mining dist. These exposures have not yet been studied by writer, but from descriptions of their lithology and relations they do not appear to be in any way related to the beds herein discussed. The fm. as here defined includes rocks previously mapped as "Glassy trachyte" and "Montana breccia" but does not include all exposures that have been so assigned by Spurr, Burgess, and others. Best exposures of fm. are in westerly workings of Tonopah Extension mine, notably on 1,200-ft., 1,540-ft., and 1,880-ft. levels. Less extensive but equally significant exposures are present in 1,050-ft. level from Extension No. 1 shaft, 1,000-ft. level and 1,140-ft. levels of the Sand Grass, the 700-ft. level of the Mizpah, and the 800-ft. and 960-ft. levels of the West End. Outstanding feature of fm. is that it is composed of an interbedded sequence of volcanic breccias, massive tuffs of varying grain size, porphyritic flows, banded flows, and water-laid deposits of several kinds, the most striking of which is probably the well-laminated material that closely resembles much of Esmeralda fm. The rocks described by Burgess as bedded pyroclastic material belong to this fm., and the exposures in Tonopah Extension workings add abundant proof of nonintrusive character of great bulk of these rocks. Some intrusive rocks are, however, included within the fm., as may be expected in such an accumulation of dominantly volcanic debris. Base of fm. not yet exposed. In all but a few places its top is marked by the intrusive West End rhyolite, which separates it from Mizpah trachyte. On 1,300-ft. level of Midway mine the West End rhyolite is absent and Tonopah fm. is seen in contact with Mizpah trachyte. Base of fm. is not exposed, so total thickness of fm. is unknown, but approx. 1,000 ft. is present in W. part of Tonopah Extension mine, exclusive of the interbedded Sandgrass andesite. Is uncon. overlain by Esmeralda ["Siebert"] fm. (upper Mio.) and contains fragments of black sl. that presumably belong to Camb. or Ord. The Sandgrass andesite and Mizpah trachyte are of essentially same geol. age as Tonopah fm. Age of Tonopah fm. is most probably Tert., and older than upper Mio.

†Tonopah rhyolite.

†Tonopah rhyolite dacite.

See 1930 entry under *Tonopah fm.*

Tonto group.

Middle Cambrian: Arizona.

G. K. Gilbert, 1874 (Phil. Soc. Wash. Bull., vol. 1, p. 109). *On the age of the Tonto sss.*—A group of rocks exposed in the Grand Cañon of the Colorado, and locally designated as the *Tonto group.* Full description will appear in Wheeler Rept.

G. K. Gilbert, 1875 (U. S. Geog. and Geol. Surv. W. 100th Mer., vol. 3, pp. 60, 171–186, fig. 82). *Tonto group.*—Consists of (descending): Marbled ls. (mottled ls.), 75 to 200 ft.; *Tonto sh.* (aren. and argill. shales), 600 ft.; *Tonto ss.* (vitreous ss.), 80 ft. Uncon. overlies Archean crystalline schists and granites and underlies Redwall ls. group in Grand Canyon. Tonto group floors the valleys that contain the headwaters of Big Williams Fork of the Colorado and of the Verde and Tonto Creek, tributaries of Salt River, Ariz.

The "Marbled ls." is now known as *Muav ls.*, the "Tonto sh." as *Bright Angel sh.*, and the "Tonto ss." as *Tapeats ss.*

†Tonto shale.

Middle Cambrian: Arizona.

G. K. Gilbert, 1875. (See under *Tonto group.*)

Replaced by *Bright Angel sh.*

†Tonto sandstone.

Middle Cambrian: Arizona.

G. K. Gilbert, 1875. (See under *Tonto group.*)

Replaced by *Tapeats ss.*

†Tonto limestone.

A name applied in some early repts to the †Marbled or mottled ls. forming top fm. of Tonto group (Middle Camb.) in Grand Canyon, Ariz. Replaced by *Muav ls.*

Tontoan series.

A name employed by C. [R.] Keyes instead of Tonto group of other geologists.

Tonzona group.

Silurian, Devonian, and Carboniferous: Central southern Alaska (Tonzona district, Kuskokwim region).

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, pp. 55, 66, 73, map). *Tonzona group.*—Black, red, and green argillites and cherts, with some graywackes, along inland front of Alaska Range and in Yukon-Tanana region; no ls., in which respect it differs from Tatina group. Thickness 4,000 to 5,000± ft. In upper Nenana Basin some gneisses (altered rhyolites) are associated with these rocks. Younger than Tatina group. Overlain, probably uncon., by Dev. ls. (Middle? Dev.). No fossils. Assigned to Sil. or Dev. Named for Tonzona River, in whose basin these rocks typically occur.

Later work (by P. S. Smith and J. B. Mertie, Jr.) proved that Tonzona group includes Carbf., Dev., and Sil. rocks, but they have not yet been differentiated.

Tookcarak diabase.

Pre-Cambrian: Canada (Belcher Islands).

E. S. Moore, 1918 (Jour. Geol., vol. 26, p. 417).

Topache limestone.

Mississippian and Devonian (?): Southwestern Utah (southeast and northeast of Frisco district).

B. S. Butler, 1913 (U. S. G. S. P. P. 80). *Topache ls.*—Heavy-bedded blue ls. with beds of sh. and chert. Thickness 1,500 ft. Underlies (apparently conformably) Talisman qtzite and overlies (conformably) Mowitza sh. (Upper Dev.). Type loc. Topache Peak, SE. of Frisco dist. G. H. Girty says fauna is without much doubt Miss., and that one lot is suggestive of upper Miss.

J. Gilluly, 1932 (U. S. G. S. P. P. 173, p. 21), stated that possibly several hundred ft. of Topache ls. is Dev., but that upper part is known to be Miss.

Topanga formation.

Miocene (middle): Southern California (Santa Monica and Santa Ana Mountains).

W. S. W. Kew, 1923 (A. A. P. G. Bull., vol. 7, pp. 411–420). *Topanga fm.*—Name proposed to include the rocks lying below Modelo fm. and above Vaqueros fm., and containing *Turritella ocoyana* fauna. The strata are essentially ss. Formerly included in Vaqueros fm. (now restricted to *Turritella inezana* fauna). Uncon. overlies true Vaqueros fm., and in Topanga Canyon, Los Angeles Co., is overlain with marked uncon. by Modelo fm. [In U. S. G. S. Bull. 753, 1924, Kew gave thickness of Topanga fm. as 6,000± ft.]

†Topatopa formation.

Eocene: Southern California (Ventura County).

G. H. Eldridge, 1907 (U. S. G. S. Bull. 309). *Topatopa fm.*—Lowest fm. outcropping in mtns N. of Santa Clara Valley. Total thickness unknown, but about 5,500 ft. are exposed. This consists of very hard submassive sss. (light gray to white) and qtzites (greenish gray, clear or mottled with white); shales (of slightly bluish hue) that differ from the qtzites in carrying additional content of mica and in fineness of their material. The qtzites and sss. greatly predominate in lower 2,000 ft. and the shales predominate in upper 2,500 ft. Qtzites also occur near middle of fm. The conspicuous features of the fm. are a tendency to broad concretionary structure in some of its members; the presence of smaller brown ferruginous sand concretions; the sparse distribution of fossil oysters and other imperfect molluscan remains through great part of its thickness, more particularly in the shales; some evidences of woody tissue; and frequent recurrence of what appears to be fucoids. Underlies Sespe fm. and probably rests on granite.

According to W. S. W. Kew (U. S. G. S. Bull. 753, pl. 3) †*Topatopa fm.* as above defined corresponds to Martinez and Meganos fms. of Bull. 753, the deposits corresponding to Tejon fm. having been included in overlying Sespe fm. of Eldridge. Topatopa fm. of Arnold as described in U. S. G. S. Bull. 321, 1907, corresponds to Tejon, Meganos, and Martinez fms. of present terminology, all of which Kew has differentiated and mapped in neighboring areas.

Topeka limestone. (In Shawnee group, Kansas.)

Topeka limestone member (of Shawnee formation, Missouri).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

E. Haworth, 1895 (Kans. Univ. Quart. vol. 3, pl. opp. p. 290; Am. Jour. Sci., 3d, vol. 50, pl. opp. p. 466). *Topeka ls.*—Three lss., separated by shales and separated from overlying Topeka coal by a thick bed of sh.

Haworth's 1908 classification (Univ. Geol. Surv. Kans., vol. 9) defined Topeka ls. as belonging to Shawnee fm., as underlying Severy sh., and as overlying Calhoun sh. This has been for many years the commonly accepted definition. In Kans. the Shawnee is now treated as a group and Topeka ls. as a fm.

R. C. Moore, Aug. 31, 1936 (Kans. Geol. Surv. Bull. 22, pp. 48, 194–195). Type loc. of *Topeka ls.* is Topeka, Kans. All its members are well exposed in SE¼ sec. 5, T. 11 S., R. 16 E., and vicinity, NE. of Topeka. Thickness ranges from less than 10 ft. in Nebr. to more than 50 ft. in parts of southern Kans. Divided into (descending) Coal Creek ls., Holt sh., DuBois ls., Turner Creek sh., and Hartford ls.

R. C. Moore, Sept. 4 to 7, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 41). *Topeka ls.* divided into (descending) Coal Creek ls., Holt sh., DuBois ls., Turner Creek sh., Hartford ls., Jones Point sh., and Dashner ls.

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser.), after further detailed surveys, made the following changes in the nomenclature of this part of the geol. column: (1) Reclassified the subdivisions of *Topeka ls.* as follows (descending): Coal Cr. ls., Holt sh., DuBois ls., Turner Cr. sh., Sheldon ls., Jones Point sh., Curzen ls., Iowa Point sh. and Wolf River ls. (new name); (2) restricted *Calhoun sh.* to the 1 to 44 ft. of beds btw. Wolf River ls. and Ervine Cr. ls. (top memb. of Deer Cr. ls.), but did not name any of its subdivisions; and (3) classified the subdivisions of Deer Cr. ls. as follows (descending): Ervine Cr. ls., Burroak sh. (new name), Haynies ls., Larsh sh., Rock Bluff ls., Oskaloosa sh., and Ozawkie ls. The outcrops at Topeka include only the Sheldon-Wolf River interval, and is same as Hartford ls. as originally used and as used by Moore in 1936. The Sheldon ls. at Curzen is upper bed of interval previously classified as Curzen. It is here proposed to restrict *Curzen* to lower 6 to 7 ft. of interval previously classified as Curzen and to continue to use the name Sheldon. The Iowa Point sh. has heretofore been included in Calhoun sh., but it can be traced into lower part of Topeka fm. at Topeka, and is therefore not of Calhoun age.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Tophet limestone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 356). *Tophet ls.*—Shaly calc. bed, 0 to 5 ft. thick, with marine fossils. Underlies Hackett sh. and overlies Upper Tophet sh.; all members of Hinton group [fm.]. Type loc. on hill road toward Lick Creek 0.2 mi. N. of Tophet, Summers Co. Also observed in Mercer Co.

Tophet sandstone. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 357). *Tophet ss.*—Reddish or greenish brown, shaly, 10 to 25 ft. thick. Underlies Upper Tophet sh. and overlies Tophet coal, where present, or Lower Tophet sh. All members of Hinton group [fm.]. Type loc. same as Tophet ls. Also observed in Mercer Co.

Tophet shale. (In Hinton formation.)

Mississippian: Southeastern West Virginia.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 297, 356–358). *Upper Tophet sh.*—Red and variegated sh., in part sandy; 10 to 15 ft. thick; underlies Tophet ls. and overlies Tophet ss. *Lower Tophet sh.*—Mostly red and variegated, with ss. streaks; plants at top; 20 to 35 ft. thick; underlies Tophet coal, where present, or Tophet ss.; overlies Goodwyn ss. All members of Hinton group [fm.]. Type loc. in vicinity of Tophet, Summers Co. Also observed in Mercer Co. Probably present in Monroe Co.

Top Hill sandstone.

Pennsylvanian: Western central Kentucky.

D. D. Owen, 1856 (Ky. Geol. Surv. vol. 1, pl. showing geol. section of Hancock, Breckinridge, and Mead[e] Counties, Ky.). *Top Hill ss.*, 51 ft. thick, forms top of Coal Measures.

Toquima formation.

Ordovician (Lower, Middle, and Upper ?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Toquima fm.*—Major part of fm. is gray-green chloritic schists merging into similar knotted schists in S. part of dist. Interspersed are numerous beds of dark blocky siliceous sl. or chert, much like the black jaspilite, and occasional beds (nowhere more than 100 ft. thick) of brown to gray crystalline ls. in massive beds. Basal part of fm. consists (descending) of (1) 200 ft. of gray ls. with black jaspilite; (2) a few ft. of qtzite; (3) a few ft. of dark sl. carrying Normanskill graptolites; (4) 0 to 50 ft. of qtzite. Thickness of fm. at least 4,000 ft. and may be much more. Overlies Zanzibar ls. and underlies Perm. (?) ss. Present over considerable part of Toquima Range.

Torbay slate.

Pre-Cambrian: Newfoundland.

C. D. Walcott, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 219). *Torbay slates.*—Green, purple, pinkish, or red, very fine-grained slates, in frequent alternations; in some cases they approach in hardness jasper or chert. Thickness 3,300 ft. Included in Avalon terrane. Finely exposed at Torbay and covers great area from Cape St. Francis to Cape Race, St. Marys Bay and across to Concepcion Bay.

Torbrook sandstone.

Silurian: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 203).

Torcer formation.

Lower Cretaceous: Western Texas (Malone Mountain region).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 254–257, 286). Name *Torcer fm.* is here applied to the portion of the section at and near Torcer (formerly Malone) station, on Southern Pacific Ry. W. of Sierra Blanca, which is of Neocomian age, overlies the Jurassic, and underlies the *Dufrenoya* (Gargasian) level. Type loc. is taken in Malone Mtn, though exposures occur also in Malone Hills in the flat about 1 mi. E. of the station. This name covers the Cret. portion of Cragin's "Malone fm.," that name having been restricted to rocks of Jurassic age. Thickness of Cret. part more than 831 ft. Included in Trinity group of Comanche series. The fm. is chiefly ls., some ls. cgl., calc. grit, calc. sh., cgl.; at base 30 ft. of calc. ss. and siliceous ls. that yielded *Astieria* and another ribbed Cret. ammonite.

Torch Lake amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name applied to an amygdaloid of Central Mine group that lies at a horizon below Old Colony ss. It occurs on property of Torch Lake Mining Company, in Houghton Co. The mineralized part is the Torch Lake lode.

Torch Lake flow.

Includes Torch Lake amygdaloid and underlying trap.

Torchlight sandstone member (of Frontier formation).

Upper Cretaceous: Northern Wyoming (Basin and Greybull oil and gas fields) and southern Montana (Carbon, Bighorn, Yellowstone, and Stillwater Counties).

F. F. Hintze, Jr., 1915 (Wyo. State Geol. Bull. 10, p. 23). *Torchlight ss.* (commonly known as *ss. B*) consists of 20 to 30 ft. of light-gray, often white saccharoidal ss., often strongly cross-bedded. Always capped by layer of black and gray pebbles, poorly cemented together. Top memb. of Benton. Lies discon. below Basin sh. (of Niobrara age) and is separated from underlying Peay ss. by 350 to 400 ft. of black adobe sh. and sandy sh. and bentonite.

C. T. Lupton, Jan. 21, 1916 (U. S. G. S. Bull. 621, pp. 167, 169–171), treated *Torchlight ss.* as a *memb.* of Frontier fm., stated that it lies 292 ft. above Peay ss. memb. in Basin oil field, where it is 83 ft. thick and is overlain by 7 ft. of cgl. forming top bed of Frontier fm.; also that it is exposed in Torchlight dome and that it is *ss. B* of Washburne (U. S. G. S. Bull. 340, 1908, p. 350).

Torchlight sand.

A subsurface sand lying at or near horizon of Torchlight ss. memb. of Frontier fm.

Tordrillo formation.

Middle Jurassic: Southern Alaska (Cook Inlet region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 153–155). *Tordrillo series.*—Considerable thickness of black shales, often carbonaceous, intercalated with many beds of ss., arkose, and impure lss.; ss. seems to become predominant in upper part. Plant remains throughout. Highly folded or cut through by intrusives. On E. side of Tordrillo Mtns it conformably overlies Skwentna series; on W. side it overlies Terra Cotta series. Evidence obtained favors Cret. age.

A. H. Brooks, 1906 (U. S. G. S. P. P. 45, table opp. p. 206), assigned this fm. to Middle Jurassic, on basis of fossils obtained.

Torio limestone.

Age(?): Panama.

O. H. Hershey, 1901 (Univ. Calif. Dept. Geol. Bull., vol. 2, p. 239).

Tornado limestone.

Pennsylvanian (early) and Mississippian (early): Central Arizona (Ray quadrangle).

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380–385). *Tornado ls.*—Thick-bedded light-gray ls., consisting of (descending): (1) Upper part thinner-bedded and contains thin layers of calc. sh., but shows no marked lithologic distinction from lower part; (2) very massive memb., 100 ft. thick; (3) few transitional beds; (4) alternating dark- and light-gray members, 75 ft. Total thickness 1,000+ ft. Upper part contains early Penn. fossils, and lower part contains Miss. [early], according to Girty. Could not separate the two. Rests conformably on Martin ls. (Dev.). Top of fm. is an erosion surface in Ray quad. Named for Tornado Peak, Dripping Spring Range.

A. A. Stoyanow, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 508, 517–521). The name *Tornado ls.* is discarded in this paper, and *Escabrosa ls.* is here used for entire Lower Miss. in depositional area SE. of Mazatzal land. The Penn. part of the "Tornado" is here named *Galiuro ls.*, because in certain ways it is different from Naco ls., or the Penn. of extreme SE Ariz.

Tornillo clay.

Upper Cretaceous (Gulf series): Western Texas.

J. A. Udden, 1907 (Univ. Tex. Bull. 93, pp. 17, 54–60). *Tornillo clays.*—Fine-textured, almost unfossiliferous clays, 600 to 700 or more ft. thick; of gray, olive-green, dull-blue, red, yellow, purple, dirty-brown, black, and white colors. Weather into lumpy surface. Grade into Rattlesnake beds [Aguja fm. of present nomenclature] below and into Chisos beds above.

Named for exposures along Tornillo Creek, Brewster Co., in Chisos Mtns quad.

†Toro formation.

Lower Cretaceous: Western California (San Luis Obispo region).

H. W. Fairbanks, 1904 (U. S. G. S. San Luis folio, No. 101). *Toro fm.*—Dark thin-bedded clay sh., with thin irregular layers of cgl. at bottom and near middle. Thickness about 3,000 ft. Uncon. underlies Chico deposits and uncon. overlies Franciscan deposits. Is local representative of the Knoxville. Named for exposures along Toro Creek, San Luis Obispo Co.

Replaced by Knoxville fm., the local name "Toro" being considered unnecessary.

Toro limestone.

Pliocene or Miocene: Panama and Costa Rica.

D. F. MacDonald, 1915 (U. S. Bur. Mines Bull. 86, p. 26).

D. F. MacDonald, 1919 (U. S. Nat. Mus. Bull. 103, p. 532, assigned to Plio.; A. A. P. G. Bull., vol. 3, p. 365, assigned to Mio.).

Toronto limestone.

Pennsylvanian: Southeastern Kansas.

E. Haworth and W. H. H. Piatt, 1894 (Kans. Univ. Quart., vol. 2, p. 117). *Toronto ls.*—Ls. toward top of Penn., in section along Verdigris River from Kans. State line to Madison, Greenwood Co., Kans. Believed to be same as Garnett-Burlington ls., but correlation not established. Separated from underlying Carlyle ls. by 125 ft. of sh. and ss. Overlain by series of Penn. shales and sss. with two thin lss.

This name fell into disuse for many years. According to G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 12), this ls. is same as Weeping Water ls. of Nebr., and is basal bed of Oread ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 32, 48, 162–163), revived *Toronto ls.* for basal bed of Oread ls. in Kans., and stated that there is doubt as to its equiv. to Weeping Water ls. of Nebr. and that its type loc. is Toronto, Woodson Co., Kans.

Toronto stage.

Toronto formation.

Pleistocene: **Ontario.**

W. Upham, 1895 (Am. Geol., vol. 16, p. 105). *Toronto stage*, Pleist., is included in Champlain epoch.

T. C. Chamberlin, 1895 (Jour. Geol., vol. 3, pp. 270–277). Position of *Toronto fm.* [of Ontario] is rather uncertain. May be later than Wisconsin fm.

Toronto fm. has been used in many Canada repts, the latest recorded being Coleman, 1933 (Ont. Dept. Mines 41st Ann. Rept., pt. 7, p. 3), who stated that it includes Don and Scarborough beds.

Torpedo sandstone member (of Ochelata formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

O. B. Hopkins, 1918 (U. S. G. S. Bull. 686H, pp. 76–77, pl. 12). *Torpedo ss.*—Lowest bench of massive cliff-making ss., 75± ft. above valley floor at Torpedo. It rims the valley of Sand Creek and is typically exposed 1 mi. NW. of Torpedo, on N. side of creek, where it consists of 30± ft. of massive medium-grained ss. which breaks into large ripple-marked blocks. Rests on sh. Near Torpedo is overlain by a thin ls. which writer believes may be Stanton ls. of Kans., but this ls. disappears to N. Separated from overlying Okesa ss. by 25± ft. of sh. Forms top memb. of Wilson fm. of Shannon and Trout 1915 rept.

F. R. Clark, 1918 (U. S. G. S. Bull. 686–I, p. 95). *Torpedo ss.* is separated from overlying Okesa ss. by 25 to 75 ft. of sh. The Torpedo is 20 to 30 ft. thick, massive, and generally forms a ledge. In many places its upper surface is filled with tubelike openings. An impure siliceous ls., probably the Stanton, lies 2 to 9 ft. above the Torpedo, the interval being filled with limy sh.; in places the ls. rests on the ss.

See also under *Okesa ss. memb.*

Torrance shale.

Permian (?): Central-northern New Mexico (Manzano Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 3, 11). *Torrance shales.*—Upper or vermilion section of Bernalillan series of Carbonic red-beds in Manzano Mtns. Thickness 500 ft. Overlie Yeso fm. [Derivation of name not given.]

Torregon formation.

Eocene: New Mexico.

See *Torrejon fm.*, the approved spelling.

Torrejon formation. (Of Nacimiento group.)

Eocene: Northwestern New Mexico.

J. L. Wortman, 1897 (as reported by G. N. Calkins, secy of Biology section, A. A. A. S., in Sci., n. s., vol. 6, p. 852). Dr. Matthew reported on status of Puerco fauna. A review of Puerco fauna, based on Dr. Wortman's geological observations in field and records kept by Am. Mus. collecting parties, shows that Upper Puerco and Lower Puerco beds do not contain a sp. in common, and only 3 or 4 genera pass through. The two faunas are entirely distinct. Dr. Wortman proposes to call the upper beds *Torregon fm.*, retaining the name Puerco for the lower beds.

W. D. Matthew, 1900 (Am. Mus. Nat. Hist. Bull., vol. 12, p. 20). *Torrejon fm.* is 300 ft. thick.

J. H. Gardner, 1910 (Jour. Geol., vol. 18, No. 8, p. 713; U. S. G. S. Bull. 381, p. 464). *Torrejon fm.*—Variegated clay sh. and soft coarse-grained ss. of white, gray, and tan colors. Thickness 275 ft. Cannot everywhere be readily separated from underlying Puerco fm. without fossil evidence. Is upper fm. of Nacimiento group (Cope's original Puerco).

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, pp. 39+). The Torrejon fm., as defined by its fauna, is known to extend from Arroyo Torrejon in Sandoval Co., N. Mex., across southern and western parts of San Juan Basin almost to Colo.-N. Mex. bdy. Is probably uncon. on Puerco fm. Where Puerco is presumably absent the Torrejon rests with erosional uncon. on older beds. Is uncon. overlain by Wasatch fm. [Fossils listed.] [See also 1924 entry under *Puerco fm.*]

Torrey sand.

Eocene: Southern California (San Diego County).

M. A. Hanna, 1926 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 7, pp. 187–246). *Torrey sand.*—Sand, usually coarse, porous, and unconsolidated; color usually white to light brown; highly cross-bedded. Consists of clean, moderately well rounded grains of quartz with varying amounts of feldspar, some muscovite and biotite, and minor amounts of ferromagnesians. Thickness more than 200 ft. Pinches out to S., where it probably was not deposited. Probably increases in thickness to N. Is middle div. of La Jolla fm. in La Jolla quad. Grades into overlying Rose Canyon sh. and into underlying Delmar sand. Typically exposed on Torrey Pines grade, where the highway climbs from Soledad Valley to 400-ft. terrace to S.

Torrington member (of Lance formation).

Upper Cretaceous: Southeastern Wyoming (Goshen County).

E. M. Schlaikjer, 1935 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 76, No. 2, pp. 31–54, 65). *Torrington memb. of Lance fm.*—Continental deposits, 60 to 100+ ft. thick, comprising top memb. of Lance fm. in Goshen Hole area, Goshen Co. Contains in upper part a new and very advanced form of *Triceratops*. That this memb. is=at least part of Arapahoe-Denver beds in Denver Basin is indicated by close affinity of ceratopsians found in both. It rests on brackish-water deposits (80 to 125 ft. thick) that are correlated with some part of Cannonball marine memb. of Lance fm. to E. Is overlain by lower Olig. Chadron fm. Named for proximity to town of Torrington, Wyo., on North Platte River N. of typical exposures on Horse Creek. In commenting on fauna (listed) Reeside says (letter): "All of the lots represent a brackish-water fauna. There are no strictly fresh-water shells and no typically marine shells. All of the species occur in Laramie fm. of Denver Basin, and most of them have been recorded from lower Lance fm. By themselves they do not indicate an extension of Cannonball sea into SE. Wyo., though they do indicate the presence somewhere nearby of truly marine waters." Perhaps the brackish-water deposit in Goshen Hole represents a different phase of the Cannonball, or a tongue of that sea which is somewhat earlier than the one represented in North and South Dak. It is believed that the 2 are nearly equiv. in time.

†Toston beds.

Oligocene (middle): Western central Montana (Broadwater County, in Helena-Big Belt region).

E. Douglass, 1902 (Am. Phil. Soc. Trans., vol. 20, n. s., pt. 3, pp. 237–245). *Toston beds*, the White River deposits NE. of Toston, near Cottonwood Creek. Local name given for convenience until correlation is established.

Totatlanika schist.

Pre-Devonian: Central Alaska (Bonnifield region).

S. R. Capps, 1912 (U. S. G. S. Bull. 501, p. 22, map). *Totatlanika schist.*—Series of quartz-feldspar schists and gneisses which form much of foothill ranges of Bonnifield region and parts of higher mtns to S., btw. Nenana and Delta Rivers, and probably occur W. of Nenana River. One belt of fm. occurs across basin of Totatlanika Creek. Thickness probably exceeds 3,000 ft. No fossils. Overlies schists thought to be pre-Ord. and underlies beds provisionally assigned to Carbf. Tentatively assigned to Sil. or Lower Dev.

This fm. is now considered to be pre-Dev.

†Totsen series.

†Totsen group.

Early Paleozoic(?): Northern Alaska.

F. C. Schrader, 1902 (Geol. Soc. Am. Bull., vol. 13, p. 239). *Totsen series.*—Mainly mica schist; some quartz schist; locally becomes graphitic and in places carries much quartz in small veins and lenticular bodies. Essentially of sed. origin, but is accompanied by igneous effusives or basaltic flows. Thickness 6,000 to 7,000 ft. Seems to uncon. overlie Skajit fm., and is uncon. overlain by Bergman series. Tentatively referred to Upper Sil.

Named for Totsenbetna, a name formerly applied by the natives to Wild Creek; *betna* signifies *river*.

For a time these rocks were by some authors included in Birch Creek schist (pre-Camb.), but they are now considered, in part at least, younger and probably of Paleozoic age.

†Toughkenamon rock.

Pre-Cambrian: Southeastern Pennsylvania (Chester County).

P. Frazer, 1883 (2d Pa. Geol. Surv. Rept. C4, pp. 307-308, 319, 321). *Toughkenamon rock,* lower memb. of Potsdam ss., is composed of weathered particles of a gneiss or syenite loosely compacted and laminated. Named for development near Toughkenamon station. The upper memb. of Potsdam ss. is the Kennett rock.

Replaced by Setters fm. (pre-Camb.). (See U. S. G. S. Coatesville-West Chester folio, No. 223, in which the rocks at and near Toughkenamon Station are mapped as Setters fm.)

Toughnut series.

Mesozoic (Lower Cretaceous ?): Southeastern Arizona (Tombstone district).

W. P. Blake, 1902 (Tombstone and its mines). [See under *Contention series.*]

J. A. Church, 1903 (Am. Inst. Min. Engrs. Trans., vol. 33, pp. 3-37). *Toughnut series* includes (descending): Contention sh. series, 700 ft.; Blue lime, 90 ft.; *Toughnut qtzite,* 120 to 140 ft.; White lime, 60 ft., Overlies Herschel qtzite.

F. L. Ransome, 1920 (U. S. G. S. Bull. 710D). Herschell qtzite, white lime, blue lime, Contention sh. series, and Randolph ls. of Church are Mesozoic, probably Comanche (Lower Cret.).

Toughnut quartzite.

See under *Toughnut series.*

†Towanda sandstone. (In Chemung formation.)

Upper Devonian: Northeastern Pennsylvania (Bradford County).

A. Sherwood, 1878 (2d Pa. Geol. Surv. Rept. G, pp. 38-39). *Towanda ss.*—In Wysox Twp. opposite and a little above Towanda, there is an extensive outcrop, perhaps 300 ft. in thickness, having a considerable dip to N., and containing carbonized stems or reedlike plants. Color is gray, except toward top of section, where there are one or two beds of red sh., one of which is 10 ft. thick. Included in Chemung.

Only recorded use of name. Definition considered inadequate by U. S. Geol. Survey workers.

Towanda limestone member (of Doyle shale).

Permian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1920 (Kans. Geol. Surv. Bull. 6, pt. 2, p. 61). One bed of ls., well exposed in W. part of El Dorado field near Towanda, which was of great assistance in mapping the structure of the field, has been designated as *Towanda bed.*

A. E. Fath, 1921 (Kans. Geol. Surv. Bull. 7, p. 54). *Towanda ls. bed of Doyle sh.*—Bluish-gray slabby ls., 5 to 9½ ft. thick in Eldorado oil and gas field, Butler Co., Kans. Lies 50 to 60 ft. below top of Doyle sh. and 35 ft. above base.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 44). *Towanda ls. memb. of Doyle fm.* persists widely as a very irregular unit. We have observed its outcrop at many places [mentioned] from type loc. northward in Kans. and at several places in Nebr. [mentioned]. In places (as NE. of Barnes, Kans.) it consists of 3 rather massive lss. and interbedded sh., but at most places btw. type loc. and Nebr. it is represented by 5 to 10 ft. or more of drab-colored slabby lss. that weather very irregularly and yellowish brown. Overlies Holmesville sh. (basal memb. of Doyle) and underlies Gage sh. (top memb. of Doyle).

Tow Creek sandstone. (In Mesaverde formation.)

Upper Cretaceous: Northwestern Colorado (Routt County).

K. M. Willson, 1920 (Colo. Geol. Surv. Bull. 23, pp. 30-39). *Tow Creek ss.*—Though massive throughout it has 2 or 3 more or less prominent divisions due to erosion of streaks of softer material. Is of brown color. Thickness 100 to 112 ft. Lies 890 ft. above base of Mesaverde fm. in Tow Creek anticline. Forms top of ridges on both sides of Tow Creek.

V. C. Perini, 1920 (Colo. Geol. Surv. Bull. 23, p. 51). *Tow Creek ss.* is most outstanding rock of lower part of Mesaverde fm. near Steamboat Springs, Routt Co. Is very massive; at some places 100 ft. thick; of cream color on fresh surfaces; weathers yellow; texture differs at various outcrops, but in general is a medium-grained ss.

Tower sandstone lentil (of Green River formation).

Eocene: Southwestern Wyoming (Sweetwater County).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 40, 45). *Tower ss.*—Massive or irregularly bedded ferruginous ss. Is lower part of Upper Green River group, and well shown in cliffs at Green River Station and in that vicinity, especially up and down the river for several miles; is also well exposed on E. side of Green River below mouth of Currant Creek. Rests uncon. on Lower Green River group and is overlain by the plant beds that form upper part of Upper Green River group.

W. H. Bradley, 1926 (U. S. G. S. P. P. 140D, p. 123, pl. 59). The Tower ss. of Powell is lenticular and therefore here designated *Tower ss. lentil of Green River fm.* It forms the tops of the weathered rock masses in vicinity of town of Green River, Sweetwater Co., known as The Towers. In N. part of Sweetwater Co. it appears to be replaced by lower part of the plant-bearing beds, which are herein named *Morrow Creek memb. of Green River fm.* The Tower ss. consists of cross-bedded and massive beds of medium- to coarse-grained brown ss. firmly indurated by limonitic cement. Thickness 0 to 250± ft. It rests uncon. on Laney sh. memb. of Green River fm. and is conformably overlain by Morrow Creek memb.

†Tower group.

Pre-Cambrian: Northeastern Minnesota (Vermilion district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept., btw. pp. 330 and 367). *Tower group.*—Earthy schists (sericitic and argillitic) with beds of hematite, 5,000 ft. thick, which change to chloritic schists. Thickness of group 15,000 ft. Includes Stuntz cgl. Underlies Ogishke cgl. and overlies graywacke group, all of which have previously been included in Keewatin.

J. M. Clements, 1903 (U. S. G. S. Mon. 45, pl. 2), mapped the rocks at Tower as (descending) Ogishke cgl., Soudan fm., Ely greenstone, and an undet. fm.

Tower Creek conglomerate.

Pliocene: Yellowstone National Park.

A. Hague et al., 1904 (geol. maps in U. S. G. S. Yellowstone Nat. Park Atlas, to accompany U. S. G. S. Mon. 32). *Tower Creek cgl.* (*Plio.*), gneissic and andesitic pebbles in friable ss. [This name was adopted by U. S. Geol. Survey to replace the descriptive term *Canyon cgl.*, used in Yellowstone Nat. Park folio, 1896.]

Named for exposure on Yellowstone River opp. mouth of Tower Creek, Canyon quad., Yellowstone Park. Largest development of rock is in NW. corner of Gallatin quad.

Towle shale.

Pennsylvanian: Kansas and Nebraska.

R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.). [*Towle sh.* shown as underlying Aspinwall ls., overlying Brownville ls., and forming basal bed of Admire sh. Derivation of name not stated.]

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8, p. 9). *Towle sh. fm.*—About 2 to 2½ ft. of gray sh. at top, 10 to 11 ft. of red sh. in middle, and 1± ft. of gray sh. at base. Total thickness 14± ft. Underlies Aspinwall ls. fm. and overlies Brownville ls. fm. Basal fm. of Admire group (*Perm.*).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville ls. to Perm. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.)

E. C. Reed (Asst. State Geol. Nebr.), 1936 (letter dated Oct. 16). Type loc. of Towle sh. is Towle farm, 2 mi. S. and 3 mi W. of Falls City, SW¼ sec. 20, T. 1 N., R. 16 E., Richardson Co., Nebr.

Towner greenstone.

Pre-Cambrian: Southeastern Wyoming (Medicine Bow Mountains).

E. Blackwelder, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 615, 622, etc.). *Towner greenstone.*—Schistose basic greenstones, probably derived from pyroclastics and flows. Underlies (probably conformably) French sl. and overlies (probably conformably) Ranger marble. Best exposed along new road btw. Brooklyn Lodge and Towner Lake.

Town Mountain granite.

Pre-Cambrian: Central Texas (Llano uplift).

H. B. Stenzel, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 144). [See under *Sixmile granite*.]

Towow formation.

Carboniferous (Pennsylvanian?): Southwestern Maine.

F. J. Katz, 1917 (Wash. Acad. Sci. Jour., vol. 7, p. 199). *Towow fm.*—Graphitic and pyritiferous quartz slates and carbonaceous sericite phyllite occurring in twp. of Lebanon, and surrounded by Rindgemere fm.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, pp. 174–175). *Towow fm.*—Uniformly very fine-grained and thin-bedded dark gray to black carbonaceous or graphitic siliceous slates and sericite sl. or phyllite. In general richly carbonaceous and in places graphitic and impregnated with pyrite and in small individual crystals and lenticular masses. Lithologically identical with Diamond Island sl. and the black pyritiferous part of Scarboro phyllite. Top presumably not present. Rests on Rindgemere fm. Thickness seems to be a few hundred ft. Approx.=a portion of lower part of Casco Bay group. Occurs only in Lebanon Twp, York Co. Assigned to Penn.(?). Name derived from original name of first settlement in town of Lebanon.

Trabuco formation.

Cretaceous: Southern California (Santa Ana Mountains).

E. L. Packard, 1916 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 9, pp. 140–141). *Trabuco fm.*—Massive red cgls., composed of angular and water-worn boulders loosely cemented, with subordinate bands of red ss. Thickness 200 ft. No fossils found, but from strat. relations the fm. is probably but slightly older than Chico group and presumably represents some phase of the pre-Chico Cret. Grades into overlying Chico group and rests uncon. on basement complex. Extends from North Star Canyon nearly to Trabuco Canyon. Best exposed at Harding Canyon.

R. Eckis, 1934 (Calif. Dept. Public Works, Water Res. Div. Bull. 45, p. 42). *Trabuco fm.* is probably of Chico age. [In table on p. 38 *Trabuco fm.*, 300 to 750 ft. thick, is placed beneath Chico fm. and uncon. above Jurassic intrusives.]

Tracey sand.

A subsurface sand in Chester group (Miss.) of Lawrence Co., Ill. (See Ill. Geol. Surv. Bull. 54, table 5, 1927.)

Tracy sand.

A subsurface sand, of early Chester (Miss.) age, in Ind. that has been correlated with Paoli ls. of Cumings.

†Tracy City Measures.

Pennsylvanian: Southeastern Tennessee.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 148–153, 167, 169). *Tracy City Measures.*—Sss., shales, and coals, surmounted by a heavy ss., here named Emory ss. Comprises middle div. of Coal Measures. Most important coal bed is "Main Sewanee." Thickness of fm. 250 to 500 ft. Overlies Bon Air Measures and underlies Brushy Mtn Measures.

Included upper part of Lee group (lower Pottsville), and is now divided into several fms., including Rockcastle (†Emory) ss., Vandever sh., Bonair ss., and Whitwell sh. Has also been called "Tracy City group" (see G. H. Ashley, Tenn. Geol. Surv. Bull. 2A, p. 21).

Named for Tracy City, Grundy Co.

Tracy Creek andesite.

Miocene (?): Southwestern Colorado (southern part of Saguache quadrangle and part of Del Norte quadrangle).

E. S. Larsen, 1935 (U. S. G. S. Bull. 843). *Tracy Creek andesite.*—Flows and subordinate tuff-breccia, in part andesite but chiefly tridymite dacite. In upper drainage of Tracy Creek and to N. lowest memb. is dense dark-gray platy andesite.

To N. this memb. consists of a number of flows with some breccia of tridymite dacite. Occurs in extreme S. part of Saguache quad. but extends a short distance into Del Norte quad. and makes up much of drainage of Tracy Creek, for which it is named. Underlies Conejos andesite. Overlies Beidell latite-andesite irregularly. Is of pre-Potosi age. Assigned to Miocene (?).

Traders iron-formation member (of Vulcan iron-formation).

Pre-Cambrian (middle Huronian): Northwestern Michigan (Menominee district).

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62). *Traders ore-bearing memb.*—Ferruginous cgls. and qtzite, ferruginous quartzose slates, and iron-ore deposits; the cgls. and qtzite usually at base. Thickness 85 to 170 ft. Basal memb. of Vulcan fm. Underlies Brier sl. memb. Uncon. overlies Negaunee fm., which is so thin in Menominee dist. that it is mapped with Vulcan fm. Named for Traders mine [N. of Lake Antoine].

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), adopted *iron-fm.* and *iron-fm. memb.* as lithologic terms, and changed age of *Vulcan iron-fm.* from upper Huronian to middle Huronian.

Tradewater formation. (Of Pottsville group.)

Pennsylvanian: Western Kentucky and southeastern Illinois.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 27). *Tradewater fm.*—Chiefly sh., with occasional inconstant ss. beds, 175 to 700 ft. thick in Webster Co., Ky. Includes coal No. 5 near top and Bell coal near base. Uncon. underlies Pennsylvanian De Koven fm. and overlies Caseyville cgl.

Top fm. of Pottsville group in western Ky. and SE. Ill. Underlies Carbondale fm. and overlies Caseyville ss.

Named for exposures along Tradewater River E. of Battery Rock, Ky.

Trail formation.

Lower Jurassic: Northern California (Taylorsville region).

J. S. Diller, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 370–394). *Trail beds*, Triassic (?); 2,900 ft. thick. On structural grounds regarded as Triassic and probably newer than Hosselkus ls.

J. S. Diller, 1908 (U. S. G. S. Bull. 353). *Trail fm.*—Largely slaty shales with some interbedded sss. and cgls. Shales often purplish or red but perhaps more frequently gray, with pencil structure locally developed; in places contain numerous cherty nodules of carbonate of lime. The sss. generally fine, often somewhat slaty, thin-bedded, and gray to almost black. Fresh-water fossils. Thickness 2,900 ft. Overlaps, uncon., Swearinger sl., Hosselkus ls., and Robinson fm. Is next older than marine Hardgrave ss., with which it is assumed to be uncon.

C. H. Crickmay, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 81, and No. 5, pp. 895–903), renamed the basal Lower Jurassic Trail fm. of Diller *Lilac ss.*, and stated that *Trail tuff and cgl.*, 2,000± ft. thick, is Upper Jurassic, and next to youngest Jurassic fm. in Taylorsville region.

Named for exposures along Hosselkus Creek on the trail, Plumas Co.

Trail Creek formation.

Silurian (Niagaran): Central Idaho (Hailey-Bayhorse region).

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10, 23). *Trail Creek fm.*—Siliceous argillites and qtzitic sss.; in basal 60 ft. the qtzitic ss. layers are separated by thin seams of carbonaceous argillites containing abundant graptolite fauna of Niagaran age. Thickness 500± ft. Older than Milligen fm. (Miss. and Dev.?) and younger than Phi Kappa fm. (Ord.). Exposures confined to W. side of Trail Creek, in its upper part, Hailey quad.

C. P. Ross, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 5, p. 956 and table opp. p. 940). In quads. to W. of Hailey quad. the *Trail Creek fm.* underlies Laketown dol. and overlies Saturday Mtn fm. [See also C. P. Ross, U. S. G. S. Bull. 877, in press, pp. 11, 22–23.]

Trail Crossing basalt.

Eocene (?): Central northern Oregon (Deschutes Basin).

H. T. Stearns, 1931 (U. S. G. S. W. S. P. 637, p. 134). *Trail Crossing basalt (Eocene?)*.—Oldest rocks that outcrop in Middle Deschutes River Basin. Exposed on both banks of Crooked River at Trail Crossing and extend NE. across Haystack Butte country in a belt about 1 mi. wide. Whether the basalt is a sill or an extrusive mass undet. Overlain in places by several ft. of tuffs probably belonging to Eocene Clarno fm. At Trail Crossing is separated by angular uncon. from fresh black basalt flows that overlie the tuffs.

Training School volcanics.

Pleistocene (late): Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Training School volcanics.*—Basalt and bedded cinders. Included in middle part of Honolulu volcanic series [q. v.]. The Maunawili Training School for Girls is located near the source of the flow.

†Trampan formation.

Miocene (upper): Western California (San Francisco region).

A. C. Lawson and C. Palache, 1902 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 2, pp. 447–448). *Trampan fm.*—Marine beds, aggregating about 2,000 ft., succeeding the fresh-water Orindan deposits. Fauna is, in opinion of Prof. J. C. Merriam, closely allied to that of San Pablo fm. Named for exposures along Las Trampas Creek, Contra Costa Co.

A. C. Lawson, 1914 (U. S. G. S. San Francisco folio, No. 193), mapped the marine beds formerly called "Trampan fm." as *San Pablo fm.*

Trangville beds.

Name used in chart opp. p. 206 of U. S. G. S. P. P. 45, 1906. Is misprint for *Tranquille beds*, the name used by Dawson in publication cited.

Tranquille beds.

Tertiary: British Columbia.

G. M. Dawson, 1896 (Canada Geol. Surv., n. s., vol. 7, pp. 26B, 72B–73B, 165B–182B).

Trappean series.

A lithologic term (meaning "pertaining to or of the nature of trap or trap rock") applied in a titular sense in some early repts to the Keweenawan rocks of Lake Superior region.

Traveller rhyolite.

Age (?): Western Maine (Piscataquis County).

F. W. Toppan, 1932 (Geol. of Maine, Dept. Geol. Union Coll., Schenectady, N. Y., pp. 69–70). *Traveller rhyolite* forms mass of Traveller Mtns, a group of peaks N. of Katahdin. Occupies about 100 sq. mi. Is in igneous contact with Katahdin granite.

Traverse formation.

Middle Devonian: Michigan (Lower Peninsula).

A. Winchell, 1871 (Mich. Geol. Surv. Rept. Prog., pp. 26–33). *Little Traverse group.*—Series of thick-bedded mag. buffish granular lss. underlying Huron group and overlying Corniferous group in Lower Peninsula of Mich. In general conforms to Hamilton group of N. Y.

A. C. Lane, as reported by M. E. Wadsworth, 1893 (Mich. Geol. Surv. Rept. for 1891 and 1892, p. 66). *Traverse group*, 100 to 600 ft. thick, underlies St. Clair shales [Antrim sh. of present nomenclature] and overlies Dundee ls.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2, btw. pp. 1 and 31). *Traverse group.*—Bluish calc. shales and lss. or dolomites, 100 to 600 ft. thick. Underlies St. Clair [Antrim] black shales and overlies Dundee ls. Outcrops at both Little Traverse [Bay] and Grand Traverse, and "Little" may as well be dropped.

A. W. Grabau, 1902 (Mich. State Bd. Geol. Surv. Rept. 1901, pp. 163+). *Traverse group* divided into (descending) Thunder Bay series, Alpena ls., Long Lake series, and Bell shales.

E. R. Pohl, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 14). *Traverse group* of northern counties of Lower Peninsula divided into (descending) Petoskey fm., Charlevoix stage, and Gravel Point stage ("basal div. of Traverse group in Mich."). In Lake Huron section Grabau has recently (unpublished ms., 1915, pp. 290–308) assigned Bell shales to their proper place as basal memb. of Presque Isle series, which also includes the respectively higher Grand Lake and Long Lake members. [p. 4.] [On p. 25 Pohl states:] The fourfold subdivision previously adopted for Traverse group in Presque Isle and Alpena Counties has more recently been restricted by Grabau, the Bell shales now forming lowest memb. of Presque Isle series. The downward sequence as now understood is as follows (Grabau, unpublished ms. 1915, pp. 298, 308, 318, 441):

Thunder Bay series (stage), 137–190 ft.
Alpena series (stage), 118–134 ft.
Presque Isle series (stage):
  Long Lake beds (memb.), 157–169 ft.
  Grand Lake ls. (memb.), 39 ft.
  Bell shales (memb.), 60–80 ft.
Total thickness Traverse group 511–612 ft.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38, pp. 19–64), correlated the subdivisions of *Traverse group* as listed in this (1933) entry under *Charlevoix stage.*

A. S. Warthin, Jr., and G. A. Cooper, 1935 (Wash. Acad. Sci. Jour., vol. 25, No. 12, pp. 524–526). *Traverse group* of Thunder Bay region divided into:

Squaw Bay ls., 12± ft. ("Probably should be excluded from Traverse group.")
Covered interval, 3 ft.
Thunder Bay stage:
  Partridge Point fm., 14+ ft.
  Covered interval, 70 ft.
  Potter Farm fm., 36 ft.
  Norway Point fm., 46 ft.
Alpena ls. stage [restricted].
Long Lake stage [redefined]:
  Killians ls., 23 ft. (The "black Alpena" zone of previous repts.)
  Genshaw fm., 51 ft.
  Ferron Point fm., 35± ft.
Rockport ls.
Bell sh. (Base of Traverse group in Alpena region.)

Travester shale.

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; and Conspectus of geol. fms. of N. Mex., pp. 3, 12). *Travester shales.*—Variegated beds 100 ft. thick, lying immediately above Exter sss. and well displayed in Travester Canyon, NE. N. Mex. Underlie Chaquaqua shales. Included in Morrisonian series.

Travis Peak formation. (In Trinity group.)

Lower Cretaceous (Comanche series): Texas.

R. T. Hill, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 118–119, 133). *Travis Peak sands or water-bearing beds.*—Sandy beds, 200 to 300 ft. thick, underlying Fredericksburg div., and divided into upper or Packsand beds and Basal or Contact beds, the latter consisting of cgls. Exposed 1 mi. below Travis Peak P. O., where basal aren. beds of overlying Fredericksburg div. are also exposed. Latter include 1st *Caprotina* horizon.

R. T. Hill and J. A. Taff, 1892 (Final geol. rept. artesian invest.; 52d Cong., 1st sess., S. Ex. Doc. 41, pt. 3, pl. opp. p. 90). *Travis cgl. and sands (Trinity).*—Base of Cret. along Colorado River in Burnet and Bastrop Counties. Underlies Alternating beds [Glen Rose ls.].

R. T. Hill and T. W. Vaughan, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 216, 219–222). *Travis Peak fm.*—Coarse angular cross-bedded sand, becoming more finely triturated until it reaches condition known in Tex. as "pack sand," i. e., a very fine-grained, loosely consolidated sand cemented by carbonate of lime, and containing patches of red and greenish-white clays, with usually a cgl. at base. Thickness 263 ft. Basal fm. of Trinity div. and of Comanche series. Underlies Glen Rose fm. or "Alternating beds," the basal bed of which is Caprotina horizon No. 1.

Named for Travis Peak post office, Burnet Co.

Travis Peak limestone. (In Travis Peak formation.)

Lower Cretaceous (Comanche series): Northeastern Texas.

W. M. Winton, 1925 (Univ. Tex. Bull. 2544), divided the beds beneath Glen Rose ls. in Denton Co. into (descending) Trinity sand, *Travis Peak ls.*, and Trinity sand.

Treadwell slate.

Upper Jurassic (?): Southeastern Alaska (Juneau region).

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 255–256, 270, chart opp. p. 247). *Treadwell sl.*—Black clay sl. with some cgl. and much graywacke. Thickness probably 7,000± ft. Apparently comprises oldest rocks on Treadwell Island, and is supposed to overlie Thane volcanic group, but Gastineau Channel separates the fms. Underlies Douglas Island volcanic group with apparent conformity. No fossils. Tentatively assigned to Upper Jurassic but may be post-Jurassic.

Treasure Mountain quartz latite. (Of Potosi volcanic series.)

Miocene: Southern Colorado (Summitville region).

H. B. Patton, 1917 (Colo. Geol. Surv. Bull. 13, pp. 20, 33–35). *Treasure Mtn latite.*—Biotite latite, differing in several material respects from the other latites of Platoro-Summitville dist. Color varies from light to dark gray, but locally may be light to dark brown. Name *Treasure Mtn* not altogether satisfactory, and study of this fm. to E. may make change necessary. The name was used by Dr. E. S. Larsen in his field notes. Included in Potosi volcanic series.

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718, table opp. p. 12). *Treasure Mtn latite* of Platoro-Summitville dist. is 1,000+ ft. thick. Named for exposures on Treasure Mtn, in NW. part of Summitville quad.

E. S. Larsen, 1935 (U. S. G. S. Bull 843), changed name to *Treasure Mtn quartz latite.*

Treat limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

See under *Aux Sable ls.*

†Trego zone. (In Niobrara formation.)

Upper Cretaceous: Northwestern Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 51). *Trego zone.*—Lower bluish and marly zone of Smoky Hill chalk, underlying upper, more chalky, Norton zone. Lenses of hard so-called "Bell rock" in base or transition to underlying Osborne ls. Named for Trego Co.

Is basal part of Smoky Hill chalk memb. (See W. W. Rubey and N. W. Bass, Kans. Geol. Surv. Bull. 10, 1925, p. 28.)

Tremaines Bridge beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 137, 141, 149, 154). *Tremaines Bridge beds* (zone of *Dekayella ulrichi* and *Arthropora cincinnatiensis*).—Basal zone of Pulaski fm. Observed only at head of "gulf" just above bridge leading to Tremaines and below Pulaski. Overlie Moose Creek beds and underlie Worthville beds.

Trembling Lake limestone.

Pre-Cambrian: Ontario.

Name applied by W. E. Logan, 1865 (Canada Geol. Surv. 16th Rept. Prog., p. 20, map), to one of the lss. in Grenville series of Ontario.

†Trempealeau formation.

Upper Cambrian: Southern Wisconsin, northern Illinois and Iowa, and southern Minnesota.

F. T. Thwaites, 1923 (Jour. Geol., vol. 31, No. 7, p. 547). *Trempealeau fm.* has been called *St. Lawrence fm.*, and in older literature was correlated with the Mendota of Madison region, Wis. The name is proposed [unpublished at this time] by E. O. Ulrich, who divides the fm. into following members, descending order:

- Norwalk fine-grained dolomitic ss. [This is lower and fossiliferous part of Jordan ss. of current nomenclature.]
- Lodi yellow and purple sandy thin-bedded dol. locally called "sh."
- St. Lawrence or Black Earth dol. [This is a restriction of St. Lawrence as heretofore defined and used.]
- Sandy dolomitic shales of local distribution.

Is overlain by Jordan ss. [restricted] and rests on Mazomanie fm.

E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett. Trans., vol. 21, pp. 72–90). In its fullest development *Trempealeau fm.* is divisible into 4 lithologically and faunally distinct members [listed below]. Locally one or two of these subdivisions might be mapped separately, but as a rule topographic conditions are such that only the lower mag. ls. memb. lends itself readily to such separate treatment.

Norwalk ss. memb., 50 ft. [See above.]

Lodi sh. memb., 50 ft.

St. Lawrence ls. or dol. restricted, 25 ft.

Basal sh. or shaly ss. with considerable greensand and occasionally thin layers of dolomitized ss., with usually at bottom a thin layer of ss. cgl., 0 to 20 ft. thick. This basal sh. may be of same age as St. Lawrence dol., and until this is determined no special name for the sh. is proposed.

There is considerable variation in character and sequence of component beds of the fm. from place to place. Thus in E. Wis. the upper (Norwalk) memb. is commonly and perhaps always absent. But the yellow calc. shaly Lodi memb. is generally present and may also be called most characteristic part of the fm. The same might be said of next underlying St. Lawrence ls. or dol. memb., but in middle and N. parts of State this memb. is entirely wanting in many places, or is so altered by addition of relatively coarse quartz sand that recognition of its zone is rendered difficult and uncertain. The fm. rests on Mazomanie ss. or, where that is absent, on Franconia ss. Is overlain by Jordan ss. restricted. Is well displayed and in fairly typical composition in Trempealeau Bluff on Mississippi River [at Trempealeau, Trempealeau Co., Wis.].

A. C. Trowbridge and G. I. Atwater, 1934 (Geol. Soc. Am. Bull., vol. 45, p. 60). St. Lawrence fm. should continue to be used for the beds btw. Franconia ss. and Jordan ss. More than half of Trempealeau fm. as defined is Jordan and should remain Jordan.

J. M. Wanenmacher, W. H. Twenhofel, and G. O. Raasch, 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 21–25). *Trempealeau fm.* divided into (descending) Jordan ss. memb., Lodi sh. memb., St. Lawrence (Mendota or Black Earth) memb., and basal greensand and greensand cgl. memb. Rests uncon. on Franconia fm. and is overlain by Madison fm. [Foregoing use of St. Lawrence is Ulrich's restricted St. Lawrence.]

A. C. Trowbridge, W. H. Twenhofel, and F. T. Thwaites, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., pp. 93, 116, 123, 131, etc.), expanded *Trempealeau fm.* by including in it, at top, *all* of Jordan ss. and the overlying Madison ss., but G. O. Raasch objected to inclusion of Madison. (See also under *Madison ss.*).

The U. S. Geol. Survey has not adopted Trempealeau fm., but treats its subdivisions (Madison ss., Jordan ss., and St. Lawrence fm.—the latter including Lodi sh. memb. and underlying beds down to top of Franconia ss.) as distinct fms.

Trent marl.

Miocene (lower): Coastal Plain of southern North Carolina.

B. L. Miller, 1910 (Geol. Soc. Am. Bull., vol. 20, pp. 674–675; also chart opp. p. 646). *Trent fm.*—A distinctly calc. fm. (fine-grained calc. marls or lss.) with little or no glauconite present. Along Neuse and Trent Rivers rests on Cret. strata belonging to Peedee fm., but farther W. it lies on pre-Camb. crystalline rocks. Assigned to Eocene. Is uncon. overlain by Castle Hayne fm.

Later work by L. B. Kellum proved that the marl (marine) at Trent type loc. is lower Mio., and that the marl (also marine) at Castle Hayne type loc. is upper Eocene (Jackson), and he restricted the names to accord, reporting a thickness of 0 to 100 ft. for Trent marl. (See U. S. G. S. P. P. 143, 1926, also Jour. Geol., vol. 33, pp. 183–187, 1925.)

Named for exposures along Trent River from vicinity of Trenton, Jones Co., to near junction of Trent and Neuse Rivers.

Trenton limestone. (**Trenton group** in parts of N. Y.)

Middle Ordovician: New York, Michigan, Pennsylvania, northern Ohio, and western Virginia.

L. Vanuxem, 1838 (N. Y. Geol. Surv. 2d Rept., pp. 257, 276, 283). *Trenton ls.*—Forms Trenton Falls (Oneida Co., N. Y.), whence its name. Thickness 10 to 125 ft.; at Trenton Falls is over 100 ft. thick. Consists of light-gray or sparry ls., which forms upper mass of Trenton Falls, underlain by dark or black, almost compact ls. Is overlain by black sh. [Utica sh.] and underlain by birdseye ls. [Lowville?]. [As thus defined includes Amsterdam ls., which forms upper part of Black River group.]

T. A. Conrad, 1839 (Phila. Acad. Nat. Sci. Jour., vol. 8, pt. 1, pp. 228–235), applied *Trenton ls.* to beds overlain by black sh. [Utica] and underlain by Mohawk ls. [Amsterdam ls.?].

In 1842 (Geol. N. Y., pt. 3) Vanuxem defined *Trenton ls.* as 0 to 300 ft. thick, practically repeated his 1838 description of its lithology, and called underlying fm. *Black River ls.*, in which he included the Lowville of present nomenclature. This is present commonly accepted definition of Trenton, although for many years most writers used *Trenton ls.* to include not only the Trenton proper, but all of underlying Black River group, while some writers used *Trenton group*, also *Trenton fm.* and *Trenton ls.*, to include the Trenton proper, all of Black River group, and in some cases Chazy ls. also. In central N. Y. *Trenton ls.* has been applied to the ls. underlying Dolgeville sh. (considered a shaly representative of upper part of the Trenton at its type section, and overlain by Utica sh.). Repts give thickness of *Trenton proper* as 200 ft. in Utica quad.; 300+ ft. in Clinton Co., N. Y.; 400+ ft. in Thousand Islands region; and 20 ft. in Broadalbin quad., Fulton and Saratoga Counties, N. Y. In parts of N. Y. the Trenton is a *group*, separated into several named fms. of ls. and sh.

In 1926 (N. Y. State Mus. Bull. 270, p. 65) F. Holzwasser stated that the 450 ft. of Trenton ls. at Trenton Falls is middle Trenton, "the base and upper beds of that fm. not being exposed."

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 283). *Trenton beds* comprise lss., shales, and sss. Glens Falls ls. has been determined to be of very early (basal) Trenton age. It is well developed in Mohawk and Upper Hudson valleys, where it has a thickness of 17 to 40 ft. It is missing below the typical Trenton ls. at Trenton Falls.

†Trenton gravel.

Pleistocene: Southeastern Pennsylvania and western New Jersey.

H. C. Lewis, 1881 (Phila. Acad. Nat. Sci. Proc. 1880, vol. 32, pp. 296–309). *Trenton gravel.*—The last and newest of all the gravels. Is an alluvial gravel, 0 to 100 ft. thick. At Phila. lies close along the river and rises a few ft. above it. Covers flat ground of Camden and lower part of Phila. and forms islands in the river. From its great development farther up the river is now called *Trenton gravel.*

Is a local development of *Cape May fm.*, which name replaces it. Part of city of Trenton, N. J., is built on terrace covered with this gravel.

Trenton clays.

Upper Cretaceous: Western New Jersey.

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 197). *Trenton clays.*—Commonly red or red-spotted grading into blue at bottom of pits. In some places upper layer is white clay, and locally a black lignitic clay occurs beneath the blue clay; elsewhere a sand bed underlies the clay. Belong in Raritan fm. [broad use of Raritan, which included Magothy fm.]. Two mi. E. of Trenton the clays are dug in a number of pits along Pond Run. They are locally known as *Dogtown clays*, from occurrence at Dogtown, near Trenton.

†Trenton conglomerate.

Name used in some early repts for an intraformational ls. cgl. of lower Trenton age in Rensselaer Co., N. Y., that was later named *Rysedorph cgl.* Has also been called "Lower Trenton cgl."

†Trenton period.

A term applied in some early repts to the time during which Trenton ls., Black River group, and Chazy ls. were deposited; also to the time during which only Trenton ls. and Black River group were deposited. In latter sense the name is now replaced by *Mohawkian epoch*. In former sense it covers Middle Ordovician or Mohawkian epoch and upper part of Lower Ordovician epoch. The U. S. Geol. Survey employs *Trenton epoch* to include the time covered by deposition of Trenton ls.

Trenton Falls series.

Ordovician: New York.

T. A. Conrad, 1837 (N. Y. Geol. Surv. 1st Ann. Rept., p. 165), in a description of gray sss. and shales of Salmon River, stated that their fossils were "very different from those of *Trenton Falls series of rocks* on which they repose."

†Trentonian.

A time term proposed by A. W. Grabau in 1909 (Sci., n. s., vol. 29, pp. 351–356) to include Upper Ordovician series and upper part of Middle Ordovician (Mohawkian) series, because "Trenton deposition covers at least one-half this division" and because "Trenton period was used by Dana for Trenton ls. and later divisions." He suggested, however, that *Nashvillean* might be a better name "if the Nashville group of Safford covers both Trenton and later Ordovicic formations."

Trent River shales.

Age (?): British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 105). [No age assigned.]

J. D. MacKenzie, 1922 (Canadian Inst. Min. and Met. Mon. Bull. 122, p. 679). Trent River fm. is Cret.

Tres Hermanos sandstone member (of Mancos shale).

Upper Cretaceous: Central northern New Mexico.

C. L. Herrick, 1900 (Am. Geol., vol. 25, pp. 331–346; N. Mex. Univ. Bull., vol. 2, pt. 1, pp. 3–63, pt. 2, pp. 1–17). *Tres Hermanos ss.*—Massive yellow ss., 75 ft. thick. Lies 225+ ft. lower than Punta de la Mesa ss. and 100+ ft. below the cephalopod zone. Is separated from underlying gastropod zone (containing Benton fossils) by 100 ft. of yellow sh. Lies 150 to 250 ft. above Dakota ss. [Derivation of name not stated.]

W. T. Lee, 1912 (Geol. Soc. Am. Bull., vol. 23, pp. 592–598). *Tres Hermanos ss. memb. of Mancos sh.* lies lower than and in close association with the concretion (Septaria) zone and higher than the gastropod zone of previous repts. It is typically developed in Rio Puerco field, but is readily recognized in Tijeras, Hagan, and Cerrillos fields, and is probably represented throughout San Juan Basin. It consists of a series of yellow sss. 150± ft. thick on Rio Puerco and thinner in some other fields. It thickens westward and thins to E. The name may be used to designate the zone of yellow ss. that occurs near base of Mancos sh. in all the fields described in central N. Mex. W. of the mtns.

W. T. Lee, 1915 (U. S. G. S. P. P. 95, July 12, 1915, p. 45). Near base of Mancos sh. is *Tres Hermanos ss. memb.*, which is recognizable from Datil Mtns to Casa Salazar but not found farther N., near Gallina. This ss. is coal-bearing in Datil Mtns, but in Rio Puerco field only a single layer of carbonaceous sh. was found in it.

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 172, 174, 179, 199, 203, 213–214). *Tres Hermanos ss. memb. of Mancos sh.* lies 1,147± ft. below Punta de la Mesa ss. at Casa Salazar. At its type loc. it is 20 ft. thick and consists of thin irregular layers of ss. an in. or less thick, on whose faces are ripple marks, worm tracks, and markings of many kinds; the sandy layers are separated in some places by films of sh.; a few imperfect casts of gastropods were found in it, and impressions supposed to be *Halymenites major* are abundant in some places. The ss. is unlike any other rocks near it and has a peculiar appearance that makes its recognition easy. About 100 ft. above it is a small ridge of ls. 3± ft. thick, which presumably represents Greenhorn ls. In Hagan field the Tres Hermanos is only 5 ft. thick, but increases to 15 or 20 ft. nearby. Near Rogers, 2 mi. SW. of Cerrillos, it is 20 ft. thick and consists of hard quartzose ss., in thin irregular layers and weathers yellowish brown. In Tijeras coal field it is 145 ft. thick and consists of hard quartzose ss. containing worm borings and indefinite markings of various kinds.

D. E. Winchester, 1920 (U. S. G. S. Bull. 716A, pp. 3, 6). The two lower resistant and persistent ss. members of Miguel fm. may represent Tres Hermanos ss. of Lee, but they are the least conspicuous of the sss. in this area and were not mapped. They are exposed 1 mi. E. of Tres Hermanos Buttes [shown on map a short distance E. of Gallego Creek].

C. B. Hunt, 1936 (U. S. G. S. Bull. 860-B, pp. 40, 41, 42). East of Mount Taylor are the 3 prominent sss. [separated by shales] in lower 350 ft. of Mancos sh. to each and all of which the name "Tres Hermanos ss." has been applied in previous repts. These sss. are medium and fine-grained buff sss., prominent in vicinity of Seboyeta but thin out to E. and NE. Fossils collected from them suggest Graneros age. The upper ss. (No. 3) is 30 ft. thick, and is separated from ss. No. 2 (75 ft. thick) by 30 ft. of sh. The lower ss. (No. 1) is 50 ft. thick and lies 65 ft. below ss. No. 2 and 72 ft. above Dakota (?) ss.

Tres Pinos sandstone.

Eocene: Southern California (San Benito County).

P. F. Kerr and H. G. Schenck, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 470 and 475). *Tres Pinos ss.*—Massive coarse-grained quartzose buff-colored marine ss., with cgl. phases; jointed; more indurated on exposed surfaces; large erosional cavities common. Thickness about 900 ft. No diagnostic fossils. Of possible Eo. age. Quite similar lithologically to Pinecate ss. and may prove to be same. But at present is considered to be Tejon (?), because it overlies well-established Meganos deposits with no marked uncon.

Probably named for exposures at or near Tres Pinos or Tres Pinos Creek.

Trias.

Same as Triassic. Used chiefly by Europeans.

Triassic period (or **system**).

The time (and the rocks) of the oldest period of Mesozoic era, following the Carboniferous period and preceding the Jurassic period. For definition see U. S. G. S. Bull. 769, p. 64.

Tribes Hill limestone. (In Beekmantown group.)

Lower Ordovician: Central, eastern, and northern New York.

E. O. Ulrich and H. P. Cushing, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 780-781; and N. Y. State Mus. Bull. 140). [See explanation in item 11 (1910) under *Beekmantown group*.] In 1911 (Am. Jour. Sci., 4th, vol. 31, pp. 135-144) Cushing described *Tribes Hill ls.* as much more calc. and more fossiliferous than underlying Little Falls dol. [restricted]. Repts give thickness in Thousand Islands region as 0 to 40 ft. Named for exposures at Tribes Hill, Montgomery Co. [about 30 mi. E. of type loc. of Little Falls dol.].

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 33). Evidence so far obtained indicates *Tribes Hill ls.* is at least as old as lower Beekmantown as now restricted. Overlies Little Falls dol., and is present in Thousand Islands region.

H. P. Cushing, 1916 (N. Y. State Mus. Bull. 191, p. 35). *Tribes Hill fm.* believed to be of oldest Beekmantown age. Rests uncon. on Theresa fm. in Brier Hill, Ogdensburg, and Red Mills quads.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 263, 270). Beekmantown submergence in N. Y. in general begins with *Tribes Hill ls.*, which overlies Little Falls dol. nearly everywhere in Mohawk Valley, the type region. [But in tables on pp. 191, 194, and 268 she excluded Tribes Hill from Beekmantown. She also listed Tribes Hill as present in central, east-central, and eastern N. Y.]

See also under *Beekmantown group* and *Little Falls dol.* The U. S. Geol. Survey classifies Tribes Hill ls. as of Beekmantown age (upper part of div. B).

†Tribune limestone. (In Chester group.)

Mississippian: Western Kentucky and southeastern Illinois.

E. O. Ulrich, 1904 (Mo. Bur. Geol. and Mines vol. 2, 2d ser., p. 109). *Tribune ls.*—Main ls. of Chester group; underlies Birdsville fm. and overlies [so-called] Cypress ss. [Not true Cypress, which is much higher, but the Aux Vases ss., according to Ulrich and others.]

Now divided into several named fms. Abandoned by Ulrich in 1917 (Ky. Geol. Surv. Mississippian series of western Ky., p. 7).

Named for Tribune, Crittenden Co., Ky., but the ls. on which town of Tribune is built is now known to be Menard ls., in middle of †Birdsville fm.

†Triceratops beds.

A name applied to deposits of Western States that contain the remains of the dinosaur *Triceratops*, a genus belonging to the Ceratopsidae family. The U. S. Geol. Survey now classifies the *Triceratops*-bearing beds as Upper Cret.

†Trickham bed. (In Graham formation.)

Pennsylvanian: Central Texas (Coleman County).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 402). *Trickham bed*.—Sandy clay, chiefly bluish, with some ss., ls., and cgl. Thickness 100 to 160 ft. Basal memb. of Cisco div. Underlies *Bellerophon* bed and overlies *Campophyllum* bed, of Canyon div.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, pp. 136, 154, table 2). state (p. 136) that their Graham fm. (of Cisco group) includes *basal shales of Trickham bed* of Drake. Their table 2 shows *upper part* of Trickham beds is = Avis ss., which is made basal memb. of their Thrifty fm. Named for Trickham, Coleman Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103). *Trickham sh. of Drake* lies near bottom of Thrifty fm. in Colorado River Valley [but he included it in Graham fm.].

Wallace Lee and C. O. Nickell state (rept completed and soon to be published by Tex. Geol. Surv.) *Trickham bed* of Drake is same as Wayland sh. memb. of Graham fm. and is abandoned. This is accepted by U. S. Geol. Survey for its repts.

Trident.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to 575 ft. of lss. of early Miss. age in Mont. Derivation of name unknown.

Trimble granite.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Trimble granite*.—Fine-grained gray biotite granite. Intrudes Eolus granite in neighborhood of Trimble Pass, La Plata Co., but does not intrude Ignacio qtzite [Upper Camb.]. [Mapped over large area surrounding Trimble Pass.]

For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

Trimmers Rock sandstone.

Upper Devonian: Southern central Pennsylvania.

B. Willard, 1935 (Geol. Soc. Am. Proc. 1934, p. 123). *Trimmers Rock ss.* is introduced to supplant *Ithaca* in Susquehanna Valley, Lehigh Valley, and Upper Delaware Valley, because of more inclusive nature of the Pa. beds than typical Ithaca. [In Susquehanna Valley shown as underlying Parkhead ss. (?) and overlying Losh Run sh.; in Lehigh Valley shown as underlying Catskill red beds and overlying Burket ("Genesee") sh.; in Upper Delaware Valley shown as underlying Delaware River flags.]

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 8, pp. 1195-1218). *Trimmers Rock memb. of Fort Littleton fm*.—Is usually a ridge-forming ss., gray to greenish gray, massive to flaggy. Occurs in central and eastern Pa. Underlies Parkhead memb. and overlies Losh Run memb. In Lycoming Co. 3,000 ft. thick and is time equiv. of lower Chemung and all of Portage group. Thins to W. and finally disappears. Is distinguished from Chemung chiefly by lacking *Spirifer disjunctus*. Well developed in region of Susquehanna and Juniata Valleys. Named for Trimmers Rock, a prominent hill which it supports 1½ mi. E. of Newport, Perry Co. Corresponds to Ithaca, Enfield, and much if not all of the Sherburne. [Long description.] The strata that I. C. White called *Starrucca* in Monroe Co., are simply upper part of Trimmers Rock ss.

B. Willard, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 4, pp. 571, 588). In part of Pike and Monroe Counties Delaware River flags rest on marine Portage (the Trimmers Rock ss.), the intervening local Analomink red sh. being absent. Beyond the Lehigh the Delaware River and Trimmers Rock fms. have not been clearly separated, both being fossiliferous marine Portage. [Table on p. 571 shows following downward succession: Delaware River flags, Analomink red sh., and Trimmers Rock ss. Table on p. 606 shows Trimmers Rock ss.=Delaware River and Analomink.]

Trincheras division.

A term used by E. T. Dumble (Am. Inst. Min. Engrs. Trans., vol. 29, 1900, and vol. 31, 1902) for 2,000± ft. of "late Tertiary" [Cret. or Tert.] andesitic lavas and sss. in Sonora, Mexico, and Cochise Co., SE. Ariz. Derivation of name not stated.

Trinidad lignitic group.

F. V. Hayden, 1875 (U. S. Geol. and Geog. Surv. Terr., Bull. 1, p. 402). At Trinidad the Lignite or coal-bearing group reaches a thickness of about 2,000 ft., containing a large number of coal beds and seams. As the development of the fm. is very typical at that loc., I have designated it as the *Trinidad Lignitic group*.

According to J. B. Reeside, Jr., these beds correspond to Raton and Vermejo fms. of present nomenclature.

Trinidad sandstone.

Upper Cretaceous (Montana): Southeastern Colorado and northeastern New Mexico.

R. C. Hills, 1899 (U. S. G. S. Elmoro folio, No. 58). *Trinidad fm.*—Upper 70 to 80 ft. light-gray ss. with sometimes a pale-greenish tint, usually massive, *Halymenites* abundant; lower 75 ft. thin layers of fine-grained dark-gray ss. with sh. partings. Underlies Laramie fm. and overlies Pierre sh. Uncertain what part of Fox Hills group it represents.

N. H. Darton, 1905 (U. S. G. S. P. P. 32), treated *Trinidad ss.* as upper memb. of Fox Hills fm. in eastern Colo., the rest of the Fox Hills being described as consisting of aren. yellowish shales with occasional bands of yellowish clay.

G. B. Richardson, 1910 (U. S. G. S. Bull. 381). *Trinidad ss.* of Trinidad coal field consists of 150 to 225 ft. of massive fine-grained feldspathic ss. lying between thinner-bedded ss. and sh. by which it merges into overlying Laramie fm. and underlying Pierre sh. Contains fossils which T. W. Stanton says are known only from Fox Hills and upper Pierre.

W. T. Lee, 1913 (Am. Jour. Sci., 4th, vol. 35, pp. 531-534). *Trinidad ss.* underlies Vermejo fm. and overlies Pierre sh. in Trinidad-Raton coal field.

W. T. Lee, 1917 (U. S. G. S. P. P. 101). *Trinidad ss.* [*restricted*].—Massive feldspathic light-gray ss., 70 to 100± ft. thick in Raton Mesa region. Conformably underlies Vermejo fm. and conformably overlies Pierre sh. The name as here used applies to only the "Upper Trinidad" of Hills, his "Lower Trinidad" (consisting of a few ft. to 200± ft. of alternating beds of thin-bedded fine-grained ss. and sh.) being here included, as the transitional zone, in top of Pierre sh., from which it is not clearly separable, while it is usually sharply separated from the massive ss. here called *Trinidad ss.* It is doubtful whether these transitional beds should be included in a fm. with the overlying ss. or regarded as a part of underlying sh., but for purposes of this paper they are included in Pierre sh. The Trinidad persists with slight variation throughout Trinidad coal field and over much of Raton field. It should probably be placed as far down in time scale as lower part of the Fox Hills if not somewhat lower.

J. B. Reeside, Jr., 1924 (U. S. G. S. P. P. 134, pl. 4), correlated Vermejo fm. with Fox Hills ss. of Denver region and Trinidad ss. with upper part of Pierre sh. of that region.

Named for exposures at Trinidad, Las Animas Co.

Trinity group (also **Trinity sand**).

Lower Cretaceous (Comanche series): Texas, central southern and southeastern Oklahoma, southwestern Arkansas, and northwestern Louisiana.

R. T. Hill, 1888 (Sci., vol. 11, p. 21). *Trinity fm.*—Alternations of fine, closely packed white sands and red and blue gypsiferous marl, with occasional thin but extensive beds of fissile, aren., and crystalline lss., highly fossiliferous, often wave-marked, and seldom more than 10 in. thick; in places extensive strata of poor saccharoidal gyp. are present. Underlies Comanche series and overlies Carbf. [This definition applied to basal part of Trinity group of current nomenclature.]

In a rept published later in 1888 (Ark. Geol. Surv., vol. 2) Hill (p. 188) divided his *Trinity div.* in SW. Ark. (400± ft. thick, p. 123) into upper crawfish sands (=Upper Dinosaur sands of Tex.), *Ostrea franklini* beds and ls. (=Lower Dinosaur sands of Tex.), and basal lignitic sands; and stated that it underlies Fredericksburg div. and rests uncon. on Carbf. rocks. On p. 125 he stated that his Trinity underlies lowest Comanche (very early Cret., Neocomian), and that it is either uppermost Jurassic, lowest Cret. (Wealden), or transitional Jura-Cret. In 1889 (Tex. Geol. Surv. Bull. 4, pp. xiii-xiv) Hill definitely included *Trinity div.* in Lower Cret. or Comanche series, and divided it into upper or Packsand beds and Basal or Contact beds. In 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 503–528) Hill included Walnut clay and Paluxy sand in the Fredericksburg and divided the Trinity ("possibly pre-Cret., Jurassic?") into Glen Rose or Alternating beds and Trinity or Basal sands. In 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 269–279) J. A. Taff included Paluxy sand in Trinity group. In 1894 (Geol. Soc. Am. Bull., vol. 5, pl. 13, pp. 317–319) Hill divided Fredericksburg into (descending) Caprina ls., Comanche Peak chalk, and Walnut clay, and divided the Trinity into (descending) Paluxy sands, Glen Rose beds, and Trinity sands. In 1901 (U. S. G. S. 21st Ann. Rept., pt. 7) Hill divided the Trinity into (descending) Paluxy, Glen Rose, and Travis Peak, the latter name replacing the narrow use of Trinity for the basal sands of the group. This is the present generally approved definition of *Trinity group*.

In Tex. the Trinity is now called a group, divided, in eastern Tex., into (descending) Paluxy sand, Glen Rose ls., and Travis Peak sand. In southern Okla. and Ark. the Trinity deposits are not divisible, and *Trinity sand* is adopted name of U. S. Geol. Survey for the deposits of Trinity age, which there are chiefly sand. But *Trinity sand* in restricted sense in which the name was used in some early repts (for basal sand of Trinity group) was long ago replaced by *Travis Peak sand*.

Named for exposures on the Trinity Rivers of Tex.

†Trinity formation.

Term applied by O. H. Hershey (Am. Geol., vol. 27, p. 226, 1901) to the serpentine in Klamath Mtn region of northern Calif.

Trinityan series.

A name proposed by C. [R.] Keyes for basal part of Lower Cret. (Comanche) series of Ariz., correlated with Aptian of Europe and divided into (descending) Morita shales (1,800 ft.) and Etholen cgl. (100 ft.). (See Pan-Am. Geol., vol. 64, No. 2, 1935, pp. 128, 129, 139.)

Trinity Bay sandstone.

Age (?): Newfoundland.

J. B. Jukes, 1839 (Rept. geol. of Newfoundland, p. 2), and 1840 (Edinburgh New Phil. Jour., vol. 29, p. 106).

Triphammer shale member.

Upper Devonian: Central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). *Triphammer sh. memb.*—Top div. of Ithaca facies subgroup in vicinity of Ithaca. Thickness 140 ft. Includes *Beebe ls.*, 1 to 3 ft. thick, which may be coeval with Parrish ls. at base of Rhinestreet sh. to W. Overlies Marathon ss. memb. and underlies Hatch ss. memb. The Triphammer and Marathon probably constitute Oneonta of the East.

†Triple limestone system.

Pennsylvanian: Eastern Kansas.

See under †*Erie ls.*

Trippe limestone.

Middle Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Trippe ls.*—Largely thin-bedded sh., with mottled lss. similar to those so abundant in the older Abercrombie fm. Also contains a few dark dol. layers, beds of more massive ls., and several horizons of finely laminated white dol. and ls. Most beds appear lenticular. Thickness 725 ft. No fossils, but assigned to Middle Camb. because it is lithologically similar to Abercrombie fm. Underlies Lamb dol. and rests on Young Peak dol. Named for exposures in Trippe Gulch, on S. side of North Pass Canyon, Gold Hill dist.

See also U. S. G. S. P. P. 177, 1934, by T. B. Nolan.

Triste formation.

Cretaceous: Mexico.

W. F. Foshag, 1934 (Econ. Geol., vol. 29, No. 4, p. 335).

Triumph conglomerate.

Term applied by J. F. Carll (2d Pa. Geol. Surv. Rept. I, pp. 38–40, 1875) to the coarse cgl. that appears in hilltops at Triumph, Warren Co., NW. Pa. Probably same as Olean cgl. memb. of Pottsville fm.

Triunfo formation.

Tertiary: Mexico.

W. A. Ver Wiebe, 1925 (Pan-Am. Geol., vol. 44, p. 133).

Trivoli cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179–193) to upper part of McLeansboro fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Includes coal No. 8. Derivation of name not stated.

Trizoic.

A time (life) term applied by E. Hitchcock (Geol. Vt., 1861, vol. 1, p. 19) to "Oolitic" (probably=Upper and Middle Jurassic of present nomenclature).

Troedsson Cliff formation.

Ordovician (Trenton ?): Northwest Greenland (Washington Land).

L. Koch, 1929 (Meddelelser om Grönland, Bd. 73, Afd. 1, No. 1, p. 27).

Tropic shale.

Upper Cretaceous (Colorado): Central southern Utah (Kaiparowits Plateau region).

H. E. Gregory and R. C. Moore, 1931 (U. S. G. S. P. P. 164). *Tropic sh.*—Chiefly uniform dark-drab clayey sh. and fine-textured sandy sh., thinly laminated and soft, which breaks down readily to form slopes and broad, gently undulating flats. Upper third is more or less sandy and in places contains thin beds of ss. Gyp. is uncommon. Thickness 600 to 1,400 ft. Conformably underlies Straight Cliffs ss. and conformably overlies Dakota (?) ss. Exposed at and around village of Tropic, Garfield Co., for which it is named. The village is built on this sh.

Trough Creek limestone member (of Mauch Chunk formation).

Mississippian: Central Pennsylvania (Huntingdon County).

I. C. White, 1885 (2d Pa. Geol. Surv. Rept. T_3, pp. 73–76, 85). *Trough Creek ls. group.*—On S. bank of Trough Creek [Huntingdon Co.], ¾ mi. below Todd (Brick) mills, on Mr. Taylor's land, it consists of (descending): Red limy sh., 10 ft.;

red ls., 4 ft.; red limy sh., 16 ft.; gray ls., 2½ ft.; red sl., 3 ft.; gray-green ls., 4 ft. Here it rests on Pocono ss., but elsewhere it is separated from Pocono ss. by 141 ft. of red and variegated shales, thick sss., and shales with gray flagstones. Whole thickness 50 ft. [He in places includes these beds in Mauch Chunk sh. and in other places excludes them from it and treats them as a distinct div.]

C. Butts, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 249–257). *Trough Creek ls.* of I. C. White is in base of Mauch Chunk red sh. and probably is a tongue of marine Greenbrier ls. Is younger than Loyalhanna ls.

C. Butts (U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press). *Trough Creek ls. memb. (of Mauch Chunk fm.)*.—Red and gray ls., 0 to 32 ft. thick. Occurs at base or in lower part of Mauch Chunk fm., being in places underlain by red and green sh., with thin layers of soft yellow ss., forming basal part of Mauch Chunk fm.

Trousdale shale.

Upper Devonian: Central Tennessee.

E. R. Pohl, April 1930 (Tenn. Acad. Sci. Jour., vol. 5, No. 2, pp. 56–63). Because of unestablished relations of the Genesee equiv. in Tenn. the name *Trousdale sh.* is here tentatively proposed for it. The study of presence of Genesee deposits in Tenn. is in progress by author, and a detailed rept should be forthcoming shortly.

E. R. Pohl, August 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 151–152). The black shales of central Tenn. that were formerly called "Chattanooga" comprise 2 fms. of Lower Miss. (Kinderhookian) age, separated by widespread erosional uncon., and locally one fm. of Upper Dev. age. The upper of the Miss. shales correlates by physical and faunal evidence with Sunbury sh. of Ohio and Ky., and the lower Miss. sh. correlates with Cleveland sh. of Ohio and Ky. The Upper Dev. black sh. (which contains Genesee-Portage fossils) is present in N. part of State only, and is physically associated with fossiliferous Dev. lss. For it the name *Trousdale sh.* is suggested. [Derivation of name not stated. There are 2 Trousdales in central Tenn., one in Sumner Co. and one in Warren Co. The former appears to be the type.]

Trout Creek sandstone (distinct formation). Also
Trout Creek sandstone member (of Iles formation).

Upper Cretaceous: Northwestern Colorado (Yampa region).

N. M. Fenneman and H. S. Gale, 1906 (U. S. G. S. Bull. 297, p. 26). *Trout Creek ss. memb. of Mesaverde fm.*—Ledge-making ss., massive, white, containing great concretions; iron-oxide stains common. Thickness 75 ft. Underlies middle coal group (400 ft. thick) of Mesaverde fm. Lies 1,900 ft. above base of Mesaverde. Named for Trout Creek, NE. side of Twentymile Park, about 10 mi. NW. of Yampa.

E. T. Hancock, 1925 (U. S. G. S. Bull. 757). *Trout Creek ss.* is here treated as top memb. of Iles fm. (of Mesaverde group) in Axial and Monument Butte quads.

M. R. Campbell, 1931 (Tentative correlation of named geol. units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Trout Creek ss.* is elevated to rank of a fm. of Mesaverde group in Yampa coal field, where it underlies Mount Harris fm. and overlies Milner fm.

Trout Creek formation.

Miocene (middle): Southeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Trout Creek fm.*—Fine white and cream-colored ash beds, containing fossil plants referred by Knowlton to upper Eo. but pronounced by Dr. Chester Stock to be lower Mio. Thickness undet. Type loc., Trout Creek, on E. side of Alvord Valley, SE. part of Harney Co.

R. E. Fuller, 1931 (Univ. Wash. Pub. Geol., vol. 3, No. 1, p. 52). Vertebrate remains recently collected by Stock indicate quite clearly that Trout Creek fm. is not earlier than middle Mio. (Chester Stock, personal communication.)

Troutdale granite.

Pre-Cambrian (?): Central northern Colorado (Georgetown-Central City-Montezuma region).

J. Underhill, 1906 (Univ. Colo. Studies, vol. 3, No. 4, p. 272; also Colo. Sci. Soc. Proc., vol. 8, pp. 103–122). *Troutdale granite*.—Hypidiomorphic mixture of quartz, red or pink feldspar, and biotite. Is probably same as granite at Georgetown, but so far as known not directly connected. Named for town in Evergreen [Denver Mtn Parks] quad. [Jefferson Co.]. Differs from Central City granite in less amount of femic or ferromagnesian minerals and in presence of muscovite.

Troutdale formation.

Pleistocene: Northwestern Oregon (Willamette Valley).

E. T. Hodge, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 157). [See under *Rhododendron fm.*]

Probably named for Troutdale, Multnomah Co.

Trout Lake conglomerate.

Pre-Cambrian: Ontario.

A. P. Coleman, 1905 (Ont. Bur. Mines Rept., vol. 14, pt. 3).

Trout Pond limestone.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199, pp. 112, 114 and fig. 25). *Trout Pond ls.*—Crystalline ls., commonly siliceous and containing various green silicates that have changed to serpentine. Thickness about 50 ft. Lies btw. two qtzite fms. that are believed to correspond to Swede Pond qtzite. Occurs on Geo. W. Smith property, S. of Clintonville, Clinton Co. [Trout Pond is in Ausable quad.]

Troy shales.

Lower Cambrian: Eastern New York (Rensselaer County) and western Vermont (?).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 67–70). *Troy shales.*—Div. H of [T. N.] Dale's Rensselaer series. Consist of colored shales with small beds of calc. qtzite. Thickness 25 to 100 ft. Exposed at Troy [N. Y.], at dam in Poesten Kill, and other localities. Overlies Diamond Rock qtzite and is older than Schodack sh. and lss.—all Lower Camb.

R. Ruedemann, 1930 (N. Y. State Mus. Bull. 285, p. 27), used *Troy shales and lss.* for the beds overlying Diamond Rock qtzite and underlying Schodack shales and lss.

Troy quartzite.

Upper and Middle Cambrian: Central Arizona.

F. L. Ransome, 1915 (Wash. Acad. Sci. Jour., vol. 5, pp. 380–385). *Troy qtzite.*—Upper part consists of thin, generally yellowish to rusty worm-marked shaly qtzite indicative of a change in sedimentation preparatory to deposition of succeeding Dev. ls. Most characteristic material of these upper beds is a fine-grained unevenly colored pink and green qtzite in layers 1 or 2 in. thick separated by films of olive-gray sh. The middle and lower parts of fm. are cross-bedded pebbly strata in beds 25 to 50 ft. thick. Thickness 400 ft. Separated from underlying Mescal ls. by 75 to 100 ft. of vesicular basalt. Is top fm. of Apache group.

N. H. Darton, 1932 (Wash. Acad. Sci. Jour., vol. 22, No. 11, p. 319), removed this fossiliferous fm. from underlying nonfossiliferous fms. of Apache group, which he assigned to "Algonkian," because of uncon. at their top, their strong lithologic resemblance to the pre-Camb. Chuar and Unkar groups of the Grand Canyon, and fact that the qtzite has yielded Upper and Middle Camb. fossils.

Named for exposures on Troy Mtn, Ray quad.

Troy granite.

Pre-Cambrian: Central southern Oklahoma (Johnston County).

C. H. Taylor, 1915 (Okla. Geol. Surv. Bull. 20). Medium- to fine-grained gray granite specked with black. Occurs along Rock Creek near town of Troy, Johnston Co. Probably part of same intrusive mass as Tishomingo granite.

Truchas slate.

Pre-Cambrian: Central northern New Mexico (Santa Fe region).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 12). *Truchas slates.*—The upper sl. section of the Archeozoic succession at Picuris, N. of Santa Fe. Thickness 900 ft. [Derivation of name not given.]

Truckee formation.

Miocene: Northern and central western Nevada, eastern California (Lake Tahoe region), and southeastern Oregon.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, map V) and 1878 (U. S. Geol. Expl. 40th Par. Rept., vol. 1, p. 412). *Truckee group*.—Fresh-water deposits of Mio. age, consisting of coarse sands and gravels, white stratified trachytic tuff, pelagonite tuff, marly grits, some sss., and one 60-foot bed of saccharoidal ls. Large part of material is made of trachytic muds, which carry, especially in Oreg., numerous numbers of Mio. fossil mammals. The deposits are partly older and partly contemp. with the trachytes that are interbedded with the sediments. Thickness about 4,000 ft. Deposited in lake to which name "Pah-Ute lake" is applied. [As mapped in above-mentioned atlas the fm. occurs in disconnected areas across Nev., indicating probable deposition in several disconnected lakes. It is mapped over considerable areas in valleys E. and W. of S. end of Truckee Range and in Truckee Canyon btw. Reno and Verdi, Nev.]

Truckee fm. is used by U. S. Geol. Survey to include the deposits to which the name "Siebert fm." has been applied in some parts of Nev.

Trujillo formation. (In Dockum group.)

Triassic (Upper?): Panhandle of Texas.

C. N. Gould, 1907 (U. S. G. S. W. S. P. 191, pp. 20-29). *Trujillo fm.*—Several ledges of massive, more or less cross-bedded ss. and cgl. with interbedded red and gray shales. Thickness 25 to 250 ft. Upper fm. of Dockum group. Overlies Tecovas sh. and uncon. underlies Tert.

Named for exposures on Trujillo Creek, Oldham Co.

Trujillo formation.

Cretaceous: Puerto Rico.

C. P. Berkey, 1915 (N. Y. Acad. Sci. Annals, vol. 26, pp. 21, 61).

Trumbull gneiss.

Pre-Cambrian: Northern New York (Adirondacks).

H. L. Alling, 1918 (N. Y. State Mus. Bull. 199, pp. 45, 127, etc.). Careful studies indicate that lower beds of Hague gneiss have been "soaked" and saturated by igneous solutions of Laurentian granite. In this syntectic rock the characteristic garnets of the former are absent, but the sillimanite is still persistent. This syntectic rock is termed *Trumbull gneiss*, from Trumbull Mtn [Essex Co.]. The lower portions of the Trumbull are comparatively free from sed. admixture and approach the true Laurentian granite in character. Included in Grenville series. Rests on Dresden amphibolite.

H. L. Alling, 1924 (Am. Jour. Sci., 5th, vol. 8, pp. 30-31). At town of Graphite, Warren Co., the Hague gneiss (Grenville) is saturated by Laurentian granite, forming a composite rock. This syntectic the writer proposed to call the "Trumbull gneiss" (Alling, H. L., N. Y. State Mus. Bull. 199, 1917 [1918]), a term later abandoned. The reason for this is that such expressions as "The footwall is the Hague gneiss in its typical development, which in turn lies upon the Trumbull gneiss," give impression that both are normal strat. fms. of Grenville series.

Truro limestone.

Pennsylvanian: Central southern Iowa.

J. L. Tilton, 1897 (Iowa Acad. Sci. Proc., vol. 4, pp. 52, 54). *Truro ls.*, 0 to 2½ ft. thick, lies about 80 ft. below top of Des Moines stage in Madison Co. Underlain and overlain by sh. of Des Moines stage.

Named for Truro, Madison Co.

†Truro series.

Pleistocene: Southeastern Massachusetts (Barnstable County).

N. S. Shaler, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 541-593). *Truro series.*—Fine gray micaceous sands and sandy clays, 100+ ft. thick. Apparently overlie Nashaquitsa series but may possibly be regarded as belonging to same group as Nashaquitsa series.

J. B. Woodworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). "Truro series" of Shaler includes Gardiners clay and other deposits.

Named for occurrence in Truro, Barnstable Co.

Truxton limestone.

Mississippian: Northwestern Arizona (Grand Wash Cliffs region).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 243, 251, 338). *Truxton lss.*, applied to middle Miss. section, carrying Burlington fauna. Fine sections shown in Grand Wash Cliffs and in Yampai Cliffs, overlooking Truxton Plateau [Mohave Co.]. Thickness 450 ft. Older than Elden lss.

Tseax River lava flow.

Recent: British Columbia.

G. Hanson, 1924 (Canada Geol. Surv. Summ. Rept. 1923, pt. A, p. 39).

Tshinakin formation.

Pre-Cambrian: British Columbia.

R. A. Daly, 1913 (12th Int. Geol. Cong. Guidebook 8, p. 124).

Tuckahoe group. (In Newark group.)

Upper Triassic: Eastern Virginia (Richmond Basin).

N. S. Shaler and J. B. Woodworth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, pp. 423–435). *Tuckahoe group.*—Lower div. of Newark system in Richmond Basin. Divided into (descending) productive coal measures, 500± ft.; lower barren beds, 0–300 ft.; and Boscabel boulder beds, 0–50± ft. Underlies Chesterfield group and rests on granite and gneiss. Exposed in shafts and mines bordering Tuckahoe Creek, Goochland Co., in vicinity of Gayton.

Tuckahoe marble.

Pre-Cambrian: Southeastern New York (Westchester County).

C. P. Berkey and J. R. Healy, 1912 (Columbia Univ. Contr., vol. 20, pp. 1907–1912). "Other names for Inwood ls. are *Tuckahoe marble, Sing Sing marble,* and *Stockbridge dol.*" [Tuckahoe and Sing Sing are in Westchester Co.]

Tucker sand.

A subsurface sand, of early Penn. (Cherokee) age, in Okla., 0 to 60± ft. thick, lying lower than Bartlesville sand and higher than Burgess sand. Correlated with Booch sand, also with Taneha sand.

†Tucquan gneiss.

Pre-Cambrian: Southeastern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 128–129, 136, 203, 204). *Tocquan (Philadelphia) gneisses and mica schists.*—Overlain by chloritic phyllites. [Seems to be named for exposures in broad, flat anticlinal arch whose axis crosses Susquehanna River at mouth of Tocquan [Tucquan] Creek (McCalls Ferry).]

Replaced by Wissahickon fm.

Tucson sandstone.

Upper Cretaceous (Benton): Southern central New Mexico (Sierra Blanca region).

G. H. Hansen, 1931 (Geo. Wash. Univ. Bull., Summaries of doctoral theses, 1925–28, p. 84). *Tucson ss.*—Chiefly hard ss., in places almost qtzitic, but contains a few thin beds of highly fossiliferous sandy limes and clay partings. Forms escarpment. Well exposed on Tucson Mtn. Thickness 200 to 400 ft. Fossils (listed) of middle Benton age. Overlies Fort Stanton sh. and underlies Sierra Blanca coal measures.

†Tucumcari beds.

Cretaceous, Jurassic, and older (?): New Mexico to southern Kansas.

W. F. Cummins, 1892 (Tex. Geol. Surv. 3d Ann. Rept., pp. 201–209). *Tucumcari beds.*—In descending order: Massive ss., 60 ft.; sh., 50 ft.; massive yellowish ss., 235 ft. Characterized by *Gryphaea* and other fossils. Assigned to Cret. Underlie Tert. and overlie Triassic on Tucumcari Mtn, N. Mex.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 381). *Tucumcari shales.*—Zone of *Gryphaea tucumcari*, consisting chiefly of clay shales and lighter-colored as a whole than underlying Blue Cut shales, which graduate insensibly into them. Included in top of Kiowa shales in southern Kans.

The fms. of Tucumcari Mtn as mapped by N. H. Darton on his geol. map of N. Mex. include (descending) Dakota ss., Purgatoire fm., Morrison fm., Navajo ss., Kayenta fm. (called Todilto on map), and Wingate ss.

Named for Mount Tucumcari, Quay Co., N. Mex., where zone of *Gryphaea tucumcari* was originally discovered by Jules Marcou.

Tufts quartzite member (of Cambridge slate).

Carboniferous or Devonian: Eastern Massachusetts (Boston region).

M. Billings, 1929 (Am. Jour. Sci., 5th, vol. 18, pp. 101, 102, 106, 107, 111, 112). *Tufts qtzite.*—In the athletic field of Tufts College, Medford, about 40 ft. of greenish, reddish, and yellowish qtzite are exposed above the Cambridge argillite. A similar rock on Evelyn St., Everett, is correlated with Tufts qtzite. [In this paper Billings assigned *Tufts qtzite* and underlying rocks to Perm. Although Tufts qtzite had been in common use for many years among geologists working in Boston Basin, and was adopted by U. S. Geol. Survey in June 1910, as *Tufts qtzite memb. of Cambridge sl.*, for rept of L. LaForge cited below, Billings appears to have been the first to publish the name.]

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Tufts qtzite memb. of Cambridge sl.*—Greenish and white qtzite exposed in 3 places. Thickness probably less than 40 ft. Uncertain whether it is top memb. of Cambridge or whether there is more sl. above it. Occurs on athletic grounds of Tufts College.

Tulameen group.

Triassic (?): British Columbia.

C. Camsell, 1913 (Canada Geol. Surv. Mem. 26, p. 37).

Tulare formation.

Pliocene and Pleistocene (?): Southern California (San Joaquin Valley region).

F. M. Anderson, 1905 (Calif. Acad. Sci. Proc., 3d ser., vol. 2, p. 181). *Tulare fm.*—Fresh-water deposits of gypsiferous sands and clays exposed at intervals along W. border of Great Valley. In Kettleman Hills, 10 to 15 mi. SE. of Coalinga, and near W. shore of Tulare Lake these beds aggregate fully 1,000 ft. in thickness. They lie conformably on San Joaquin clays (upper div. of Etchegoin fm.), which they in some respects resemble. [Fossils listed.] Doubtfully assigned to Plio.

Contemp. with part of Paso Robles fm., but deposited in separate basin, according to B. L. Clark (personal communication Dec. 1932).

Tularosa formation.

Tertiary or Quaternary (?): Southeastern New Mexico.

C. L. Herrick, 1904 (Am. Geol., vol. 34, pp. 179, 187). *Tularosa fm.*—Sandy marls, largely gypsiferous and moderately saline. In many places contain fresh-water lacustrine shells. Probably derived from Cret. ss. and sh. and soft gypsiferous sh. and sss. of the Permian. Sharply separated from underlying Otero fm., of Tert. (?) age. [Derivation of name not stated.]

Tule formation.

Pleistocene: Panhandle of Texas.

W. F. Cummins, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 199–200, 203). *Tule div.*—Alternating sand and clay, 150 ft. thick, overlying Triassic in Swisher, Crosby, and Armstrong Counties. Younger than Blanco beds. Prof. Cope assigns fossils to Equus beds.

Named for Tule Canyon, Swisher Co.

Tule Spring limestone.

Pennsylvanian and Mississippian: Southeastern Arizona (Clifton region).

W. Lindgren, 1905 (U. S. G. S. P. P. 43). *Tule Spring ls.*—Heavy-bedded bluish gray lss. fairly extensively developed in N. part of Clifton quad.

W. Lindgren, 1905 (U. S. G. S. Clifton folio, No. 129). *Tule Spring ls.*—Heavy-bedded bluish-gray lss., at least 500 ft. thick, which rest conformably on Dev. Morenci sh., where present, or on Ord. Longfellow ls. where the sh. is absent. Of Penn. and Miss. age. Fossils listed. Named for exposures around Tule Springs, at head of Tule Creek, Clifton quad.

According to G. H. Girty the fossils are of Penn. and lower Miss. age. No upper Miss. fossils were found.

Tuleta sand.

A subsurface sand in Duval Co., Tex. According to A. Deussen and E. W. K. Andrau (A. A. P. G. Bull., vol. 20, No. 5, 1936, p. 540) it lies in upper part of Yegua fm., 170 ft. below Pettus sand, in Pettus dist.

Tulillo beds.

Cretaceous: Mexico.

E. Böse and O. A. Cavins, 1927 (Univ. Tex. Bull. 2748, p. 37).

Tulip Creek formation.

Middle and Lower(?) Ordovician: Central southern Oklahoma (Arbuckle Mountains).

E. O. Ulrich, 1928. See under *West Spring Creek fm.*

F. C. Edson, July 1930 (A. A. P. G. Bull., vol. 14, No. 7, p. 947). *Tulip Creek fm.* is overlain with angular uncon. by Bromide fm.

C. E. Decker, Dec., 1930 (A. A. P. G. Bull., vol. 14, No. 12, pp. 1493-1505). *Tulip Creek fm.*—Chiefly shales and sss., with some lss. Usually a thick ss. at base. Thickness of fm. 0 to 600± ft. Underlies Bromide fm. and overlies McLish fm. Whether of early Black River or late Chazy age to be determined after further study of fossils. Occurs only in W., SW., and central parts of Arbuckle Mtns.

C. E. Decker and C. A. Merritt, 1931 (Okla. Geol. Surv. Bull. 55, pp. 11+). The *Simpson* is here raised to a *group*, divided into 5 fms. (ascending): Joins, Oil Creek, McLish, *Tulip Creek*, and Bromide. A few fossils near base of the Tulip Creek seem to be upper Chazy, but those in middle and near top are typical Black River forms.

See also 1933 entries under *Simpson fm.*

Named for exposures at headwaters of Tulip Creek, in Carter Co., N. of Springer.

†Tullahoma formation.

Mississippian: Tennessee and western Kentucky.

J. M. Safford and J. B. Killebrew, 1900 (Elements of geol. of Tenn., pp. 104, 143, 144). *Tullahoma ls.* (*Siliceous group in part; Fort Payne chert; Barren group*).—Excepting Maury Green sh., the Tullahoma fm. embraces the lowest Subcarbf. rocks. Varied in character and outcrops in all divisions of State, but most extensively in East and Middle Tenn. Its most common rock is cherty or flinty ls., the chert often in thick layers. In East Tenn. the chert of dyestone ridges and the sss. and shales (Grainger sh.) of Poor Valley ridge E. of Clinch Mtn and of other allied ridges belong to it. West of Nashville it includes Erin Burry ls. of Houston Co. and the siliceous Harpeth sh. [Ridgetop sh.] of bluffs of Harpeth River and Turnbull Creek in vicinity of Kingston Springs. Thickness 200 to 600 ft., and at one locality in East Tenn. 1,200 ft. Tullahoma is located on the fm. Overlies Maury green sh. and underlies St. Louis ls.

Includes Ridgetop sh. (exclusive of Maury glauconitic memb.), New Providence fm., Fort Payne chert, and Warsaw fm. The name was also used in SE. Ill. to cover Warsaw ls. and Osage group, exclusive of Fern Glen ls.

Named for Tullahoma, Coffee Co., Tenn.

Tullock formation.

Upper Cretaceous or Eocene: Central southern, southeastern, and northeastern Montana.

G. S. Rogers and Wallace Lee, 1923 (U. S. G. S. Bull. 749, p. 29). The upper memb. of Lance fm. in Tullock Creek coal field, Mont., is herein named *Tullock* *memb.*, from exposures in valley of Tullock Creek [Treasure Co.]. It consists of yellowish ss. and sh. and contains 10 more or less lenticular coal beds. The rocks resemble lower portion of the Lance in a general way, but certain differences are apparent on close examination. Although the ss. is lithologically similar to that in lower part of fm., it commonly occurs in beds less than 20 ft. thick, which seem to be more persistent than the thicker ones that are common in lower part of the Lance. Much of the ss. and sh. is more or less calc., but true ls. was seen at only one point. The sh. is chiefly yellowish gray to brownish, and the faint greenish tint so characteristic of the sh. in lower part of Lance is very uncommon. Many bands of carbonaceous sh. are present, which help to give it a brownish-yellow cast. Thickness 300 ft. Overlain by Lebo sh. memb. of Fort Union fm.

The part of Lance fm. that underlies the Tullock deposits was later named *Hell Creek memb. of Lance fm.*, but in Dec. 1935 the Tullock and Hell Creek deposits were raised to rank of fms. by U. S. Geol. Survey, the age of *Hell Creek fm.* was changed to *Upper Cret.*, and the age of *Tullock fm.* was changed to *Upper Cret. or Eocene*. These changes were based upon a large amount of additional field work over extensive areas.

Tullock member (of Lance formation).

See *Tullock fm.*

†Tullock Creek member (of Lance formation).

Name applied by E. S. Perry to beds formerly called *Tullock memb. of Lance fm.* but now called *Tullock fm.* (See Mont. Bur. Mines and Geol. Mem. 2, 1931, p. 27, and Mem. 14, 1935, p. 10.)

Tully limestone.

Upper Devonian: New York and Pennsylvania.

L. Vanuxem, 1839 (N. Y. Geol. Surv. 3d Rept., p. 278). *Tully ls.*—A mass of bluish and brownish ls. 12 to 16 ft. thick, not remarkable for purity. Exposed at Tully Corners, at Borodino, on both sides of Skaneateles Lake, on road from Owasco to Kellogsville, at Martville and falls of Dry Creek, below Moravia, and in ravines along Cayuga Lake from 4 to 5 mi. S. of Aurora to Blooms lime-kiln.

J. Hall, 1839 (N. Y. Geol. Surv. 3d Rept., pp. 300–301, 313). *Tully ls.*—Overlies Moscow shales and underlies Upper Black sh. [Genesee sh.]. Greatest thickness (16 ft.) in Seneca Co., but maintains very uniform character over great area. Consists of three or four layers, for most part of uniform thickness. Is of light bluish-gray color; in some localities blue, fine-grained, and very compact. Few fossils.

Is well exposed in town of Tully, Onondaga Co.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19). *Hypothyridina venustula* zone at base of Tully ls. and at base of Sherburne ss. is base of Upper Dev.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included *Tully ls.* in Upper Dev.

D. W. Trainer, 1932 (N. Y. State Mus. Bull. 291, pp. 2–26). To east the *Tully ls.* grades into underlying Hamilton; to W. there is a physical and lithological hiatus that author considers a discon.

B. Willard reported (Pa. Acad. Sci. Proc., vol. 8, pp. 57–62, 1934) occurrence of a diagnostic Tully fossil (*Hypothyridina venustula*) in central Pa., and applied name *Rush memb. of Tully ls.* to the 10 ft. of ls. containing the fossil, "the first specimen of the species found in Pa." In early Pa. repts many beds were identified as Tully ls. that are now considered not to belong to that fm. Willard stated that Tully ls. is reported in wells across most of northern Pa., and that as South Danville locality is most southeasterly known occurrence of a representative of Tully fauna, "we deduce Rush memb. here approaches SE. limit of Tully deposition." In 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 1209–1213) Willard modified his 1934 nomenclature by calling his *Rush memb. of Tully ls.* the *Tully memb. of Rush fm.*, and included in his *Rush fm.* the beds called *Genesee* in his 1934 paper cited above.

B. Willard, 1935 (Pa. Acad. Sci. Proc., vol. 9, p. 44). The Tully, although dominated by Hamilton species, does mark appearance of 4 or 5 new kinds of organisms which are unrecognized in Middle Dev. of Pa. Some of the new arrivals survived into post-Tully time. The strat. and paleontology of Pa. show Tully to be base of Upper Dev. [On pp. 40 and 42 he includes Tully ls. in Portage group of Pa.]

This fm. has for many years been classified as Upper Dev. by N. Y. State Survey, U. S. Geol. Survey, and others.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, p. 309), listed 6 sp. which are "all that there are to distinguish the Tully from the Hamilton," and in footnote added that G. A. Cooper has reduced this number to 4. "As no one of these 6 sp. ranges upward into undoubted Upper Dev. strata, they are, while diagnostic, wholly noncommittal as to Middle or Upper Dev. appurtenance of the Tully. Not a single sp. originates in the Tully to persist beyond. Such forms as do continue are all Hamilton, 34 in number; nor is this fact of consequence as compared with the much larger number of Hamilton sp. unknown in the Tully that, nevertheless, reappear above it. The paleontologic claim for Upper Dev. age of the Tully ls. rests, therefore, upon the single sp. *Hypothyridina venustula*." "The strat. evidence, as now understood, is equally unconvincing. With 63 sp. of Hamilton fossils in Tully ls. that are not among the long-range Hamilton forms of the Senecan strata above, and with all its physical characteristics like those of the Hamilton lss. below, rather than those of the Senecan lss. above, the Tully seems to belong lithically and faunally in the Hamilton, although there are places, as at Taghanic Falls, where the sharp break seems to come below and a transition to occur above into the Genesee. Yet there are other places where the reverse is true. Followed westward, the Tully ls. disappears into an uncon.; but whether it goes out from top down, and is thus Middle Dev., or from bottom up, making it Upper Dev., seems never to have been investigated, although this is the decisive criterion. Footnote: I am informed that this may be treated in a forthcoming paper on the Tully by G. A. Cooper and J. S. Williams."

G. A. Cooper and J. Stewart Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 823–824). There are no known American antecedents of *Hypothyridina* and *Scutellum* in Mid. Dev. of eastern U. S. These species therefore probably reached N. Y. by migration, but whether or not they reached N. Y. during Mid. or Upper Dev. time is regarded as an open question by writers. Although Tully fauna is now regarded Upper Dev., the predominant Hamilton elements would suggest an earlier age. This question can only be convincingly settled after comparison of Tully species with actual European specimens. Because of lack of European strat. material in Nat. Mus. this comparison cannot be undertaken. The whole problem of age of Tully must await further exploration, faunal description, and strat. discrimination in western U. S., Canada, Europe, and Asia. [Divided into several members in different areas.]

B. Willard, 1936 (Geol. Soc. Am. Proc. 1935, p. 376). Since 1933 the presence of the Tully has been definitely established in Pa., where it extends from south-central part into central region of State, as a narrow band concentric to base of Allegheny Front. Isolated occurrences of fauna have been found E. of the Susquehanna. Thickness 0 to 200+ ft. Lithology ranges from dense to shaly ls. Is characterized by a fairly numerous fauna, including *Hypothyridina venustula*, *Chonetes aurora*, and *Lopholasma carinatum*, and the newly described *Echinocoelia ambocoeloides*.

For many years the true Tully ls. was believed to be absent in Pa., and the thin ls. in that State that Willard now includes in his Tully was treated as a bed in the Hamilton, and it is mapped with the Hamilton by C. Butts in U. S. G. S. Hollidaysburg-Huntingdon folio, No. 227, in press.

†Tulsa group.

Pennsylvanian: Northeastern and central northern Oklahoma.

C. N. Gould, D. W. Ohern, and L. L. Hutchison, 1910 (Okla. State Univ. Research Bull. 3, pp. 6, 10). *Tulsa group*.—Includes all rocks btw. base of Lenapah ls. (in Kans. called Upper Parsons or Coffeyville ls.) above and base of Claremore fm. or Calvin ss. below. Includes Calvin, Wetumka, and Wewoka fms. and probably 200 ft. or more of Holdenville fm. of Coalgate quad. In N. part of State includes rocks which in Kans. have been called [ascending order] Fort Scott ls., Labette shales, Pawnee ls., Bandera shales, Altamont ls., and Walnut [Nowata] shales.

Named for Tulsa Co.

Tumey formation.

Oligocene: Southern California (Fresno County).

E. R. Atwill, 1935 (A. A. P. G. Bull., vol. 19, No. 8, pp. 1192-1204). *Tumey fm.* is proposed for the ss. (800 ft. thick) mapped by Anderson and Pack (U. S. G. S. Bull. 603, 1915, pl. 1) as faulted "Vaqueros" (just N. of Arroyo Ciervo) and to the immediately overlying shales (885 ft. thick). The ss. to be called *Tumey ss.* and the sh. *Tumey sh.* This ss. and sh. sequence comprises a cartographic unit for a distance of at least 7 mi. btw. Arroyo Ciervo and Tumey Gulch. To SE. of Arroyo Ciervo the ss. appears to grade into sh. A short distance NW. of Tumey Gulch it is overlapped by ss. of Temblor age, containing following fossils [listed]. The upper 20 ft. of the sh. memb. near Arroyo Ciervo contains zone characterized by a pelecypod commonly called *"Leda" washingtonensis* Weaver. Some workers in area report uncon. about 185 ft. below this contact, separating the so-called *"Leda* sh." from main mass of underlying Tumey sh. But because of its identical lithologic characteristics and faunal content with Tumey sh., and because it is not a cartographic unit, writer classifies it as upper zone of Tumey sh. The fm. uncon. overlies Kreyenhagen sh. The strata here named *Tumey fm.* have been grouped variously with the Vaqueros and the Kreyenhagen or referred tentatively to Olig. [Fossils listed.] Assigned to Olig. Type loc. is not in Tumey Gulch, but in S½ sec. 16, T. 16 S., R. 13 E., Mount Diablo base and meridian, Fresno Co. Names are scarce in the area, and *Tumey* seemed only name that could be used.

†Tuna conglomerate.

See †*Tunangwant cgl.*

†Tunangwant conglomerate.

Devonian or Carboniferous: Northwestern Pennsylvania and southwestern New York.

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_3, p. 79). *Tunangwant cgl.*—Probably older than Sub-Olean cgl. and younger than Salamanca cgl. [Seems to be exposed in hills bordering Tunangwant Creek, btw. Carrollton and Bradford.]

J. F. Carll, 1883 (2d Pa. Geol. Surv. Rept. I_4, pp. 180, 206-208, 230). *Tuna cgl.* is now popular name for original *Tunangwant cgl.* Lies at least 225 ft. above Salamanca cgl. and about 275 ft. below Olean cgl. on Ireland summit.

L. C. Glenn, 1904 (Geol. Soc. Am. Bull., vol. 14, pp. 522-531). *Tuna cgl.* is same as Salamanca, Panama, and Pope's Hollow cgls. [The Panama is now considered older than Salamanca (†Pope Hollow, †Tuna) and to correlate with Wolf Creek cgl.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 88). Salamanca cgl. has been called "Tuna."

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 425). Salamanca cgl. has been called *"Tuna."*

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 91). *Tunangwant cgl. lens* (or *Tuna cgl.*) is in upper part of Saegerstown sh. in northern McKean Co., Pa., and Olean-Salamanca region, N. Y. Is younger than Salamanca cgl. Was named for exposures in N. Y. along Tunangwant Creek, which flows N. through Bradford, Pa., into N. Y. Is same as Killbuck lens of Glenn, which is traceable into type Tuna. In fact, Glenn cites type loc. of Tuna as an outcrop of his Killbuck. Thickness few in. to 40 ft. Overlain by a sh. sequence of the upper Venango, throughout which occur cgl. lenses and some part of which is presumably the eastern correlate of Woodcock ss. to W. [On p. 93 he stated *Tuna cgl.* is younger than Salamanca cgl., and appears to be older than Woodcock ss. and=Hosmer Run cgl.]

Tunbridge granite.

Devonian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of eastern Vt., but without definition. Probably named for Tunbridge Twp, Orange Co., or some of villages of that name within that twp.

Tunnel Hill zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 8, 12). *Tunnel Hill zone* (*Archean*) comprises a narrow belt bounded on NW. by Chauga zone and on SE. by line extending from Tugaloo River near mouth of Barton Creek, immediately N. of Rich Mtn, N. of Horse Shoe Bend, and thence northeasterly. It constitutes a narrow tongue btw. Chauga and Poor Mtn ls. zones. Rocks are porphyritic granite gneiss and gneissoids. Probably=Keith's "Henderson granite," assigned to Archean. Abundant strain effects prevail. This rock appears to have resulted from granulation and recrystallization of a porphyritic granite. The Tunnel Hill granite gneiss is a very hard rock, comprising thin bands curved to enfold rounded crystal individuals of pink feldspar (Kleine augen gneiss).

Named for exposures at Tunnel Hill, Oconee Co.

Tunnel Point beds.

Oligocene: Southwestern Oregon (Coos Bay).

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 336-343). *Tunnel Point beds.*—Shales and sss. at and SW. of Tunnel Point, Coos Bay, containing sparse fauna, distinct alike from Eo. shales below and Empire beds above. Thickness 1,200 ft. Conformable with Eo.; uncon. with Empire. Faunal change and aspect of species suggest this group of beds may represent Olig. Assigned to upper Olig. or Chipolan stage.

W. H. Dall, 1909 (U. S. G. S. P. P. 59), assigned the *beds at Tunnel Point* to Olig. and stated that they uncon. overlie Arago fm., which includes Coaledo and †Pulaski fms.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12). *Tunnel Point ss.* of Coos Bay dist. is chiefly ss., 800± ft. thick, and is middle Olig. Writer considers it belongs to *Acila shumardi* horizon. [Fossils listed.] It overlies Bassendorf sh. (lower Olig.), which rests on Coaledo fm. [restricted], upper Eocene. [Judging by thicknesses given, the Tunnel Point ss. of Schenck is a restriction, part of Bassendorf sh. of Schenck having been included in Tunnel Point ss. of Dall and part of it in Coaledo fm. of Dall.]

H. G. Schenck, 1928 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 1, pp. 15-22, pl. opp. p. 4). *Tunnel Point ss.* is middle Olig. It conformably overlies Bassendorf sh., which rests on Coaledo fm.

Tununk sandstone member (of Mancos shale).

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology of Henry Mtns, pp. 4+). *Tununk ss.*—Heavy-bedded yellow ss., 100 ft. thick, underlying Blue Gate sh. and overlying Tununk sh. in Tununk Plateau.

Now treated by U. S. Geol. Survey as a memb. of Mancos sh. in Henry Mtns region.

†Tununk shale. (In Mancos shale.)

Upper Cretaceous: Central southern Utah (Henry Mountains region).

G. K. Gilbert, 1877 (Geology of Henry Mtns, pp. 4+). *Tununk sh.*—Blue-black argill. sh. that weathers to a fine gray clay. Thickness 400 ft. Underlies Tununk ss. and overlies Henrys Fork group in Tununk Plateau.

Now treated by U. S. Geol. Survey as a part of Mancos sh. Name discarded because of conflict with Tununk ss., the adopted name.

Tununkian series.

A term introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 43, p. 295, 1925) for Upper Cret. rocks in Utah that appear to correspond to Tununk ss. of Gilbert.

Tuolumne intrusive series.

Probably Cretaceous: Yosemite National Park.

F. C. Calkins, 1930 (U. S. G. S. P. P. 160, p. 121, map). The great bulk of granitic rocks in Yosemite region belong to two series of intrusions, the members of each series exhibiting especially close relationship to one another. These may be termed the *biotite granite series* of Yosemite Valley and *Tuolumne intrusive series*. The latter includes [ascending order of age] Sentinel granodiorite, Half Dome quartz monzonite, Cathedral Peak granite, and Johnson granite porphyry—fms. which extend in large bodies from upper half of Yosemite Valley N. to Tuolumne River and NE. into High Sierra.

Named for exposures along Tuolumne River, Yosemite National Park.

Tuolumne group.

Jurassic (?) and Triassic (?): Sierra Nevada, California.

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, pp. 233-234). The recognized divisions of bedrock complex are wholly inadequate, and they ignore a very extensive and important rock group. This group is made up of tuffs, flows, and aggls. with interbedded sediments of very distinctive character in which radiolarian cherts predominate. The sediments, including a little interbedded tuff, have max. thickness of 1,100 ft. in Mariposa and Tuolumne Counties. They are interbedded with and included in a very thick series of tuffs, flows, and aggls., usually andesitic. For this group of rocks the name *Tuolumne* is proposed, from the county of that name in which they are well developed. It occurs in 2 or more parallel belts along lower W. slope of the Sierra btw. Merced-Yosemite highway on S. and Grass Valley on N., a distance of 135 mi. Although no organic remains other than Radiolaria have been found, it is thought *Tuolumne group* represents a part of both Triassic and Jurassic time. The Milton and Sailor Canyon fms. of easternmost part of Sierras are probably more or less contemp. with it.

N. L. Taliaferro, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 149). *Tuolumne group* is largely submarine basic volcanic rocks and radiolarian cherts, 15,000+ ft. thick. Is thought to be lower Mesozoic, as its stage of metamorphism is exactly similar to Mariposa group, which it uncon. underlies. Is here divided into (descending): Agua Fria slates, lss., cherts, and tuffs, 2,000+ ft.; Penyon Blanca aggls., 9,000 ft.; Hunter Valley cherts and tuffs, 1,500 ft.; pillow basalts, 1,400 ft.; aggls., tuffs, and flows, 1,500+ ft.

Tupelo tongue (of Coffee sand).

Upper Cretaceous: Northeastern Mississippi.

L. W. Stephenson, 1917 (Wash. Acad. Sci. Jour., vol. 7, pp. 243-250). *Tupelo tongue*.—A tongue of uppermost part of Coffee sand memb. of Eutaw fm., resting on Mooreville tongue of Selma chalk and overlain by a large body of Selma chalk. The material composing the tongue is dark-gray, chiefly massive calc., glauconitic sand. Thickness 100 ft. Geographic extent about 100 mi. in Lee Co. [The Coffee sand is now treated as a distinct fm.]

Named for Tupelo, Lee Co.

Tupper syenite.

Pre-Cambrian: Northern New York (Long Lake quadrangle, Adirondack Mountains).

H. P. Cushing, 1907 (N. Y. State Mus. 60th Ann. Rept., pt. 2, pp. 476-482, 515, and map). [Map reads: "Green to gray syenite, usually augite syenite; mostly very feldspathic. *Tupper syenite*."]

Exposed about Tupper Lake, Franklin Co.

Turgeon formation.

Silurian: New Brunswick.

G. A. Young, 1911 (Canada Geol. Surv. Mem. 18, p. 36).

Turk sand.

A subsurface sand, of Penn. age, in Thomas pool, Kay Co., central northern Okla., that is reported to correspond to Upper Endicott sand and to a part of Nelagoney fm. It lies at 2,600 ft. depth and several hundred ft. below Thomas sand.

Turkey Creek sandstone member (of Mineral Wells formation).

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 25, 31; Univ. Tex. Bull. 2132, pp. 77-78 and many charts). *Turkey Creek ss. memb. of Mineral Wells fm.*—The thick, very massive ss. which forms first prominent escarpment E. of outcrop of Palo Pinto ls. has been named *Turkey Creek ss.*, from creek of that name NW. of Mineral Wells (Palo Pinto Co.). Thickness 10 to 15 ft. At type loc. (on Turkey

Creek road 2¼ mi. NW. of Mineral Wells) it consists of 10 ft. of dark reddish-brown massive cgl. of small angular pebbles of quartz and qtzite in a matrix of coarse sand, is overlain by Keechi Creek ss. and sh. and underlain by Salesville sh., all members of Mineral Wells fm.

Above is definition still in use. See F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534).

Turkey Creek beds. (In Yegua formation.)

Eocene: Eastern Texas (central Brazos County).

L. C. Reed and O. M. Longnecker, Jr., 1929 (Univ. Tex. Bull. 2901, pp. 163–174). *Turkey Creek beds.*—Gritty clay mottled and lensed with sand; volcanic ash makes up part of beds. Thickness at least 25 ft. Is a lithologic div. of Yegua fm., but name is used for convenience only, and is not intended as a fm. or memb. name. [Is mapped.] Underlies Upper Turkey Creek beds, also underlies Yegua River cgl. Exposed on upper part of Turkey Creek and tributaries, also in North Turkey Creek. The *Upper Turkey Creek beds* are at least 20 ft. thick, and consist of strata varying from slightly carbonaceous laminated light-gray ashy clay to a finely laminated volcanic ash partially decomposed to bentonite and containing specks of carbonaceous matter and some thin lignite beds. Exposed along upper part of Turkey Creek.

Turkey Mountain sand.

A subsurface sand in Okla., 0 to 25 ft. thick, which is included in base of Simpson fm. (Middle and Lower Ord.) by some geologists and in top of Arbuckle ls. (Lower Ord. and Upper Camb.) by other geologists. In Turkey Mtn pool, Tulsa Co., this sand lies at 2,145 ft. depth and the Wilcox sand at 2,090 ft. depth.

Turkey Mountain lime.

Drillers' term for 100 ± ft. of beds in NE. Okla. correlated with upper part of Arbuckle ls.

Turkey Ridge sandstone member.

Middle Devonian (Marcellus): Central Pennsylvania (Juniata, Dauphin, and Perry Counties).

B. Willard, 1935 (Geol. Soc. Am. Bull., vol. 46, Proc. Pal. Soc. Feb. 28, pp. 202–203). *Turkey Ridge ss. memb.*—Flaggy to massive, rather coarse hard olive-gray ss., underlying Mexico ss. and overlying Shamokin black sh.; all members of Marcellus fm. in central Pa. Named for Turkey Ridge, which separates Juniata and Perry Counties. Best exposed in Delaware Creek section. Max. thickness (slightly over 200 ft.) in Juniata Valley; gradually thins to E. and to W. Distribution nearly = that of Mexico ss. Is merely reworked Oriskany.

Turkey Run limestone member (of Buck Creek formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

K. C. Heald and K. F. Mather, 1919 (U. S. G. S. Bull. 686M, pp. 150, 153). *Turkey Run ls.*—Dark-gray ls., fine-grained, thin-bedded, hard, brittle; weathers into smoothly rounded slabs a few inches long; weathered surface generally light gray, with many curving traceries and irregular patterns of darker gray or yellowish brown, due to fragments of brachiopod and gastropod shells, the margins of which are thus etched by weathering. On fresh fracture the color is much darker bluish gray, at some places almost black. Thickness 1 to 3 ft. Well-preserved fossils very rare; in fact, this ls. can most readily be distinguished from the lithologically similar ls. 60 ft. higher by absence of the brachiopod species commonly found in higher bed. Lies 40 to 90 ft. above Deer Creek ls. memb. of Pawhuska ls. Lies 45 ± ft. above Little Hominy ls. and about same distance below Bird Creek ls. Named for excellent exposures near head of Turkey Run, in secs. 9, 16, and 17, T. 24 N., R. 8 E.

Turkey Track limestone layer. (In Richmond group.)

Upper Ordovician: Southwestern Ohio.

J. J. Wolford, 1930 (Ohio Jour. Sci., vol. 30, No. 5, p. 304). *Turkey Track ls. layer.*—Hard fine-grained, essentially barren ls., top of which bears impressions resembling turkey tracks. Thickness approx. 7 in. Base of this ls. has been designated by Dr. Geo. M. Austin as plane of division btw. Whitewater and Liberty fms. in SW. Ohio.

Turner sandy member (of Carlile shale).

Upper Cretaceous: Northeastern Wyoming and southeastern Montana.

W. W. Rubey, 1930 (U. S. G. S. P. P. 165A). *Turner sandy memb.*—Upper and major part of Carlile sh. in NE. Wyo. and SE. Mont. Consists of 150 to 200 ft. of more or less sandy sh. and siltstone, with iron-stained concretions, persistent thin beds of ss., locally conglomeratic and phosphatic and containing abundant shark teeth, in lower part. Marine fossils. Forms a minor scarp. A distinct faunal break and possible uncon. at base. Overlies lower part of Carlile sh., which consists of 75 to 125 ft. of dark-gray sh. with a few calc. concretions. Named for exposures along Turner Creek in Twps 46 and 47 N., R. 64 W., Weston Co., Wyo.

Turner Creek shale. (In Topeka limestone.)

Pennsylvanian: Southeastern Nebraska, southwestern Iowa, northeastern Kansas, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 42, 52, 53). *Turner Creek sh.*—Bluish-gray calc. sh., named for the Turner Creek exposure SE. of Du Bois, Nebr. Thickness 5 ft. in SW. Iowa, 3¾ ft. in SE. Nebr., 4½ ft. in Kans., 5+ ft. in Mo. Overlies *Curzen ls.* and underlies Du Bois ls. [This is definition followed by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr. G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), discarded *Curzon ls.* for Hartford ls., the older name. For Condra's latest interpretation of strat. position of this sh. see 1937 entry under *Topeka ls.*]

Turnley hornstone.

Turnley shale.

Pre-Cambrian (Belt series): Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, p. 434). *Turnley hornstones.*—The Turnley beds comprise 200 ft. of *Turnley quartzitic hornstone*, underlain by 200 ft. of *Turnley sh.*, the latter consisting of red sandy strata indurated to very dense hornstone of light-brown biotite and quartz and containing in middle a bed of impure iron ore 20 to 30 ft. thick. The Turnley qtzitic hornstones, although well bedded, are very dense and hard and of gray-black color, finely saccharoidal, with conchoidal fracture. In color, composition, and relation to overlying Alpreston qtzite (=(?) Flathead qtzite) the Turnley beds correspond to red Spokane sh. of Belt series at Whitehall, Townsend, and Helena. They occur only on slopes above Turnley placer, in SW. part of Elkhorn min. dist.

†Turritella marl.

Paleontologic term applied in early repts to Caloosahatchee marl (lower Plio.).

†Turritella limestone.

†Turritella rock.

Paleontologic terms applied in early repts to Clayton fm. (basal Eocene).

Turtleback complex.

Upper Jurassic: Northwestern Washington (San Juan Islands).

R. D. McLellan, 1927 (Univ. Wash. Pub. Geol., vol. 2, pp. 142, 148–154). *Turtleback complex.*—Intrusive igneous rocks, both acid and basic, of so many different types and ages that it is impossible to map them individually. It is a confused network or injection breccia containing dunites of Fidalgo fm.; basalt and andesite porphyrite belonging to Eagle Cliff porphyrite; Wark gabbro-diorite; Colquitz quartz diorite; scattered offshoots of diorite-porphyrite, rhyolite porphyry, granodiorite porphyry, aplites, pegmatites, igneous quartz veins, and lamprophyric rocks ranging from the more basic porphyrites to the ultrabasic pyroxenites and hornblendites. Well exposed on Turtleback Mtn. Assigned to late Jurassic.

Turtle Mountain group.

Devonian and Carboniferous: Alberta.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Mus. Bull. 4, p. 5).

Tusayan series.

A term proposed by C. [R.] Keyes to include Coconino ss., Hermit sh., and Supai fm. of Grand Canyon region. Derivation of name not stated. (See Pan-Am. Geol., vol. 66, No. 3, 1936, pp. 195–216.)

†Tuscahoma marl.

Eocene (lower): Southwestern Alabama.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, p. 50). [See *Bells Landing marl memb.*, for definition.]

Conflicts with Tuscahoma sand, better-established name, of which it is a single memb.

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw Co.

Tuscahoma sand. (In Wilcox group.)

Eocene (lower): Southern Alabama.

E. A. Smith, 1888 (Ala. Geol. Surv. Rept. Prog. 1884–88, geographic map of Ala.). *Tuscahoma (Bells Landing)*: Underlies Bashi (Wood's Bluff) and overlies Nanafalia. [All of definition.]

For more specific definition see †*Bells Landing series*, a binomial name which has one year's priority over Tuscahoma but which has been used in two senses.

Belongs in Wilcox group and contains deposits of both marine and nonmarine origin. (See also 1932 entry under *Salt Mtn ls.*)

Named for exposures at Tuscahoma, on Tombigbee River, in Choctaw Co.

Tuscaloosa formation.

Upper Cretaceous: Coastal Plain from western Tennessee, northeastern Mississippi, and northwestern Alabama, across southern Alabama, Georgia, South Carolina, and North Carolina.

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 18, 95–117, 136–138, pl. 11). *Tuscaloosa fm.*—Irregularly or obscurely bedded qtzitic and micaceous sands, of yellowish, gray, pink, and light-purple colors, often cross-stratified; interbedded with heterogeneous clays, of mottled, purple, and gray colors, sometimes carbonaceous or lignitiferous; also lenticular pebble beds (pebbles commonly of chert) and discontinuous lignitic layers. No fossils except lignite and leaf impressions. Of undet. age but probably Cret. Thickness probably 1,000 ft. Rests uncon. on eroded surface of Carbf. or other Paleozoic rocks. Underlies Eutaw fm.

In eastern S. C. and in N. C. the Tuscaloosa is overlain by Black Creek fm. (of Upper Cret. age). It is possible (according to L. W. Stephenson and C. W. Cooke, personal communication) that in these States beds older than the Tuscaloosa may in the future be differentiated from the deposits now called by that name. In S. C. the Tuscaloosa replaces †Middendorf fm. and in N. C. it replaces †Cape Fear fm.

Named for Tuscaloosa, Tuscaloosa Co., Ala., and Tuscaloosa (Black Warrior) River at Steele's Bluff and White's Bluff, Hale Co., Ala.

Tuscan tuff.

Pliocene: Northern California (Lassen Peak, Redding, and Chico regions).

J. S. Diller, 1895 (U. S. G. S. Lassen Peak folio, No. 15). *Tuscan fm.*—Composed wholly of fragmental material derived from the numerous volcanoes of Lassen Peak dist. Much of it is fine, clearly stratified, and properly called tuff, but a large part is aggl. of coarse and fine material intermingled. Most fragments are angular, but some beds are made up of pebbles well rounded by water action. Best exposed in canyons of Mill, Deer, and other creeks on their way from the mtns to Sacramento Valley. At a number of points there are sheets of lava in the tuff. Is youngest Tert. deposit in region. Rests on Ione fm. [The deposits mapped and described as *Tuscan fm.* in 1892 prel. proof-sheet ed. of Lassen Peak folio are divided into Tuscan fm. and Ione fm. in the completed Lassen Peak folio.]

The Tuscan tuff ranges in thickness up to more than 1,000 ft.

See under *Nomlaki tuff memb.* and under *Tehama fm.*

N. E. A. Hinds, 1932 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 20, No. 11, pp. 375–410), assigned Tuscan fm. to late Plio.

Named for exposures at or near Tuscan Springs, Lassen Peak quad.

Tuscarora sandstone.

Tuscarora quartzite.

Silurian (early): Central southern and eastern Pennsylvania, western Maryland, western Virginia, and eastern West Virginia.

N. H. Darton, 1896 (U. S. G. S. Piedmont folio, W. Va.-Md., No. 28, and Franklin folio, W. Va.-Va., No. 32). *Tuscarora qtzite.*—White and gray massive qtzite, 250 to 480 ft. thick. Underlies the red Cacapon ss. and overlies the red Juniata fm. Is a part of the Medina of early repts on this region. Assigned to Sil. [Derivation of name not stated.]

W. B. Clark, 1897 (Md. Geol. Surv. vol. 1, pp. 172–188). *Tuscarora fm.* (white Medina ss.) of Appalachian region of Md. is chiefly ss., hard and massive, generally white or gray. Few fossils have been found, but it is undoubted equiv. of white Medina ss. to north. Is found at widely separated points in Appalachian dist. Named for Tuscarora Mtn, Pa. [which extends along border line of Juniata and Perry Counties, Pa.]. Is 1,500 ft. thick in W. part of dist. Assigned to Sil.

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 107, pp. 34–35). *Arthrophycus* is only fossil mentioned as coming from Tuscarora ss., which is regarded as perhaps nearly identical with the White Medina of Pa. and N. Y. Surveys.

This fm. continued to be assigned to Sil. until 1907, when R. S. Bassler (Min. Res. Va. (Watson), p. 102) classified it as Ord., and repeated this assignment in 1908 (Econ. Geol., vol. 3, p. 510). Other geologists, however, continued to classify it as Sil., and it is now universally assigned to that system.

Tuscher formation.

Tertiary? (Eocene?): Central eastern Utah (Book Cliffs).

D. J. Fisher, 1936 (U. S. G. S. Bull. 852). *Tuscher fm.*—Largely quartz sss., massive, cross-bedded, friable, light gray to creamy white, with minor interbedded buff to gray shales. Thickness 131 to 600± ft. Underlies Wasatch fm. and overlies Price River fm. Erosional uncon. almost certain both at top and base. Named after canyon just E. of Green River.

Tuscumbia limestone.

Mississippian: Northern Alabama.

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala., with explanatory chart). *Tuscumbia (St. Louis).*—Tuscumbia ls., a somewhat cherty ls. 20 to 150 ft. thick, occurring in immediate valley of Tennessee River from Huntsville westward. Overlies Lauderdale cherty ls. and underlies Mountain ls. Is=upper part of Fort Payne chert.

Tuscumbia ls. as later defined by C. Butts (Ala. Geol. Surv. Spec. Rept. No. 14, 1926) applies to the lss. of Ala. that underlie Ste. Genevieve ls., overlie Fort Payne chert (restricted), and include rocks corresponding to only St. Louis, Spergen, and Warsaw limestones of Mississippi Valley section. This is present definition of U. S. Geol. Survey. (See also under *Fort Payne chert.*)

Named for exposures at Tuscumbia, Colbert Co.

†Tuskaloosa fm.

Cretaceous: Alabama.

An early spelling of *Tuscaloosa fm.*

Tusquitee quartzite.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 4). *Tusquitee qtzite.*—Almost entirely white qtzite, of remarkably uniform appearance throughout all its areas. Composed of fine grains of rolled quartz sand. To N., W., and S. of Marble there are a few seams of fine cgl. in the qtzite. On headwaters of Cheoah River some qtzites of medium grain contain sl. pebbles of same nature as underlying Nantahala sl. But as a rule the grain of the rock is very fine. The beds

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of qtzite range in thickness from a few inches up to 2 or 3 ft. Interbedded with the qtzites are a few seams and layers of black sl. and schist similar to those of underlying Nantahala sl. These are seldom over a foot thick. Thickness of fm. 20 to 500 ft. Underlies Brasstown schist and overlies Nantahala sl.

Named for excellent exposures in Tusquitee Mtns, Clay Co., N. C.

Tutshi series.

Age (?): British Columbia.

R. G. McConnell, 1906 (Canada Geol. Surv. Summ. Rept. 1905, p. 28).

Tutshi series.

Cretaceous: Yukon.

D. D. Cairnes, 1908 (Canada Dept. Mines, Geol. Surv. Branch, Pub. 982, pp. 23, 31).

Tuxedni sandstone.

Middle Jurassic: Central southern Alaska (Cook Inlet region).

G. C. Martin and F. J. Katz, 1912 (U. S. G. S. Bull. 485, p. 59, map, chart opp. p. 30). *Tuxedni ss.*—Chiefly ss. but contains much sh. and a few thin beds of ls. and cgl. Thickness exposed at type section (on S. shore of Tuxedni Bay) 1,128 ft. Base exposed on S. shore of E. arm of Iniskin Bay, where it rests uncon. on crystalline rocks. Marine invertebrates and fossil plants, the former in great abundance and variety and referred to Middle Jurassic by T. W. Stanton. Underlies Chinitna sh.

Tuxpam formation.

Tuxpan formation.

Miocene: Mexico (Vera Cruz).

E. T. Dumble, 1911 (Sci., n. s., vol. 33, p. 234). *Tuxpam fm.*, Mio., Mexico.

T. W. Vaughan, 1924 (Geol. Soc. Am. Bull., vol. 35, p. 737). *Tuxpan fm.*, Mio., Mexico. Named for city of Tuxpan (which is also spelled Tuxpam), Vera Cruz.

Tuxtepec formation.

Miocene: Isthmus of Tehuantepec.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 375).

Tuxtla formation.

Lower Cretaceous: Mexico.

C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 328).

Tuya lavas.

Tertiary: British Columbia.

F. A. Kerr, 1926 (Canada Geol. Surv. Summ. Rept. 1925, pt. A, p. 94).

Twelvemile beds.

Tertiary: Southwestern Alaska (Yukon gold district).

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3). *Twelvemile beds.*—Slightly consolidated and coarse-bedded gravels and sands that carry seams of light-brown sandy lignite and fragments of wood, but no fossil leaves or shells. Exposed at junction of Twelvemile Creek and Mission Creek. Overlies Mission Creek series, probably uncon. Are younger than Kenai series and probably of Mio. or Plio. age and deposited in lake.

Twentymile sandstone (distinct formation). Also

Twentymile sandstone member (of Williams Fork formation).

Upper Cretaceous: Northwestern Colorado (Yampa region).

N. M. Fenneman and H. S. Gale, 1906 (U. S. G. S. Bull. 297, p. 27). *Twentymile ss. memb. of Mesaverde fm.*—Massive ss.; in a single bed in some places, but in other places it consists of a series of massive layers aggregating several hundred ft. Thickness 75 to several hundred ft. Underlies upper coal group (400 ft. thick) of Mesaverde fm. Is separated from underlying Trout Creek ss. memb. by 600 ft. of weak sss. and shales underlain by 400 ft. of coal-bearing rocks called Middle coal group. Named for Twentymile Park, about 10 mi. NW. of Yampa.

E. T. Hancock, 1925 (U. S. G. S. Bull. 757). *Twentymile ss.* is here treated as a memb. of Williams Fork fm. (of Mesaverde group) in Axial and Monument Butte quads.

M. R. Campbell, 1931 (Tentative correlation of named geologic units of Colo., compiled by M. G. Wilmarth, U. S. G. S. separate chart). *Twentymile ss.* is elevated to rank of a fm. of Mesaverde group in Yampa coal field, where it underlies Holderness fm. and overlies Mount Harris fm.

Twentymile coal group. (In Mesaverde group.)

Name locally applied to the group of coal-bearing strata overlying Twentymile ss. memb. of Williams Fork fm. to N. of Axial Basin, NW. Colo.

Twiggs clay member (of Barnwell formation).

Eocene (upper): Eastern Georgia.

C. W. Cooke and H. K. Shearer, 1917 and 1918 (Ga. Geol. Surv. Bull. 31, pp. 14, 158–173, 1917; U. S. G. S. P. P. 120C, pp. 51–56, 1918). *Twiggs clay memb.*—Extensive but not entirely continuous beds and lenses of clay, varying from porous and siliceous to calc., glauconitic, pyritiferous, carbonaceous, or lignitic. Max. thickness 100 ft. *Basal memb. of Barnwell fm.* (of Jackson age) in most of its area, but near Savannah River it tongues out and older strata of the Barnwell (*Ostrea georgiana* zone) underlie the Twiggs memb. Replaces "Congaree" clay memb., which was originally included in McBean fm., of Claiborne age, and supposed to be=Congaree shales of Sloan. The latter, however, are now known to be much older than Twiggs clay.

Named for exposures in Twiggs Co. Typically seen near Pikes Peak station, on Macon, Dublin, and Savannah R. R.

Twilight granite.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Twilight granite.*—Light grayish-pink gneissoid granite. Intrudes the Archean schists in this quad. and in Engineer Mtn quad. Composes Twilight Peak, in Needle Mtns quad. Does not intrude the Algonkian rocks.

Was assigned to "Algonkian" by E. S. Larsen in U. S. G. S. Bull. 843, 1933. The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. On 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

Twin Buttes member (of Bridger formation).

Eocene: Southwestern Wyoming.

H. E. Wood, 2d, 1934. (See under *Blacks Fork memb. of Bridger fm.*)

Twin Creek limestone.

Upper Jurassic: Southwestern Wyoming and southeastern Idaho.

A. C. Veatch, 1907 (U. S. G. S. P. P. 56, pp. 56+, chart opp. p. 50, map, etc.). *Twin Creek fm.*—Black and gray calc. shales and thin-bedded shaly lss. with occasional beds of yellow ss. Thickness in SW. Wyo. 3,500 to 3,800 ft. Abundant marine Jurassic fauna [listed]. Conformably underlies Beckwith fm. and conformably overlies Nugget fm. Named for excellent exposures on Twin Creek, btw. Sage and Fossil, SW. Wyo.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, p 3). Typical Twin Creek ls. of SW. Wyo. is considered=Carmel fm.

Twin Lakes quartz monzonite porphyry.

Tertiary: Central Colorado (Chaffee and Lake Counties).

J. V. Howell, 1919 (Colo. Geol. Surv. Bull. 17). *Twin Lakes quartz monzonite porphyry.*—A fresh coarse-grained light-gray monzonite carrying large euhedral orthoclase crystals. Found on both sides of valley of Lake Creek below Everett and in vicinity of Twin Lakes, Lake Co. ["Probably late Paleozoic" on map and on p. 33; "tentatively assigned to Mesozoic and correlated with Mesozoic intrusions elsewhere" on p. 51.]

J. T. Stark and F. F. Barnes, 1935 (Colo. Sci. Soc. Proc., vol. 13, No. 8, map). *Twin Lakes porphyry* assigned to Tert.

Twin Lakes andesites.

Age (?) : Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 21, No. 8, pp. 214–376, map). *Twin Lakes andesites.*—Black porphyritic quartz-bearing andesites, 1,000± ft. thick. Believed to have been poured out at about same time as Juniper andesites and before Flatiron andesites. [Mapped over large area surrounding Twin Lakes.]

Twin River formation.

Oligocene: Northwestern Washington.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52, pp. 579, 584, 604). *Twin River fm.*—Soft clay shales with occasional thin beds of ss. that wash out on the beach as flags. Thickness 2,000 ft. Occurs on N. coast of Wash. Younger than Seattle fm. Is=upper part of Astoria (Olig.).

B. L. Clark and R. Arnold, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 303–308). C. E. Weaver has apparently shown (Calif. Acad. Sci. Proc., 4th ser., vol. 6, No. 3, 1916, pp. 41–52) that the beds forming Twin Creek fm. are part of Arnold and Hannibal's Seattle fm. (*Acila gettysburgensis* zone), and they are here included in Seattle fm.

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2, pp. 245, 261–264). [See 1925 entry under *Blakeley fm.*]

Twisp physiographic stage.

Pleistocene: Central Washington (Cascade Range).

B. Willis, 1903 (U. S. G. S. P. P. 19). Interglacial. Type loc., canyon of the Twisp, Methow quad.

Two Medicine formation. (Of Montana group.)

Upper Cretaceous: Northwestern Montana (Blackfeet Indian Reservation).

E. Stebinger, 1914 (U. S. G. S. P. P. 90, pp. 62–68). *Two Medicine fm.*—Gray to greenish-gray clay and soft irregular ss., which is most abundant in lower 250 ft.; in places thin beds of red clay and nodular ls. Thickness 1,950 ft. An abundant reptilian fauna of Judith River types; at many horizons a fresh-water fauna. Overlies Virgelle ss. and underlies Bearpaw sh. Corresponds to Judith River, Claggett, and upper part of Eagle of central Mont. Exposed, together with underlying and overlying fms., on Two Medicine River btw. its mouth and Family post office.

Does not extend E. as far as Sweetgrass Hills, where a different rock classification is now used.

Twomile limestone. (In Conemaugh formation.)

Pennsylvanian: Southern West Virginia.

I. C. White, 1885 (The Virginias, vol. 6, pp. 8, 9). *Twomile ls.*—Dark-gray, sometimes earthy ls., 5 ft. thick. Occupies same relative position as marine Green Crinoidal ls. [Ames ls.] of northern W. Va., Ohio, and Pa., but appears to be of fresh-water origin. Like the Green Crinoidal ls. it is underlain by 25 to 30 ft. of dark-red marly sh. containing iron-ore nodules. Named for development on Twomile Run, below Charleston, Kanawha Co.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2). There can be no doubt the *Two Mile lss.* represent horizon of Ames or Green Crinoidal bed, though they contain only fresh-water fossils. Consists of an upper ls. 1 ft. 8 in. thick and a lower ls. 1 ft. 4 in. thick, the two separated by 6 ft. of gray sh. [Later W. Va. repts confirm this correlation.]

Tybo shale.

Cambrian: Central Nevada (Tybo district).

H. G. Ferguson, 1933 (Nev. Univ. Bull., vol. 27, No. 3, pp. 13–25). *Tybo sh.*—Dominantly fissile olive-gray to dark sh.; near top thin beds of ls. and calc. sl. with concretions of dense gray ls. Thickness 1,600± ft. Grades into overlying Hales ls. (Upper? Camb.) and into underlying Swarbrick fm. No fossils. Exposed in Tybo Canyon, near camp of Tybo.

Tye granite.

Jurassic: Central Washington (Skykomish Basin).

W. S. Smith, 1915 (School of Mines Quart., vol. 36, p. 157) and 1916 (Jour. Geol., vol. 24, p. 560). *Tye granite* (also *Tye soda granite*). Jurassic. Named for Tye River.

Tye formation. (In Clear Fork group.)

Permian: Central and central northern Texas.

W. E. Wrather, 1917 (SW. Ass. Pet. Geol. Bull. 1, pl. opp. p. 96). *Tye fm.*—Soft red clays with thin unimportant sss. in upper part. Thickness 340 ft. Is basal part of Clear Fork beds. Underlies Bullwagon dol. and overlies Wichita beds.

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, p. 47). *Vale fm.*—Red sh., some of it quite sandy, extending from top of Ferguson's Ford section to base of section at Smith place, on Bull Hollow. Thickness 154 ft. in Runnels Co.; Wrather gives thickness of 340 ft. in Taylor Co. Replaces *Tye fm.* of Wrather, which is preoccupied by an igneous fm. and also conflicts with Tyee fm. of Pacific coast. Basal div. of Clear Fork stage. Overlies Arroyo fm., of Wichita stage. Named for old post office of Vale, on Ballinger-Maverick road, on E. side of Valley Creek, Runnels Co.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 176). *Tye fm.* is preoccupied and is discarded for *Vale fm.*

Probably named for Tye, Taylor Co.

Tyee sandstone.

Eocene: Southwestern and northwestern Oregon (as far north as Tillamook County).

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Tyee ss.*—Massive ss. with occasional shales. Thickness 1,000 ft. in Roseburg quad. Differs from underlying Umpqua fm. in sss. being heavier-bedded and containing more conspicuous mica scales. Eocene fossils. Forms prominent escarpment from Tyee Mtn to Camas Valley.

C. W. Washburne, 1914 (U. S. G. S. Bull. 590). *Tyee ss.* (upper Eo.) is 2,000 ft. thick. Extends from type loc., in Douglas Co., southward to Rogue River Mtns and northward 120 mi. into Tillamook Co.

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., vol. 3, No. 1, pp. 6–7), gave thicknesses of Tyee ss. as 2,500 ft. in Roseburg quad., 5,000+ ft. at Florence, Lane Co., and 4,000+ at Newport, Lincoln Co., and placed it below Coaledo fm., but stated that Tyee of Florence and Newport doubtless includes same horizon as Coaledo of Coos Bay.

W. D. Smith, 1924 (Econ. Geol., vol. 19, p. 458), published same statements as Harrison & Eaton regarding thickness and placed Coaledo above Tyee.

H. G. Schenck, 1928 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 1, p. 24). On basis of superposition the Tyee is to be regarded as=Coaledo fm., of Tejon age. However, characteristic Meganos fossils have been collected from typical Tyee ss. from places other than type loc. of Tyee, an obvious discrepancy that has not yet been explained.

Tyee porphyrite.

Jurassic: British Columbia.

C. H. Clapp and H. C. Cooke, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 25).

Tyende sandstone.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 66, No. 1, pp. 71–72). *Tyende ss.* is introduced as a name for "upper LaPlata" of SW. Colo. and Ariz. Named for Tyende Arroyo, a tributary of Rio San Juan, passing by north point of Black Mesa, near Kayenta settlement. In Ariz. this ss. is variously included under such titles as Navajo ss. (preoccupied), Kayenta fm. (which includes very much more), and Lohali ss. (preoccupied). Overlies Montezuma shales (middle LaPlata shaly marine strata).

Tygee sandstone. (In Gannett group.)

Cretaceous (?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98G, pp. 76, 83). *Tygee ss.*—Gray to buff, even-grained, and without greenish or reddish tinges of some of higher sss. Top is not exposed, and in much of region this ss., with part or all of underlying Draney ls., was eroded before deposition of Wayan fm. At type loc. about 100 ft. of this ss. is exposed. Named for Tygee Creek, E. of which, in T. 8 S., R. 46 E., the fm. is well exposed in association with Draney ls. Is top fm. of Gannett group.

Tygee erosion cycle.

Name applied by G. R. Mansfield to a Miocene erosion cycle in SE. Idaho. (See Jour. Geol., vol. 32, 1924, p. 485.)

Tyger zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 7, 12). *Tyger zone* (*Archean*) is not conspicuously separated from Anderson-Spartanburg zone, except that in addition to Carolina gneiss series it comprises the very prominent development of Roan gneiss or hornblende series. This zone comprises an irregularly shaped tract bounded on W. by Saluda zone, along a line extending southwesterly from Gap Creek toward Pendleton and thence to Tugaloo River near point where intersected by 83° long.; on N. it is limited by N. C. line; on SE. by a meandering line from a point of N. C. State line (near 82° long.) to Savannah River near Brown's Ferry; the latter river and Tugaloo River complete the bdy to 83° long. It is constituted chiefly of Carolina gneiss series with a prominent development of Roan gneiss series and some Table Rock granite. It comprises granite gneiss exposed in successive belts (coarse porphyritic prominent); granite; feldspar; porphyry; granitite; gneissoid slates; mica slates and schists; hornblende schists; graphite schists; dikes of granite, pegmatite, diabase, and diorite. Many of the rocks are garnetiferous.

Named for exposures on Tyger River.

Tyler slate.

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Penokee-Gogebic district).

C. R. Van Hise, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, p. 338). *Tyler sl.*—The upper sl. fm. of Upper Huronian in Penokee-Gogebic dist. Named for exposures on Tylers Fork. Overlies Ironwood fm. and uncon. underlies the great basal gabbro of the Keweenawan.

Later repts give thickness 7,000 to 11,000+ ft.

Tyler red beds. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia and eastern Ohio.

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, pp. 30, 44). *Tyler red beds* (also *Tyler reds*).—A widespread deposit of red beds in Ohio, 14 to 52 ft. thick; lies 18 to 46 ft. above Upper Sewickley coal, and underlies Ritchie red beds, with which it is in places continuous. Is thicker in Tyler, Ritchie, and Wood Counties, W. Va.

Tyler sandstone member (of Quadrant formation).

Pennsylvanian (?): Central southern Montana (Big Snowy Mountains, Fergus County).

O. W. Freeman, 1922 (Eng. and Min. Jour.-Press, vol. 113, No. 19, p. 827). *Tyler ss.*—White to red sss. interbedded with varicolored sandy sh. Thickness 300 ft. Beautifully exposed at E. end of Middle Bench, 1 mi. W. of post office of Tyler. On Alaska Bench is overlain by Alaska Bench ls. [according to text, but in generalized section of Quadrant fm. of central Mont. he showed 100 ft. of gray sh. btw. Alaska Bench ls. and Tyler ss.]. Rests on Otter shales, also a memb. of Quadrant fm.

H. W. Scott, 1935 (Jour. Geol., vol. 43, pp. 1028–1029). O. W. Freeman (1922) grouped, under name *Tyler sand*, the ss. beds that occur in top part of Heath fm. on NE. flank of Big Snowy Mtns. The Tyler sands occur at same strat. zone as Van Dusen sand on SE. flank of Big Snowy Mtns. They are neither a lithologic, paleontologic, or mappable unit over broad areas, and at present must be considered a memb. of Heath fm.

Tyler greensand member (of Sparta sand).

Eocene (middle): Eastern Texas.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, pp. 1359–1360). In west-central and SW. Smith Co. there is at least 130 ft. of Sparta sand exposed. In this low area, ranging in elev. from 70 to 120 ft. above top of the Weches, is a sandy glauconitic zone which has been termed *Tyler member of the Sparta*. It is well exposed throughout city of Tyler, and W. and NW. of Swan, Smith Co., where it consists of approx. 50 ft. of very sandy, partly cross-bedded glauconite, with a few clay lumps. Weathers rapidly. No fossils yet found. Some geologists place *Tyler greensand* in Crockett fm., but writers believe it is a local memb. of the Sparta, because no similar bed has been seen to S. at normal Sparta-Crockett contact, and because the interval in Smith Co. btw. the Weches and the Tyler memb. of Sparta is not great enough to represent entire Sparta fm.

Tymochtee shale.

Silurian (Cayugan): Northern central Ohio and southeastern Michigan (?).

N. H. Winchell, 1873 (Ohio Geol. Surv. vol. 1, p. 633). *Tymochtee sl.*—Homogeneous tough thin slaty beds, 24 ft. thick, chiefly of drab color, sometimes containing so much bituminous matter as to appear like the great Black Sl. Occurs in midst of the Waterlime.

E. Orton, 1890 (Ohio Geol. Surv., 3d ser., 1st Ann. Rept.). *Tymochtee sl.*—Dark-blue shaly ls. Lies below middle of Lower Helderberg ls. or Waterlime and 100 to 200 ft. higher than Hillsboro ss. and lower than Sylvania ss.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, p. 521). The limits of "Tymochtee sl." were not definitely fixed by Winchell, and further investigation may render it inadvisable to retain this name. Prof. Winchell, however, used it for the thin-bedded Waterlime in several northwestern counties and compared the beds of this character in Wood Co. with it.

C. R. Stauffer, 1908 (Ohio Nat., vol. 8, pp. 271–276), applied name *Tymochtee fm.* to 20± ft. of rather thin-bedded compact drab ls. underlying Sylvania ss. in Lucas Co., Ohio.

A. C. Lane, C. S. Prosser, W. H. Sherzer, and A. W. Grabau, 1909 (Geol. Soc. Am. Bull., vol. 19, pp. 553–556), divided "Lower Monroe or Bass Islands series" into (descending) Raisin River dolomites, 200 ft.; Put-in-Bay dolomites, 100 ft.; *Tymochtee shales and lss.;* and Greenfield dol., 100+ ft. They described the Tymochtee as something over 100 ft. thick in Wyandot Co., Ohio, "but its relation to overlying and underlying fm. is unknown. Its fauna likewise is unknown, and the fm. must be considered a tentative division of Lower Monroe. It is not impossible it represents in part one or more members recognized elsewhere."

W. H. Sherzer and A. W. Grabau, 1910 (Mich. Geol. and Biol. Surv. Pub. 2, geol. ser. 1, pp. 20, 32). *Tymochtee shales.*—Thickness 0 to 90 ft. Strat. position of *Tymochtee sl.* is unsettled. That it rests above Greenfield dol. seems certain from its geographic position, but whether it lies below or above Put-in-Bay dol. has not been determined. There is some reason for believing it lies below that fm., filling gap btw. Greenfield and Put-in-Bay.

C. S. Prosser, 1915 (Outlines of field trips in geol. for central Ohio). Pre-Sylvania part of Monroe fm. is divided into (descending) Raisin River dol., Put-in-Bay dol., *Tymochtee sh.*, and Greenfield dol.

J. E. Carman, 1927 (Jour. Geol., vol. 35, p. 488). Lower Monroe or Bass Islands fm. divided into (descending): Raisin River dol., 0 to 50 ft.; Put-in-Bay dol., 50± ft.; *Tymochtee shaly dol.*, 150± ft.; and Greenfield dol., 75 to 100 ft. The Tymochtee Creek exposure consists of gray to drab thin-bedded dol., with partings or thin layers of carbonaceous argill. material. Writer is convinced the Tymochtee should be recognized as a distinct div., even if its limits are not now definitely known. It has a meager fauna.

Named for exposures on Tymochtee Creek at Crawford, Wyandot Co., Ohio.

Tyner formation.

Upper and Middle Ordovician: Eastern Oklahoma (Tahlequah quadrangle).

J. A. Taff, 1905 (U. S. G. S. Tahlequah folio, No. 122). *Tyner fm.*—Brown ss. and thin siliceous ls. and chert above; brown thin-bedded and flaggy ss. and greenish sh. below. Thickness 60 to 100 ft. Overlies Burgen ss. and uncon. underlies Chattanooga fm. Named for exposures along Tyner Creek, near N. border of

Tahlequah quad. Occurs in but 3 places in quad., all in N. part. Has yielded fossils of Lorraine [Upper Ord.] and Trenton or Black River [Middle Ord.] age. In S. part of quad. the Chattanooga is underlain by St. Clair marble (of Niagaran, Sil., age).

J. P. Boyle, 1929 (Okla. Geol. Surv. Bull. 40KK). *Tyner sh.* [restricted].—In Okfuskee Co. is 50 to 150 ft. thick and directly overlies Burgen ls. (30 to 70 ft. thick), which rests on Burgen ss. (20 to 60 ft. thick). Is present over entire county. Directly underlies Wilcox ss. Top consists of a light-green fine-grained sand. Sandy green sh. occurs near base.

W. F. Cloud, 1930 (Okla. Geol. Surv. Bull. 40RR). In Tulsa Co. Tyner fm. [restricted] (40 to 200+ ft. thick) underlies Wilcox ss. (0 to 50 ft. thick) and overlies Burgen ss. (10 to 75 ft. thick).

I. H. Cram, 1930 (Okla. Geol. Surv. Bull. 40QQ). Tyner fm. of Taff in Cherokee and Adair Counties is here divided into (descending): Fernvale ls. (Upper Ord., Richmond) 0 to 10 ft.; Fite ls. (early Richmond), 0 to 8 ft.; *Tyner fm. restricted*, 0 to 69+ ft. The Fernvale is uncon. on Fite ls. and Fite ls. is uncon. on Tyner fm. restricted, but without discordance in dip. *Tyner fm. restricted* rests on Burgen ss., its relations to which are uncertain, as contact is seldom exposed. Fossils from upper part identified by E. O. Ulrich as Black River. Fossils from lower part suggest Chazy [Lower Ord.].

J. P. Boyle, 1930 (Okla. Geol. Surv. Bull. 40XX). *Tyner fm.* not exposed in Hughes Co., but is present everywhere beneath Wilcox sand and above Burgen ls. (30 to 70 ft. thick), which rests on Burgen ss.

The U. S. Geol. Survey has not had occasion to consider, for its publications, the restricted definitions of Tyner fm.

Tyonek formation.

Eocene: Southern Alaska (Cook Inlet region).

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 171–172, 184). *Tyonek beds.*—Clay alternating with sand and ss.; peaty brown lignite abundant. Believed to be later than Kenai series, and provisionally referred to Neocene. Uncon. underlies Cook Inlet gravels (Pleist.). Exposed along shore of Cook Inlet SW. of Tyonek.

These beds are now believed to be same as Kenai fm., but are across the bay from Kenai Peninsula.

†Tyre sandstone.

Misprint for *Tyee ss.* on p. 399 of U. S. G. S. Bull. 191.

†Tyringham gneiss.

Pre-Cambrian: Western Massachusetts.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902). *Tyringham gneiss*, Algonkian, believed to be older than Becket gneiss.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 18). [*Tyringham stretched biotite gneiss* shown as older than Becket and Washington gneisses and younger than East Lee gneiss.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 150, 155). "Tyringham gneiss" is a widely distributed facies of Becket granite gneiss, Archean.

Named for occurrence in Tyringham Twp, in which it covers a large area.

Tyrone limestone.

Middle Ordovician: Central Kentucky.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 9, 14). *Tyrone substage.*—Compact ls., light and dove-colored, with conchoidal fracture, interbedded with some clay and clay sh.; 90 ft. thick; characterized by *Helicotoma verticalis*. Top fm. of Highbridge stage. Is "Birdseye ls" of Linney. Underlies Lexington stage and overlies Oregon bed of Highbridge stage.

A. F. Foerste, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 377–385). It is proposed to remove *Tyrone ls.* from Highbridge ls., because the Tyrone is of Black River age and rest of the Highbridge of Chazy age.

Named for Tyrone, Anderson Co.

†Tyrone conglomerate.

Upper Ordovician: Central Pennsylvania (Blair County).

A. W. Grabau, 1909 (Sci., n. s., vol. 29, pp. 353, 355). *Tyrone cgl.*—Basal white beds; generally called "Oneida;" of continental origin. Underlie Juniata red beds and overlie Eden fm. Typically shown at Tyrone [Blair Co.], Pa.

A. W. Grabau, 1909 (Jour. Geol., vol. 17, p. 235). "Tyrone" preoccupied. Replaced by Bald Eagle cgl.

U. S. Geol. Survey uses *Oswego ss.*, instead of "Tyrone cgl." or "Bald Eagle cgl."

Uffington shale member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania and northern West Virginia.

I. C. White, 1903 (W. Va. Geol. Surv. vol. 2, p. 323). *Uffington sh.*—Dark sandy fossiliferous sh., 0 to 40 ft. thick, underlying Lower Mahoning ss. and overlying Upper Freeport coal. Exposed at Uffington, Monongalia Co., W. Va. Contains plants and marine fossils. In some areas replaced by ss. Is basal memb. of Conemaugh series.

W. A. Price, 1917 (Sci., n. s., vol. 46, pp. 540-542). *Uffington sh.* may then be redefined as a plant-bearing sh., frequently sandy in lower portion, of *nonmarine origin*, occupying in places the interval btw. Upper Freeport coal and Mahoning ss. Uncon. overlain by Mahoning ss. Max. reported thickness 40 ft. Absent in many places. Fossil plants abundant. At Uffington is 30 ft. thick. "Stevenson's identification of Uffington sh. as marine was due to miscorrelation with the marine Brush Creek sh."

Uinta formation.

Eocene (upper): Northeastern Utah (Uinta Basin).

O. C. Marsh, 1871 (Am. Jour. Sci., 3d, vol. 1, p. 196). The lake basin lying S. of Uintah Mtns is probably distinct from Green River Tert. basin lying N. of the mtns, and it may appropriately be called Uintah Basin. The fossils from the two basins, however, indicate synchronism of the deposits, although there is great difference in elevation.

T. B. Comstock, 1874 (Rept. reconn. NW. Wyo. made in summer of 1873 by W. A. Jones, 43d Cong., 1st sess., Ex. Doc. 285, chart opp. p. 103). *Uintah Basin beds* (*Upper Eocene*)—upper part of Bridger group of western Wyo., which overlies Green River beds. [No description of *Uintah Basin beds* or of Uintah Basin, but on p. 126 he says Prof. Marsh discovered evidence of a synchronous basin (to Green River basin) S. of Uinta Mtns.]

O. C. Marsh, 1875 (Am. Jour. Sci., 3d, vol. 9, p. 50). The deposits of Uintah Basin are of very great thickness, and fauna is essentially same as that of Green River Basin, N. of Uintah Mtns. These two lakes were contemp. for a long period at least, but there is evidence the southern lake (Uintah) continued for some time after the northern one (Green River) dried up.

C. King, 1876 (U. S. Geol. Expl. 40th Par., Atlas, map 2), showed following superposition of strata in NE. Utah (descending): Wyoming cgl. (Pliocene), *Uinta* (*Eocene*), Bridger (Eocene), Green River (Eocene), and Vermilion Creek (Eocene). *Uinta* as here used apparently included Browns Park fm. Advance copies of this map were distributed in 1875.

S. F. Emmons, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 307-320). *Uinta Eocene* (*middle and upper Eocene*) is later than Bridger, according to Marsh, and older than Wyoming cgl. [Apparently included Browns Park fm.]

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 405, 531-544). *Uinta group* (*latest Eocene*).—Lower members chiefly rough, gritty cgl., passing up into finer-grained sss. and at certain points developing creamy calc. beds. Is a shallow-water deposit, in all probability the sediment of a very restricted post-Bridger lake, wholly S. of Uinta Range, and the last memb. of that remarkable series of Eocene lakes whose great deposits are piled uncon. over one another in the region. To this group alone should *Uinta* be applied. As provisionally used on 40th Par. Atlas *Uinta group* was a term stretched for convenience to cover all Tertiaries S. of Uinta Range, of whose true subdivisions we were ignorant. Thickness 500 (?) ft.; 400 ft. only exposed. Marsh and Emmons by accident gave same name to the group. Vertebrates found in the continuation of these beds in White River Valley belong to a period higher than Bridger series. They even contain some forms closely approaching lowest Mio. types. Believed to be uncon. with all earlier Eo. groups, including Bridger. [Apparently included Browns Park fm.]

C. A. White, 1878 (U. S. Geol. and Geog. Surv. Terr. 10th Ann. Rept., pp. 20-21, 37-39). Although Mr. King has not upon his map recognized the deposits called "Brown's Park group" by Prof. Powell as separate from Green River group N. of an E.-W. line that may be made to compass through S. base of great Uinta fold, a careful comparison of deposits on both sides of Uinta Mtns has left no doubt in my mind of their identity. I therefore adopt Mr. King's name "Uinta group" instead of Prof. Powell's name "Brown's Park group."

O. C. Marsh, 1886 (U. S. G. S. Mon. 10, pp. 5-10). *Diplacodon beds*, the uppermost Eo., or the *Uinta group*, is especially well characterized by large mammals of genus *Diplacodon*. It overlies *Dinoceras* beds or Bridger series.

O. A. Peterson, 1895 (Am. Mus. Nat. Hist. Bull., vol. 7, pp. 72-75), divided the beds overlying Green River fm. in Uinta Basin, Utah, as follows (descending): (1) C, true Uinta (*Diplacodon elatus* beds), 600 ft.; B, 350 to 400 ft. of coarse brown sss. with alternating clays, transition from Bridger to Uinta; A, light-reddish stratum, 20 to 40 ft., underlain by 500 ft. of hard brown sss., Bridger fossils.

According to H. F. Osborn (U. S. G. S. Bull. 361, 1909, U. S. G. S. Mon. 55, 1929, and earlier publications as far back as 1895) the beds in Uinta Basin that are younger than Bridger fm. belong to the latest Eo. *Diplacodon* zone, and are 600 ft. thick. These latest Eo. beds have not been recognized in adjacent areas, and the U. S. Geol. Surv. therefore restricts *Uinta fm.* to its typical area. The Browns Park fm., which occurs to NE., is now considered much younger than Uinta fm., and to be of either late Mio. or early Plio. age. W. B. Scott has classified Uinta fm. as Olig., but its Eo. age seems now to be generally accepted. (For further information see explanation at end of *Bridger fm.* and also see under *Blacks Fork memb. of Bridger fm.*)

†Uinta quartzite.

†Uinta sandstone.

Pre-Cambrian: Northeastern Utah (Uinta Mountains) and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 42, 61, 70, 138, 139, 141-145). *Uinta group* (also *Uinta ss.*).—Massive, thinly bedded sss.; some intercalated aren. shales; all of group is very ferruginous; some portions metamorphosed, becoming a qtzite. Thickness 12,500+ ft. Uncon. overlies Red Creek qtzite (white) and uncon. underlies Lodore group (shales and sss.). The Uinta Mtns are composed chiefly of this ss. About 10,000 ft. of it was deposited against the old qtzite headland before it was buried by the upper members of the Uinta group. Provisionally classified as Dev.

H. S. Gale, 1910 (U. S. G. S. Bull. 415, p. 47). *"Uinta" qtzite.*—The oldest sed. rocks of Uinta Mtns exposed in territory adjacent to the coal fields are the red and white qtzites that form so prominent a feature throughout entire length of that mtn. range. The "Uinta" qtzite forms crest and core of main axis of Uinta Mtns and extends E. into Colo. nearly as far as junction of Little Snake and Yampa Rivers. The fm. in Uinta Mtns is largely heavy-bedded ss. and qtzite with intervening bodies of sh. and some massive cgl. beds. The color characteristic throughout Uinta Range is a dark brick red or reddish brown, but some beds of light-colored or white ss. and qtzite occur. At places the rock is banded or of a gneissoid structure. Thickness is said to exceed 12,000 ft., although base of fm. is nowhere exposed. Is oldest fm. in Uinta Range. No fossils have been reported, but assigned to Algonkian (?) on basis of strat. position and suggested correlation with rocks in Wasatch Mtns. May include considerable Camb.

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24). Uinta qtzite of Gale's Bull. 415 included Powell's Uinta group and Red Creek qtzite, both of which are considered pre-Camb.

The name *Uinta* is preoccupied by the latest Eocene fm. of Utah, and is therefore not available as a name for the old red sss. and qtzites that form Uinta Mtns. In the past these rocks have been tentatively assigned to different systems, and have even been miscorrelated with Weber qtzite (Penn.). Most workers have regarded them as early Camb. or pre-Camb., or both. Because of great uncon. at their base they were on the 1935

Colo. geol. map definitely assigned to pre-Camb., and the name *Uinta Mtn group* was adopted to replace the preoccupied name "Uinta quartzite," which has also been called "Uinta ss." and "Uinta group."

†Uinta group.

Pre-Cambrian: Northeastern Utah and northwestern Colo.

See under †*Uinta ss.*

Replaced by *Uinta Mtn group.* (See also *Emmons Peak qtzite.*)

†Uinta glacial epoch.

A name applied by W. W. Atwood and K. F. Mather (Sci., n. s., vol. 35, p. 315, 1912; Jour. Geol., vol. 20, p. 388, 1912; and G. S. A. Bull., vol. 23, p. 732, 1912) to the time during which a till sheet of Wisconsin age was laid down in San Juan Mtns of SW. Colo. The name was derived from Uinta Mtns, Utah. Atwood and Mather later replaced the name with *Wisconsin glacial stage*, being satisfied of the correlation with the Wisconsin deposits to E.

†Uinta moraine.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1912 (Jour. Geol., vol. 20, pp. 392–409), mapped and described "Uinta moraine" and "Uinta outwash" in San Juan Mtns of SW. Colo., correlating the deposits with similar glacial deposits in NE. Utah, all of which are now considered by glacial specialists as belonging to Wisconsin stage of glaciation, and which are therefore now designated as *Wisconsin till* and *Wisconsin outwash*.

†Uintah Basin beds.

See second entry under *Uinta fm.* (Eocene), NE. Utah.

Uinta Mountain group.

Pre-Cambrian: Northwestern Colorado and northeastern Utah.

T. S. Lovering and others, 1935 (geol. map of Colo.), adopted *Uinta Mountain group* as the geographic name to replace the preoccupied names "Uinta ss.," "Uinta group," and "Uinta qtzite," and, because of great uncon. at base of the group, they assigned the rocks definitely to pre-Camb. This name was also used by W. H. Bradley in U. S. G. S. P. P. 185–I, 1936, to replace "Uinta qtzite" (preoccupied).

Uintan series.

A term applied by C. [R.] Keyes to part of the Lower Camb. series of Nev. and Utah, including Pioche sh. and Prospect Mtn qtzite.

†Uintatherium beds.

A paleontologic name that has been applied to middle part (*Uintatherium* zone) of Bridger fm. of western Wyo.

Ulm coal group. (In Wasatch formation.)

Eocene: Eastern Wyoming and southeastern Montana.

J. A. Taff, 1909 (U. S. G. S. Bull. 341, pp. 123–150). Eo. rocks of Sheridan coal field, Wyo., divided into (descending) Ulm coal group, Intermediate coal group [Sentinel Butte sh. memb.], and Tongue River coal group. Two workable coal beds of considerable areal extent occur 1,100 to 1,200 ft. above top of Tongue River coal group. Over larger part of Sheridan field these upper coal beds have been removed by erosion. Their remnants are found in south-central part of area mapped, near top of watershed btw. Tongue River and Clear Creek. These two coal beds are termed for convenience the *Ulm coal group*, because of their best known occurrence in vicinity of Ulm, on Burlington R. R. They are separated by about 100 ft. of sh. and soft ss. similar to the ss. and sh. lying below.

W. T. Thom, Jr., and C. E. Dobbin, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 484, 496). *Wasatch fm.* (*Ulm coal group*).—In southern Mont. and in Powder River Basin, Wyo., the Sentinel Butte sh. (Intermediate coal group) is conformably overlain by yellow coal-bearing strata belonging to *Ulm coal group*, which is correlated with

Wasatch beds of Pumpkin Buttes, Wyo. It is believed by writers that strata representative of both Sentinel Butte sh. and Ulm coal group may be included in Fort Union as mapped in Red Lodge coal field, and it is possible that one or both of them may be represented in beds now classed as Fort Union in Bull and Crazy Mtns. [This definition of Ulm coal group appears to include more than Taff included, because the two coal beds referred to are shown in diagram on p. 484 as lying a considerable distance above Sentinel Butte sh. memb.]

R. L. Nace, 1936 (Wyo. Geol. Surv. Bull. 26, p. 104), applied *Ulm fm.* to the rocks which he stated were same as Ulm coal group of Taff, 1909.

Ulm formation.

See 1936 entry under *Ulm coal group.*

†Ulsterian group.

Middle Devonian: New York.

J. M. Clarke and C. Schuchert, 1899 (Sci. n. s., vol. 10, pp. 874–878). *Ulsterian period or group* includes Onondaga ls., Schoharie grit, and Esopus grit, all of which outcrop in Ulster Co.

The 1901 geol. map of N. Y., by F. J. H. Merrill, excluded Esopus grit from Ulsterian group and placed it in Oriskany group, as did Schuchert in 1903 (Am. Geol.), Grabau in 1906, Chadwick in 1908, Schuchert in 1910, Ulrich in 1911, and Hartnagel in 1912. Although all geologists did not immediately transfer the Esopus to Oriskany group, it is now uniformly included in that group.

The N. Y. State Survey still divides the Middle Devonian series into *Erian stage or epoch* (which covers Hamilton group) and *Ulsterian stage or epoch* (in which it includes Onondaga ls. and underlying Schoharie grit). The U. S. Geol. Survey has not adopted either Erian or Ulsterian.

Ultima Thule gravel lentil (of Trinity formation).

Lower Cretaceous: Southwestern Arkansas.

H. D. Miser and A. H. Purdue, 1918 (U. S. G. S. Bull. 690B). *Ultima Thule gravel lentil of Trinity fm.*—Thickness 0 to 40 ft. Pebbles are less than 1 in. diam. Separated from underlying Dierks ls. lentil of the Trinity by variegated clays, and also separated from overlying De Queen ls. memb. of the Trinity by 70 to 600± ft. of variegated clays. Exposed near Ultima Thule, De Queen quad.

H. D. Miser, 1927. [See 1927 entry under *Pike gravel memb.*]

Ulupau tuff.

Pleistocene (late): Hawaii (Oahu Island).

C. K. Wentworth, 1926 (Bernice P. Bishop Mus. Bull. 30, pp. 85–90), described Ulupau Craters, including the tuff crater of Ulupau Head, and in several places used *Ulupau tuff*, also *tuff of Ulupau Head*, also *Ulupau alluvium*, but he mapped the tuff and the *tuff alluvium* without the geographic name. He also spoke of "*the principal Ulupau tuff.*"

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Ulupau tuff.*—Gray and brown tuff of Ulupau cone, which forms the tip of Mokapu Point. Included in lower part of Honolulu volcanic series [q. v.]. Assigned to late Pleist.

†Umbral series.

See *H. D. Rogers 1858* under †*Vespertine series* and under †*Seral series.*

†Umbral limestone.

A name applied in early repts of Pa. Geol. Survey to Loyalhanna ls. of present terminology.

Umfraville gabbro.

Pre-Cambrian: Ontario.

F. D. Adams and A. E. Barlow, 1910 (Canada Geol. Surv. Mem. 6, p. 149).

Umpqua formation.

Eocene: Southwestern Oregon (Roseburg and Riddle quadrangles and vicinity).

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Umpqua fm.*—Chiefly thin-bedded sss. and very thin-bedded shales with some cgls.; locally contains coal seams, also interstratified calc. siliceous beds, which, although of small extent, on account of their exceptional character are treated separately as Wilbur fm. (Wilbur tuff lentils). Contains Eo. fossils. Thickness 12,000± ft. Underlies Tyee ss. and uncon. overlies Myrtle fm. Of the igneous rocks diabase is associated almost exclusively with Umpqua fm. [Maps in this folio show Umpqua River flows through Umpqua fm.]

J. H. Smith, 1900 (Jour. Geol., vol. 8, pp. 462–463). *Umpqua fm.*, described by Diller in Roseburg folio, stretches far beyond Roseburg quad. and plays important role in make-up of whole country W. of Cascade Range.

R. E. Dickerson, 1914 (Calif. Acad. Sci. Proc., 4th ser., vol. 4, pp. 114–115). *Siphonalia sutterensis* zone is present in uppermost part of Umpqua fm. on Umpqua River near mouth of Little River.

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, and Jour. Geol., vol. 27). [See 1919 entry under *Arago group.*]

L. G. Hertlein and C. H. Crickmay, 1925 (Am. Phil. Soc. Proc., vol. 64, No. 2). [See 1925 entry under *Arago group.*] *Umpqua fm.* is well exposed near mouth of Little River at its junction with Umpqua River, near Roseburg, Oreg. Underlies Tyee ss. and uncon. overlies upturned and eroded edges of Myrtle fm. (Cret.).

J. S. Diller and G. F. Kay, 1924 (U. S. G. S. Riddle folio, No. 218). *Umpqua fm.*, chiefly yellowish sss. and shales, with some cgl. and Eo. marine fossils, is uncon. on Chico fm. (Upper Cret.).

F. G. Wells and A. C. Waters, 1934 (U. S. G. S. Bull. 850). The rocks mapped as diabase by Diller in Roseburg folio are basalt flows interstratified with sediments of Umpqua fm. Writers believe all of "diabase" is extrusive; Diller thought part of it was intrusive. In Black Butte-Elkhead area the Umpqua is uncon. overlain by beds here named *Calapooya fm.*

Umpqua group.

Eocene: Southwestern Oregon.

See under *Willamette group.*

Unadilla formation.

Upper Devonian: East-central New York.

C. S. Prosser, 1903 (Am. Geol., vol. 32, pp. 380–384). *Unadilla fm.* includes Ithaca and Sherburne members of Portage stage. Underlies Oneonta ss. and overlies Genesee sh. Named for Unadilla River below New Berlin village [Chenango Co.], where both members are present.

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 826, 829). *Unadilla fm.* was proposed by Prosser to include the practically indivisible Sherburne and "Ithaca" fms. in Unadilla Valley and to E. But since it is there impossible to separate the Sherburne and the underlying Genesee and upper Tully the base of Unadilla fm. must be redefined and placed above top of *fimbriata* zone of the Tully. Top of Prosser's Unadilla is at base of Oneonta ss. As thus defined the fm. can be easily recognized as far E. as Otego Valley, where *fimbriata* zone at top of the Tully is still well developed. East of this valley the name *Gilboa* must apply because of disappearance of *fimbriata* zone.

Uncas shale.

Permian: Central northern Oklahoma (Kay County).

D. W. Ohern and R. E. Garrett, 1912 (Okla. Geol. Surv. Bull. 16, p. 10). *Uncas sh.*—Largely more or less pure clay beds, of alternating red and lighter color, with, locally, about 10 ft. above base, 2 ft. of fossiliferous ls. which may represent Luta ls. of Kans. Thickness 50–54 ft. Underlies Herington ls. and overlies Winfield ls. Named for exposures in vicinity of Uncas, Kay Co.

Uncompahgre formation. (In Needle Mountains group.)

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Silverton folio, No. 120). *Uncompahgre fm.*—A complex of massive white or smoky qtzites and dark slates, with a few members in which those rocks alternated in thinner layers. Thickness 8,000+ ft. No fossils, but considered to be of Algonkian age. Uncon. underlies Ignacio qtzite (Camb.) and uncon. overlies schist and gneiss of probable Archean age. Well exposed in Uncompahgre Canyon, in Silverton and Ouray quads.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Uncompahgre fm.* in this quad. overlies a cgl. here named *Vallecito cgl.* These 2 fms. are here united into a group called *Needle Mtns group.*

For many years this fm. was classified as "Algonkian," but the terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey the fm. is now classified as pre-Camb.

†Uncompahgre interglacial interval.

Pleistocene: Southwestern Colorado.

W. W. Atwood and K. F. Mather, 1912 (Jour. Geol., vol. 20, pp. 392–409), applied this name to interval preceding the Durango ("Bighorn") glacial stage and following the Cerro ("San Juan") glacial stage in SW. Colo. They stated: "This may not be in a strict sense an interglacial epoch but may include one or more glacial epochs as well." Later (U. S. G. S. P. P. 166, 1932) they discarded this preoccupied name and classified the post-Cerro and pre-Durango events in a different way, as including the deposition of Florida gravel followed by a period of uplift and erosion.

Underwood lava.

Tertiary (?): Southern Washington (Skamania County).

I. A. Williams, 1916 (Oreg. Bur. Mines and Geol., Min. Res. Oreg., vol. 2, No. 3, pp. 108, 115–117). *Underwood lava.*—Series of flows of dark-gray lava in vicinity of Underwood, which have come since the basalt was distorted by the folding of Cascades uplift. Underwood Mtn., and possibly other nearby hills to N. of it, was at least in part the source of these new-born lavas, which are younger by far than Columbia Gorge. Rest on Columbia River basalt. Not found in Oreg.

Unga conglomerate.

Miocene: Southwestern Alaska.

W. H. Dall and G. D. Harris, 1892 (U. S. G. S. Bull. 84, p. 234). *Unga cgl.*—Brown cgls. with *Sequoia*, occurring on Unga Island, Alaska. Rest conformably on coal-bearing Mio. beds. Are upper beds of Kenai group, of early Mio. or latest Eo. age. [Kenai fm. is now classified as Eo. and is restricted to its type region, Kenai Peninsula.]

Ungalik conglomerate.

Upper Cretaceous: Southwestern Alaska (Nulato-Norton Bay district, Lower Yukon River region).

P. S. Smith and H. M. Eakin, 1911 (U. S. G. S. Bull. 449, p. 55). *Ungalik cgl.*—Lowest Cret. sed. fm. in Norton Bay-Nulato region. Is a basal cgl. of marine origin. Exposed in steep-faced cliffs along Ungalik River and forms most of prominent range of hills btw. the river and the coastal plain from Bonanza Creek N. to 1± mi. below Camp A17. Is made up of rounded debris from the older fms., upon which it rests uncon. Conformably overlain by Shaktolik group. Most characteristic materials are variety of porphyritic rocks and abundant angular feldspar crystals in sandy matrix. Weathers red, from abundant iron content.

See also G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 395+), who applied *Melozi* to conformably overlying fm. (which he correlated with lower part of Shaktolik group), gave thickness of Ungalik cgl. as 3,000 ft., and showed it as uncon. on Paleozoic rocks.

See also U. S. G. S. P. P. 159, 1930.

Unibon shale.

Cretaceous (?): Puerto Rico.

D. R. Semmes, 1919 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 1, p. 74).

Unicoi formation.

Lower Cambrian: Southwestern Virginia, eastern Tennessee, and northwestern North Carolina.

M. R. Campbell, 1899 (U. S. G. S. Bristol folio, Va.-Tenn., No. 59, p. 3 and columnar section; name proposed by A. Keith). *Unicoi ss.*—Heavy bed of coarse feldspathic ss. or qtzite with exposed thickness of about 1,000 ft., but on its lower side bounded by a fault, so that full thickness cannot be determined. Underlies Hampton sh. Oldest fm. in area.

A. Keith, 1903 (U. S. G. S. Cranberry folio, Tenn.-N. C., No. 90, which describes an area lying E. of and not adjoining Unicoi Co., Tenn.). *Unicoi fm.*—A great series of sss. and qtzites with small interbedded shales and slates and much cgl. The sss. are light gray or white and frequently feldspathic. Very near base occur the cgl., arkose, and coarse ss. beds, and in center of fm. are layers of cross-bedded ss. A thin bed of amygdaloid is interstratified with the fm. in Iron Mtn. Interbedded shales are most frequent in upper third of fm. Thickness in Tenn. 2,000 to 2,200 ft.; in N. C. 1,500 to 2,500 ft. Underlies Hampton sh. and uncon. overlies pre-Camb. Named for Unicoi Co., Tenn., where it is prominently displayed.

A. Keith, 1907 (U. S. G. S. Roan Mtn folio, No. 151, which describes the rocks of Unicoi Co., Tenn., the type loc.). *Unicoi fm.* occupies areas in Holston and Iron Mtns E. of Elizabethton and in Unaka and Flattop Mtns. It is strongly developed along Nolichucky River in Unicoi Co., and is=Snowbird fm., Hiwassee sl., and Cochran cgl. of other parts of the quad. It underlies Hampton sh. and uncon. overlies Archean gneisses and granites. Consists of massive white ss., feldspathic ss., and qtzite, with interbedded shales and sandy shales in upper part, a thin bed of amygdaloid near middle, and cgl., arkose, and graywacke in lower part.

Union formation.

Devonian or Carboniferous: Nova Scotia.

H. M. Ami, 1900 (Can. Rec. Sci., vol. 8, pp. 154–160, and Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, pp. 207, 210).

Union shale.

Upper Devonian: Western central Montana (Elkhorn region).

W. H. Weed, 1901 (U. S. G. S. 22d Ann. Rept., pt. 2, map, pp. 434, 438). *Union sh.*—Black shales and hornstone. Upper 100 ft. consists of metamorphosed siliceous ls. altered to light-colored jaspery material; lower 30 ft. consists of black sh., in Queen Gulch altered to dark purplish-red hornstone. Horizon corresponds to Threeforks sh., Dev. Near Union mine, at head of Alpreston Gulch [Elkhorn min. dist.] it is altered to a light-colored rock.

Union formation.

Pleistocene: Western Kentucky.

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Union fm.*—Yellowish or brownish loam in Webster Co., locally a typical loess, with land shells. Thickness 8 to 20 ft. Underlies Pleist. Graves Creek fm. and overlies Plio. Lafayette fm. Assigned to Plio.

L. C. Glenn, 1922 (Ky. Geol. Surv., ser. 6, vol. 5, p. 122). The larger part of Graves Creek fm. is believed to be older than *Union fm.*, but it is probable the surface part of it is contemp. with Union fm. Named for Union Co., where it is usually a typical loess. Assigned to Pleist.

Union limestone.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 7, 13, 37). *Union ls.*—Separated from underlying Meadow ls. by 5 to 6 ft. of sh., and overlain by a series of interbedded shales and lss. Thickness 1 ft. 8 in. to 8 ft. Exposed in old quarry at Union, in valley side in NW¼ sec. 22, T. 10 N., R. 13 E.; also 1½ mi. SW. of Union, in secs. 33 and 28, T. 10 N., R. 13 E. In section at Jones Point consists of (descending): Ls., 1 ft.; carbonaceous sh., 1 ft. 2 in.; blue ls., 8 in.; bluish ls. in 5 distinct beds, 4 ft.; sh., 1 in.; brittle ls. that weathers rusty, 1 ft. 3 in.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 52, 53). Upper unit of Topeka ls. was named *Union ls.* by Condra and Bengston. This name being preoccupied the div. is here named *Coal Creek ls.*, from exposures on Coal Creek, N. of Union, Nebr. The ls. is dark blue, dense, brittle, and very fossiliferous. At places it is split in 2 or 3 beds. Overlies Holt sh. The Meadow ls. belongs down in Calhoun sh. memb.

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, 2d ser., pp. 11, 26, 28, 47). Topeka ls. memb. is divided into (descending) Coal Creek ls., Holt sh., and Du Bois ls. Meadow ls. belongs down in Stanton ls., of which it is basal memb.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Union limestone. (In Greenbrier limestone.)

Mississippian: Southeastern West Virginia and southwestern Virginia (Giles County).

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 450, 467). *Union ls.*—Gray, weathering white, hard, often crystalline and usually pure, often oolitic; very little chert or other impurities. Thickness 100 to 275 ft. Marine fossils. Underlies Greenville sh. and overlies Pickaway ls.; all members of Greenbrier series [ls.]. Type loc. at W. edge of Union, Monroe Co. Also observed in Mercer and Summers Counties, W. Va., and in Giles Co., Va.

†Union moraine.

Name used by F. Leverett in U. S. G. S. Mon. 41, pp. 475–494. Derived from Union City, Ind. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53, where it is called *Union City moraine*.

Union shales.

An abbreviated form of *Fort Union fm.* employed by C. [R.] Keyes.

Union City moraine.

Pleistocene (Wisconsin stage): Western Ohio and eastern Indiana. See statement under *†Union moraine*, which it replaces.

Union Corners granite.

Pre-Cambrian: Southeastern New York (New York City).

W J McGee, 1894 (Geol. map of N. Y. prepared under direction of James Hall). *Union Corners granite*, of the "ancient crystalline rocks." [Shown on map as a small patch SE. of Bronxville.]

Union Dairy member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 15). *Union Dairy ls. memb. of Hoxbar fm.* lies 400± ft. above the basal (Confederate) ls. memb. of the Hoxbar. It locally carries abundant *Fusulinae* and other fossils.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 40). *Union Dairy memb.* consists of (descending): (1) 25 ft. of fossiliferous ls. (including shaly layers), gray to cream-colored, earthy to finely and even coarsely crystalline; (2) 20 to 30 ft. of calc. sh.; (3) 5 to 20 ft. of buff ss. Lies 800± ft. below Westheimer memb. and 400± ft. above Confederate ls. memb. Named for Union Dairy Hill, in NE ¼ sec. 7, T. 5 S., R. 2 E.

C. W. Tomlinson, 1934 (A. A. P. G. Bull., vol. 18, No. 8, p. 1085). *Union Dairy memb.* is same as Crinerville ls. memb. As *Crinerville* has been in current use for many years with definite geographic significance, it is to be preferred to *Union Dairy*, which has never been in use as a geographic name and is therefore dropped.

Union Hill trap.

Upper Triassic: Southeastern New York (Rockland County).

N. H. Darton, 1890 (U. S. G. S. Bull. 67). *Union Hill trap*, 150 ft. thick, is an isolated trap ridge forming upper part of Union Hill, NE. of Suffern, N. Y. Rests on cgl. Is possibly an extension of Palisade trap sheet.

Union Pass erosion cycle.

Pleistocene: Central western Wyoming.

E. Blackwelder, 1915 (Jour. Geol., vol. 23, pp. 310–340). The oldest Pleist. erosion cycle recognized in central western Wyo. Effects of the erosion are evidenced at Union Pass.

Union Springs member (in Marcellus shale).

Middle Devonian: Central New York.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, pp. 132, 218, 219, etc.). *Union Springs memb. of Marcellus fm.*—Alternating beds of black ls. and sooty sh. overlying Onondaga ls., underlying Cherry Valley ls., and forming basal memb. of Marcellus fm. from Unadilla Valley westward to Seneca Lake. Type section is in upper part of Wood's quarry, 1 mi. S. of Union Springs, Cayuga Lake, where it is 17 ft. thick, and where its relation to Cherry Valley ls. can be studied. At Marcellus it is 13 ft. thick, at Oneida Creek above Stockbridge Falls 25 ft. and on Flint Creek, near Phelps, 9 ft. Is not known W. of Phelps [Ontario Co.].

Uniontown limestone member (of Monongahela formation).

Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_5, pp. 55–104, 286, 292). *Uniontown ls.*, 10 to 12 ft. thick. Top memb. of Pittsburg ls. group and 160 ft. above Pittsburg coal. Is older than Uniontown coal and younger than Sewickley coal. [In places called *Uniontown or Great ls.*]

E. V. d'Invilliers, 1895 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 3, pt. 2, btw. pp. 2153 and 2588), applied *Uniontown ls.* to upper 0 to 20 ft. of *Great ls.*, immediately underlying Uniontown coal; and J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18), also followed that usage. The definition adopted by U. S. Geol. Survey for Pa. in 1910, and published in Burgettstown-Carnegie folio (No. 177, 1911) and subsequent repts up to present time, applied *Uniontown ls.* to beds in Pa. which underlie Uniontown coal, or in places occur a few ft. below that coal, and which in places are separated from Benwood ls. memb. by an interval of 5 to 20 ft. of sh. with thin lenses of ls.

W. Stout, 1929 (W. Va. Acad. Sci. Proc., vol. 3, pp. 140, 143), restricted *Uniontown ls.* of Ohio and W. Va. to upper ls. of interval btw. Uniontown coal and Fulton sh., and introduced *Arnoldsburg ls.* for the lower ls., lying on or close to Fulton sh. (See *Arnoldsburg ls.*)

Named for exposures at Uniontown, Fayette Co., Pa.

Uniontown sandstone member (of Monongahela formation).

Pennsylvanian: Southwestern Pennsylvania, western Maryland, and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 58–59). *Uniontown ss.*—Massive gray ss. Occurs immediately above Uniontown coal, hence its name, although it is not prominent at Uniontown [Fayette Co., Pa.]. Lies 60 to 75 ft. below Waynesburg coal and just below Waynesburg ls.

Uniontown member. (In Monongahela formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa., No. 27, Pittsburgh quad., p. 31, 1929) to include (descending) Uniontown ss., Uniontown coal, and Uniontown ls.

Uniontown limestone.

Pennsylvanian: Southeastern Kansas.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, p. 97). [See under *Bourbon group.*]

J. M. Jewett, 1932 (p. 99 of book cited above). [See under *Bourbon group.*]

R. C. Moore and G. E. Condra, Oct. 1932 (revised chart of Penn. of Kans. and Nebr.). *Uniontown ls.* underlies Ladore sh, and is separated from underlying Dudley sh. by unnamed sh. and ss.

R. C. Moore, 1935 (Kans. Geol. Surv. Bull. 20, table opp. p. 14). Bourbon group underlies Hertha ls. and uncon. overlies Lenapah ls. It is divided into (descending): Undiff. sh. and ls.; "Uniontown" ls.; unnamed sh.; and Warrensburg channel ss.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), did not use this name and did not explain its fate.

Union Valley sandstone member. (In Wapanucka formation.)

Pennsylvanian (Pottsville): East-central Oklahoma.

R. V. Hollingsworth, 1934 (Geol. Soc. Am. Proc. 1933, p. 364). The oil-field names "Cromwell," "Lyons-Quinn," and "Pagoose" [evidently a misprint for *Papoose*] have been applied to a petroleum-producing ss. forming middle memb. of Wapanucka fm. of east-central Okla. The name *Union Valley ss.* is here proposed for this ss. memb., which crops out near Union Valley schoolhouse, Pontotoc Co., the type loc., and which there consists of light-brown massive to thin-bedded coarse- to fine-grained sss., with max. thickness of 242 ft., discon. overlain by the upper memb. of the Wapanucka, which consists of ls. and sh., and grading into lower memb. of the Wapanucka, which consists of black carbonaceous and gray shales with a few thin beds of ls. At its top the Union Valley memb. includes 4 to 6 ft. of aren. ls. containing a Morrow fauna of Brentwood affinities [listed].

D. L. Hyatt, 1936 (A. A. P. G. Bull., vol. 20, No. 7, pp. 954, 959). *Union Valley fm.* (Hollingsworth, 1934) normally consists of 2 members, a lower ss. 100 ft. thick and an upper ls. 50 ft. thick. The *Union Valley ss.* is medium- to coarse-grained ss., calc., shaly, and very lenticular in nature. Difficult to identify its contact with underlying Caney (Penn.). This fm. is known in field as *Cromwell ss.* The *Union Valley ls.* is blue shaly, sandy, and glauconitic ls., rather impure, and grades into Union Valley ss. below with here and there a sh. break, 10 to 15 ft. thick, btw. the two. The Union Valley fm. underlies Wapanucka fm.

Unionville sandstone.

Pennsylvanian: Northwestern Illinois (Whiteside County).

J. Shaw, 1873 (Ill. Geol. Surv., vol. 5, pp. 147–149). *Unionville sss.*—Soft, friable dirty-white to yellowish-red sss., 12 to 33 ft. thick, belonging to Millstone grit. Overlain by Coal Measures and uncon. underlain by Niagara ls. in Whiteside Co.

Named for outcrop at Unionville, Whiteside Co.

United Verde diorite.

Pre-Cambrian: Central Arizona (Jerome district).

L. E. Reber, Jr., 1920 (Am. Inst. Mg. Engrs), and 1922 (Am. Inst. Min. and Met. Engrs. Trans., vol. 66, pp. 3–26 and map). *United Verde diorite.*—Augite diorite. Intrusive into quartz porphyry and older rocks near Jerome. Regarded as a late phase of Bradshaw granite. [Probably named for the United Verde mine. The Bradshaw granite is pre-Camb.]

University gravel.

Pleistocene: Southeastern Pennsylvania.

See under *Philadelphia red gravel.*

University beds.

Quaternary: Central northern New Mexico (Albuquerque region).

K. Bryan, 1909 (N. Mex. Univ. Bull., Geol. ser., vol. 3, No. 1). In side gulches of second canyon of the river [Rio Grande] were deposited at time of deposition of Rio Grande gravels a series of side-wash deposits here denominated *The University beds.* They form a considerable part of Sandia Mesa within this area, extending from Menaul School S. to mouth of Power House Arroyo and to E. in a wedge shape to E. limit of area. They are reddish sandy clays, frequently cross-bedded, showing many minor unconformities and containing large angular boulders of Sandia Mtn material. They are without doubt frontal apron wash. Thickness 95 ft. Deposited by a lateral from the Sandias during deposition of Rio Grande gravels.

University Mesa marl. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Western Texas (Pecos County).

W. S. Adkins, 1933 (Univ. Tex. Bull. 3232, pp. 271, 328, 339, 347). Neritic facies of Edwards fm. occurs in form of marl at Fort Stockton, here called *University Mesa marl* (p. 339). In Fort Stockton area the top of the Fredericksburg beneath the Kiamichi marl (Edwards equivalent) is a fossiliferous marl, here called *University Mesa marl.* It is about 50 ft. thick, is underlain by Comanche Peak ls., and overlain by a thin brown ls. seam, above which the Kiamichi marl occurs. At Kent and El Paso it is clay and marly ls. (p. 347).

Unkar group.

Pre-Cambrian (Grand Canyon series): Northern Arizona (Grand Canyon).

C. D. Walcott, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pl. 60, etc.). *Unkar terrane.*—Massive beds of reddish mag. ls., lava beds, sss., lss., lava, and cgl. Thickness 6,830 ft. Underlies Chuar terrane. Lower group of Grand Canyon series.

Is now divided into (descending) Dox ss., Shinumo qtzite, Hakatai sh., Bass ls., and Hotauta cgl.

Named for outcrops in Unkar Valley.

Unkpapa sandstone.

Upper Jurassic: Western South Dakota (Black Hills).

N. H. Darton, 1899 (Geol. Soc. Am. Bull., vol. 10, p. 393). *Unkpapa ss.*—Fine-grained massive sss., pink, white, buff, or purple, 0 to 225 ft. thick, overlying Sundance fm. and underlying Beulah shales [Morrison fm.] in Black Hills, S. Dak.

N. H. Darton, 1901 (U. S. G. S. 21st Ann. Rept., pt. 4, p. 524). *Unkpapa ss.*, 0 to 250 ft. thick, was named for one of the tribes of Dakota Indians which was at one time located about SE. part of Black Hills.

J. P. Connolly and C. C. O'Harra, 1929 (S. Dak. School Mines, Depts. Geol. and Min., Bull. 16, p. 47). *Unkpapa ss.* was named for Unkpapa Peak, at head of Calico Canyon, NW. of Buffalo Gap, S. Dak.

Upland formation.

Pleistocene (Yarmouth): Southern and eastern Nebraska.

A. L. Lugn and G. E. Condra, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 190). *Upland fm.* (*Yarmouth*), clay and silt 3 to 30 ft. thick, conformably overlying Grand Island fm. (Kansan).

A. L. Lugn, 1934 (Nebr. State Mus., vol. 1, Bull. 41, pp. 319–351). *Upland fm.*—Largely fluvial inwash-outwash deposits under loess region W. of till border. Alternating greenish-gray clay and greenish sand. Of Yarmouth age. Uncon. underlies Loveland fm. and overlies Kansan gumbotil in places and in other places rests on Grand Island fm. Named for outcrops along West Branch of Thompson Creek, about 2½ mi. W. of town of Upland, Franklin Co.

Upper.

The terms *Upper* and *Lower*, connected with geographic names, have long been and still are employed in a titular sense to designate many lss., sss., and clays of Appalachian region and elsewhere. A few of these are here listed. Others are mentioned under the geographic names.

†Upper Archimedes limestone.

Mississippian: Southwestern Illinois and eastern Missouri. See under *†Archimedes ls.*

†Upper Barren Coal Measures.

A term applied in some early repts to Dunkard group (of Perm. age) of Appalachian region.

Upper Cambrian series.

Same as St. Croixan series. (See U. S. G. S. Bull. 769.)

†Upper Cambridge limestone.

A name applied in some repts to Cambridge ls. memb. of Conemaugh fm. of current usage.

†Upper Carboniferous.

A term applied in early repts to Pennsylvanian series of present nomenclature, also to Penn. and Perm. series.

Upper Clarion clay. (In Allegheny formation.)

A clay bed underlying Upper Clarion coal in Pa.

†Upper Connoquenessing sandstone.

See under *Connoquenessing ss. memb.*

†Upper Cross Timber sands.

A name applied in some early Tex. repts to Trinity group (Lower Cret.), also to Travis Peak fm. (basal fm. of Trinity group).

†Upper Cross Timbers formation.

A name applied in some early Tex. repts to Comanche (Lower Cret.) series.

Upper Devonian series.

The generally accepted definition includes all Dev. beds down to base of Tully ls.

Upper Freeport limestone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, and northern West Virginia.

F. and W. G. Platt, 1877 (2d Pa. Geol. Surv. Rept. H_2, p. 316). *Upper Freeport ls.* substituted for *Freeport ls.* of previous repts, *Lower Freeport coal* substituted for *Middle Freeport coal*, *Lower Freeport ls.* substituted for *Middle Freeport ls.*, and *Upper Kittanning coal* substituted for *Lower Freeport coal.*

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Freeport Upper ls.*, formerly called *Freeport ls.*, consists of 8 ft. of very hard, compact grayish or white ls. in 3 layers separated by fire clay. Underlies Freeport Upper coal and lies higher in section than Freeport (Upper or Butler) ss.

Upper Freeport clay. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). *Upper Freeport clay*, 2 to 12 ft. thick, underlies Upper Freeport ls. and is separated from underlying Lower Freeport coal by 25 ft. of ss. and sh. [The 3 to 15 ft. of clay separating Upper Freeport coal from underlying Upper Freeport ls. was not given a name in this rept. but in subsequent repts the name *Upper Freeport* has been applied to the clay above and to the clay below Upper Freeport ls.]

J. P. Lesley, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 308–316). *Upper Freeport fire clay* underlies Upper Freeport coal and overlies Upper Freeport ls.

†Upper Freeport sandstone.

Replaced by *Butler ss. memb.*

†Upper Fucoidal group.

See under *Portage group.*

†Upper Helderberg group.

See under *Helderberg group.* Various limits have been assigned to this div., which has also been called "Corniferous group" and "Corniferous ls."

†Upper Helderberg limestone.

A name applied in early repts to Onondaga ls. of present terminology, also to Dundee ls. of Mich.

†Upper Homewood sandstone.

A name applied in some repts to *Homewood ss. memb.* of Pottsville fm.

Upper Kittanning limestone. (In Allegheny formation.)

Pennsylvanian: Western Pennsylvania and northern West Virginia.

J. J. Stevenson, 1878 (2d Pa. Geol. Surv. Rept. K_3). *Upper Kittanning ls.*, 6 ft. thick in Fayette and Westmoreland Counties, is separated from overlying Upper Kittanning coal by 5 ft. of clay and from underlying Lower Kittanning coal by 30 ft. of sh.

J. P. Lesley, 1879 (2d Pa. Geol. Surv. Rept. V, pp. 238–240). *Kittanning Upper ls.* of Butler Co. is same as Johnstown cement bed [Johnstown ls. memb.] of Cambria Co.

Upper Kittanning clay.

The clay bed beneath Upper Kittanning coal in Allegheny fm. of Pa.

†Upper Laramie.

A term applied, in a titular sense, in some early repts to rocks now known, in Hanna Basin, southern Wyo., as *Hanna fm.* (Eo.) and *Ferris fm.* (Eo. and Upper Cret.).

Upper Little Pittsburgh limestone.

See under †*Little Pittsburgh ls.*

Upper Little River limestone.

Lower Cretaceous (Comanche series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 111, 188). *Upper Little River ls.*—Massive semicrystalline lss. and *Gryphaea pitcheri* breccia, in strata from 1 to 5 ft. thick, forming banks and canyons of the [Little] river for some 200 ft. in height, and containing *Gryphaea pitcheri* Morton, *Requienia (Caprotina)*, and other fossils of lithologic horizon of Comanche series, which Dr. B. F. Shumard described as "Caprina ls.," and which is about midway btw. the more fossiliferous Comanche Peak and Washita horizon. Is lower part of Washita div. in SW. Ark. Underlies Cerro Gordo blue chloritic clays and overlies Fredericksburg div.

Named for exposures on Little River, SW. Ark., at Okla. State line.

Upper Madisonville limestone.

Pennsylvanian: Western Kentucky.

See under *Madisonville ls.*; also under *Kinchloe ls.*

†Upper Magnesian limestone.

A term applied in early repts on upper Mississippi Valley region to Galena dol.

†Upper Mahoning sandstone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and Maryland and northern West Virginia.

F. Platt, 1876 (2d Pa. Geol. Surv. Rept. L), divided Mahoning ss. into *Upper Mahoning ss.*, 34 ft. thick; sh., 25 ft. thick; and *Lower Mahoning ss.*, 35 to 40 ft. thick.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, p. 33). Buffalo ss. is same as *Upper Mahoning ss.* [On pp. 303–305 of this rept J. P. Lesley also says Buffalo ss. is same as Upper Mahoning ss.]

The U. S. Geol. Survey does not use "Upper Mahoning ss." and "Lower Mahoning ss.," but treats the Mahoning as a unit, composed of an *upper ss.*, a *lower ss.*, and a middle sh. The use of "Upper Mahoning ss." and "Lower Mahoning ss." is especially undesirable because the Buffalo ss. was called "Upper Mahoning" in early repts.

†Upper Marlborough.

See under †*Piscataway sands.*

†Upper Medina.

Name applied in early repts to Albion ss. of N. Y. and to Tuscarora qtzite of Pa. and Md.

Upper Mercer iron shales. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Upper Mercer iron shales.*—Shales, dark and sandy, containing iron ore at base. Thickness 20 to 35 ft. Underlie Upper Mercer clay and overlie Lower Mercer ls.

Upper Mercer limestone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania and eastern Ohio.

I. C. White, 1879 (2d Pa. Geol. Surv. Rept. Q_2). *Upper Mercer ls.*—Generally very hard compact dark-bluish ls., often containing iron concretions. Thickness 2 to 4 ft. Overlies Upper Mercer [Mount Savage?] coal and underlies Tionesta iron shales. Is same as Mahoning ls. of Rogers and Upper Wurtemburg ls. of Lesley. During present season I have found this ls. near town of Mercer, Pa., the place after which the ls. next below was named. Owing to confusion that might result from use of Rogers' old name [Mahoning ls.] I have thought it best to drop "Mahoning" and substitute *Upper Mercer* for this ls., and change *Mercer ls. of Rogers* to *Lower Mercer.*

Upper Ordovician series.

The generally accepted definition includes (descending) Richmond group, Maysville group, Eden group, and Utica sh. The latter fm. is now excluded from Eden group by both N. Y. State Survey and U. S. Geol. Survey.

†Upper Pentamerus limestone.

A name applied in early N. Y. repts to the ls. later named *Becraft ls.*

Upper Pittsburgh limestone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q). *Upper Pittsburg ls.*—Light-gray compact ls.; breaks with conchoidal fracture; weathered surface almost white; thickness 2 ft. In Allegheny Co., Pa., it lies 65 ft. above Lower Pittsburg ls. and 20 ft. below Pittsburg coal.

See also under †*Pittsburgh ls.*

†Upper Pittsburgh sandstone.

See *Pittsburgh ss. memb.*

†Upper Productive Coal Measures.

A term applied in early repts to Monongahela fm. (of Penn. age) of Appalachian region.

†Upper Shaly limestone.

A term applied in early N. Y. repts to the ls. later named *Port Ewen ls.*

†Upper Silurian.

A term applied in early geologic repts to Silurian system of present terminology.

Upper Washington limestone member (of Washington formation).

Permian: Southwestern Pennsylvania, eastern Ohio, northern West Virginia, and western Maryland.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Upper Washington ls.*—Top memb. of Washington County group [Washington fm.]. Upper part is quite slaty and blue on fresh exposure; middle layers are almost black, frequently mottled with drab, and are exceedingly brittle; lower part is usually of light flesh color. All of the ls. weathers almost white. Thickness 30 ft. Separated from underlying Jollytown coal by 40 to 70 ft. of sh. and sss.

Upper Wurtemburg limestone.

See under *Wurtemburg ls.* and *Mercer ls.*

Upshur sandstone.

Pennsylvanian: Northeastern West Virginia.

J. A. Taff and A. H. Brooks, 1896 (U. S. G. S. Buckhannon folio, No. 34). *Upshur ss.*—White and brown ss.; some beds of cgl.; in places olive to yellow clay sh. near middle; and at least 3 coal beds. Thickness 350 to 500 ft. Covers large part of Upshur Co. Underlies Braxton fm. and overlies Pugh fm.

Corresponds to Allegheny fm. and lower part of Conemaugh fm.

Upson clay.

Upper Cretaceous (Gulf series): Southern Texas.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 224–230). *Upson clays.*—Lower part yellow clay containing calc. nodules with *Exogyra ponderosa;* upper part clay sh. Basal fm. of Eagle Pass div. Overlies Pinto ls. (Austin chalk) and underlies San Miguel beds. Thickness 700 ft. Equivalent to Ponderosa marls of Colorado River section. [Later repts—T. W. Vaughan 1900 and J. A. Udden 1907—exclude this clay from Eagle Pass.]

L. W. Stephenson, 1928 (Am. Jour. Sci., 5th, vol. 16, p. 492), shows typical Upson clay overlain by San Miguel fm. and underlain by Austin chalk; and shows, in Anacacho Mtn, a thin development of Upson clay beneath Anacacho ls. and above Austin chalk.

Named for Upson, Maverick Co. F. M. Getzendaner says (letter of Mar. 1, 1937, to L. W. Stephenson): "Mr. Ed Smidt, who was born and raised at Eagle Pass, told me that the old Upson post office was on the present Lehman ranch, near the little Mexican village of thatched houses on the Eagle Pass-Del Rio road, where the present town of Quemado is located. This is about 15 miles north-northwest of Eagle Pass."

Urschel lime. (Buried.)

Ordovician: North-central Kansas.

J. S. Barwick, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 185). *Urschel lime.*—Unit No. 5 encountered in wells in Salina Basin. Not exposed. Consists of few ft. to 135+ ft. of white to brown, commonly cherty dolomitic ls. Underlies Engle sh. (unit No. 4) and overlies St. Peter ss. (unit No. 6). Main producing horizon of Florence-Urschel field, Marion Co. Appears to correlate approx. with Viola ls. of Okla. and part of Plattin-Kimmswick section of Mo.

Uscari shale.

Miocene: Costa Rica.

E. W. Berry, 1921 (U. S. Nat. Mus. Proc., vol. 59, p. 169).

Utah Metals limestone.

A name applied by O. P. Peterson (Am. Inst. Min. and Met. Engrs. Trans., vol. 70, pp. 908–926, 1924) to 80 ft. of alternating qtzite and ls. beds in Bingham qtzite (Penn.) of Bingham dist., Utah. Lies 270± ft. below Highland Boy ls. memb. of Bingham qtzite. Evidently named for a mine.

Utah Queen formation.

See under *Lion Hill fm.* Name evidently derived from a mine in Utah.

Ute limestone.

Middle Cambrian: Northeastern Utah and southeastern Idaho.

C. King, 1876 (Am. Jour. Sci., 3d, vol. 11, p. 477). *Ute ls.*, 2,000 ft. thick in Wahsatch Mtns, contains fossils which show it to be chiefly or wholly of Quebec [Ord.] age, although no fossils have been obtained from its immediate summit or base. Next younger fm. is Ogden qtzite.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas), mapped the *Ute* as Silurian.

S. F. Emmons, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 340–392). *Ute ls.* (*Sil.*).—Dark, almost black compact siliceous ls., with calc. shales and argillites toward base, carrying Quebec fossils at top and bottom. Thickness 1,000 to 1,500 ft. in Wahsatch Mtns. Underlies Ogden qtzite and overlies Camb. sl.

A. Hague, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 393–419). *Ute ls.* (*Sil.*) is 1,200 to 1,500 ft. thick in northern Wahsatch region. Consists chiefly of lss. but includes some calc. and argill. sh. Named for Ute Peak, Utah.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 127–248). *Ute ls.* (*Sil.*).—Dark compact fine-grained rock, 1,000 to 2,000 ft. thick in Wahsatch Range, Utah. Toward base the ls. becomes shaly for several hundred ft. Conformably underlies Ogden qtzite and conformably overlies Camb. shales.

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804). *Ute fm.*—Blue to bluish-gray thin-bedded fine-grained lss. and shales, with some oolitic, concretionary, and intraformational cgl. layers. Thickness in Blacksmith Fork

759 ft.; in section W. of Liberty 731 ft. Abundant Middle Camb. fossils. Type loc., slopes of Ute Peak, near forks of East Fork, E. of Paradise, Cache Co., Utah. Underlies Blacksmith fm. and overlies Langston fm., all Middle Camb. This fm. was named *Ute ls.* by 40th Par. Surv., but aside from fact it was stated to overlie Camb. qtzites and to be composed of 2,000 ft. of lss. containing Camb. fossils, it was not defined or limited. The beds here referred to Ute fm. contain the fossils mentioned by 40th Par. Surv. as characterizing lower part of Ute ls.

As defined by Walcott the name *Ute* is restricted to a lower part of Ute ls. of 40th Par. Surv. This is present accepted definition. The Ute ls. of King appears to have included all the lss. (Ord. and Upper and Middle Camb.) beneath the Ord. Swan Peak qtzite, which he apparently mistook for the qtzite in Ogden Canyon, which is of Middle and Lower Camb. age.

Utica shale.

Upper Ordovician: New York, Michigan, and Ontario.

E. Emmons, 1842 (Geol. N. Y., pt. 2, div. 4, geol. 2d dist., pp. 116–118, 183, 278, 319, 397, 429). *Utica sl.*—Black shaly mass, 75 ft. thick, underlying Lorraine shales and overlying Trenton ls.

In 1911 (N. Y. State Mus. Bull. 149, pp. 10–12) J. M. Clarke separated, under name *Canajoharie sh.*, the lower part of black sh. previously included in Utica sh. of Hudson and Mohawk Valleys, which he stated thins out westward, does not reach meridian of Utica, and contains a Trenton fauna. (See further explanation under *Canajoharie sh.*) In 1912 (N. Y. State Mus. Bull. 162) R. Ruedemann stated that true Utica sh. is absent in Hudson River region, but that it is overlain by true Frankfort sh. in Utica region.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258). *Utica sh.* underlies Lorraine group and overlies Trenton ls. in Utica Basin, and overlies Canajoharie sh. [of lower Trenton age] in middle Mohawk Valley. Is 70 to 1,000 ft. thick in Utica Basin, being nearly 800 ft. thick at Utica, but only upper 250 ft. is exposed.

The present generally accepted definition of Utica sh. is for the beds beneath the Lorraine and above the Trenton.

†Utica limestone.

Silurian: Southeastern Indiana.

W. W. Borden, 1874 (Ind. Geol. Surv. 5th Ann. Rept., pp. 143, 172). *Utica ls.*—Beds of Niagara age, 52 ft. thick, overlying Clinton group and underlying Corniferous ls. in Clark and Floyd Counties. Quarried at Utica, on Ohio River [in Clark Co.].

Utica quartz monzonite porphyry.

Tertiary: Central northern Colorado (Boulder County).

P. G. Worcester, 1921 (Colo. Geol. Surv. Bull. 21, pp. 31–32). *Utica quartz monzonite porphyry* occurs as a dike extending for about ½ mi. SE. from Utica mine.

Utley metarhyolite.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Green Lake County).

S. Weidman, 1898 (Wis. Geol. Nat. Hist. Surv. Bull. 3, Sci. ser. 2, pp. 4–31). *Utley metarhyolite.*—Consists of a single rounded knoblike area more than 100 ft. high at Utley, Green Lake Co.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). Utley metarhyolite of Weidman may be supposed to be pre-Huronian.

Utopia limestone.

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). [See under *Bachelor Creek ls.* On p. 21 *Utopia ls.* is described as consisting of (1) 2.65 ft. of yellowish-brown slabby ls. interbedded with yellowish calc. sh., underlain by (2) 1.65 ft. of dark-blue massive ls. with *Cryptozoon*.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 209). *Utopia ls.*, basal memb. of Howard ls., overlies Winzeler sh. memb. and underlies White Cloud sh. memb. Type loc. just E. of village of Utopia, sec. 5, T. 25 S., R. 11 E., Greenwood Co., Kans.

Uvalde gravel.

Tertiary ? (Pliocene ?) : Southern Texas.

R. T. Hill, 1891 (Am. Geol., vol. 7, p. 368). *Uvalde fm.*—Grand detrital deposit, 50 ft. thick, of either a fresh-water lake or great embayment of gulf, occurring 400 to 1,000 ft. above Rio Grande. Composed of flint and ls. pebbles and boulders, mostly from Comanche rocks, cemented by calc. matrix. Occurs on terraces, benches, and remnantal patches around perimeter of area from San Antonio to Del Rio, thence SE. through Mexico to indefinite distance coastward beyond Lampazos, Mexico.

A. C. Trowbridge, 1923 (U. S. G. S. P. P. 131, pp. 98–100). In 1891 Hill described remnants of a fm. that consisted of coarse and fine gravel cemented by a calc. matrix and that occupied terraces 400 to 1,000 ft. above Rio Grande to N. of this region. This he called *Uvalde fm.* Dumble applied *Reynosa div.* to the series of deposits forming the plateau btw. Nueces and Rio Grande, which he called the Reynosa Plateau. He stated that "Reynosa ls." of Penrose formed top memb. of his Reynosa div., which rested on Lagarto fm. These downstream deposits to which Dumble applied name *Reynosa* are now known to be same as the upstream remnants to which Hill applied name *Uvalde*, and the necessity for discarding one of the names has become apparent. In view of fact that *Reynosa* as applied to a part of this fm. has priority over Uvalde, and that the downstream deposits perhaps afford a better type loc., the name *Reynosa* has been adopted by U. S. Geol. Survey and "Uvalde" fm. has been abandoned.

A. Deussen, 1924 (U. S. G. S. P. P. 126, p. 102). The position of the ls. at Reynosa, Mex., only 50 ft. above the streamway and 732 ft. below the ls. at Torrecillas, 100 mi. to NW., would seem to suggest that it occupies a lower terrace than Torrecillas and Realitos terraces, and that its age is Pleist. rather than Plio. However, until more definite information can be obtained as to age of the ls. at type loc. it is considered advisable to continue the use of *Reynosa* as used by Dumble and Kennedy, it being well established in literature with this significance.

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 777). *Uvalde* was name given by Hill to the upland gravel deposits of central and south Tex. Name is appropriate, applicable, and well defined. It was not generally accepted by geologists for a long time, however. Penrose had named the gravel and caliche deposits along Rio Grande *Reynosa*, for town of Reynosa, Mex. These Reynosa gravels are now thought to be Pleist., and younger than Uvalde gravel of Hill. No fossils have been found in the upland interstream deposits. The topographic position and general physiographic relationships of these deposits indicate so clearly that they antedate the river terraces that Hill's name must take precedence over others. The Uvalde gravels occur on the stream divides and in many places cap the highest hills in area S. of Edwards Plateau. They rest on fms. ranging in age from Lower Cret. to Mio. They are especially prominent in area btw. Brazos and Devils Rivers and occur in even greater thickness in northern Mex. Thickness, thin to 30 ft. Are younger than Goliad fm. and are correlated with basal part of Lissie fm. Are of late Plio. or oldest Pleist. age.

A. N. Sayre, 1934 (letter dated Dec. 29). *Uvalde fm.* is probably older than Lissie and is younger than Goliad. It is older than Reynosa at Reynosa, Mex. Name should be restored for the high-level gravels near Uvalde.

J. T. Lonsdale and J. R. Day, 1937 (U. S. G. S. W. S. P. 778). The Uvalde gravel of this rept. [on Webb Co., Tex.] is regarded as = in age to the high-level gravel near Uvalde. The materials are similar to the sand and gravel of the Goliad but are found at considerably lower altitudes and hence are probably younger.

The Tex. Geol. Survey and U. S. Geol. Survey have discontinued the use of *Reynosa* in Tex. *Uvalde gravel* (Plio.?) is present approved name of U. S. G. S. for the high-level gravels near Uvalde, and *Goliad sand* (Plio.) is the approved name for the deposits that are apparently older than the Uvalde and that overlie Lagarto clay (restricted).

Uvalde phonolite.

Eocene (?) : Southern Texas.

T. W. Vaughan, 1900 (U. S. G. S. Uvalde folio, No. 64, p. 4 and maps). *Uvalde phonolite.*—Very dark porphyry, with predominant aphanitic groundmass containing a few distinct crystals of sanidine, nepheline, brown hornblende, augite, and olivine. Occurs at Inge Mtn, near Uvalde. Unlike any other type of rock in region. [Another Eocene (?) phonolite is mapped without a geographic name.]

Named for Uvalde, Uvalde Co.

Vail slate.

Lower Cambrian: Quebec.

T. H. Clark, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 1, pp. 6, 10).

Val Brilliant formation.

Silurian: Quebec (Matapedia Valley).

G. W. Crickmay, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 368–385). *Val Brilliant fm.*—Series of alternately thin- and thick-bedded white and buff sss., 200 ft. thick. Cross-bedding common. Clinton fossils. Typically exposed along shore of Lake Matapedia from village of Val Brilliant to NW. for 1¼ mi. Overlies Shickshock fm. and conformably underlies Sayabec fm. Fossils [listed].

Valcour limestone.

Lower Ordovician: Eastern New York (Champlain Valley).

H. P. Cushing, 1905 (N. Y. State Mus. Bull. 95), adopted the subdivisions of the Chazy proposed by E. Brainerd and H. M. Seely in 1888 (Am. Geol., vol. 2, pp. 323–330), as explained under *Chazy group*, and proposed *Valcour ls.* for div. C, or Upper Chazy (which forms N. and SE. shores of Valcour Island) and *Crown Point ls.* for underlying div. B, or middle Chazy.

Foregoing definiton is still employed by N. Y. State Survey, according to N. Y. State Mus. Hdb. 10, 1931, by W. Goldring.

Valdes group.

Triassic: British Columbia.

J. A. Bancroft, 1913 (Canada Geol. Surv. Mem. 23, p. 68).

Valdez group.

Mesozoic and Paleozoic (?): Central southern Alaska.

F. C. Schrader, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 408–410, 413). *Valdes series.*—Bluish-gray and dark qtzites, arkoses, and quartz schists, interbedded with generally thin beds of dark-blue or black sl., sh., mica schist (sometimes slightly graphitic), nodular mica schist, and some stretched cgl. May be a direct continuation of Orca group to S., but more highly metamorphosed and altered. Best exposed about Port Valdes. Extend N. over the range and to region of Lake Klutina, also down into Copper River Basin, and to E. Fossils are indeterminate plant remains. Lithology suggests Dev. or Carbf., but the series may be early Tert. or Cret. Thickness great.

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, p. 64). U. S. Grant and D. F. Higgins have shown (U. S. G. S. Bull. 443, 1910, pp. 20–26) Orca group rests uncon. on Valdez group. [Valdez is approved spelling.]

According to F. H. Moffit (1924) there is evidence to support assignment of Valdez group to Mesozoic, possibly Cret., at least in part. Fossils collected at several places from rocks regarded as belonging to Valdez group, although not diagnostic, make Paleozoic age seem doubtful. There is evidence to support assignment of at least part of Orca group to Paleozoic, possibly in part as low as Sil. or Dev. Moffit excluded the greenstones from Orca group, being uncertain whether they belong to Orca or Valdez group.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, p. 484). Relative sequence of Valdez and Orca groups is in doubt, and even validity of their differentiation has been questioned. There is very little fossil evidence on which to form opinion as to their ages.

Vale formation. (In Clear Fork group.)

Permian: Central and central northern Texas (Taylor and Runnels Counties).

J. W. Beede and V. V. Waite, 1918 (Univ. Tex. Bull. 1816, p. 47). [See 1918 entry under *Tye fm.*, which name it replaces.]

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 169, 176, 181). The original definition of *Vale fm.* is here modified by including in it at top the Bullwagon dol. memb., which in previous repts has been treated as a distinct fm.

Named for old post office on Ballinger-Maverick road, on E. side of Valley Creek, Runnels Co.

Valencian series.

A term introduced by C. [R.] Keyes to cover the "latest pre-Cambric succession of volcanics and granites" in N. Mex. (See his Conspectus of geol. fms. of N. Mex., 1915, pp. 4, 12.)

Valentine beds.

Pliocene (?): Northwestern Nebraska.

E. H. Barbour and H. J. Cook, 1917 (Nebr. Geol. Surv. vol. 7, pt. 19, p. 173). The *Valentine beds* are probably a lower phase than either the Snake Creek or the *Devil's Gulch*.

E. H. Barbour and H. J. Cook, 1917 (Nebr. Geol. Surv. vol. 8, pt. 18, p. 170). The 3 phases of Plio. in N. and NW. Nebr. are (ascending) *Valentine beds*, Snake Creek beds, and *Devil's Gulch beds*.

H. F. Osborn, 1918 (Am. Mus. Nat. Hist. Mem., vol. 2, pt. 1, p. 23). Valentine beds of Barbour and Cook, 1917, are upper Mio. or lower Plio.

H. J. and M. C. Cook, 1933 (Nebr. Geol. Surv. Paper No. 5, pp. 42–43). Careful systematic collecting in region about Valentine, Nebr., by R. A. Stirton, P. O. McGrew, and others indicates that at least 3 faunal phases are present in that region, to only the upper one of which the term "*Valentine*" can properly be applied. The lower memb. of this section agrees closely with typical "Ft. Niobrara;" and there is at least one distinct stage yet to be differentiated. It will undoubtedly be shown that certain beds in Valentine region agree closely with the phase of Snake Creek beds, in which the type of *Hesperopithecus* was found (on Olcott Hill). If we place beginning of Plio. at first appearance of *Hipparion*, then line btw. Plio. and Mio. will occur in Valentine beds.

F. W. Johnson, 1936 (Am. Jour. Sci., 5th, vol. 31, pp. 467–473). Ogallala fm. of Valentine area, Cherry Co., northern Nebr., is divisible into: (1) "cap-rock bed;" (2) *Burge sands* (name proposed for the fine-to coarse-grained sands and gravels containing the "Burge fauna"); and (3) *Valentine beds*. Latter consist of 175 to 225 ft. of chiefly fine-grained unconsolidated gray sss. and clay beds above, and below of loose channel sands containing the "Valentine fauna." Type loc. on S. side of a drainage cut btw. the old and new railroad grades in NE¼ sec. 17, T. 33 N., R. 27 W., Cherry Co. Were called *Fort Niobrara fm.* by Osborn, 1918. The "cap-rock bed" and Burge sands are lower Plio.; the Valentine beds are transitional Mio.-Plio., and uncon. overlie Brule (?) clay (Olig.?). [Faunas listed.]

Valentine formation.

Lower Ordovician (Chazy): Central and central southern Pennsylvania.

R. M. Field, 1919 (Am. Jour. Sci., 4th, vol. 48, pp. 404, 414–417, 422). *Valentine fm.*—Pure quarry rock, 0 to 90 ft. thick; no evidence of stratification except under high powers. Occurs as lens in upper Stones River beds. Merges into overlying Center Hall fm. (impure ls. 15 ft. thick) and rests with sharp contact on Carlim fm. Thins to E., and its beds are successively replaced by upper beds of the Carlim, the younger of which appears to be synchronous with the Center Hall at Bellefonte. Named for small hamlet and forge near Bellefonte, Center Co.

Valentine limestone member (of Sultan limestone).

Devonian: Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 10, 14, etc.). *Valentine ls. memb.*—Light-gray ls. and dol., 75 to 380 ft. thick, forming middle memb. of Sultan ls. Underlies Crystal Pass ls. memb. and overlies Ironside dol. memb. Is exposed E. of Valentine mine, in sec. 23, T. 25 S., R. 58 E. Some fossils; late Middle or early Upper Dev., E. Kirk says.

Valera shale. (In Belle Plains formation.)

Permian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 421, 426). *Valera bed.*—Clay, thin to 40 ft. thick. Memb. of Albany div. Underlies Bead Mtn bed and overlies Jagger Bend bed.

F. B. Plummer and R. C. Moore, 1922 (Univ. Tex. Bull. 2132, p. 195). *Valera sh.* is a middle memb. of Belle Plains fm. (middle fm. of Wichita group). Underlies Bead Mtn ls. and overlies Jagger Bend ls.

This definition is still recognized by Tex. Geol. Survey. (See E. H. Sellards, Univ. Tex. Bull. 3232, 1933.)

Named for Valera, Coleman Co.

Valhalla granite.

Tertiary: British Columbia.

O. E. LeRoy, 1913 (12th Int. Geol. Cong. Guidebook 9, p. 62).

Vallecito conglomerate. (In Needle Mountains group.)

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Vallecito cgl.*—A heavy cgl. exposed on both sides of Vallecito Creek for about 1 mi. N. from S. bdy of quad. Is better exposed on Pine River. Thickness 2,000 or more ft. Contact (conformable) with overlying Uncompahgre fm. is shown to E. of quad., in Pine River drainage. The Vallecito cgl. and Uncompahgre fm. compose Needle Mtns group in this area. [See also under *Needle Mtns group.*]

For many years this fm. was classified as "Algonkian," but the terms "Algonkian system" and "Archean system" having been discarded by U. S. Geol. Survey the fm. is now classified as pre-Camb.

Vallenar formation.

Middle Devonian: Southeastern Alaska (Ketchikan region).

A. H. Brooks, 1902 (U. S. G. S. P. P. 1, pp. 40–52, map). *Vallenar series.*—Bluish lss. and calc. schists, with some black slates. Named for typical exposures on Vallenar Bay. Is Middle Dev., at least in part, according to fossils identified by Schuchert. Uncon. overlies Wales group. Relations to Ketchikan series undet. Has been mapped as broad belt on W. side of Gravina Island, but was positively identified only at Vallenar Bay.

This name is now restricted to its type area, as later work proved only small part of Gravina Island is composed of Dev. rocks.

†Valley limestone.

Ordovician and Cambrian: Eastern Pennsylvania to northern Virginia.

P. Frazer, Jr., 1883 (2d Pa. Geol. Surv. Rept. C_4, pp. 99–100, 112–144), applied *Valley ls.* and *Chester Valley ls.* to the "Siluro-Cambrian? ls." of Chester Co., Pa., map accompanying this rept.

Same as Shenandoah ls. of subsequent repts, which has been subdivided and discarded in many areas.

The ls. of valley of Va. was described by W. B. Rogers in repts as early as 1839.

Named for Great Valley of Appalachian region, of which Shenandoah Valley is a part.

†Valley Forge quartzite.

Lower Cambrian: Southeastern Pennsylvania (Philadelphia region).

F. Bascom, 1904 (Am. Jour. Sci., 4th, vol. 17, p. 143), used *Valley Forge and Edge Hill qtzite (Lower Cambrian)* in tables.

Same as Chickies qtzite, older name.

Valley Head sandstone.

Upper Devonian: Eastern West Virginia (Randolph County).

D. B. Reger, 1928 (Am. Jour. Sci., 5th, vol. 15, pp. 50–57). *Valley Head ss.*—Partly greenish brown and partly reddish brown, thick-bedded, with sh. streaks; partly ripple-marked and having occasional small white quartz pebbles. Marine fossils and tree trunks. Thickness 50 to 100 ft. Included in Chemung series. Separated from underlying Elkins ss. of Chemung by 650 to 750 ft. of sh. and sss., and from overlying Hendricks ss. (top div. of Chemung) by 300 to 325 ft. of shales and sss. Good exposures at village of Valley Head, Randolph Co.

Valley Heads moraine.

Name applied to a Pleist. moraine in southern central N. Y., extending from Pa. line to Mohawk Valley. Appears to be nongeographic. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627+, 1932.)

Valley Spring gneiss.

Pre-Cambrian (Llano series): Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. Ann. Rept., pl. 3, pp. lvi, 274). *Valley Spring series.*—Acidic and basic mica and hornblende schists, forming basal div. of Fernandan system. Underlies Iron Mtn series and overlies Burnetan system.

S. Paige, 1911 (U. S. G. S. Bull. 450, pp. 15–23). *Valley Spring gneiss.*—Dominantly acidic series, of light color, containing some altered ls. and bands of basic dark material. Lower fm. of Llano series in Llano and Burnet Counties. Grades, by transition zone, into overlying darker basic Packsaddle schist. [Adopted definition.]

Named for Valley Spring, Llano Co.

Valley Springs formation.

Miocene: Northern California (Mokelumne River Basin).

A. M. Piper, H. S. Gale, and H. E. Thomas (U. S. G. S. W. S. P. 780, in press). *Valley Springs fm.*—Pumice and fine siliceous ash, with much greenish-gray clay and some vitreous tuff, glassy quartz sand, cgl.; commonly well bedded; derived largely from rhyolitic ejectamenta thrown out in high Sierra Nevada. Thickness 75 to 525 ft. Uncon. underlies Mehrten fm. and uncon. overlies Ione fm. as restricted by V. T. Allen in 1929. The Valley Springs fm. is "Ione clay rock or tuff," forming upper memb. of Ione fm. (Eocene) as originally defined, but is now known to be of Mio age. Named for exposure on W. slope of Valley Springs Peak, 1½ mi. NW. of town of Valley Springs, near center of sec. 11, T. 4 N., R. 10 E.

Valleytown formation.

Lower Cambrian: Western North Carolina, eastern Tennessee, and central northern Georgia.

A. Keith, 1907 (U. S. G. S. Nantahala folio, No. 143, p. 4). *Valleytown fm.*—In the main consists of mica schist and fine-banded gneiss in vicinity of Valleytown and basin of Valley River. Northeastward to Nantahala River the amount of metamorphism becomes less. Mica schist gives way to mica sl. and argill. sl., and gneiss to graywacke and feldspathic ss. The mica schist passes downward into Brasstown schist, and individual layers of each fm. cannot be distinguished from those of the other. In same region numerous beds of coarse qtzite and graywacke are to be seen. Near Hiwassee River the number and thickness of coarse beds are considerably less, and bdy separating this fm. from Brasstown schist is very difficult to draw. At great bend of Nantahala River the amount of coarse material is very small and slates predominate. In each direction from that point the slates become less and less prominent. Thickness 900 to 1,200 ft. Underlies Murphy marble.

Named for exposures in vicinity of Valleytown, Cherokee Co., N. C.

Valmeyer series.

R. C. Moore, 1933 (Historical geol., pp. 261–264). *Valmeyer series* is name proposed by J. M. Weller and A. H. Sutton to include beds from Osage group to top of Ste. Genevieve ls. and strata of equiv. age. Name is derived from southern Ill., where the rocks of this series are well exposed.

Valmonte diatomite member (of Monterey shale).

Miocene (upper): Southern California (Palos Verdes Hills).

W. P. Woodring, M. N. Bramlette, and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 143). *Valmonte diatomite memb.*—Middle memb. of Monterey sh. in Palos Verdes Hills. Is chiefly diatomite and diatomaceous silt or clay. Estimated thickness 750 ft. Overlies Altamira sh. memb. and underlies Malaga mudstone memb. Type region is E. of Valmonte dist., where upper part is well exposed in quarries of Dicalite Co. Is upper Mio.

Valparaiso morainic system.

Pleistocene (Wisconsin stage): Western Michigan, northwestern Indiana, northeastern Illinois, and eastern Wisconsin. Shown in part on moraine map (pl. 32) in U. S. G. S. Mon. 53, and in part on moraine map in P. P. 106. Named for Valparaiso, Ind.

Valverde flags.

Upper Cretaceous (Gulf series): Southern Texas.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 221, 229, 230). *Valverde flags.*—Grayish-white laminated to flaggy lss., separated into bands by laminated clays. Contain Inocerami. Thickness 600 ft. Basal fm. of Upper Cret. Overlies Vola ls. and underlies Pinto ls. Correlated with Eagle Ford shales. Named for Val Verde Co., in which they form bluffs [along Rio Grande].

Vamoosa formation.

Pennsylvanian: Central Oklahoma (Seminole County).

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 125–128, pls. 3, 27, and map. Name was also used by Morgan, but not defined, in Okla. Geol. Surv. Circ. 12, pl. and p. 15, 1923). *Vamoosa fm.*—About 230 ft. of chert cgls., massive coarse red and brown sss., and red shales, underlain by about 30 ft. of dark sh. that might easily be mapped as a separate fm. The clastic material is finer near top, and red coloration is there less pronounced. The fm. contains a greater thickness of chert cgls. than does any other fm. of area. The chert fragments are mostly angular. No fossils found, and probably none are present in the clastic beds, but the basal dark sh. is very probably fossiliferous. Overlies Belle City ls. and underlies Ada fm., which overlaps it.

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, pp. 1454, 1458, 1459), reported that N. of Stonewall quad. 225 ft. of "unclassified nonconglomeratic shales and sss." separate Vamoosa fm. from Belle City ls., and that Vamoosa fm. is there overlain by Deer Creek memb. of Pawhuska ls.

Named for exposures about ½ mi. E. of village of Vamoosa, Seminole Co. Is typically developed on main road btw. Sasakwa and Konawa.

Vamos Vamos beds.

Oligocene or Miocene: Panama.

E. Howe, 1908 (Am. Jour. Sci., 4th, vol. 26, p. 219). [Assigned to Olig., but C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 584), assigned these beds to middle Mio.]

Vanalta sand.

An oil-producing sand, 5 to 15 ft. thick, in basal part of Kootenai fm. (Lower Cret.) in Border-Red Coulee oil field of NW. Mont. and SW. Alberta. It is a fine- to medium-grained gray quartz sand, containing thin laminae of black sh. and small amounts of pyrite, and forms the upper eastward-extending tongue of Cosmos sand. Is separated from lower part of Cosmos sand by 10 to 15 ft. of gray-green pyritic siltstone. Named for discovery well.

Van Buren formation.

Lower Ordovician (Beekmantown): Southeastern Missouri.

H. S. McQueen, 1930 (Insoluble residues as a guide in stratigraphic studies, Mo. Bur. Geol. and Mines, separate). *Van Buren fm.*—The name *Gasconade* has been applied to the cherty dol. beds lying btw. Gunter ss. memb. at base and overlying Roubidoux fm. Ulrich believes, however, that two fms. occupy this interval, and for upper part he has retained name *Gasconade fm.*, but for lower part he has proposed *Van Buren*. In recent field work Bridge (Geol. of Eminence-Cardareva quads., Mo. Bur. Geol. and Mines, 2d ser., vol. in preparation) has used *Van Buren* to designate a faunal memb. lying above Gunter ss. memb. and a well-defined oolite bed in the Gasconade. Subsurface studies by writer indicate that the Mo. fms. may be distinguished on basis of their insoluble residues, and in this paper they are described separately. Base of Van Buren fm. is marked by a ss. memb. Ulrich believes this ss. is older than true Gunter and for that reason has proposed for it the name ***Van Buren ss.***

The present study would indicate, however, that the ss. is traceable in drilling over wide areas. As it occupies strat. position of Gunter memb., that name is retained in this paper. This ss. is absent at many localities, but in S. part of State it has a known thickness of at least 60 ft. Locally it contains large amount of dol. The Van Buren consists of dol., finely crystalline, dark bluish gray, often granular, with white dense porcelainlike and oolitic chert. Thickness of beds above Gunter ss. memb. 35 to 235 ft. The Van Buren is uncon. overlain by Gasconade fm. as here restricted and uncon. underlain by Proctor dol., from which it is distinguished, in absence of Gunter ss. memb., by fact that the Van Buren is cherty and the Proctor is noncherty. The character of the chert in the Van Buren is such that it can also be distinguished from overlying cherty Gasconade fm. restricted. The dolocastic chert is found only in lower 50 to 75 ft. of the Van Buren. The Van Buren contains siliceous oolite and oolitic chert in abundance. Above the dolocastic chert memb. the chert is more translucent, while below it the chert is denser and marked by quartz veinlets and incrustations. The Gasconade chert is much darker than any similar material in Van Buren or Eminence.

C. L. Dake, 1930 (Mo. Bur. Geol. and Mines, vol. 23, 2d ser., p. 137). *Van Buren fm.* does not outcrop in immediate vicinity of town of Van Buren [Carter Co.], which is built on Eminence fm. Nearest exposures are on tops of nearby hills, and no good sections are known anywhere in vicinity. But since name has appeared in print it does not seem wise to attempt to substitute another.

Vanceburg black shale.

Mississippian: Northeastern Kentucky.

E. Orton, 1880 (Review of strat. geol. of eastern Ohio, p. 21, table). *Vanceburg black sh.*, 16 ft. thick, is=Berea [Sunbury] sh. of Ohio and Orangeville sh. of Pa.

Probably named for Vanceburg, Lewis Co.

Vanceburg sandstone member.

Mississippian: Southern Ohio and northern Kentucky.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 656, 657, 665, 758, 763, 768). *Vanceburg ss. memb. of Cuyahoga fm.*—Best developed in vicinity of Vanceburg, Ky., and Buena Vista, Ohio. Here memb. is about 150 ft. thick, and on whole the sss. are thicker than intervening shales. To N. and E. the shales become relatively more important, and at Bainbridge they form much the larger part of memb. These sss. give place by transition to the shales of Scioto Valley sh. facies of Cuyahoga fm. [Cuyahoga fm. of Hyde includes lower part of Black Hand fm.] Underlies Churn Creek memb. of Cuyahoga and overlies Rarden memb. of Cuyahoga.

Is a part of Black Hand fm. of Prosser and other geologists.

Vanceburg sandstone facies.

Mississippian: Southern Ohio and northern Kentucky.

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 657, 758–763). *Vanceburg ss. facies of Cuyahoga fm. of southern Ohio.*—Sparingly fossiliferous sss. of different type from those in the cgl. area. Includes (descending): Churn Creek memb., 50 to 100 ft.; Vanceburg ss. memb., 150 ft.; Rarden sh. memb., 8½ to 58 ft.; Buena Vista memb., 1 to 30 ft.; Henley sh. memb., 5½ to 226 ft. Best developed in vicinity of Vanceburg, Ky., and Buena Vista, Ohio.

Corresponds to Cuyahoga fm. and lower part of Black Hand fm.

Vancouver series.

Triassic and Jurassic: British Columbia.

G. M. Dawson, 1887 (Canada Geol. Surv. Rept. 1886, pp. 10B, 20B, 41B). *Vancouver series*, Triassic, B. C.

The rocks in Alaska that have been called "Vancouver series" by some geologists are now considered to be Mesozoic or older. Late repts of Canada Geol. Survey assign Vancouver series of B. C. to Jurassic and Triassic.

†Vancouver group.

Upper Cretaceous: Southwestern British Columbia (Vancouver Island) and northwestern Washington (Sucia and Waldron Islands).

C. A. White, 1889 (U. S. G. S. Bull. 51, p. 33). Prof. J. S. Newberry, of Columbia College, N. Y., has placed in my hands for investigation a collection of Cret. fossils from some of small islands at S. end of Gulf of Georgia, adjacent to Vancouver Island. The islands from which these fossils came are Sucia, Waldron, and Sheep Jack. The fossils all belong to same fm., which is identical with the coal-bearing fm. at Comox and Nanaimo, on Vancouver Island, which I shall designate *Vancouver group*. Although this fm. is paleontologically equiv., at least in part, to Chico of Calif., I prefer to use for it local name *Vancouver group*.

C. A. White, 1891 (U. S. G. S. Bull. 82, p. 194). When I proposed *Vancouver group* for Cret. strata I overlooked fact that G. M. Dawson had in 1886 applied that name to rocks which he regarded as Triassic and had suggested *Nanaimo group* for the Upper Cret. strata in question. (Canada Geol. Surv. Rept. 1886, p. 10B.) Subsequently (Am. Jour. Sci., vol. 39, 1890, pp. 180–183) Dawson confirmed his selection of Nanaimo group for these Cret. strata and briefly discussed their relations and characteristics. I have therefore abandoned *Vancouver group* for the Upper Cret. strata of Vancouver dist., and adopted *Nanaimo* instead.

Vanderburg sandstone. (In Henshaw formation.)

Pennsylvanian: Western Kentucky (Webster County).

L. C. Glenn, 1912 (Ky. Geol. Surv. Rept. Prog. 1910 and 1911, p. 26). *Vandersburg ss.*—Fine-grained variable ss., possibly 25 ft. thick, in middle of Dixon [Henshaw] fm. in Webster Co.

L. C. Glenn, 1922 (Ky. Geol. Surv. ser. 6, vol. 5, p. 119). *Vanderburg ss.*—Medium- to coarse-grained, usually soft ss., 10 to 60 ft. thick. Underlies Mount Gilead shales and overlies Bald Hill shales. N. and NW. of Catesville and at Mount Pleasant Church it lies close above Dixon ss. and has probably cut out most of Bald Hill shales. Underlies crest of ridge on which Vanderburg is located.

Named for Vanderburg [correct spelling], Webster Co.

Vandever shale. (In Lee group.)

Pennsylvanian: Central Tennessee.

C. Butts, 1916 (Tenn. Geol. Surv. Res. of Tenn., vol. 6, pp. 107–110). *Vandever sh.*—Somewhat ferruginous sandy and clay sh. with heavy ss. beds in lower half. Thickness 200 ft. Underlies Rockcastle ss. and overlies Bonair ss.

C. Butts and W. A. Nelson, 1925 (Tenn. Dept. Ed., Div. Geol., Bull. 33D, pp. 14–16, pl. 4), stated that Lantana coal is at or near base of Vandever sh. and Morgan Springs coal is near top.

Named for exposures at Vandever, Cumberland Co.

Van Dusen sand.

See *Van Duzen sand*, the correct spelling.

Van Duzen sand.

Name applied to a thin calc. ss. (occurring in a series of gray and black shales and lss.) that lies 500 to 600 ft. below top of Quadrant fm. in parts of Musselshell, Fergus, and Garfield Counties of central Mont. (in Cat Creek anticline, Devils Basin dome, etc.). Lies at depth of 1,120 to 1,230 ft. Is pay sand in first well put down in Devils Basin, which was drilled by Van Duzen Oil Co. in Dec. 1919. (See U. S. G. S. Bull. 786B, 1927, pp. 68–69.)

See under *Heath fm.*, H. W. Scott, 1935.

Van Etten.

Upper Devonian: Central southern New York (Chemung and adjacent counties).

H. S. Williams, 1907 (Jour. Geol., vol. 15, pp. 97, 108, 109). *Van Etten zone of Tropidoleptus* included in Enfield sh. memb. of Nunda fm. Transferred from Chemung.

H. S. Williams, 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169, p. 9). In NE. corner of Watkins quad. the uppermost 100 ft. or more of Enfield sh. memb. contains first *Tropidoleptus* fauna, traces of which fauna are seen in rocks exposed along railroad cuts at Van Etten [Chemung Co.].

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 201).
Senecan series:
Ithaca-Enfield group of fms.:
(Ithaca-Enfield facies group):
(Enfield facies subgroup):
Van Etten memb., 200 ft. Presumably of West Hill age; includes 1st *Tropidoleptus* zone at its base and grades into the "transition beds" of Chenango Valley.
Grimes (?) ss. memb., 100± ft.
Hatch ss. memb., 500 ft.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, No. 4, pp. 99, 285). To E. the Enfield is divisible into 3 members (descending): *Van Etten sh.* ("first *Tropidoleptus* zone"), Juliand memb., and Kattel sh. The Van Etten underlies Cayuta memb. of Chemung fm.

G. H. Chadwick, 1935 (Am. Mid. Nat., vol. 16, No. 6, pp. 858, 862). To E. the Enfield splits into (descending): *Van Etten ("First Tropidoleptus")* zone, Juliand zone, and Kattel (*"Leiorhynchus globuliforme"*) zone.

Van Horn sandstone.

Cambrian (Upper): Western Texas.

G. B. Richardson, 1904 (Univ. Tex. Min. Surv. Bull. 9, p. 28). *Van Horn fm.*—Massive coarse red ss. and cgl. in red valley NW. of Van Horn and in southern Diablo Mtns. Thickness 0 to 500 or more ft. No fossils, but tentatively assigned to Camb. Probably younger than Bliss ss. Uncon. at base. Merges upward into varicolored ss. and white calc. ss. containing early Ord. (uppermost Calciferous) fossils.

G. B. Richardson, 1908 (Am. Jour. Sci., 4th, vol. 25, pp. 476–477), correlated Van Horn ss. with Bliss ss. and assigned both to Upper Camb.

G. B. Richardson, 1914 (U. S. G. S. Van Horn folio, No. 194). Lower 475 ft. of *Van Horn ss.* is reddish ss. and cgl., changing upward to varicolored, yellowish, and white ss.; upper 55 ft. is massive white ss. Uncon. underlies El Paso ls. (which also includes some massive white sss. near base) and uncon. overlies Algonkian (?) Millican fm.

Named for Van Horn, El Paso Co.

Vanhornsville sandstone.

Silurian (Niagaran): Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). *Vanhornsville ss.*—Red coarse hematite-quartz mixture, exposed at Vanhornsville [Herkimer Co.]. Thickness 20 ft. Fossils [listed]. Underlies Herkimer ss. and overlies Sauquoit beds. [Is a memb. of Clinton fm.]

Vann sand.

A subsurface sand, of late Penn. (?) age, in central northern Okla. In Perry pool, Noble Co., it lies at 1,587 ft. depth and is 8 ft. thick, the Ragan sand lying at 1,805 ft. and the Tonkawa at 2,714 ft.

†Van Nest Gap gneiss.

Pre-Cambrian: Northern New Jersey.

N. E. A. Hinds, 1921 (Am. Jour. Sci., 5th, vol. 1, pp. 355–364). *Van Nest Gap gneiss.*—An alkali-quartz syenite gneiss; a rather coarse, even-grained rock of dark grayish-green color and fresh unweathered appearance. Occurs at Van Nest Gap, near Oxford Furnace, Warren Co. Its chemical and lithological characters closely resemble those of certain phases of Byram gneiss, and the rock is therefore tentatively assigned to that group. Exact geol. relations of Van Nest Gap rock are unknown, but chemical composition places it with dark-colored variety of Byram gneiss.

In U. S. G. S. Raritan folio, No. 191, 1914, the gneiss around Oxford Furnace was mapped as Byram gneiss.

Vanoss formation.

Pennsylvanian: Central southern Oklahoma.

G. D. Morgan, 1924 (Bur. Geol. [Okla.] Bull. 2, pp. 133–137, pls. 3, 27, and map). *Vanoss fm.*—Alternating sss., cgls., shales, and a few thin lss., all arkosic, some sss. so arkosic as at first glance to be mistaken for granite. The sss. are less prominent in upper part than near base. Shales generally of light color, ranging through shades of green and gray; some red shales also present. Rests on nonarkosic Ada fm. and is overlain by arkosic Stratford fm. Is basal fm. of Pontotoc terrane [group]. Thickness 250 to 650 ft. Fossil plants and shells. Named for exposures in Vanoss, Pontotoc Co.

Vanport limestone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania and Maryland, eastern Ohio, and northern West Virginia.

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q, pp. 60–66). *Ferriferous ls. (Vanport ls.)*.—Massive ls., fossiliferous, 1 to 15 ft. thick. Overlain by Buhrstone iron ore. Lies 30 ft. below Kittanning ss. and sh. and 25 to 55 ft. above Clarion coal.

Named for exposures at Vanport, Beaver Co., Pa.

Van Schaick.

Middle Ordovician: Eastern New York (Mohawk Valley).

R. Ruedemann and G. H. Chadwick, 1935 (Sci., n. s., vol. 81, p. 400). *Van Schaick* introduced for lowest Snake Hill or zone of *Climacograptus caudatus* in Mohawk Valley.

Vanuxem.

Name applied to a Pleist. glacial lake in central N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, p. 615, 1932.)

Van Wert stage.

A name applied by W. H. Sherzer (Mich. Geol. Surv., vol. 7, pt. 1, 1900, pp. 133–135) to the stage of the ice at the time the Defiance moraine of Ohio and Mich. was deposited.

Vaquero sandstone.

See *Vaqueros ss.*

Vaqueros sandstone.

Miocene (lower): Southern California (Salinas and San Joaquin Valleys).

H. Hamlin, 1904 (U. S. G. S. W. S. P. 89). *Vaquero ss.*—Rather coarse, uniformly gray, white, or light-yellow quartzose ss., with an occasional stratum of granitic pebbles. In Salinas Valley it is a well-defined fm. So far as observed in this region it rests uncon. on Basement complex and on stratified terranes older than Neocene, being thus in this locality the oldest known memb. of the Neocene, but in other localities Neocene fms. are found below Vaqueros ss. Is of great thickness along E. slope of Santa Lucia Range, especially in *Los Vaqueros* Valley, hence the designation proposed by writer for this series of sss. [Lists fossils. *Los Vaqueros Creek* is shown on Hamlin's map. It is in Monterey Co.]

B. L. Clark, 1930 (Geol. Soc. Am. Bull., vol. 41, pp. 751–770). Faunas of Vaqueros and Temblor horizons have always been found in same sequence, and though they are very different they occur in similar facies of deposition (arkosic sss.). To N. the Temblor is conformable on underlying Vaqueros; in southern Calif. there is well-marked uncon. btw. them.

H. G. Schenck, 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 521–534). *Vaqueros fm.* has not been adequately defined as strat. unit and its early Mio. age is an assumption. Lower part of type Temblor is=upper part of Vaqueros at its type loc. [Long discussion. Suggests *Vaqueros group*.]

The present accepted definition of Vaqueros ss. is for oldest known Mio. deposits in southern Calif., which range in thickness from 500 to 6,000 or more ft., and which contain the *Turritella inezana* fauna. In Santa Cruz Mtn region the Vaqueros is uncon. underlain by San Lorenzo fm., of Olig. age. In Coalinga and neighboring districts it is uncon. underlain by Kreyenhagen sh., of Eo. and Olig. (?) age. In Ventura and Los Angeles Counties it is underlain, in places uncon., by Sespe fm., of Olig. and Mio. (?) age. In Salinas Valley region it is conformably overlain by Monterey (†Salinas) sh. In NW. part of Kern Co. it is overlain by Monterey (†Maricopa) sh. In parts of Ventura and Los Angeles Counties it is overlain, probably conformably, by Topanga fm., which is characterized by *Turritella ocoyana* fauna. Vaqueros ss. seems now to generally be considered as in part at least older than Temblor ss. or *Turritella ocoyana* zone. The U. S. Geol. Survey formerly included it in Monterey group, but that usage was discontinued in 1935. (See under *Monterey group*, also under *Temblor ss.*)

Named for exposures on Los Vaqueros Creek, Monterey Co.

Varennesic period.

C. [R.] Keyes, 1914 (Iowa Acad. Sci. Proc., vol. 21, p. 201). "A term proposed to take the place of A. C. Lawson's name Ontario, which is preoccupied. Is the old French designation for Ontario Province. Is probably not coextensive with term Loganian series."

Vashon drift.

Pleistocene (Wisconsin): Western Washington (Puget Sound region).

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Vashon till.*—Prevailingly sandy loam and coarse rounded gravel deposited by Vashon glacier and representing latest occupation of Puget Sound Basin by the northern ice tongue. Occurs typically, but not heavily, on Vashon Island. Is underlain by stratified blue clay along plateau face on E. side of Duwamish Valley.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54), gave thickness of *Vashon drift* as 1 to 100 ft.

Vashon glacial epoch.

Pleistocene: Western Washington.

B. Willis, 1898 (Geol. Soc. Am. Bull., vol. 9, pp. 111+). *Vashon glacial epoch.*—Latest glacial epoch of Wash. Includes Steilacoom fm., Vashon till, Osceola till, Osceola clays, and Douty gravels. Separated by erosion uncon. from preceding Puyallup interglacial epoch.

Covers Wisconsin time and some pre-Wisconsin deposits.

Vasquez series.

Miocene(?): Southern California (Los Angeles County).

R. P. Sharp, 1935 (Pan-Am. Geol., vol. 63, No. 4, p. 314). In Ravenna quad., 18 mi. E. of Saugus, 9,000± ft. of early Tertic fangls. and 4,000± ft. of curiously interbedded basalts are exposed. They lie uncon. on pre-Tertic basement and uncon. under Mint Canyon fm. (upper Mio.). For this group of rocks *Vasquez series* is suggested, replacing "Escondido series," preoccupied. The upper part of section contains local occurrences of fine silty lacustrine beds. [Derivation of name not stated.]

Vassalboro sandstone.

Silurian: Central southern Maine (Kennebec County).

E. H. Perkins and E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 9, pp. 204–228). A series of fine-grained sss., well exposed in town of Vassalboro. Typically the *Vassalboro ss.* is a massive bluish-gray ss. Locally it is recrystallized and becomes a qtzite, and the shales associated with the qtzite become altered to biotite schist. Often pyritiferous. In vicinity of China Lake the sss. terminate adjacent to Branch Pond gneiss, but no evidence found that they grade into each other. Vassalboro ss. grades into Waterville shales through a series of transition beds consisting of interbedded shales and sss. [Do not state in which fm. the transition beds are included.] No fossils, but relation to Waterville sh. indicates they are of about same age—mid-Silurian.

On 1933 geol. map of Maine, by A. Keith, these rocks are mapped as Silurian.

Vaucluse zone.

Pre-Cambrian: Northwestern South Carolina.

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in Catalogue of mineral localities of S. C., S. C. Geol. Surv. ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 6, 9, 12). *Vaucluse zone (Archean).*—The Vaucluse area is bounded on NW. by Edgefield-Chesterfield zone;

on SW. by Savannah River; the delimiting line on SE. is highly irregular by reason of variable distribution of overlapping coastal plain sands; the line which interruptedly connects the tongued projections of this area on SE., beginning near Hamburg, extends by Vaucluse, Miles Mill, Fox Bridge (Chinquepin Creek), Quattlebaum Mill (Lightwood Creek), thence by Red Bank Creek to Granby; beyond which this fm. is obscured to Granny's Quarter, whence it is successively observed at old Sumter Quarry, at Taxehaw 40-acre Rock; and at N. C. line, near Great Pee Dee River. The rocks comprise granite, granite-gneiss, gneissoid slates, mica schists, hornblende slates, qtzite, and kaolinized schists.

Named for exposures at Vaucluse, Aiken Co.

Vaurial formation.

Ordovician: Quebec (Anticosti Island).

W. H. Twenhofel, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 269), and 1921 (Canada Geol. Surv. Bull. 33, pp. 4, 5).

Veale sand.

A subsurface sand, 20 ft. thick, lying near base of Marble Falls ls. of central Tex. Was first found in Veale well, S. of Caddo, Stephens Co.

Vedder greenstone.

Carboniferous (?): Southwestern British Columbia and central northern Washington.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, maps 16 and 17). [Mapped on Vedder Mtn, B. C.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, p. 522).

Vedder sand.

A name that has been applied to coarse productive sands, 40 to 85 ft. thick, lying at av. depth of 1,400 ft. below top of what is loosely identified as Temblor fm. (Mio.) in Mount Poso oil field, Kern Co., Calif. Apparently named for Vedder oil wells. (See V. H. Wilhelm and L. W. Saunders, Calif. State Min. Bur., vol. 12, No. 7, pp. 8-9, 1927.) In 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, p. 18, pl. 2), A. Diepenbrock stated that lower memb. of lower part of [so-called] Temblor fm. in Mount Poso oil field is known as *Vedder sand*, which has thickness of 290 to 750 ft. and directly underlies Jewett silt memb. of the Temblor [so-called]. He divided his Vedder sand memb. into upper Vedder zone, *Vedder silt*, and lower Vedder zone.

Vedder silt.

See under *Vedder sand.*

Velasco formation.

Upper Cretaceous: Mexico (Tampico embayment).

J. A. Cushman and E. A. Trager, 1924 (Geol. Soc. Am. Bull., vol. 35, p. 100).

Venango group.

Venango oil sand group.

Venango stage.

Venango monothem.

Devonian or Carboniferous: Northwestern Pennsylvania.

J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I₃, Atlas, pl. 11). *Venango oil sand group* (*No. 7*), 350 ft. Underlies Crawford [Meadville] shales and is separated from underlying Warren oil group by 300 to 350 ft. of shales and thin sss. Consists of (descending): (1) First ss.; (2) sh.; (3) Second ss.; (4) sh.; (5) Stray sand; (6) sh.; (7) Third ss.

I. C. White, 1881 (2d Pa. Geol. Surv. Rept. Q_4, pp. 99-116). *Venango oil sand group* (also *Venango group*).—Consists of (descending): (1) Venango Upper ss. (First oil sand) [Woodcock ss. of Chadwick, 1925, according to Chadwick], 20 ft. of sandy shales or flags, with no coarse or pebbly strata [in Erie and Crawford Counties]; (2) Venango Upper shales [Saegerstown sh. of Chadwick, 1925], 90 to 100 ft. of pale-blue sh. with occasional thin sandy layers, which sometimes thicken into sandy flags, prevailing fossils of Chemung types; (3) Venango Middle ss. (Second oil sand) [Millers ss. of Chadwick, 1925], 20 ft. of soft shales with sandy shales or flagstone layers, but nowhere is it a ss. mass and there are no layers of pebbles; (4) Venango Lower shales [Amity sh. of Chadwick, 1925], 140 ft. thick, consisting of 15 ft. of red sh. underlain by 125 ft. of blue sh.; (5) Venango Lower ss. (Third oil sand), 30 ft. thick and=LeBoeuf cgl. "I am disposed to regard Venango group as upper Chemung." Underlies Riceville sh., which contains Chemung fossils. [Chadwick's names in brackets above and their equivalents were given in Geol. Soc. Am. Bull., vol. 36, pp. 455–464, 1925.]

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69), showed *Venango group* included all beds btw. *base* of Riceville sh. down to base of Le Boeuf ss., and assigned it to *Bradfordian*. He repeated this classification in 1924 (N. Y. State Mus. Bull. 251, p. 157) and 1925 (Geol. Soc. Am. Bull., vol. 36, p. 464), when he divided *Venango group* into (descending) Woodcock, Saegerstown, Millers, Amity, and Le Boeuf.

K. E. Caster, Feb. 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Venango group (delimited "Conewango" group)*, divided into (descending): (1) Riceville fm. [restricted], including Oswayo sh. memb. (lower "Riceville"); and (2) Cattaraugus fm., including (descending) Woodcock ss. memb. (Venango 1st oil, Tuna cgl.), Saegerstown sh. memb., Millers ss. memb. (Venango 2d oil "B"), North Warren sh. memb. (in midst of the Salamanca), Watson ss. memb. (Venango 2d "A"), Amity sh., and Panama cgl. memb. (Le Boeuf, Venango 3d oil, Wolf Creek). Underlies Smethport sh. memb. (upper part of "Riceville") of Knapp fm. and overlies Chadakoin fm. of Chemung group.

G. H. Chadwick, Oct., 1933 (Pan-Am. Geol., vol. 60, p. 195), assigned Conewango of Butts to Dev. and divided it into (descending) Riceville sh. restricted, Woodcock, Saegerstown, Millers, Amity, and Panama. On p. 197 he stated: White limited his Venango fm. to the 3 sands and their 2 included shales. But his description of Riceville sh., next above these, shows its essential identity with them. Therefore I proposed to expand *Venango* to include Riceville, being then uncertain as to eventual limits of Mr. Butts' Conewango fm., defined as covering Venango and Riceville. Now that we find scope of Conewango to be correct we must apply that name to the enlarged group.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71), included in his *Venango stage (Venango monothem)* all beds btw. *base* of Riceville and base of Panama cgl., and treated the Riceville as a distinct "stage." He assigned the beds to Dev.

G. H. Chadwick, 1935 (Geol. Soc. Am. Bull., vol. 46, No. 2, pp. 328, 334), Conewango group includes Cattaraugus and Oswayo and the equiv. Venango and Riceville of Pa. Venango first sand is Woodcock ss. (and not Berea nor Corry), as long ago worked out correctly by Mr. Carll and by Dr. White and as subsequently confirmed independently by both Caster's field work and writer's surface and subsurface studies.

Named for Venango Co.

Venango formation.

Upper Devonian: Northern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 2, pp. 1405–1406, 1438–1440, 1500–1506). My own opinion is that these intermediate [Chemung-Catskill] passage beds [btw. Lackawaxen cgl. and Allegrippus cgl.] can very well be formulated as a separate fm., and well deserve a separate name; and I propose for them the name *Venango fm.* For although it is not proven that interval btw. Allegrippus and Lackawaxen cgls. is the very interval btw. Carll's Venango Third and First oil sands, yet, as Ashburner has shown in his McKean and Cameron repts (R, R2), the increase of red rocks southeastward renders this a very probable hypothesis; and general horizon is undoubtedly the same. Therefore in speaking of Chemung fm. in northern Pa. it must be understood to include Venango fm. as its uppermost subdivision.

Venice member (of Columbus limestone).

Middle Devonian: Northeastern and central Ohio.

C. K. Swartz, 1907 (Johns Hopkins Univ. Circ. 7, p. 62). *Venice memb.*—Blue ls. with chert, 6 to 20 ft. thick; bone bed at top. Upper memb. of Columbus fm. Overlain by Delaware fm. and underlain by Marblehead memb. of Columbus fm.

Named for Venice, Erie Co.

Ventana sandstones.

A name introduced by C. [R.] Keyes in 1922 (Pan-Am. Geol., vol. 38, pp. 250, 338) for 325 ft. of sss. described as forming top memb. of his Doloresian series (late Triassic) in Apache Co., Ariz., and later applied by him in Utah and Colo. Named for Ventana Mesa, near Chinle, Apache Co., NE. Ariz.

Ventioner beds. (In Brad formation.)

Pennsylvanian: North-central Texas.

G. Scott and J. M. Armstrong, 1932 (Univ. Tex. Bull. 3224, p. 35). In Wise Co. the Adams Branch ls. is absent, and the beds below Ranger ls. memb. of Brad fm. and above Devils Den ls. memb. of Graford fm. are here named *Ventioner beds*. The beds are at least 300 ft. thick, and consist of sands and shales with 2 ls. lentils, the lower of which lies about 40 ft. above Devils Den ls. on W. side of Trinity River upstream from mouth of Ventioner Creek, and the higher of which lies about 40 ft. higher and is exposed 1 mi. W. of Ventioner Creek bridge. For convenience of mapping these beds are included in Brad fm., although lower part is of Graford age.

Ventura formation.

Triassic (?): Central northern Washington.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137, map). *Ventura fm.* (text heading), *Ventura system* (map).—Thick-bedded sss., shales, coarse cgls., of characteristic reddish-brown color, lithologically and structurally distinct from Cret. terranes bordering them on E. and W. No fossils, but color and association with Similkameen fm. on W. and Winthrop ss. on E., both Cret., suggest that fm. belongs to Triassic. Named for abandoned mining camp in mtns bordering Methow Valley.

Ventura sands.

Pliocene and Pleistocene: Southern California (Ventura County).

C. M. Carson, 1925 (Pan-Am. Geol., vol. 43, pp. 265–270). *Ventura sands.*—The Ventura fm. of Ventura Co. is well exposed in foothills btw. Ventura and Santa Paula, in Las Posas Hills, near Camarillo, on S. and W. flanks of South Mtn, and in Simi Valley. The fm. is from 500 to 1,000 ft. thick, and is composed of coarse and fine yellowish sand, which in places becomes quite gravelly. It is in general only moderately consolidated, although locally hard beds occur. [Fossils listed.] This fauna is a cold-water facies, but its habitat is not so cold as that of the Santa Barbara fauna which follows. Assigned to Plio. Is younger than San Diego clays.

U. S. Grant, IV, and H. R. Gale, Nov. 3, 1931 (San Diego Soc. Nat. Hist. Mem., vol. 1, pp. 36, 37). Name *Ventura horizon* given by Carson is vaguely defined, without definite type loc., and its mixed Plio. and Pleist. fauna and original correlation below Santa Barbara zone rule it out of consideration for the marine Pleist. in W. part of Ventura Basin, which has been called *Saugus fm.* in some repts. The type Saugus, however, is nonmarine, and these marine deposits should not be called *Saugus*. It seems desirable to have a single name for this series of marine strata overlying Santa Barbara zone, and *lower San Pedro series*, proposed by Arnold, although lower part of the section was not originally included, seems most appropriate.

†Venus cancellata bed.

Paleontologic term applied in early repts to Plio. beds of Fla. characterized by *Venus cancellata*.

†Vera Cruz graphite schist.

Pre-Cambrian: Southeastern Pennsylvania (Easton-Reading district).

B. L. Miller, 1911 (Pa. Topog. and Geol. Surv. Rept. No. 4, p. 16). *Vera Cruz graphite schist.*—Consists of quartz, graphite, biotite, orthoclase, and some pyrite. Underlies Franklin ls.

Is a facies of Baltimore gneiss and not a distinct fm. and has been abandoned by its author and by U. S. Geol. Survey.

Veraguas crystalline series.

Age (?): Panama.

O. H. Hershey, 1901 (Calif. Univ. Dept. Geol. Bull., vol. 2, p. 247).

Verdan series.

A term employed by C. [R.] Keyes to designate "the Coconino ss. and some associated layers as well developed on Verde River, S. of Flagstaff, Ariz."

Verde formation.

Tertiary or Quaternary (Pliocene or Pleistocene): Central Arizona (Yavapai County).

L. E. Reber, 1922 (Am. Inst. Min. and Met. Engrs. Trans., vol. 66, pp. 3–26). Quat. lake beds, 1,200± ft. thick. Jenkins has recently studied and mapped the ls. deposits formed by this lake and named them *Verde fm.*

O. P. Jenkins, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 65–81, map). *Verde form.*—Chiefly white hard impure reprecipitated cavernous ls. interbedded with sands, gravels, and clays and exposed in high white bluffs along the stream courses; generally horizontal and rather evenly bedded; near the border, or shore line, of old Verde Lake, cgl. beds are in evidence, the boulders of which represent nearly all the rocks of surrounding country, including pieces of basalt. Thickness of fm. 1,400 to 2,000 ft. at least. Occurs along Verde River Basin in region about Clarkdale and Camp Verde, Yavapai Co., Ariz. Overlies greatly eroded surface of various members of the Paleozoic and earlier rocks, and also some of basic lavas which occur in abundance in this region. The fm. as a whole must not be confused with local spring deposits, although they have undoubtedly aided in its limy accumulation and alteration. It is a local deposit, but similar local deposits, formed in a like manner, may be expected to occur in same general geologic or physiographic province. It covers an area of about 300 sq. mi. No well-preserved fossils were found. Is uncon. overlain by terrace gravels which have generally been regarded as Pleist. The Verde fm. may be late Tert. or very early Pleist.

Verde Creek granite.

Age (?): British Columbia.

V. Dolmage, 1934 (Canada Dept. Mines, Geol. Surv. Mem. 171, No. 2344, p. 17).

Verden sandstone.

Permian: Central southern and southwestern Oklahoma (Grady, Stephens, and Caddo Counties).

N. Meland and R. D. Reed, 1924 (Jour. Geol., vol. 32, No. 2, pp. 150–167). *Verden ss.*—Name suggested by N. Meland in unpublished thesis, Univ. of Okla. A strikingly cross-bedded calc. red ss. 10 ft. thick. Caps a row of elongated buttes extending from a point a few mi. NW. of village of Verden, Grady Co., in a straight line to SE., a distance of somewhat more than 30 mi. from end to end. Is a supposed river-channel deposit in Perm. Red Beds of SW. Okla. Is enclosed in gypsiferous shales and fine-grained sss. of Perm. age. Max. width is 1,200 ft. Many fossils, which Beede says are probably not strictly fresh-water forms. Lies 75 to 100 ft. below base of sandy phase of Whitehorse ss.

C. N. Gould, 1924 (A. A. P. G. Bull., vol. 8, No. 3, pp. 324–341). An unusual phase of Dog Creek sh. is a channel ss. which has been named *Verden ss.*

C. N. Gould, 1925 (Okla. Geol. Surv. Bull. 35, p. 92). *Verden channel ss.* is not more than 10 ft. thick nor more than 500 ft. wide. It occurs in Grady, Stephens, and Caddo Counties, where it is exposed on a line of outcrops extending across the country like a railroad grade for 40 mi. Not yet determined whether it was originally a stream channel, tidal channel, or sea beach, or formed in some other manner. In Grady Co. it occupies upper part of Dog Creek sh.

C. D. Stephenson, 1925 (A. A. P. G. Bull., vol. 9, No. 3, pp. 626–631). Writer has carefully observed strat. position of Verden ss. and has reached conclusion that it rather definitely occurs about 35 ft. below base of Whitehorse ss. in Grady, Caddo, and Canadian Counties (the 35 ft. of overlying beds consisting of sh.); and that *although the Verden has been included in Whitehorse ss.*, it does not seem proper to include a channel ss. in the massive Whitehorse fm. It also seems to writer that Greenfield ls. is strat. equiv. of Verden ss.

C. M. Becker, 1927 (Okla. Geol. Surv. Bull. 40–I, pp. 9–13). The so-called Verden ss. occurs btw. base of Whitehorse ss. and top of Dog Creek fm. It is a long channel-like deposition.

A. J. Freie, 1930 (Okla. Geol. Surv. Bull. 48). Verden channel ss. occurs at base of Whitehorse ss.

For many years the U. S. Geol. Survey designated this fm. as *Verden channel ss.* Recent work by N. W. Bass, however, revealed the presence in it of marine fossils, showing that the ss. was deposited as a barrier beach, instead of by a stream. The name has therefore recently been changed to *Verden ss.*

Verdi beds. (In St. Louis limestone.)

Mississippian: Southeastern Iowa.

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 319). *Verdi beds.*—Alternating sss. and lss. [100 ft. thick] forming middle [top now] memb. of St. Louis fm. Overlain by Pella beds [of Ste. Genevieve age] and underlain by Springvale beds [see Croton ls.].

Named for exposures in old railroad quarry near Verdi station, Washington Co.

Verdigris limestone. (In Cherokee formation.)

Pennsylvanian: Northeastern Oklahoma (Rogers County).

C. D. Smith, 1928 (Okla. Geol. Surv. Bull. 40U, map). [*Verdigris ls.* mapped in upper part of Cherokee fm. in Verdigris River region, Rogers Co. Lies higher than Chelsea ss., also mapped in upper part of Cherokee sh.]

C. L. Cooper, 1928 (Univ. Okla. Bull., Proc. Okla. Acad. Sci., vol. 7, p. 161). The most conspicuous ls. in Cherokee sh. N. of Arkansas River lies 35 to 50 ft. below Fort Scott ls. It is remarkably persistent, although only about 6 ft. thick, and extends from Kans. line S. to Arkansas River and beyond. [This appears to refer to Verdigris ls. as mapped by Smith.] The most persistent coal bed in the Cherokee lies 35 to 50 ft. below this ls. It ranges in thickness from a few inches to 4± ft. and is called Cherokee coal by the miners and also on the map that is to appear in the bulletin on Okla. coals.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 56). Same as *Ardmore ls.*, which has priority, but Verdigris ls. has been more used.

Verdigris sandstone.

A subsurface sand, of Penn. age and 28 ft. thick, in NE. Okla., lying lower than Prue sand and higher than Skinner sand.

Verdigris sandstone.

Upper Cretaceous: Southern Alberta.

S. E. Slipper and H. M. Hunter, 1931 (A. A. P. G. Bull., vol. 15, No. 10, p. 1186). The basal ss. of Foremost fm. is most persistent memb. of fm. It is proposed to call it *Verdigris ss.* because it is best exposed at 3 localities in coulee of that name. It is also fully exposed along Milk River at intervals for 7 mi. W. of town of Milk River. It does not occur in basal sections of the Foremost exposed along South Saskatchewan River W. of Medicine Hat. It is transitional into underlying Pakowki sh. to such an extent that it is difficult to place the div. line btw. them. Is buff on exposures and light-gray and medium-grained in core samples. Varies considerably in thickness but in general increases southward and southwestward, where it is 60± ft. thick.

Vergennes sandstone member (of Carbondale formation).

Pennsylvanian: Southwestern and central western Illinois.

E. W. Shaw and T. E. Savage, 1912 (U. S. G. S. Murphysboro-Herrin folio, No. 185, p. 7). *Vergennes ss. memb.*—Micaceous loose friable brownish ss. or sandy sh., 15 to 45 ft. thick, in lower part of Carbondale fm. Separated from underlying Murphysboro or No. 2 coal by 20 to 40 ft. of sh. or shaly ss. underlain by clay seam.

T. E. Savage, 1927 (Am. Jour. Sci., 5th, vol. 14, p. 309), showed *Vergennes ss.* of Fulton Co. as in part of the area overlying his Francis Creek sh. and ss. and in other parts of area as completely replacing his Francis Creek and as resting on No. 2 coal.

Named for Vergennes, Jackson Co.

†Vergent series.

Nongeographic name introduced by H. D. Rogers in 1858 (Geol. Pa., vol. 1, pp. 108, 140+, and vol. 2, p. 756). Divided into *Vergent shales* (*Chemung group of N. Y.*), 3,200 ft. thick in Huntingdon Co., Pa., and *Vergent flags* (*Portage flags of N. Y.*), 1,700 ft. thick in Huntingdon Co.

†Vergent flags.

†Vergent shales.

See under †*Vergent series.*

†Verkin shales.

Lower Triassic: Southwestern Utah (Washington County).

E. Huntington and J. W. Goldthwait, 1903 (Jour. Geol., vol. 11, pp. 46–63), divided the rocks underlying Shinarump cgl. and overlying "Super-Aubrey variegated shales and cherty ls." into *Upper Verkin* (chocolate ss. at top, red and white sh. in middle, and red sh. at base) and *Lower Verkin* (gray sss. and sh. above and red sh. below). In 1904 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 42, p. 203, pl. 7, etc.), they stated that they discarded their *Verkin shales* in favor of Ward's prior term *Moencopie* [*Moenkopi*]. The name was apparently derived from Verkin Creek, Washington Co.

Vermejo formation.

Upper Cretaceous: Southeastern Colorado and northeastern New Mexico.

W. T. Lee, 1913 (Am. Jour. Sci., 4th, vol. 35, p. 531). *Vermejo fm.* [See 1913 entry under *Raton fm.*]

W. T. Lee, 1917 (U. S. G. S. P. P. 101, pp. 40, 51–56). *Vermejo fm.*—Consists of coal-bearing ss. and sh., chiefly of fresh-water origin. The sh. is dark, carbonaceous in many places; the ss. is light gray and friable. It uncon. underlies Raton fm. (Eocene) and conformably overlies Trinidad ss. Total thickness 425 ft. Is of Montana age. Type loc. is at SE. extremity of Vermejo Park, N. Mex., where the rocks are well exposed and have max. thickness of 375± ft. [See also under *Raton fm.*]

†Vermetus rock.

Pleistocene and Recent: Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 153, 157, 337). The Vermetus rock was formed by agency of that mollusk on coast of Fla. It is the Pleist. and recent "Worm rock" of the residents of Fla.

†Vermicular sandstone.

†Vermicular sandstone and shales.

Terms applied in early Mo. repts to the beds later named *Hannibal sh.*

†Vermilion series.

†Vermilion schists.

†Vermilion group.

Pre-Cambrian (Keewatin): Northeastern Minnesota (Vermilion district).

N. H. and A. Winchell, 1887 (Minn. Geol. Nat. Hist. Surv. 15th Ann. Rept., pp. 4, 192, 355–357). *Vermilion series* (also *Vermilion group*).—Embraces the mica-hornblendic schists that appear at NW. extremity of Vermilion Lake and their equivalents at W. end of Birch Lake, as well as their extension eastward from Vermilion Lake to Basswood Lake. Belongs to lower part of Keewatin series.

C. R. Van Hise and C. K. Leith, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 401–409, map). *Vermilion series* (Archean) includes (descending): (1) intrusive granite, greenstone, and porphyry; (2) Soudan fm. (iron-bearing); and (3) Ely greenstone.

Vermilion granite.

Pre-Cambrian (pre-Huronian): Northeastern Minnesota (Vermilion district).

F. F. Grout, 1923 (Econ. Geol., vol. 18, pp. 253-269). *Vermilion granite.*—Predominantly a biotite granite of light-pink color. Along S. side it has locally a basic border facies. Intrudes Huronian schists and is supposed to be Algomian in age. Named for exposures on Vermilion Lake and along Vermilion River, northern St. Louis Co.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184). *Vermilion granite* assigned to pre-Huronian (Algoman).

Vermilion moraine.

Pleistocene (Wisconsin stage): Northern Minnesota.

W. Upham, 1894 (Minn. Geol. and Nat. Hist. Surv. 22d Ann. Rept., pl. 1, p. 51). Extends past SW. side of Vermilion Lake.

†Vermilion Cliff group.

Upper Triassic: Southwestern to northeastern Utah and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 52-54, 151). *Vermilion Cliff group.*—Massive sss. with ferruginous layers, often with thin, irregular beds of cherty ls.; the massive beds are sometimes broken into thinner strata. In type area the sss. are of red, orange, vermilion, and light-gray colors. In Uinta Mtns region the Vermilion Cliff group is everywhere darker than the overlying White Cliff group and exhibits false bedding. Thickness 1,100 ft. Underlies White Cliff group and overlies Shinarump group. Named for Vermilion Cliffs, to S. of White Cliffs, near Paria, a little town on Paria River [Kane Co.], Utah.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 33), showed that the ss. of Vermilion Cliffs (Kane Co., southern Utah), and the Vermilion Cliff group of Powell in Uinta Mtns, NE. Utah, are Chinle fm. (Upper Triassic).

†Vermilion Cliff sandstone.

See †*Vermilion Cliff group.*

†Vermilion Creek group.

Eocene: Southwestern Wyoming, northwestern Colorado, and northeastern Utah.

C. King, 1876 (U. S. Geol. Expl. 40th Par., Atlas, maps 1, 2), divided the Tert. deposits of NE. Utah and adjacent areas into (descending) Wyoming cgl. (Plio.), Uinta (Eo.), Bridger (Eo.), Green River (Eo.), and *Vermilion Creek* (Eo.). Advance copies of this map were distributed in 1875, but Atlas is dated 1876.

Hayden and Cope originally considered Wasatch group of Hayden of NE. Utah as synchronous with the Green River deposits of SW. Wyo. (See under *Wasatch group.*)

S. F. Emmons, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 207-250), described the Tert. rocks of Green River region, Bridger Basin, Washakie Basin, and other areas in SW. Wyo. where Hayden had applied the name *Green River group*, and divided them as follows (descending): Wyoming cgl., Bridger group, Green River group, and *Vermilion Creek group.*

F. V. Hayden, 1877 (U. S. Geol. and Geog. Surv. Terr. Bull. 3, No. 1, pp. 181-185). Wasatch group of Hayden is same as Vermilion Creek group of King, and Wasatch group has priority. [On p. 608 of this Bull. C. A. White showed Green River group above Wasatch group.]

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 339, 353, 355, 360, etc.). [See 1878 entry under *Wasatch group* for reasons why he did not adopt Hayden's name *Wasatch group* for these rocks.]

According to U. S. G. S. Bull. 191, 1902, geologists seem to have unanimously adopted Hayden's name *Wasatch*, instead of King's name *Vermilion Creek*, and the U. S. Geol. Survey also has discarded latter name.

†Vermilion Lake iron-bearing series.

A term applied by R. D. Irving (U. S. G. S. 3d Ann. Rept., 1883, pl. 3, map, and 7th Ann. Rept. pp. 440–441, 1888) to the Huronian rocks of Vermilion Lake region, Minn., which were described as resting uncon. on rocks assigned to the Laurentian, but as consisting of granite, gneiss, green schist, mica schist, and hornblende schist and therefore evidently including Keewatin.

Vermilion River beds.

Cretaceous: Manitoba.

S. R. Kirk, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 123).

Vermilionville sandstone lentil (in Carbondale formation).

Pennsylvanian: Northeastern Illinois.

G. H. Cady, 1919 (Ill. Geol. Surv. Bull. 37, pp. 31, 56–58). *Vermilionville ss. lentil*, in Carbondale fm., lies higher than LaSalle (No. 2) coal and lower than Harrisburg (Springfield, No. 5) coal, in Hennepin and LaSalle quads; thickness 25 to 35 ft. Consists of micaceous sand containing much white mica and blotches and streaks of carbonaceous material. Is massive or heavy-bedded. [Columnar section on p. 31 shows base of Vermilionville ss. lentil lying 50± ft. above No. 2 coal and top underlying clay below Streator (No. 7) coal (in McLeansboro fm.), the ss. in part of area replacing sh. both above and below No. 5 coal.]

Named for exposures near Vermilionville, SW. part of LaSalle Co.

†Vermont formation.

†Vermont quartzite.

Lower Cambrian: Western Massachusetts and southwestern Vermont.

J. D. Dana, 1873 (Am. Jour. Sci., 3d, vol. 6, pp. 272–278). At Rutland, SW. Vt., massive qtzite (*Vermont qtzite*) seems to overlie Rutland ls. The fm. consists of qtzite, chlorite slates, and magnetite and hydromica slates.

T. N. Dale, 1891 (Am. Geol., vol. 8, pp. 1–7). *Vermont fm.*—Qtzite, 870 ft. thick, cropping out in Mount Greylock area only once, but possibly underlying entire mass. Underlies Stockbridge ls.

T. N. Dale, 1891 (Geol. Soc. Am. Bull., vol. 3, pp. 514–519, in description of *Vermont Valley*—Rutland, Danby Ridge, Clarendon, SW. Vt.). *Vermont fm.*—Qtzites, cgls., and schists. Underlies Stockbridge ls.

T. N. Dale, 1894 (U. S. G. S. Mon. 23, p. 190 and map, pl. 1). *Vermont fm.*—Qtzite, fine-grained, alternating with a thin-bedded micaceous and feldspathic qtzite. Associated with these qtzites, and probably at base of this horizon, is a coarse-grained micaceous qtzite, passing in places into a cgl. Thickness 800 to 900 ft. Underlies Stockbridge ls. and overlies Stamford gneiss on Mount Greylock, NW. Mass. [Derivation of name not stated, but probably named for development in southern Vt., as shown on Dale's map, pl. 1. On geol. map (by R. Pumpelly) forming pl. 2 of Mon. 23 the fm. is designated *Vermont qtzite*, and this name was also used in some subsequent repts.]

Includes, in Mass., Cheshire qtzite, Dalton fm., and some granite (see B. K. Emerson, 1917, U. S. G. S. Bull. 597, map), and has been discarded by U. S. Geol. Survey.

F. A. Burt, 1929 (16th Rept. Vt. State Geol., pp. 68–84). *Vermont fm.* consists locally, in Bennington area, SW. Vt., of 1,600± ft. of massive, brecciated, and schistose Lower Camb. qtzites called by Bain (Rept. Vt. State Geol., vol. 15, p. 230, 1925–26) *Bennington qtzite*.

F. A. Burt, 1931 (17th Rept. Vt. State Geol., pp. 115–135). *Vermont fm.* consists of Cheshire and Monkton qtzite and quartz schists with feldspathic and argill. and cgl. beds. Underlies Stockbridge ls. and overlies pre-Camb. gneisses.

Vermont.

Name applied to a glacial lake, of Pleist. age, in Lake Champlain region. Also called *Champlain*.

Vernal.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to 30 ft. of late Jurassic shales in Mont. Derivation of name unknown.

Vernal Mesa granite.

Pre-Cambrian: Central western Colorado (Gunnison River region).

J. F. Hunter, 1925 (U. S. G. S. Bull. 777). Coarse porphyritic granite, resembling the coarsest phase of Powderhorn granite group. Near its borders contains numerous inclusions of biotite schist and gneiss. Is cut by many dikes of aplite and pegmatite. Intrudes the Archean schists. Occurs near NW. end of Vernal Mesa and walls adjacent portion of Black Canyon.

The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

Vernon limestone.

Devonian: Western central Massachusetts and southeastern Vermont.

B. K. Emerson, 1890 (Am. Jour. Sci., 3d, vol. 40, p. 365). *Vernon ls.*, a ls. in Bernardston series, described on pp. 263–275 and 362–374 of same vol.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 276). *Vernon ls.*—Coarse granular ls., highly crystalline, of light color; contains some garnet, hornblende, and green mica. Occurs in Vernon Twp, Vt.

†Vernon gneiss.

Late Carboniferous or post-Carboniferous: Western central Massachusetts and southeastern Vermont.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 17, pl. 34). [*Vernon gneiss* shown in strat. table as underlying the Bernardston rocks. Pl. 34 states that the qtzite of Bernardston series to N. passes into Vernon gneiss.]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), discarded "Vernon gneiss." According to personal communication the rock thus designated is Pelham granite.

Named for occurrence in Vernon Twp, Vt.

Vernon shale member (of Salina formation).

Silurian: Western to east-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, pp. 18–19 and chart). *Vernon sh.*—Red and green shales, gray gypsiferous shales, and thin platten dolomites. Underlies Syracuse salt and overlies Pittsford sh.

Later repts give thicknesses of 150 ft. (at type loc.) to 700 ft. (in central N. Y.).

Next to basal memb. of Salina fm.

Type loc. is in town of Vernon, Oneida Co.

Verona iron ore.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). This ore, typically exposed in old workings N. and W. of Verona [Oneida Co.], is herein identified with the highly important oolitic lower ore of Clinton region and eastward. Fossils listed. Overlies true Sodus sh. and underlies true Wolcott ls. [memb. of Clinton fm.]. Is a much higher ore than Furnaceville ore, but was formerly called Furnaceville by Hartnagel and others. [See *Furnaceville iron ore*.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10), does not mention this ore bed. Whether it really is a separate ore bed or has been confused with one of the other ore beds of the Clinton seems uncertain.

Versailles bed. (In Richmond group.)

Upper Ordovician: Southeastern Indiana and north-central Kentucky.

A. F. Foerste, 1905 (Sci., n. s., vol. 22, p. 150). *Versailles bed.*—Proposed to include Liberty and Whitewater beds (middle Richmond), which writer found great difficulty in separating at any considerable distance from type localities; for instance, at Madison, Ind., and thence southward.

Named for Versailles, Ripley Co., Ind.

Vershire schist.

Ordovician: Northeastern Vermont (Orange County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 115). U. S. G. S. has adopted *Vershire schist*, instead of *Bradford schist* (preoccupied), for the noncalc. memb. of Calciferous mica schist. [For definition see †*Bradford schist*. Richardson continued to use Bradford schist in 1908 and 1924 repts.]

C. H. Hitchcock, 1912 (8th Rept. Vt. State Geol., pp. 100-123). It will be best to drop term *Coos* as a memb. of old Calciferous mica schist and substitute *Goshen mica schist* [Sil. ?] because it has priority over suggestion of Dr. Richardson of use of *Vershire schist*.

C. H. Richardson, 1927 (15th Rept. Vt. State Geol., pp. 127-158). *Vershire schist* overlies Waits River ls.

Probably named for exposures in or near Vershire village or elsewhere in Vershire Twp, Strafford quad., in Orange Co.

†Vespertine series.

Mississippian: Appalachian region.

H. D. Rogers, 1844 (Am. Jour. Sci., 1st, vol. 47, pp. 153-158). *Vespertine series* includes the strata of Appalachian region btw. top of Ponent cgl. below and base of the great [Pottsville] cgl. under the coal measures above. [As thus defined it included Mauch Chunk sh., Loyalhanna ls., and Pocono fm. of present nomenclature.]

H. D. Rogers, 1858 (Geol. Pa., vol. 1, pp. 108, 142-144+; vol. 2, pt. 2, p. 756). Introduced *Umbral series or Middle Carbf.* for 3,000 ft. of fossiliferous red shales and argill. red sss. [Mauch Chunk sh.] underlying the coarse cgl. or millstone grit forming basal memb. of *Seral series or Coal Measures*, and applied *Vespertine series or Lower Carbf.* (also *Vespertine cgl. and ss.*) to the underlying 2,000 to 2,660 ft. of white, gray, and yellow sss., cgl's., and slates resting on *Ponent series or Catskill group*. As thus defined and used in subsequent repts "Vespertine" applied to Pocono fm. of present usage.

Named to indicate "evening period of the great Appalachian Palaeozoic day," according to Rogers, 1844 citation above.

Vestal limestone.

Lower Ordovician: Central Tennessee.

C. H. Gordon, 1924 (Tenn. Dept. Ed. Div. Geol. Bull. 28, pp. 35, 40). *Vestal ls.*—At or near base of [Ottosee fm.] is a lentil of red ls. or marble to which name *Vestal ls.* is here applied, from town on S. side of river opposite Knoxville, where these beds are well displayed. These constitute what Safford termed "Upper Marble." Thickness about 150 to 200 ft. in Knoxville area. Thins out locally but has been noted at a number of places up and down the Valley. [See also under *Meadow marble*.]

Named for exposures in town of Vestal, Knox Co.

Veta Pass limestone member.

Pennsylvanian: Southern-central Colorado (Sangre de Cristo Range).

F. A. Melton, 1925 (Jour. Geol., vol. 33, p. 812). A series of black lss. and shales, containing marine fossils of Penn. age, is present in bottom part of Sangre de Cristo cgl., interbedded with coarse arkoses and micaceous shales of continental origin. So far as known, its max. thickness, 2,100 ft., is found at Placer, near La Veta Pass, and from this exposure it has been named by writer the *Veta Pass ls. memb. of Lower Sangre de Cristo cgl.*

†Vicarya beds.

A paleontologic name applied by R. T. Hill (Biol. Soc. Wash. Proc., vol. 8, pp. 10-15, 1893) to 10 ft. of aggl. in lower part of Glen Rose ls. of Tex.

†Vicksburg fossiliferous loam.

Recent (?): Mississippi.

T. A. Conrad, 1846 (Am. Jour. Sci., 2d, vol. 2, p. 212). *Vicksburg fossiliferous loam.*—Above the Eocene of Vicksburg, Grand Gulf, Rodney, and Natchez is a deposit of loam of uniform composition and appearance, at least 50 ft. thick in many places and probably much more in others; but owing to landslides and vast accumulation of debris btw. this loam and the Eocene, the depth of the former is uncertain, and there may be a distinct deposit btw. the two. Contains land shells.

Conflicts with better-established name, Vicksburg group, of Olig. age.

Vicksburg group.

Oligocene (middle and lower): Gulf Coastal Plain.

T. A. Conrad, 1848 (Phila. Acad. Nat. Sci. Proc., vol. 3, pp. 280–299). [Describes 105 new fossils from Eocene fm. of vicinity of Vicksburg, Miss. Divides the Eo. into "Upper or Newer Eocene" and "Lower or Older Eocene," and states that *Vicksburg group* belongs to former and *Claiborne sands* to latter. Neither *Vicksburg group* nor *Claiborne sands* is described. The former he correlated with the "white ls. of St. Stephens and uppermost stratum at Claiborne, Ala."] "*Ostrea georgiana* occurs at Jackson, Miss., where its position is said to be below Vicksburg group. It is therefore the line of demarkation btw. Upper and Lower Eocene."

T. A. Conrad, 1856 (Phila. Acad. Nat. Sci. Proc., vol. 7, pp. 257–258). The following table will show order of succession of Eocene groups, but it is not pretended to be more than an exposition of my limited knowledge of them, though they are doubtless presented in true order of superposition. Further research may develop intercalated groups. When a group of corresponding fossils is to be found elsewhere, its relative position can be stated by referring to the typical subdivision which contains many identical species.

Groups of characteristic fossils

Newer Eocene, Vicksburg:

8. [Fossil lists only.] } Convenient to designate this *Vicksburg group.*
7. *Corbula alta, Natica.* }
6. *Pecten poulsoni, Orbitolites mantelli.* Is probably synchronous with Orbitolite ls. of St. Stephens, Ala., as its two most prominent fossils are very abundant in this stratum at Vicksburg. Convenient to designate this *St. Stephens group.* Limestone of Jacksonboro, Ga., is probably referable to this division.
5. Ostrea georgiana (?). Lowest bed exposed in bank of Mississippi River at Vicksburg.

Older Eocene, Jackson. Convenient to designate it *Jackson group:*

4. [Lists fossils.] Includes no Vicksburg species, and 5 only of Claiborne species. I believe the group to be newer than Claiborne deposit and certainly older than that at Vicksburg.

Older Eocene, Claiborne. Convenient to designate it *Claiborne group.*

3. [Fossil lists only.]
2. *Ostrea sellaeformis.*
1. *Cardita densata. Cyclas.*

E. W. Hilgard, 1860 (Rept. Geol. and Agric. Miss., pp. 138–147). *Vicksburg group.*—Marls and lss. 92 ft. thick, consisting of (1) 80 ft. of crystalline lss. and blue marls, underlain by (2) 12 ft. of ferruginous rock of Red Bluff; fossils listed from both divisions. Overlain by Grand Gulf group and underlain by Lignitic clay and lignite. [On p. 135 Hilgard stated that *Red Bluff group* seems to stand intermediate, by position and fossils, btw. Vicksburg and Jackson groups, but that fauna on whole seems to approach more nearly the Vicksburg than the Jackson.]

The Vicksburg group of present usage conforms to these early definitions in that it is characterized by a distinctive fauna, is overlain by Catahoula ss. (lowest fm. included in †Grand Gulf group), and is underlain by Jackson fm. In Miss. it is divided into following fms. (descending): Byram marl, Glendon fm., Marianna ls., and Forest Hill sand (=Red Bluff clay to east). In part of Ala. the Marianna ls. ("chimney rock") includes Red Bluff time. (See under *Red Bluff clay.*)

Named for exposures at Vicksburg, Miss.

Vicksburgian.

Time term used by some authors to cover the epoch during which the Vicksburg group (of Olig. age) was deposited.

Victor andesite.

A name that has been applied locally to **Mizpah trachyte** on the lower levels of Tonopah Extension mine, Tonopah dist., Nev., from Victor shaft, in this mine. (See T. B. Nolan, Univ. Nev. Bull., vol. 24, No. 4, p. 16, 1930.)

Victor moraine.

Name applied to a Pleist. moraine in N. Y. (See H. L. Fairchild, Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 627+, 1932.)

Victor formation.

Pleistocene: Northern California (Mokelumne River Basin).

A. M. Piper, H. S. Gale, and H. E. Thomas (U. S. G. S. W. S. P. 780, in press). *Victor fm.*—Sand, silt, and gravel, in small part well sorted and well stratified. Deposited by Mokelumne River and adjacent streams in building the Victor alluvial plain, on which are situated the settlements of Lodi, Lockeford, and Clements. Thickness 0 to 125 ft. Youngest Pleist. fm. in Mokelumne River Basin. Overlies Arroyo Seco gravel (Pleist.).

Victoria series.

Devonian or Carboniferous.

G. M. Dawson, 1878 (Canada Geol. Surv. Rept. 1876–77, p. 101).

†Victoria formation or clays (also Victoria shale).

Upper Cretaceous: Central Kansas.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, p. 50). *Victoria fm. or clays.*—Highly carbonaceous, almost black sticky clay sh., with a zone of frequently large "cannonball" septaria in lower part. Upper fm. of Benton div. in Kans. Overlies Russell fm. (lower fm. of Benton div.) and underlies Osborne ls., lower fm. of Niobrara div.

Same as Blue Hill sh. memb. of Carlile sh.

Named for exposures at Victoria, Ellis Co.

†Victoria amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name long in use locally. According to B. S. Butler (personal communication) this amygdaloid is same as Forest amygdaloid. The mineralized part is the Victoria lode. Named for occurrence in Victoria mine, Ontonagon Co.

†Victoria flow.

Includes †Victoria amygdaloid and underlying trap.

Victoria sandstone.

Upper Cretaceous: Alberta.

J. A. Allan, 1918 (Canada Geol. Surv. Summ. Rept. 1917, pt. C, p. 12).

Victoria quartzite.

Mississippian (lower): Central northern Utah (Tintic district).

G. F. Loughlin, 1919 (U. S. G. S. P. P. 107). *Victoria qtzite.*—Alternating beds of limy qtzite and siliceous ls., some of them conglomeratic. Thickness 0 to 85 ft. Underlies Gardner dol. and uncon. overlies Pinyon Peak ls. (Dev.). No fossils, but believed to be lower Miss. Named for Victoria mine.

Victoria limestone.

Upper Cretaceous: Mexico.

J. E. Brantly, 1924 (A. A. P. G. Bull., vol. 8, No. 1, p. 23).

Victoria Peak massive member (of Bone Spring limestone).

Permian: Western Texas (Sierra Diablo).

P. B. and R. E. King, 1929 (A. A. P. G. Bull., vol. 13, pp. 921, 922, 925). The gray ls. uncon. below Delaware Mtn ss. [a part only of Delaware Mtn fm.] has thickness of 500 to 1,000 ft., and contains *Productus ivesi* and other forms which serve to correlate it with upper part of the Leonard on one hand and with the San Andres [?] on the other. It is here proposed to call it *Victorio Peak memb. of Leonard fm.*, because of prominent exposures at summit of mtn of that name, which is a conspicuous promontory of Sierra Diablo scarp. Below it is Bone Canyon memb. Is absent in Guadalupe Mtns, but a short distance N. of Bone Canyon, on W. side of Guadalupe Mtns, it wedges into the section and separates Bone Canyon memb. from Delaware Mtn ss. [This ls. and the Bone Spring ls. were originally included in Delaware Mtn fm., but are now excluded from the Delaware Mtn.]

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 731, 755–768), designated the Victorio Peak deposits as *Victorio Peak massive memb. of Bone Spring ls.* This is designation approved by U. S. Geol. Survey.

Victory Junction shale member.

Pennsylvanian: Central eastern and northeastern Kansas.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pt. 1, pp. 76–79). *Victory Junction sh. memb.*—Brown ss. underlain by sh. Thickness 3 to 14 ft. Underlies Little Kaw ls. and overlies Olathe ls., all members of Stanton ls. in Johnson and Miami Counties. Named for hamlet (Victory Junction) in W. part of Wyandotte Co.

See also N. D. Newell, 1936 (Jour. Geol., vol. 44, No. 1, pp. 23–31).

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 135–136). *Victory Junction sh. memb.* of Kans. is possibly same as *Rock Lake sh.* of Condra in Nebr., which was originally erroneously included in Scranton sh. but which belongs in Stanton ls.

Vidrio massive member (of Capitan limestone).

Permian: Western Texas (Marathon region).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 52). *Vidrio fm.*—Very uniform dark- to light-gray dolomitic ls. or dol. with a few layers of pure dol. containing considerable chert in irregular form; in uppermost part one or two beds of reddish-brown ss. about 4 ft. thick. Thickness 2,000 ft. Underlies Gilliam fm. and overlies Word fm.

P. B. King, 1931 (Univ. Tex. Bull. 3038, pp. 73–84). *Vidrio memb. of Capitan fm.* [See 1931 entry under *Tessey dol.*]

P. B. King, 1933 (Historical geol. of R. C. Moore, p. 325). *Vidrio massive ls. memb. of Glass Mtns fm.* [See 1933 entry under *Tessey dol.*]

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 736+), designated the Vidrio deposits as *Vidrio massive memb. of Capitan ls.* This is present approved name of U. S. Geol. Survey.

This fm. is most conspicuous part of Glass Mtns. Vidrio is Spanish word for glass and is often used among local Mexican population as a name for the mtns.

Vieja series.

Upper Cretaceous: Western Texas.

T. W. Vaughan, 1900 (U. S. G. S. Bull. 164, pp. 76–81). *Vieja series.*—Interbedded lavas, pyroclastics, and unfossiliferous sss., clays, and cgls. Thickness not stated but seems to be at least 900 ft. Overlies (whether conformably or uncon. not discovered) San Carlos fm. in Presidio and Jeff Davis Counties.

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bull. 44, pp. 78–79, table opp. p. 59). *Vieja series* correlates with Navarro fm.

Named for exposures in Vieja Mtns, Presidio Co.

Viejas gabbro-diorite.

Late Jurassic or early Cretaceous: Southern California (San Diego and Imperial Counties).

W. J. Miller, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 2, pp. 115–141, map). *Viejas gabbro-diorite.*—Cuts Black Mtn volcanics and is of about same age as Alpine quartz diorite. Type occurrence in Viejas Mtn, southern Peninsular Range.

Vienna limestone. (Of Chester group.)

Mississippian: Southern Illinois and western Kentucky.

Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41). *Vienna ls.*—Usually highly siliceous or cherty ls. Thickness 0 to 70 ft. Present in Johnson and Pope Counties. Rests, apparently conformably, on Tar Springs ss., and underlies, apparently conformably, the Waltersburg ss.

Named for excellent exposures at Vienna, Johnson Co., Ill., where it is exposed in some streets and in an old quarry just W. of the town.

Vierling sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Paoli ls. of Cumings.

Vilas shale. (Of Lansing group, Kansas.)

Vilas shale member (of Lansing formation), Missouri.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

E. Haworth, 1898 (Kans. Univ. Geol. Surv. vol. 3, pp. 51, 103). *Vilas sh.* proposed by G. I. Adams (in field notes) for sh., 75 ft. thick, overlying Earlton ls. and underlying Iola ls. [Miscorrelation with Iola ls., the sh. exposed at Vilas really underlying Stanton ls. and overlying Plattsburg ls. See H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines, vol. 13).]

The present generally accepted definition treats Vilas sh. as a memb. of Lansing fm. in Mo., underlying Stanton ls. memb. and overlying Plattsburg ls. memb. In Kans. the Lansing is now treated as a group and the Vilas sh. as a fm.

Named for exposures in vicinity of Vilas, Wilson Co., Kans.

Village Bend limestone. (In Mineral Wells formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer, 1929 (Tex. Bur. Econ. Geol., geol. map of Palo Pinto Co.). *Village Bend ls.* lies 30± ft. below Lake Pinto ss. and 100± ft. above East Mtn sh. [restricted], all in Mineral Wells fm. [East Mtn sh. as originally defined occupied interval btw. Brazos River ss. and Lake Pinto ss., within which interval lies this ls.]

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 31–36). *Village Bend ls.*—A grayish-buff impure hard fossiliferous ls., from 6 in. to 14 ft. thick, occurring near top of East Mtn sh. memb. of Mineral Wells fm. [One section they give shows Village Bend ls. lying 60 ft. below top of the East Mtn.] Type loc. is exposure near W. end of Village Bend of Brazos River 2¾ mi. in direct line SE. of Palo Pinto, where this ls. is 6 ft. thick, very hard, and its upper part is made up of an aggl.

Villa Nueva sandstone member (of Fayette formation).

Eocene (upper): Northeastern Mexico (Tamaulipas).

W. G. Kane and G. B. Gierhart, 1935 (A. A. P. G. Bull., vol. 19, No. 9, p. 1387). *Villa Nueva ss. memb.*—Uppermost beds of Fayette fm. that admit of measurement, in section measured on both sides of Rio Grande btw. Roma and Rio Grande City, [Starr Co.], Tex. Consists of 63 ft. of coarse-grained soft gray ss. commonly weathering brown, with, at base, a fossiliferous horizon containing species of *Turritella*, *Volutocorbis*, and other fossils. [Derivation of name not stated.]

Vinales limestone.

Jurassic (?): Cuba.

E. L. DeGolyer, 1918 (A. A. P. G. Bull., vol. 2, p. 139). [Assigned to Jurassic, and thus classified by J. W. Lewis, 1932 (A. A. P. G. Bull., vol. 16, p. 536); but R. E. Dickerson and W. H. Butt, 1935 (A. A. P. G. Bull., vol. 19, No. 1), assigned it to Lower Cret., and C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 514), also assigned it to Cret.]

Vinalhaven rhyolite.

Silurian: Central southern Maine (Penobscot Bay region).

G. O. Smith, 1896 (Geology of the Fox Islands, Maine, pp. 12, 46–55). *Vinal Haven acid volcanics.*—Characterize NW. part of Vinal Haven, with exception of the strip of volcanics designated as Thoroughfare volcanics. Both lavas and pyroclastics are represented. The rocks include, in ascending order, tuffs, taxitic aporhyolite, spherulitic aporhyolites, and flow breccias, with the other tuffaceous beds as probably the highest members of the series represented. On NW. side of the area the lower members of Vinal Haven series are in contact with the more basic series [Thorofare volcanics], and the relations seem to be wholly conformable.

G. O. Smith, 1907 (U. S. G. S. Penobscot Bay folio, No. 149, p. 8). *Vinalhaven rhyolite.*—Name applied to the rocks earlier described and mapped as *Vinal Haven acid volcanics.* Assigned to Sil. Are of post-Niagara age—probably late Sil.

On 1933 geol. map of Maine, by A. Keith, these rocks are assigned to Dev.

Vincent member (of Meaford formation).

Ordovician: Ontario.

M. Fritz, 1926 (Roy. Soc. Canada Proc. and Trans., 3d ser., vol. 20, pt. 1, sec. 4, p. 93).

Vincent sand.

A subsurface unit of ss. lenses lying at or near horizon of Ames ls. memb. of Conemaugh fm. (Penn.) at places in SE. Ohio. Near Vincent, Barlow Twp, W. part of Washington Co., one of these stray sss., directly on top of Ames ls., produced gas and was named *Vincent ss.* (W. Stout et al., Geol. of nat. gas, A. A. P. G., 1935, p. 900.)

Vincentown sand. (Of Rancocas group.)

Eocene (lower): New Jersey.

W. B. Clark, R. M. Bagg, and G. B. Shattuck, 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 316–338). *Vincentown lime-sands.*—Highly calc. greensands, 20 to 100 ft. thick, forming upper part of Rancocas fm. Overlie Sewell [Hornerstown] marls. Named for Vincentown, Burlington Co.

The present classification treats *Vincentown sand* as upper fm. of Rancocas *group.*

Vindicator rhyolite.

Tertiary: Southwestern Nevada (Goldfield district).

F. L. Ransome, 1909 (U. S. G. S. P. P. 66, pp. 28, 37, etc.). *Vindicator rhyolite.*—Oldest memb. of volcanic succession, and a flow. Of white or light-gray color. Rests uncon. on alaskite and Camb. sh. and is older than Siebert [Esmeralda] fm. [which is upper Mio.]. Most extensively exposed on flanks of Vindicator Mtn. Thickness probably 200± ft.

Vinemount moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map (fig. 8) in U. S. G. S. Niagara folio (No. 190), p. 17.

Vinent formation.

Cretaceous (?): Cuba.

S. Taber, 1934 (Geol. Soc. Am. Bull., vol. 45, No. 4, p. 575). [Assigned to Cret., but C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 493) assigned it to Eocene.]

†Vineyard series.

Southeastern Massachusetts (Marthas Vineyard).

N. S. Shaler, 1888 (U. S. G. S. 7th Ann. Rept., pp. 303–363 and map). *Vineyard series.*—Reddish clays, whitish sands, brown and greenish sands, cross-bedded, composing the [supposed] Tert. deposits of Marthas Vineyard and well exposed at both extremities of the island. Thickness 15,000 ft. Believed to uncon. underlie Weyquosque series. Assigned to Tert. [but now known to include, as mapped, deposits of several ages—Plio. to Upper Cret.].

Vineyard interglacial stage (also **Vineyard formation**).

Pleistocene: Southeastern Massachusetts (Marthas Vineyard, etc.) and southeastern New York (Long Island).

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 975–988). *Vineyard erosion interval* (interglacial), accompanied by some deposits. Separates the glacial Tisbury beds [Manhasset fm.] of Marthas Vineyard from the deposits of last glacial epoch [Wisconsin stage]. [See also Geol. Soc. Am. Bull., vol. 8, pp. 197–212, 1897.]

M. L. Fuller, 1914 (U. S. G. S. P. P. 82). The *Vineyard interglacial stage* is represented on Long Island by an erosion interval and some marine and peat deposits, the deposits being called *Vineyard fm.* It separates Wisconsin morainal deposits from Manhasset fm., and is correlated with Peorian (?), Iowan (?), and Sangamon (?) stages of Mississippi Valley region.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Vineyard interglacial stage* is characterized chiefly by erosion on Block Island, Marthas Vineyard, Nantucket, and Cape Cod but is accompanied by some marine deposits, and, locally, on Marthas Vineyard, by some beds of peat.

Vinita beds.

Upper Triassic: Eastern Virginia (Richmond Basin).

N. S. Shaler and J. B. Woodworth, 1899 (U. S. G. S. 19th Ann. Rept., pt. 2, p. 435). *Vinita beds* (*Estheria beds*).—Black fissile shales carrying *Estheria ovata*, passing upward and intercalated with gray sss. Thickness 2,000± ft. Basal div. of Chesterfield group of Newark system. Underlie Otterdale sss. and overlie Tuckahoe group. Occur in James River bluff, W. of Vinita station, on Tomahawk Creek, and crop out on E. slope of Goat Hill near Vinita.

†Vinita formation.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 12). *Vinita fm.*—Alternating shales and sss., with thin coals and lenticular lss., 450 to 1,000 ft. thick, uncon. overlying Miss. and underlying Claremore fm. Represents all of Muskogee group in N. part of State.

Practically synonymous with Cherokee sh.

Named for Vinita, Craig Co.

Vinland shale.

Pennsylvanian: Northwestern Missouri and eastern Kansas.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 82). A persistent coal bed occurs in Stranger fm. 8 to 10 ft. beneath its top (which is placed at base of Haskell ls.). The marine sh. btw. this coal and Haskell ls. has been called *Vinland sh.* in unpublished thesis by J. M. Patterson, from village in Douglas Co., Kans., SE. of Lawrence.

R. C. Moore and N. D. Newell, 1936 (Kans. Geol. Surv. Bull. 22, pp. 146, 150–152). *Vinland sh.* restricted to the sh. and ss., probably all marine, overlying Westphalia ls. and underlying Haskell ls. It ordinarily consists of 9 to 50± ft. of gray argill. limy or sandy sh., locally with some ss. Originally the Vinland included Westphalia ls. Type loc. is 2± mi. NE. of Vinland, Douglas Co. Best exposures in NW. part of sec. 12, T. 14 S., R. 20 E.

Vintage dolomite.

Lower Cambrian: Southeastern Pennsylvania.

G. W. Stose and A. I. Jonas, 1922 (Wash. Acad. Sci., Jour., vol. 12, pp. 359, 362, 363). *Vintage dol.*—In part a gray heavy-bedded dol. which weathers to whitish chalky surface, and in part a knotty dark-blue dol. with argill. partings. Some beds are sparkling, gray to blue mottled, with siliceous and calc. blebs that stand out on weathered surfaces. At base is a whitish schistose thin-bedded impure dol. containing muscovite flakes. Thickness 500–650 ft. Underlies Kinzers fm. and overlies Antietam qtzite. Well exposed in cut of Pa. R. R. at Vintage, 15 mi. E. of Lancaster.

Vinton member.

Mississippian: Central Ohio.

J. E. Hyde, 1912 (Hist. of Fairfield Co. and representative citizens, by C. C. Miller, pp. 206–212). *Vinton memb.*—Fine-grained yellowish sss. and sandy shales, usually

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50 to 100 ft. thick, but in Fairfield Co. 150 ft. thick. Forms top memb. of Logan fm. Overlies Allensville memb. and uncon. underlies Maxville ls. [Logan fm. as used by Hyde included upper part of Black Hand fm. His Vinton memb. corresponds to Logan fm. of previous repts.]

J. E. Hyde, 1915 (Jour. Geol., vol. 23, pp. 771–779). Vinton memb. was named for Vinton Co., Ohio. [On other pp. in this vol. Hyde states Vinton memb. is=Logan fm. of Prosser.]

C. S. Prosser, 1915 (Outlines of field trips in geology for central Ohio, p. 13), accepted Hyde's expansion of Logan fm. and restriction of *Black Hand* to basal part of the Black Hand of previous repts, his restricted Black Hand being treated as top memb. of his expanded Cuyahoga fm.

See under *Logan fm.*

Vinton phase (of Otis limestone).

Middle Devonian: Central eastern Iowa.

W. H. Norton, 1921? (Iowa Geol. Surv. vol. 27, p. 377). *Vinton phase of Otis ls.*—Basal layers of the Otis exposed in quarries N. of Vinton [Benton Co.] along Cedar River. Probably somewhat higher in Otis terrane than Coggon phase. In all these quarries the stone is a buff, finely laminated mag. ls., remarkably homogeneous, lying in even and rather heavy horizontal beds. Chemical analysis shows it to be somewhat less mag. than Coggon phase.

Viola limestone.

Middle and Upper Ordovician: Central southern Oklahoma.

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Viola ls.*—Massive white and bluish lss., with occasional irregular bands and nodular masses of chert or flint, most abundant in lower and middle portions. Some beds coarsely crystalline, others composed chiefly of shells and shell fragments. Thickness 750 ft. Overlies Simpson fm. with transition, and underlies Sylvan sh.; all of Ord. age.

J. A. Taff, 1903 (U. S. G. S. Tishomingo folio, No. 98). *Viola ls.* is 700± ft. thick, and represents a continuous but slightly variable deposition of ls. The upper and lower parts, each approx. one-third of fm. in thickness, are composed of thicker and less evenly stratified beds than middle part. Chert is usually most abundant in lower and middle parts of fm. Texture of middle part is generally dense and fine. Some beds, especially in upper part, are uneven, earthy, and coarsely crystalline, while others are composed largely of fossil shell fragments and shells. There is gradual transition from a thin-bedded platy ls. belonging to Simpson fm. upward into the thicker beds of Viola ls., while at top there is an abrupt change from ls. to the dark-bluish or greenish clay shales of Sylvan fm. According to E. O. Ulrich the fossils of basal memb. of Viola ls. are of latest Black River and earliest Trenton age; the fossils of middle memb. are later Trenton; and the fossils of upper memb. are of Richmond age.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 27), assigned *Viola ls.* wholly to Trenton, and the beds of Black River and upper Chazy age to a new and undefined fm. called *Bromide*. He also designated the beds of Richmond age as Fernvale ls., which he showed as uncon. above his Viola [restricted] ls., with beds of Maysville and Eden age absent.

C. A. Reeds, 1926 (Am. Mus. Nat. Hist. Jour., vol. 26, pp. 470–474), listed fossils from the 3 members of Viola ls. and assigned them as follows: (1) Upper 300± ft., gray crystalline rock containing abundant Richmond fauna; (2) middle 300± ft., thin-bedded dark-gray ls. containing upper Trenton fossils; (3) basal 60 to 100 ft., massive-bedded light-colored ls. containing latest Black River and earliest Trenton fossils. He assigned entire Simpson fm. to the Chazy.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, p. 30), showed *typical Bromide*=upper part of Simpson fm. and of late Chazyan (Lower Ord.) age, and stated that the beds of Black River and early Trenton age (Middle Ord.) are "provisionally referred to Bromide fm." He also showed the rest of the Trenton and early part of Eden as absent; assigned Viola ls. [restricted] to rest of Eden epoch and early part of Maysville epoch; and showed it as uncon. overlain by Fernvale ls., of Richmond age.

F. C. Edson, 1927 (A. A. P. G. Bull., vol. 11, No. 9, pp. 967–975), stated that Taff mapped type loc. of Ulrich's Bromide as lower Viola ls., and she recognized above her Bromide ("post-Wilcox") fm. 200 ft. of lower Viola (massive dense buff-colored "lithographic" ls. of upper Black River age), 700 ft. of middle Viola (ls. carrying graptolites in base, of Trenton or Cincinnatian age), uncon. overlain by 50 ft. of Fernvale ls. (upper Viola), of Richmond age.

E. O. Ulrich, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73), assigned his *Viola ls.* to all of Maysville epoch and upper part of Eden epoch, and showed it as uncon. overlain by Fernvale ls., of Richmond age. He included in his Bromide all beds of Trenton and Black River age.

C. E. Decker, 1933 (A. A. P. G. Bull., vol. 17, No. 12, pp. 1405–1435). Evidence is given for extending Viola ls. into Atoka region, "where it has not been previously recognized." Has 40 or more separate outcrops, most of them small, in Arbuckle Mtns, Wichita Mtns, the Criner Hills, the Mansville anticline, and Atoka region, extending over an aggregate area of 45 sq. mi. The molluscoids and mollusks, as well as the graptolites, correlate parts of the Viola with Normanskill, Trenton, Utica, Lorraine, and Richmond.

C. W. Tomlinson, 1935 (Geol. of nat. gas, A. A. P. G., p. 581). Most of Viola ls. is Middle Ord., probably chiefly Trenton, with Fernvale ls. (Richmond) at top.

The U. S. Geol. Survey has not yet adopted Bromide fm. and follows original definition of Viola ls.

Named for former village of Viola, near Bromide, Johnston Co., which was located close to outcrop of fm.

Vipond series.

Pre-Cambrian: Ontario.

L. C. Graton and H. E. McKinstry, 1933 (Canadian Min. and Met. Bull. 249, pp. 3, 4).

Virgelle sandstone. (Of Montana group.)

Virgelle sandstone member (of Eagle sandstone).

Upper Cretaceous: Northwestern, central northern, and central southern Montana.

E. Stebinger, 1914 (U. S. G. S. P. P. 90, pp. 62–68). *Virgelle ss.*—Gray to buff coarse-grained massive ss., much cross-bedded, with many ferruginous concretions in upper half. In lower half slabby gray ss., becoming shaly toward base. Thickness 220 ft. on Two Medicine River btw. its mouth and Family post office. Underlies Two Medicine fm. in NW. Mont. (Blackfeet Indian Res.) and overlies Colorado sh. In central Mont. it comprises basal memb. of Eagle ss., and still farther E. it represents all of Eagle ss. that is present. Is well exposed along Missouri River from town of Virgelle, a few mi. below Fort Benton, eastward.

In Yellowstone-Bighorn Counties region the 350± ft. of transition beds underlying Virgelle ss. memb. of Eagle ss. and containing a fauna of predominantly Montana types are now known as *Telegraph Creek fm.* In that area the Telegraph Creek fm. separates Virgelle ss. memb. of Eagle from deposits of unquestioned Colorado age, carrying Niobrara fossils and designated *Niobrara sh.*

Virgen [Virgin] series.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, pp. 52 and 61). *Vergen series.*—Deposits of late Tertic age, mainly Plio. perhaps. Appear partially to fill a canyon of old Virgen [Virgin] River [SE. Nev.] that was excavated before Bonneville days, and the line of which is occupied by the lower Virgen [Virgin] River of today. In Nev. divided into Kyle sss. above and Funeral cgls. below. [In Pan-Am. Geol., vol. 41, p. 79, 1924, Keyes defined Virgen series as follows: Name applies to thick cgl. beds overlying the boraciferous clays in Virgen Valley and in Furnace Canyon, Inyo Co., Calif.]

Virgil series.

Pennsylvanian: Kansas, Missouri, Iowa, Nebraska, and Oklahoma.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Virgil series* extends from base of Americus ls. down to top of sh. uncon. overlying Iatan ls., and includes Wabaunsee group redefined, Shawnee group, and Douglas group redefined.

R. C. Moore, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, pp. 279–280). The Penn. system of Mid-Continent region is divisible into 4 major natural divisions or series, here named (descending): (1) *Virgil series,* consisting of alternating ls. and sh. with prominent ss. deposits at base, resting, with very important uncon., on (2) *Pottawatomie series* (distinguished by prominence and wide distribution of ls.); beneath it occurs an uncon. and one of most clearly defined paleontologic boundaries in the Penn., which is succeeded downward by (3) *Des Moines series*, which rests, with distinct and widespread uncon., on (4) *Bend series* [restricted to Penn. part of Bend of the literature]. [The foregoing classification discards *Missouri group*, replacing it with *Virgil series* and *Pottawatomie series*.]

M. K. Elias, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 285), reported fossil plants from "the sh. overlying the eroded surface of Stanton ls. about 6 mi. NW. of Garnett, Kans. This horizon belongs directly above the important uncon. that marks base of *Virgil series* (R. C. Moore, new), which comprises upper 1,400 ft. of Kans. Pennsylvanian (i. e., beds below Americus ls.)."

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 88, 96). It is proposed to recognize 3 major divisions or series in the Penn. rocks of Kans., designated (ascending order) *Des Moines series*, *Missouri series*, and *Virgil series*. The *Des Moines series* is essentially unchanged from previous usage, including strata from base of Cherokee sh. to an uncon. near top of Marmaton group. The *Missouri series* as formerly defined included all Penn. strata above the Des Moines. Writer now proposes to restrict this name to apply to the beds btw. the uncon. at top of Des Moines series and another important uncon. in what has previously been classed as *Douglas fm. or group*. The beds btw. the uncon. last noted and base of Perm. are defined as *Virgil series*. The uncon. btw. the Missouri and Virgil series corresponds to the time of major folding in Arbuckle Mtns, southern Okla., and probably also of deformation in Ouachita Mtns, farther E. The Virgil series includes Wabaunsee, Shawnee, and Douglas (redefined) groups. Contact btw. Virgil series and overlying Perm. (Americus ls. at base) is conformable so far as known.

R. C. Moore, 1933 (Historical geol., pp. 304–305, 319). *Virgil series*.—Uppermost Penn. in Mid-Continent region. Thickness 1,300 ft. in N. Okla.; about 700 ft. in Nebr. [On p. 319 he draws top of Penn. at base of Americus ls.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 41, 49, 50, 142). Upper bdy of *Virgil series* is located at break that occurs near horizon of Brownville ls. and within group of beds formerly known as Admire sh. [p. 41]. [Moore's diagram on p. 49 shows this uncon. as in places occurring a short distance above Brownville ls.] Named for town in E. part of Greenwood Co., Kans., located about midway btw. lower and upper limits of Virgil series outcrop in this part of State. Exposure (about 960 ft. thick) along Verdigris River, from W. of Madison to Virgil and SE. to central Wilson Co. exhibits clearly the boundaries indicated. [Page 49 shows discon. at top of Brownville ls. and includes latter ls. in Virgil series. On p. 50 he restricts *Admire group* (as he calls it) to beds from base of Towle sh. (top of Brownville ls.) up to base of Americus ls., and includes his Admire group in Perm.]

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Virgilina group.

Virgilina volcanic group.

Virgilina greenstone.

Pre-Cambrian: Central southern Virginia and central northern North Carolina (Virgilina district).

T. L. Watson, 1916 (Va. Geol. Surv. geol. map of Va.). *Virgilina group*.—Divided into 3 mapped units (descending): Gabbro; quartz porphyry; and volcanic acid and basic tuffs. Overlies pre-Camb. granite and granite gneiss.

F. B. Laney, 1917 (Va. Geol. Surv. Bull. 14, pp. 15, 19, 27–34, and map). The basic volcanics, for which *Virgilina greenstone* is proposed, were originally andesite and andesitic tuffs but have become, through intense metamorphism, chlorite-epidote schists or simply greenstone schists. These for most part retain something of their original minerals. The rocks form Virgilina Ridge and are typically developed in and near town of Virgilina [Halifax Co., Va.]. In present conditions the rock is a well-defined greenstone schist. [Mapped as Ord. (?).]

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.). [The block of pre-Camb. extrusive rocks younger than Glenarm series and designated "greenstone volcanics" is stated to "include meta-andesite in Virgilina area called *Virgilina greenstone*."]

A. I. Jonas, 1932 (Va. Geol. Surv. Bull. 38, pp. 6, 24–25, map). *Virgilina volcanic group* (p. 6); *Virgilina volcanic rocks* (text heading, p. 24); *Virgilina volcanics* (map). Acidic and basic volcanic rocks occur in a small area btw. Meherrin and Keysville, Va., which is included in Laney's map of Virgilina dist., and his rept describes these rocks in detail. They extend SW. 35 mi. to Virgilina, on Va. line, and across N. C. into S. C. Of pre-Camb. age. Older than Columbia granite, which intrudes them. Not seen in contact with Wissahickon fm. but probably overlies the Wissahickon.

Virgin limestone member (of Moenkopi formation).

Lower Triassic: Southwestern Utah (Washington County) and northwestern Arizona.

R. Bassler and J. B. Reeside, Jr., 1921 (U. S. G. S. Bull. 726C, pp. 90-92). *Virgin ls. memb.*—Earthy greenish-yellow ls., in 3 thin bands separated by greenish-yellow and reddish-brown sh. Thickness 80 to 160 ft. Lies 400 to 435 ft. below Shnabkaib sh. memb. of Moenkopi and 355 to 610± ft. above base of Moenkopi. Named for Virgin City, Utah, where it is well exposed. [See also U. S. G. S. P. P. 129D, 1922.]

Virginia slate.

Pre-Cambrian (upper Huronian): Northeastern Minnesota (Mesabi district).

C. R. Van Hise and C. K. Leith, 1901 (U. S. G. S. 21st Ann. Rept., pt. 3, pp. 353, 360). *Virginia sl.*—Dense fine-grained gray or black sl. Called Virginia sl. because in its typical form it has been found in numerous test pits and drill holes W. of town of Virginia, St. Louis Co. Top fm. of Upper Huronian in Mesabi dist. Uncon. underlies the great Keweenawan gabbro and conformably overlies iron-bearing Biwabik fm.

C. K. Leith, 1903 (U. S. G. S. Mon. 43), stated that *Virginia sl.* grades both vertically and laterally into Biwabik fm.; and C. R. Van Hise and C. K. Leith made same statement in U. S. G. S. Mon. 52, p. 174, 1911.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360) and 1911 (U. S. G. S. Mon. 52), treated Virginia sl. as younger than Biwabik fm., but assigned both to upper Huronian.

C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), assigned Virginia sl. to upper Huronian and Biwabik iron-fm. to middle Huronian.

Virginia quartz hypersthene norite.

Late Jurassic (?): Southern California (Riverside County).

P. H. Dudley, 1935 (Calif. Jour. Mines and Geol., vol. 31, No. 4, pp. 491, 501). Most important body of rock occurs near old Virginia mine, and extends W. into E. part of the Gavilan.

†Virginian.

A term introduced by A. Heilprin (Phila. Acad. Nat. Sci. Proc. 1882, pp. 183–184, 1883; also Phila. Acad. Nat. Sci. Jour., 2d ser., vol. 9, pt. 1, p. 120, 1884) for the "Middle Atlantic Miocene deposits of Va. and the newer group of Md. ('Yorktown' epoch, in part of Dana)." See under †*Carolinian*. Corresponds to an indefinite part of Chesapeake group of present nomenclature.

Virgin Valley beds.

Miocene: Northwestern Nevada.

J. C. Merriam, 1907 (Sci., n. s., vol. 26, pp. 380–382). *Virgin Valley beds.*—Mammal-bearing fm., largely volcanic ash or tuff, showing variable amount of induration and varying in color from white to green or bright red. Fauna, especially of upper beds, appears to belong to same period as Truckee Miocene. Upper beds are usually softer than the others and consist of cream-colored ash; middle beds are generally brownish or gray and weather in gently rounded knolls; lower beds are somewhat harder than the others, and where badland structure occurs in them very steep faces are frequently produced. Thickness of fm. 1,000 to 2,000 ft. Virgin Creek drains the valley in which the beds occur. There are older tuffs, ashes, and rhyolitic lavas that resemble Clarno Eocene of Oregon.

Appears to be same as Truckee fm.

Vishnu schist.

Pre-Cambrian: Northern Arizona.

C. D. Walcott, 1889 (Geol. Soc. Am. Bull., vol. 1, p. 50). *Vishnu*, bedded qtzite and schists, 1,000+ ft. thick. Uncon. underlies Grand Canyon [Unkar] group in Grand Canyon of Colorado.

C. D. Walcott, 1894 (U. S. G. S. 14th Ann. Rept., pt. 2, pl. 60, etc.). *Vishnu terrane* (Algonkian?) consists of sss., schists, etc., and overlies Archean gneisses, schists, etc.

L. F. Noble, 1910 (Am. Jour. Sci., 4th, vol. 29). *Vishnu schist*, the fundamental crystalline complex, consists of quartz, mica, and hornblende schists, invaded by quartz diorite and injected by veins of pegmatite and aplite.

L. F. Noble and J. F. Hunter, 1916 (U. S. G. S. P. P. 98–I, p. 113). The Archean complex of Grand Canyon is now known as Vishnu schist in usage of U. S. Geol. Surv. It is evident, however, from present study, that the name includes two or more very different series of rocks. Doubtless it will be advisable at some future time to restrict name *Vishnu schist* to the mica schist series and give another name or names to the gneisses, but until a more detailed study is made a change in present usage would be premature.

I. Campbell and J. H. Maxson, 1936 (Geol. Soc. Am. Proc. 1935, p. 342). Calc. concretions have been found in *Vishnu schist* (restricted by writers to include only the sed. series) on Boucher Creek in W. part of Bright Angel quad., which confirms sed. origin of the schist.

The U. S. Geol. Survey has not yet had occasion to consider the proposed restriction of Vishnu schist.

Named for Vishnu's Temple, on Colorado River, 30 mi. E. of mouth of Shinumo Creek.

Vishnuan series.

A term employed by C. [R.] Keyes instead of *Vishnu schist* of other geologists.

Vivian sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 232). *Vivian ss.*—Massive to heavy-bedded, medium-grained, micaceous, bluish gray, 0 to 35 ft. thick. Lies 0 to 5 ft. below Pocahontas No. 2 coal and rests on Pocahontas No. 1 coal. Has been quarried 300 yds. E. of East Vivian railway station, McDowell Co.

Vivien sand.

A name that has been applied by drillers to Nacatoch sand (Upper Cret.) of NW. La.

†Vola limestone. (In Washita group.)

Lower Cretaceous (Comanche series): Southern Texas.

R. T. Hill, 1889 (Am. Geol., vol. 3, p. 289; Am. Jour. Sci., 3d, vol. 37, p. 290). *Vola ls, or Shoal Creek horizon.*—Red chalk ls. At Austin 50 ft. thick. Top fm. of Lower Cret. in Burnet and Travis Counties. Overlies *Exogyra arietina* clays [Del Rio clay].

Paleontologic name. Replaced by *Buda ls.*

Volcan group.

Pre-Cambrian: Mexico (Lower California).

G. P. Merrill, 1897 (U. S. Nat. Mus. Rept. 1895, p. 985).

Volcan Peak group.

Paleozoic (?): Mexico.

S. F. Emmons and G. P. Merrill, 1894 (Geol. Soc. Am. Bull., vol. 5, p. 511).

Volga shales.

Upper Ordovician: Iowa.

C. [R.] Keyes, 1931 (Pan-Am. Geol., vol. 55, pp. 217–222), applied this name to beds underlying his Wykoff ls. and overlying his Dubuque ls. shales in Iowa. He stated that his Wykoff ls.=†Elgin ls., so that his Volga shales appear to correspond to upper part of Dubuque fm.

Volusia sh.

Upper Devonian: Western New York (Chautauqua County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). Upper Dev. of Chautauqua Co. divided into (descending): Knapp beds; Conewango fm.; Chadakoin; Volusia sh. (=Girard sh. of Pa.); uncon.; Northeast sh.; Shumla ss.

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 153). *Volusia sh.*—Green fossiliferous sh., about 100 ft. thick E. of Volusia [Chautauqua Co.], about 180 ft. thick on the Canadaway. On approaching N. Y. line the Girard sh. becomes increasingly fossiliferous from top down, carrying specially *Camarotoechia duplicata* and changing to green sandy sh. On Chautauqua Creek the green Volusia sh. overlies about 140 ft. of normal Girard sh. On Canadaway Creek the Volusia sh. is 180 ft. thick and if normal Girard is present beneath it it cannot exceed 40 ft. in thickness. Volusia sh. is overlain by Chadakoin beds.

G. H. Chadwick, 1935 (Geol. Soc. Am. Proc. 1934, p. 71). [See 1935 entry under *Northeast sh.*]

Vulcan iron-formation.

Pre-Cambrian (middle Huronian): Northwestern Michigan (Crystal Falls, Menominee, and other districts).

C. R. Van Hise, 1899 (U. S. G. S. 19th Ann. Rept., pt. 3, p. 16; and Mon. 36, pp. xxv, xxvi). *Vulcan iron fm., containing slates.*—Highest fm. of Lower Menominee series of Menominee dist. Overlies Antoine dol. and uncon. underlies the great sl. fm. of Upper Menominee series. Correlates with Negaunee fm. of Marquette dist. and Groveland fm. of Crystal Falls dist.

C. R. Van Hise and W. S. Bayley, 1900 (U. S. G. S. Menominee folio, No. 62), defined *Vulcan fm.* as uncon. overlying Negaunee fm., as underlying Hanbury sl., and as divided into (descending) Curry ore-bearing memb., Brier sl. memb., and Traders ore-bearing memb. Thickness of fm. 0 to 700 ft.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52), treated the Vulcan rocks of Iron River dist. as a memb. of Michigamme sl. (upper Huronian).

R. C. Allen, 1915 (Jour. Geol., vol. 23, pp. 703+) and 1919 (Am. Inst. Min. and Met. Engrs. Bull. 153, pp. 2579–2594), correlated Vulcan fm. with Negaunee and assigned it to middle Huronian.

C. K. Leith, 1933 (16th Int. Geol. Cong. Guidebook 27), assigned this fm. to middle Huronian, as did C. K. Leith, R. J. Lund, and A. Leith, 1935 (U. S. G. S. P. P. 184), who called the rocks *Vulcan iron-fm.*

Named for exposures in vicinity of West Vulcan, Menominee dist.

Waban formation.

Ordovician or Cambrian: Newfoundland.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 199). The term *Waban fm.* is suggested as an appropriate designation for the iron-bearing strata of Great Bell Island.

Wabana series.

Lower Ordovician: Newfoundland.

G. Van Ingen, 1914 (Princeton Univ. Contr. to geology of Newfoundland, No. 4). *Wabana series.*—Upper part of Lower Ord. of Newfoundland. Discon. overlies Bell Island series. Divided into several fms. Correlated with Middle Arenig, Upper Arenig, and Llandeilo(?) of western Europe. [Derivation of name not stated.]

†Wabash group.

Pennsylvanian: Indiana.

G. H. Ashley, 1902 (U. S. G. S. 22d Ann. Rept., pt. 3, p. 273). *Wabash group.*—Main coal-bearing measures, 100 to 600 ft. thick. Overlain by Merom ss. and uncon. underlain by Mansfield ss.

Includes Ditney, Somerville, Millersburg, Petersburg, and Brazil fms. of Fuller, or strata of Pottsville, Allegheny, and Conemaugh age.

Named for Wabash River, Ind., which cuts through the various fms.

Wabash formation.

Pennsylvanian: Southwestern Indiana.

M. L. Fuller and F. G. Clapp, 1904 (U. S. G. S. Patoka folio, No. 105). *Wabash fm.*—Lower half heavy sss., with thin shales, lss., and coal beds; upper half alternating sss. and shales. Thickness 180 ft. Basal bed is Parker coal. Underlain by Inglefield ss. [supposed=Merom ss.] and overlain by Tert. river deposits.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 526). *Wabash fm.* of Fuller and Clapp is recognized provisionally, pending final determination of its relations to Merom ss., which in this rept is treated as terminal memb. of Penn. in Ind.

Named for exposures in bluff of Wabash River in Patoka quad.

†Wabash stage.

†Wabash beds.

Pleistocene: Central Indiana.

O. P. Hay, 1912 (Smithsonian Misc. Coll., vol. 59, No. 20, p. 13). *Wabash beds* (also *Wabash stage*).—Interglacial deposits consisting mostly of fillings of old marshes, ponds, and lakes. Underlain by Wisconsin drift. Contains Pleist. fossils.

Preoccupied.

Named for Wabash River, being especially developed in valley of that river and its tributaries. Type loc. about 4 mi. E. of Fairmount, Grant Co.

Wabash moraine.

Pleistocene (Wisconsin stage): Northwestern Ohio, northeastern Indiana, and southern Michigan. Shown in part on moraine map (fig. 8) in U. S. G. S. Columbus folio (No. 197), p. 12, and in part on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Wabash River, Ind.

Wabaunsee formation (also **group**).

Pennsylvanian: Eastern Kansas, northwestern Missouri, southeastern Nebraska, and southwestern Iowa.

C. S. Prosser, 1895 (Jour. Geol., vol. 3, pp. 688-697). *Wabaunsee fm.*—Series of alternating fossiliferous lss. and calc., argill., and aren. shales, about 575 ft. thick, underlying Cottonwood ls. and overlying Osage coal. Includes rocks from top of Swallow's bed No. 154 to base of bed No. 80.

Later restricted in repts of Kans. Geol. Surv. so as to include only beds from top of Scranton sh. of Shawnee group (a horizon considerably higher than Osage coal) to base of Cottonwood ls. This definition was adopted by E. Haworth and J. Bennett in 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1, pp. 71–85, and Univ. Kans. Geol. Surv. vol. 9); and it was followed by Kans. Geol. Surv. until 1931, although J. W. Beede (in Univ. Kans. Geol. Surv. vol. 9, 1908) stated that in his opinion Wabaunsee should include only from top of Americus ls. down to *base* of Scranton sh.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., p. 59). The coal which Haworth and Prosser called the Osage is the Silver Lake coal, and the Topeka coal, 125 ft. lower, is the Osage. Prosser meant base of the Wabaunsee to be at Silver Lake coal, not the Osage. Later the lower bdy of fm. was placed higher, at base of Burlingame ls., which is widely persistent and a good horizon marker.

R. C. Moore, Sept. 1931 (Kans. Geol. Soc. 5th Ann. Field Conf., correlation chart), redefined *Wabaunsee group* so as to include beds below Americus ls. and above Topeka ls., and this definition was adhered to by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. of Kans. and Nebr. This definition subtracts several fms. (Eskridge sh., Neva ls., Elmdale sh., and Americus ls.) from top of Wabaunsee group and adds several (Scranton sh., Howard ls., and Severy sh.) at base. These changes have not yet been adopted by U. S. Geol. Survey.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, pp. 94, 96). *Wabaunsee group* is redefined to include the beds from top of Topeka ls. to base of Americus ls. Thus limited the Wabaunsee is a natural strat. unit consisting mainly of gray and brown shales and thin but persistent blue and brownish lss. that differ in several respects from those of underlying Shawnee. Perhaps most important of these differences is that in few or no cases can the representative divisions of the ls. cycle be recognized definitely. Nevertheless, ls. beds 1 or 2 ft. thick have been traced for distances of more than 200 mi. in some cases, and coal beds a few in. thick have been followed on the outcrop for like distances.

G. E. Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), still further restricted Wabaunsee group by drawing its top at top of his Brownville ls., which is where R. C. Moore draws top in his 1936 classification (Kans. Geol. Surv. Bull. 22). These modified definitions have not been considered by U. S. Geol. Survey for its publications.

In Kans. the Wabaunsee is now treated as a group; in Mo. and Iowa it is treated by U. S. Geol. Survey as top fm. of Missouri group.

Named for exposures in Wabaunsee Co., Kans.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Wabi formation.

Silurian: Ontario.

G. S. Hume, 1920 (Am. Jour. Sci., 4th, vol. 50, p. 303).

Wabiabi shale.

Upper Cretaceous: Alberta.

W. Purdy, 1920 (A. A. P. G. Bull., vol. 4, p. 250). Basal memb. of Benton sh.

Waccamaw formation.

Pliocene (lower): Southern and eastern South Carolina and southern North Carolina (south of Hatteras axis).

W. H. Dall, 1892 (Wagner Free Inst. Sci. Trans., vol. 3, pt. 2, pp. 209–213). For the beds exhibited in S. C. along Waccamaw River, above the Cret. marl, as sectionized by Tuomey and Johnson, the name *Waccamaw beds* may be adopted. [Fossils are listed on pp. 210–211.] Assigned to Plio.

In present usage the Waccamaw fm. represents all known Plio. beds in S. C., and it uncon. underlies Pleist. terrace deposits (so-called "Lafayette") and overlies the Miocene Duplin marl. In N. C. the Waccamaw includes all marine Plio. deposits S. of Hatteras axis, the name *Croatan sand* being applied to the Plio. deposits N. of Hatteras axis. No outcrops known N. of Neuse River, N. C. It consists of soft lss. and loose gray to buff fine quartz sands in which occasional small quartz pebbles are present; in places it contains a small number of black water-worn phosphatic pebbles that were evidently derived from the Cret. Approx. thickness 0 to 25 ft. in N. C. and 0 to 12 ft. in S. C.

Named for exposures along Waccamaw River, Horry Co., S. C.

†Wachusett gneiss.

Late Carboniferous or post-Carboniferous: Central northern Massachusetts (Worcester County region).

L. S. Burbank, 1876 (Rept. on geol. map of Mass., by W. O. Crosby, pp. 43–52), in several places called the gneiss of Wachusett Range the *Wachusett gneiss*. According to B. K. Emerson (U. S. G. S. Bull. 597, p. 233, 1917) the rocks of Wachusett and Little Wachusett Mtns consist of Fitchburg granite overlain by 600 ft. of dark granodiorite.

Waco limestone.

Silurian (Niagaran): East-central Kentucky.

A. F. Foerste, 1905 (Ky. Geol. Surv. Bull. 6, p. 145) and 1906 (Ky. Geol. Surv. Bull. 7, pp. 10, 52). *Waco ls.*—Basal part solid ls., 1 to 2 ft. thick; upper part numerous thin layers of fossiliferous lss. interbedded with clay. Thickness 8 to 10 ft. Middle memb. of Alger fm. (of Niagaran age). Overlain by Estill clay and underlain by Lulbegrud clay.

In 1931 (Ky. Geol. Surv., ser. 6, vol. 36, pp. 172, 173) Foerste assigned this ls. to Clinton epoch.

Named for Waco, Madison Co.

†Waconia moraine.

Pleistocene (Wisconsin stage): Southeastern Minnesota.

Name applied in early Minn. repts to morainal deposits which F. Leverett (U. S. G. S. P. P. 161, pp. 76–77, 1932) considers to be "only a spur formed in a recess in the ice harbor of the Gary moraine." Named for occurrence at Waconia, Carver Co.

†Wadmalaw shell marl.

†Wadmalaw phase.

Pleistocene: Southern South Carolina (Charleston County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 20–21). *Wadmalaw shell marl* (also *Wadmalaw phase*).—Immediately overlies Edisto marl (upper Ecphora Miocene). Consists of a bed of loosely matted post-Plio. shells varying from nil to 4 ft. in thickness. This phase is exhibited S. of Bees Ferry, at the Faber place, and along northerly shore of Stono and Wadmalaw inland waterway, at Cherokee, Bolton, and St. Andrews phosphate mines, and at base of Simmons Bluff; also in sundry depressions on Edisto Island. Is overlain by Bohicket marl sand. Is a marine deposit.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867, p. 151). Wadmalaw phase of Sloan is a facies of Pamlico fm.

†Wafer shale. (In Kiowa shale.)

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, pp. 361, 363, 368, 380). *Wafer sh.* is applied to Black Hill sh. because of its "peculiar method of disintegration, breaking down under the weather into small flat and thin, sharp-edged spalls resembling wafers."

Wages sand.

Drillers' name for two sands (Upper and Lower Wages) in Pottsville group of Knox Co., SE. Ky.

Wagonhound member.

Eocene: Southwestern Wyoming and northeastern Utah.

H. E. Wood, 2d, 1934. (See under *Blacks Fork memb. of Bridger fm.* The beds to which this name is applied are included in Bridger fm. by U. S. Geol. Survey and other writers, but Wood includes them in Uinta fm.)

Wagontire formation.

Eocene(?): Central southern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207–214). *Wagontire fm.*—Massive effusives of rhyolite and coarse-grained gray porphyritic andesite, of undet. thickness. Type loc. Wagontire Mtn, NE. part of Lake Co.

Wagonwheel formation.

Oligocene(?): Southern California (McKittrick-Sunset region).

H. R. Johnson, 1909 (Sci., n. s., vol. 30, pp. 63–64). *Wagonwheel fm.*—Local occurrence of sss. and several layers of white diatomaceous shales, which appear, upon paleontologic evidence, to be Olig. Underlie Vaqueros ss. and overlie Tejon ss. Occur in isolated group of hills S. of Bartons and NE. of Point of Rocks, in Devils Den dist.

G. C. Gester and J. Galloway, 1933 (A. A. P. G. Bull., vol. 17, No. 10, p. 1169), divided *Kreyenhagen group*, as he called it, into (descending) Leda sh., uncon. on *Wagonwheel*, uncon. on Kreyenhagen sh.; and assigned his Leda and Wagonwheel fms. to Olig. and his Kreyenhagen sh. to Eocene.

Named for exposures N. and SW. of Wagonwheel Mtn, Kern Co.

Wagon Yard gypsum.

Permian: North-central Texas (Stonewall County).

L. W. Storm, 1929 (Tex. Econ. Geol. Surv. map of Stonewall Co.), shows *Wagon Yard gyp.* lying 230± ft. below Quartermaster fm., 40± ft. below Ward gyp., and 150± ft. above Aspermont or Guthrie dol.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, pp. 167, 168). *Wagon Yard gyp.*, Storm, 1929; Stonewall Co.; lies about 100 ft. below Ward gyp. and about 300 ft. above Guthrie (Aspermont) dol. Is apparently same as Childress dol. and gyp. Although proposed at about same time, the term *Childress* is in more common use, and *Wagon Yard gyp.* is discarded.

Wahkiakum formation.

Miocene (lower): Southwestern Washington and Puget Sound region.

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 15, pp. 10–22). *Wahkiakum fm.*—Sss., shales, and grits, the sss. predominating. Thickness 4,000 ft. Occur on N. side of Columbia River in Wahkiakum Co. near head of Alockaman River. Fauna quite different from that of Blakeley fm. Rests uncon. on series of shales whose faunal position seems to correspond to Blakeley fm. Is largely covered by Pleist. sands.

C. E. Weaver, 1916 (Wash. Geol. Surv. Bull. 13). The fauna [listed] of Wahkiakum deposits is here called *Arca montereyensis* zone. It is distinct from Olig. and from overlying upper Mio., and is assigned to lower Mio.

Wahnapitae quartzite.

Pre-Cambrian: Canada.

A. P. Coleman, 1915 (Problems of American geology, p. 97). Included in Sudbury series.

See *Wanapitei qtzite*, Coleman, 1914.

Wahsatch group.

The approved spelling is *Wasatch*. In some early repts the name was spelled *Wahsatch*.

Wahs Creek shale. (In Moran formation.)

Permian: Central northern Texas (Shackelford County).

O. F. Hedrick, E. Owens, P. A. Meyers, 1929 (Tex. Bur. Econ. Geol., geol. map of Shackelford Co.). *Wahs Creek sh.*, 25± ft. thick, underlies Dothan ls. and overlies Camp Colorado ls.

Wahweap sandstone.

Upper Cretaceous: Central southern Utah (Kaiparowits Plateau region).

H. E. Gregory and R. C. Moore, 1931 (U. S. G. S. P. P. 164). *Wahweap ss.*—A series of buff sandy sh. and massive sss., conformably overlying Straight Cliffs ss. and underlying Kaiparowits fm. Thickness 200 to 1,300 ft. Characterized by topog. expression, the absence, so far as observed, of coal beds, and the scarcity of fossils. Upper part of Wahweap Creek, Kane Co., is cut in the fm.

Waianae volcanic series.

Tertiary and possibly early Pleistocene: Hawaii (Oahu Island).

H. T. Stearns, 1935 (Geol. and gd. water res. Island of Oahu, Hawaii: Div. Hydrog. Bull. 1). *Waianae volcanic series.*—Comprises all lava flows, intrusive rocks (dike complex), pyroclastics, breccias, and intercalated soils in Waianae Range. The basalts can be divided into a lower memb., a middle memb., and an upper memb., which have been mapped separately in most of the range. The lower basalt is correlated with Kailua volcanic series, and the upper basalt with the bulk of Koolau volcanic series. In places, however, flows of the Koolau series overlie Waianae series with erosional uncon.

Waits River limestone.

Ordovician: Northeastern Vermont (Orange, Washington, Orleans, Essex, and Caledonia Counties) and southeastern Vermont (Windsor County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., pp. 79–115). *Waits River ls.* replaces *Washington ls.* (preoccupied), which was introduced for the calc. memb. of calciferous mica schist. The fm. consists of lss. interstratified with numerous beds of phyllite schist. Three distinct phases of the ls. can be recognized in field.

The first is a beautifully banded variety closely resembling the Columbian marble of Rutland, Vt. This variety is typically developed at Waits River [NE. part of Orange Co.], Vt. [The other "phases" are described.] Uppermost members of Waits River ls. are Lower Trenton.

C. H. Richardson, 1908 (6th Rept. Vt. State Geol., pp. 265–291). *Waits River ls.*—Replaces preoccupied name *Washington ls.*, but *Washington* is here retained for one of the 3 distinct phases of Waits River ls. The first phase is the beautifully banded variety closely resembling Columbian marble of Rutland, Vt. The second, the dark steel-gray *Washington phase* (Lower Trenton) of Derby, Brownington, Newport, and Coventry. The third or *Coventry phase* is darker than the other two, more carbonaceous, sometimes shaly, and never susceptible of polish.

C. H. Richardson, 1912 (8th Rept. Vt. State Geol., pp. 162–183). Upper members of *Waits River ls.* are undoubtedly Lower Trenton. The lower members are much earlier than Trenton. The fm. is divided into 3 phases: Coventry phase, Washington phase, and *Waits River phase*. Latter is lighter-colored than the other phases and in some instances is variegated. Named for Waits River village [Orange Co.], near which it has been quarried for years. The Memphremagog sl. (Lower Trenton) and Waits River ls. are interstratified.

G. H. Perkins, 1912 (8th Rept. Vt. State Geol., pp. 21–56). Reference of Memphremagog sl. and Waits River ls. to Trenton is not certain but probable.

C. H. Richardson and H. G. Turner, 1914 (9th Rept. Vt. State Geol., pp. 283–293). No logical reason for placing Memphremagog sl. as other than Lower Trenton.

C. H. Richardson, 1916 (10th Rept. Vt. State Geol., pp. 120–146). *Waits River ls.* includes beds of quartzose marble, some calc. qtzite, and many beds of phyllite schist interstratified. Where the calc. sediments appear to predominate the area is mapped as ls.; where the non-calc. sediments predominate the area has been mapped either as sl. or phyllite schist, according to amount of secondary cleavage that has been introduced and amount of metamorphism. Age of Memphremagog sl. and Waits River ls. probably ranges from Deepkill [Beekmantown] to Lower Trenton. Author never contended they were all Lower Trenton, but advocated that deposition began fairly early in Ord. time and ceased in Lower Trenton. Paleontologic evidence now supports that view.

C. H. Richardson, 1924 (14th Rept. Vt. State Geol., pp. 77–103). The phyllites here named *Randolph phyllite*, of Memphremagog group, are interbedded and interstratified with *Waits River ls.* The Orleans phyllite of Jacobs underlies Waits River ls. and Bradford schist overlies the Waits River. The Waits River and Washington phases of the ls. are both present in Bethel Twp.

E. L. Perry, 1929 (16th Rept. Vt. State Geol.). The *Memphremagog group* of slates and phyllites occurs in and near base of Waits River ls. in northern section. Randolph phyllite is a phase of Waits River ls.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, p. 360), assigned, without discussion, *Waits River ls.* to Lower Ord. (Chazy); Randolph phyllite to Middle Ord. (Black River); and Memphremagog sl. to the Beekmantown; and stated that Waits River ls. had yielded Chazy fossils and that Memphremagog sl. had yielded Beekmantown fossils.

Waits River phase (of Waits River limestone).

See 1912 entry under *Waits River ls.* In many subsequent Vt. repts Richardson continued to use this term.

Wakarusa limestone. (In Wabaunsee group.)

Pennsylvanian: Northeastern Kansas and southeastern Nebraska.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 30). *Wakarusa ls.*—Very fossiliferous ls., 2 to 4 ft. thick, included in Upper Coal Measures of Shawnee Co. Named for fine exposure on Wakarusa Creek immediately S. of Auburn. [From statement on p. 28 it appears to underlie Auburn sh. and overlie Soldier Creek sh.]

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser.). *Wakarusa ls.* underlies Auburn sh. and overlies Soldier Creek sh. Was named by Beede in 1898. Is same as "Fargo" ls. of Condra and Bengston. In places it is one solid ls. 6± ft. thick; in other places it is 2 dense blocky bluish lss. separated by 1 to 4 ft. of argill. sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 49, 218–225). *Wakarusa ls.* underlies Auburn sh. and overlies Soldier Creek sh. [p. 49]. Beede's original Wakarusa ls., however, is identified as Reading ls.; and Wakarusa ls. as now defined by usage, mainly by Condra, was included in upper part of Beede's "Stanton" (=Burlingame) ls. [p. 219]. Condra's 1927 usage of *Wakarusa ls.*

seems to agree with Beede's original definition, but when the ls. called Wakarusa by Condra is traced to southern Shawnee Co., Kans., it is found to comprise upper memb. of Beede's "Stanton" ls. It is desirable to separate this unit from Burlingame ls., and because Condra's use of *Wakarusa* is the only one since original publication, and because this name has been extensively employed recently with application given it by Condra, it is here retained with Condra's definition. This is case where usage desirably takes precedence over priority. The beds called *Wakarusa ls.* by Condra and here designated by that name are present along Wakarusa Creek S. of Auburn, but much better exposures are on Kansas Highway 10 W. of Topeka, in sec. 35, T. 11 S., R. 13 E., and along the creek N. of the highway near this place [p. 220].

Wakefield marble.

Commercial term substituted for *Winooski marble* of Vt. by company quarrying the marble. (See G. H. Perkins, Am. Nat., vol. 19, 1885, pp. 128–136.)

†Wakulla formation.

Miocene (lower): Northern Florida.

L. C. Johnson, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 128–132). Defined in a more extended sense, the Chattahoochee embayment will stretch out almost to basin of Suwanee River, or at least to about middle of Madison Co., Fla. The rocks found in this extension present quite another aspect. When collections were first made in this part of Fla. a few years ago, the leading type was called [in unpublished ms.?] *Wakulla fm.*, because it abounds in vicinity of springs of that name [in Wakulla Co.]. The material was taken out of a deep well 2 mi. SW. of Tallahassee. The leading features of this rock were an abundant *Hemicardium* (species not determined so far as writer is aware) and the large *Orbitulites floridana*, together with many land shells. The rocks vary greatly in material; sometimes a quite pure ls., at other places, or in other layers, aluminous and siliceous. The collection from the well shows a good ls., with calcite filling the cavities left by removal of the substance of the shells, and with some lumps or streaks of chert; the deposit was said to be 80 ft. thick. Assigned to Mio.

The deposits above described are now regarded as belonging to Tampa ls. (See C. W. Cooke and S. Mossom, Fla. Geol. Surv. 20th Ann. Rept., pp. 92–93, 1929.)

†Walden sandstone. (In Pottsville group.)

Pennsylvanian: Southeastern Tennessee, northeastern Alabama, and northwestern Georgia.

C. W. Hayes, 1892 (Ala. Geol. Surv. Bull. 4, pp. 49–51). *Walden ss.*—Sss. and shales, with beds of coal and fire clay. Overlies heavy cgl. [Sewanee cgl.] constituting top memb. of Lookout ss., and forms top part of Coal Measures in NE. Ala. and adjacent portions of Ga. and Tenn. Thickness 500 or more ft. More homogeneous than underlying Lookout ss. Contains most of coal of region. Is=Upper Coal Measures of Smith.

Comprises upper part of Pottsville group of this region. Is=Rockcastle ss., Vandever sh., Bonair ss., and Whitwell sh. of present classification of central Tenn.

Named for exposures on Walden Ridge, Chattanooga, Pikeville, and Kingston quads., SE. Tenn.

†Walden Ridge sandstone.

A name applied, probably inadvertently, by S. W. McCallie (Ga. Geol. Surv. Bull. 17, 1908, p. 47) to *Walden ss.*

†Waldo formation.

Miocene (lower): Northern Florida.

L. C. Johnson, 1888 (Am. Jour. Sci., 3d, vol. 36, pp. 230–236). The *"Chimney rock," or Waldo fm.*, having Mio. fossils, and generally phosphatic. Is the site and source of phosphatic rocks of this part [northern and central] of Fla. Thickness not less than 10 ft. and possibly 50; average 30 ft. In places has suffered much erosion, and the reworked material has often been redeposited in beds of uncertain age, making a cgl. with clay, bones, and nodules of the rock. Undisturbed and in situ it may be seen, among other places, near Waldo [Alachua Co.], at old Fort Harlee, in Preston's marl bed. Fossils at this locality innumerable.

Replaced by *Hawthorn fm.* (See C. W. Cooke and S. Mossom, Fla. Geol. Surv. 20th Ann. Rept., pp. 129–130, map, 1929.)

Waldoboro moraine.

Pleistocene (Wisconsin): Central southern Maine.

G. H. Stone, 1887 (Am. Jour. Sci., 3d, vol. 33, pp. 381–385). *Waldoboro moraine.*—Named for occurrence about 3 mi. N. of Waldoboro, Lincoln Co.

†Waldrip division.

Pennsylvanian: Central Texas.

E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, p. lxvii). *Waldrip-Cisco series.*—Alternating clays, shales, fire clays, and lss., with coal seams, overlying Brownwood-Ranger series and underlying Coleman-Albany series.

R. S. Tarr, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 207–210). *Waldrip coal div.*—Alternating clays, shales, sss., and lss., 300 ft. thick, with basal ss. 100 to 500 ft. thick. Overlies Brownwood div. and underlies Coleman div.

Same as Cisco group.

Named for Waldrip, McCulloch Co.

†Waldrip bed.
†Waldrip formation. } (In Cisco group.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 412). *Waldrip bed.*—Chiefly blue clays, but locally ss. of considerable thickness, three well-marked and persistent lss., and some shaly clay, carbonaceous sh., and a coal bed. Thickness 100 to 200 ft. Memb. in middle of Cisco div. Underlies Saddle Creek bed and overlies Chaffin bed.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Waldrip fm.*—Is characterized by a coal bed below *Waldrip ls.* (top memb. of Waldrip fm.) which forms a conspicuous scarp throughout its outcrop. At Cisco the ls. is a dense crystalline and dark-gray fossiliferous bed, but in N. part of Shackelford Co. W. of Breckenridge it changes to ss. and disappears. Another ls., however, occurs about 40 ft. lower and can be traced farther N. To NE. of Newcastle the fm. is composed largely of sand. In places where the coal does not outcrop the Waldrip ls. can be identified by the large numbers of large crinoids on its surface and the characteristic fossils from the sh. just below. Underlies Pueblo fm. and overlies Breckenridge fm.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132), replaced their Waldrip fm. with *Harpersville fm.* and correlated their Waldrip ls. memb. with Saddle Creek ls. of Drake and the remainder of Harpersville fm. with Waldrip bed of Drake.

Named for Waldrip, McCulloch Co.

†Waldrip limestone member (of Harpersville formation).

Pennsylvanian: Central northern Texas.

F. B. Plummer, 1919 (A. A. P. G. Bull., vol. 3, pp. 133–145). *Waldrip ls.*, a memb. of Waldrip fm. [See 1919 entry under †*Waldrip bed.*]

In 1922 Plummer and R. C. Moore replaced this name with *Saddle Creek ls. memb.*, finding it to be same as Drake's older name *Saddle Creek bed.*

Waldrip member. (In Harpersville formation.)

Pennsylvanian: Central Texas (McCulloch County, Colorado River region).

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 238–244). Drake applied *Waldrip beds* to all strata btw. top of Breckenridge ls. below and base of Saddle Creek ls. above, which makes it nearly synonymous with Harpersville fm., since it covered all of the Harpersville except the thin Saddle Creek ls. In this paper (on McCulloch Co.) the name *Waldrip beds* is restricted to the 65± ft. of strata (sh., ss., coal beds, and 3 thin lss.) from base of Waldrip ls. No. 1 of Drake up to base of Saddle Creek ls. memb. The beds underlying this *Waldrip memb.* are here designated as *Lower Harpersville*. They consist of 90 ft. of reddish to yellowish clay beds separated by relatively thin red to brown sss. The Waldrip ls. No. 1 lies 2 to 3 ft. above a thin impure coal bed near top of Lower Harpersville beds.

Waldron shale. (In Indiana.)

Waldron clay member (of Wayne formation) in Tennessee.

Silurian (Niagaran): Indiana and west-central Kentucky and Tennessee.

M. N. Elrod, 1883 (Ind. Dept. Geol. and Nat. Hist. 12th Ann. Rept., pp. 106–111). *Upper Niagara or Waldron sh.*—Calc. clay, sh., and thin strata of ls., 10 in. to 6 ft. thick, overlying the quarry stone and closing Niagara period or group in Decatur and Shelby Counties, central Ind. Overlain by Lower Corniferous ls. and underlain by quarry stone of Niagara age.

Adopted by U. S. Geol. Survey as a distinct fm. in Ind. and north-central Ky., and as *Waldron clay memb.* of Wayne fm. in west-central Tenn. In southern Ind. is discon. overlain by Louisville ls. (35 ft. thick and forming top fm. of Niagaran age in that region) and is underlain by Laurel ls. In west-central Tenn. *Waldron clay memb.* is overlain by two ls. members of Wayne fm. and underlain by Laurel ls. memb. of the Wayne.

For occurrence of Waldron fauna in Ohio see *Massie clay.*

Named for Waldron, Shelby Co., Ind.

†Waldron sandstone. (In Douglas formation.)

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 52), mentioned "Waldron ss. alternating with sh." as occurring in interval btw. coals Nos. 4 and 5 near Weston, Mo. Is now considered to be a channel deposit in Lawrence sh. memb. of Douglas fm.

Named for exposures at Waldron, Platte Co.

Wales group.

Pre-Ordovician to Devonian: Southeastern Alaska (Prince of Wales Island).

A. H. Brooks, 1902 (U. S. G. S. P. P. 1, pp. 40–52, map). *Wales series.*—Crystalline white lss. and argillites or phyllites, with closely associated greenstones. The lss. alone are probably several thousand ft. thick. Lower part is chiefly argill. and upper part calc. Occupies large area on Prince of Wales Island. Uncon. underlies Vallenar series. Believed to be of Sil. and presumably older Paleozoic age.

Walker shale.

Upper Devonian: Southwestern Virginia.

M. R. Campbell, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 171, 177, pl. 4). *Walker black sh.*—Constitutes lower portion of great series of Dev. shales [in Wythe, Montgomery, and Pulaski Counties, Va.] and is separated entirely by its color. Is black carbonaceous sh., and the passage from this into the green sh. above is very gradual and is accomplished by interbedding, so that it is impossible to determine exactly where the line should be drawn. It is arbitrary at best and serves only to show that base is essentially a black sh. which, in a broad way, is clearly distinguishable from green sh. above. Overlies Giles fm. and underlies Kimberling sh.

Named for Walker Mtn, Giles Co.

†Walker beds.

Lower Cretaceous (Comanche series): Central southern Kansas.

F. W. Cragin, 1895 (Am. Geol., vol. 16, p. 359). *Walker beds* is suggested as substitute for *Belvidere beds in broad sense* (i. e., to include Cheyenne ss., Champion shell bed, and Kiowa shales), in case conflicting uses of *Belvidere* should make that name not acceptable. But *Belvidere* seems preferable to *Walker.*

Named for Walker's Draw, a well-known branch of Medicine Lodge River S. of Belvidere, Kiowa Co.

Above is only known use of *Walker* for this unit. *Belvidere* and *Walker* were discarded by U. S. Geol. Survey in 1921, the Cheyenne ss. and Kiowa sh. being treated as fms. and the Champion shell bed being included in Kiowa sh.

Walker conglomerate and sandstone.

Pennsylvanian: Western Missouri (Vernon County).

F. C. Greene and W. F. Pond, 1926 (Mo. Bur. Geol. and Mines vol. 19, 2d ser., pp. 62–65). *Walker cgl. and ss.*—This fm. includes the uncon. cgl. near Walker and the coarse ss. into which it grades. It consists of cgl. at base, very coarse ss. above, and coarse ss. at top, the three types of rock grading into each other. The cgl. at base is very coarse, consisting chiefly of ls. pebbles derived from Rich Hill ls. memb. of Cherokee fm., with a liberal sprinkling of angular to subangular quartz pebbles. The Walker fm. has been found at only one place, the crest of the ridge which extends to NW. on Walker Mound (sec. 8, T. 36 N., R. 30 W.). About 20 ft. of the material is in place at NW. end of outcrop. It rests uncon. on lower part of the sh. memb. of Cherokee fm. that overlies the Williams coal. Evidence indicates it is southern continuation of Warrensburg channel ss., of late Pleasanton age. No fossils except a few in the ls. fragments of the basal cgl.

Walker formation.

Miocene: Southern California (Kern County).

V. H. Wilhelm and L. W. Saunders, 1927 (Calif. State Min. Bur. vol. 12, No. 7, p. 9, pl. 1). *Walker fm.*—A series of land-laid beds, consisting of sands and shales of characteristic greenish color. The fm. changes rapidly in type from bed to bed and may be considered to be formed from variable proportions of 2 types of constituents—(1) granitic, including widespread unsorted angular quartz grains and white decomposed feldspar grains, large biotite flakes, and dark-green and red opaque clays; (2) volcanic, including white clays and ashy materials, and shales, also green soapy clays which form the matrix for fragmentary granitic debris. The fm. has widespread distribution in area and is characteristically continental in origin. Its deposition represents first stage of erosion of old granitic land mass to E. Only 3 wells have penetrated this fm., the thicknesses encountered being 370, 555, and 594 ft. Uncon. underlies Temblor fm. (middle Mio.) and rests uncon. on granitic basement. [Derivation of name not stated; no indication of age or whether or not exposed.]

H. A. Godde, 1928 (Calif. Oil Fields, Div. Mines and Min., vol. 14, No. 1, pp. 5–10). *Walker fm.* is lower memb. of Temblor group; is probably lower Mio. and may be = Vaqueros fm. Thickness 0–1,200 ft.; av. 700± ft. Uncon. underlies Temblor fm. and rests uncon. on granite. [Derivation of name not stated. Appears not to be exposed on surface.]

A. Diepenbrock, 1933 (Calif. Oil Fields, Div. Oil and Gas, vol. 19, No. 2, p. 19). There is little evidence as to age of *Walker fm.*, other than that Vedder sands grade into it. Basinward the fm. decreases in thickness, and it is possible it is a facies of Vedder sand. Rests on granite.

Walker sand.

A subsurface sand, of Penn. age and 15± ft. thick, in central northern Okla., correlated with part of Sand Creek fm. In Garber pool, Garfield Co., this sand lies at 1,500 ft. depth, the Hotson sand at 1,430 ft., and the Belveal at 1,600 ft.

Walker Ridge sandstones.

Post-Franciscan and pre-upper Miocene: Northern California (Humboldt County).

W. Stalder, 1915 (Calif. State Min. Bur. Bull. 69, pp. 447–449). *Walker Ridge sss.*, upper fm. of Rainbow series in Humboldt Co. Overlie Walker Ridge shales. Thickness 50 to 750 ft. Mostly siliceous and well cemented. Vary in color from green to gray; weather yellowish. Older than upper Mio. Named for exposures on Walker Ridge, Humboldt Co.

Walker Ridge shales.

Post-Franciscan and pre-upper Miocene: Northern California (Humboldt County).

W. Stalder, 1915 (Calif. State Min. Bur. Bull. 69, pp. 447–449). *Walker Ridge shales.*—Bluish to black to gray soft sh. beds alternating with fine- to medium-grained gray to bluish sss. varying from 3 in. to 10 ft. Minor bands of ls., some chert, and lenses of calcite at a few localities. Thickness 500 to 1,500 ft. Basal fm. of Rainbow series. Underlies Walker Ridge sss. Named for Walker Ridge.

Walkup clay.

Eocene: Northern California (Chico quadrangle).

V. T. Allen, 1929 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 18, No. 14, pp. 364, 403). *Walkup clays.*—Crudely bedded gray clays, which in some places become shaly and contain thin lenses of ls.; weather buff or yellowish. Less than ½ mi. E. of Gladding McBean pit these clays appear at surface at Walkup pit. Fossils listed. Rest on Cret. ss. Limited evidence points to Eo. age of Walkup clays. Contact with overlying Ione fm. not exposed. Walkup clay is somewhat different from clays of Ione fm., and there is marked difference in ceramic qualities. So even though no sharp break is known to separate the 2 fms. in field, it seems desirable to use name *Walkup* (already in use locally) to denote this transitional stage to Ione conditions.

Wallace formation.

Pre-Cambrian (Belt series): Northeastern Idaho (Coeur d'Alene district) and western Montana (Cabinet Mountains and Philipsburg district).

F. L. Ransome, 1905 (U. S. G. S. Bull. 260, pp. 277–285). *Wallace fm.*—Upper part, thin-bedded sandy shales; middle part, rapidly alternating thin beds of argillite, calc. ss., impure ls., and indurated calc. sh.; lower part, green siliceous argillites. Shallow-water features throughout; slaty cleavage common. Thickness 2,500± ft. Underlies Striped Peak fm. and overlies St. Regis fm. Well exposed at town of Wallace, Coeur d'Alene dist., Idaho, particularly at Northern Pacific R. R. station. Description of general geology of region is based almost wholly on work of F. C. Calkins.

Wallace Creek formation.

Southern Quebec and northwestern Vermont.

See under *Morgan Corners fm.*, also 1931 entry under *Philipsburg series.*

†Wallala beds.

†Wallala group.

Upper Cretaceous: Northwestern California (Mendocino County).

G. F. Becker, 1885 (U. S. G. S. Bull. 19, pp. 7–17). *Wallala beds.*—A series of sss. and cgls. extending along the coast from near Fort Ross at least to Wallala. In some places they rest uncon. on metamorphosed rocks thought to belong to Knoxville group. Fauna not decisive as to age. Fossils collected near Wallala are regarded by C. A. White as probably pre-Chico and younger than Knoxville.

C. A. White, 1885 (U. S. G. S. Bull. 22, p. 8). *Wallala group.*—Since so little is known of strat. relations of Wallala and San Diego beds with other fms. I cannot now discuss them fully, but I shall give them the provisional name *Wallala group,* referring those of both localities to one and same fm.

The beds referred to belong to lower part of Chico fm.

Wall Creek sandstone member (of Frontier formation).

Upper Cretaceous: Eastern Wyoming.

C. H. Wegemann, 1911 (U. S. G. S. Bull. 452, pp. 43, 45). *Wall Creek ss. lentil of Benton sh.*—Buff ss., ripple-marked and cross-bedded, firmly cemented, and of medium grain. Thickness 80 to 100 ft. Contains petrified wood, marine shells, and fish teeth. Is principal oil sand of Salt Creek field. Lies 220 ft. below Niobrara sh. and 800 ft. above Mowry sh. Not exposed in Salt Creek field but reaches surface in an escarpment 12 mi. W. of Salt Creek, which rims Powder River dome, forming the lofty escarpment known locally as "The Wall," and is best exposed above Wall Creek, a little stream named for it. Is 80 to 100 ft. thick along Wall Creek, but in Salt Creek dome thicknesses as great as 150 ft. are reported in some wells.

Later work resulted in tracing this ss. over considerable area, and the name was therefore changed to *Wall Creek ss. memb.* Subsequently the deposits of Benton age in this part of Wyo. were differentiated into (descending) Carlile sh., Frontier fm., Mowry sh., and Thermopolis sh., and the Wall Creek ss. was found to form top memb. of Frontier fm. The drillers in this part of Wyo. began to identify sands in this part of the geol. column as (descending) "First Wall Creek sand," "Second Wall

Creek sand," and "Third Wall Creek sand." Of these, the "First Wall Creek sand" is Wall Creek ss. memb. as defined. The "Second Wall Creek sand" has also been called "Lower Wall Creek sand."

Wall Creek sands of drillers.

See explanation at end of *Wall Creek ss. memb.*

Wallingford dolomite.

Lower Cambrian: Southwestern Vermont (Rutland County).

A. D. Hager, 1861 (Rept. geol. Vt., vol. 2), mentioned *Wallingford marble*, trade name.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 397). *Wallingford dol.*—Mainly light- and dark-gray dolomites like those of Rutland dol. Interstratified are thin beds of dolomitic or qtzitic light-gray ss. Thickness 300± ft. Bdy btw. Wallingford dol. and underlying Danby fm. is not sharp and is mainly marked by close of the strong qtzite sedimentation, the variable colors of the dol., and the sl. beds. Type loc. is Wallingford Twp, where it is well exposed. Is older than Clarendon Springs dol.

†Wallkill limestone.

Lower Ordovician and Upper Cambrian: Northern New Jersey.

J. E. Wolff and A. H. Brooks, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, pp. 443–454). *Wallkill blue ls.*—Normally a blue ls., fine-grained, homogeneous, becoming aren. or shaly as it merges into underlying Hardistonville [Hardyston] qtzite. One belt of it occupies Wallkill Valley S. of Franklin Furnace.

H. B. Kümmel, 1901 (N. J. Geol. Surv. Ann. Rept. State Geol. 1900, p. 31). In recent rept (U. S. G. S. 18th Ann. Rept, pt 2, p. 443) upon Kittatinny ls. in vicinity of Franklin Furnace and Hamburg, Wolff and Brooks used *Wallkill ls.* for that part of this fm. included in their studies. The term Kittatinny is, however, preferable, as the ls. is on the whole not well exposed along Wallkill River, and it is preeminently the great ls. fm. of Kittatinny Valley.

Walloomsac slate.

Middle or Lower Ordovician: Eastern New York (Rensselaer County), southwestern Vermont (Bennington County), and northwestern Massachusetts.

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 268–269 (map), 274–275). *Walloomsac sl.*—Thick series of dark smooth shales and soft slates that carry graptolites and rest on Ord. lss. Actual contact not seen, but areal relations of the 2 fms. in and near valley of Hoosic River make it likely the black sl. rests conformably upon the uppermost dark-blue crinoidal lss. of the calcitic lss. and marble beds. Overlies lss. of Chazy age, and is=upper Normanskill zone of Capitol dist., which is of Chazy and possibly Black River age. Named for extensive distribution in valley of Walloomsac River, W. and NW. of Bennington, Vt., in both Bennington Co., Vt., and Rensselaer Co., N. Y.

Walnut clay. (In Fredericksburg group.)

Lower Cretaceous (Comanche series): Eastern Texas.

R. T. Hill, 1891 (Geol. Soc. Am. Bull., vol. 2, pp. 504, 512). *Walnut clays* is name proposed for yellow laminated clay marls containing *Exogyra texana* and overlying and underlying the *Gryphaea* rock in Tex.-Ark. region. These clays are not always present where the *Gryphaea* rock is. The *Gryphaea* rock consists of grypheate oysters, occurring sometimes in solid masses 10 to 50 ft. thick, in some places embedded in calc. matrix. The Walnut clays overlie Paluxy sand and underlie Comanche Peak chalk. Included in Fredericksburg. [He also calls them *Walnut clays or Exogyra texana beds*. Later repts give thicknesses of 0 to 130 ft.]

Basal fm. of Fredericksburg group. See under *Fredericksburg group*. Named for Walnut (also called Walnut Springs), Bosque Co.

†Walnut shale.

Pennsylvanian: Eastern Kansas and northeastern Oklahoma.

E. Haworth and J. Bennett, 1908 (Kans. Acad. Sci. Trans., vol. 21, pt. 1, p. 74). *Walnut sh.*—Shales overlying Altamont ls. and underlying Coffeyville [Lenapah] ls.

Preoccupied. Replaced by *Nowata sh.*

Named for Walnut, Crawford Co., Kans., around which it is the surface rock.

Walnut shaly member (of Goodland limestone).

Lower Cretaceous (Comanche series): Northeastern Texas (Grayson County) and southern Oklahoma.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, pp. 135–137). The basal 3 to 6 ft. of Goodland ls. consists of layers of persistent hard thin-bedded coquina-like ls. with interbedded thin layers of dark marly sh., which in this paper are called *Walnut shaly memb.* These beds were not recognized by Hill (Geol. Soc. Am. Bull., vol. 2, pp. 502–514, 1891) in type section [of Goodland ls.] at Goodland, Choctaw Co., Okla. In 1894, and again in 1901, Hill restricted Goodland to massive ls. btw. Walnut clay below and Kiamichi clay above. In Atoka and Tishomingo folios Taff included Walnut clay in the Goodland, and this usage has subsequently been followed by Taff and other authors. Although U. S. Geol. Survey has adopted Taff's usage of Goodland, the present writer is of opinion future investigations will demonstrate appropriateness of restricting Goodland to the massive ls. above the interbedded shaly clay and coquina-like ls. here called *Walnut shaly memb.*, in accordance with Hill's original usage. The Walnut shaly memb. is correlated with Walnut clay of central Tex.

Some geologists have expressed belief that this bed is younger than any part of typical Walnut clay, and some geologists now exclude the bed from Goodland ls. (See W. M. Winton and W. S. Adkins, Univ. Tex. Bull. 1931, 1920, who called the beds *Walnut shell cgl. and clays*; also see G. Scott and J. M. Armstrong, Univ. Tex. Bull. 3224, 1932, who called the beds *Walnut shell aggl.*)

See also under *Goodland ls.* and *Fredericksburg group.*

Walsingham formation.

Pliocene: Bermuda Islands.

A. E. Verrill, 1907 (Conn. Acad. Arts and Sci. Trans., vol. 12, p. 68). [Assigned to Plio., and thus classified by several other geologists, but Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 740), assigned it to Pleist.]

Waltersburg sandstone. (Of Chester group.)

Mississippian: Southern Illinois and western Kentucky.

S. Weller, 1920 (Jour. Geol., vol. 28, No. 4, pp. 281–290, and No. 5, pp. 395–416; also Ill. Geol. Surv. Bull. 41). *Waltersburg ss.*—Massive cliff-making ss. that resembles the other sss. of Chester group. Thickness 0 to 70 ft. Absent in Mississippi River counties. Present in Pope and Johnson Counties. Underlies, apparently conformably, Menard ls. [restricted]; overlies, also apparently conformably, Vienna ls.

Named for exposures at Waltersburg, Pope Co., Ill.

Waltham gneiss.

Pre-Cambrian: Eastern Massachusetts.

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Waltham gneiss.*—A complex of gneisses of several varieties, probably mainly if not wholly of igneous origin. Comprises several varieties of biotite-bearing and hornblende-bearing gneiss, some aplitic gneiss, and a few porphyroid gneisses containing conspicuous crystals of feldspar in a matrix composed largely of biotite. The aplitic varieties appear to be intrusive into rest of complex and may be part of a much younger intrusive group. Oldest fm. in Boston quad. Age indeterminate but is regarded as probably pre-Camb., and quite possibly it is Archean. Occupies much of northern Waltham, SE. Lexington and Burlington, and NW. Woburn. Extends NE. into Lawrence and Salem quads. and SW. into Framingham and Franklin quads.

Wamsutta formation.

Carboniferous: Southeastern Massachusetts and eastern Rhode Island.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, pp. 134, 141–158 and pl. 17). *Wamsutta series* (also *Wamsutta group of red beds*).—A lithological unit of red beds, which in southern parts of Narragansett and Norfolk Basins are in part represented by ordinary gray and carbonaceous sediments of lower part of overlying Rhode Island Coal Measures. Along northern margin the red series underlies the Coal Measures; at Pawtucket it is interstratified with them. The beds consist of slates, shales, sss., arkose, and cgls. Includes flows of felsite and aggls. of felsitic material. Thickness 1,000+ ft. Rests on Pondville cgl. Wamsutta is a name proposed but not actually adopted for North Attleboro, Mass., where the Wamsutta Mills are located.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 54 and map). *Wamsutta fm.*—A group of characteristically red beds, composed of sss., felsite, aggls., arkose, and sh. The sediments, which include both felsites and melaphyres, are interbedded with some tuffs and flows of volcanic rock. Overlies Pondville cgl. where present, or rests on older rocks.

†Wamsutta volcanics.

A term applied by J. B. Woodworth (U. S. G. S. Mon. 33, pp. 155-156, 1899) to the volcanic flows interbedded in Wamsutta fm. of SE. Mass. and R. I.

Wanakah shale.

Middle Devonian: Western and central New York.

A. W. Grabau, 1917 (Jour. Geol., vol. 25, p. 338, footnote). The lower Hamilton shales, underlying the Encrinal ls. of western N. Y., are now designated *Wanakah shales* by me.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 225). *Wanakah memb. of Ludlowville fm.*—Grabau in 1917 proposed this name for the sh. below the "Encrinal" of Eighteenmile Creek (Tichenor of this paper), but did not define it further. In this paper his name is used for the sequence beginning [below] with the *Strophalosia* and *Pleurodictyum* beds of Grabau and terminating at top with base of Tichenor. Type section is in Wanakah and Lakewood Beach Cliffs, Lake Erie. Thus defined it can be traced E. to Seneca Lake. Is chiefly light and dark blue-gray shales but contains a number of thin bands of ls. (Trilobite beds), which are remarkable for their persistence for nearly 100 mi. The Wanakah memb. overlies Ledyard memb. [Thickness of Wanakah not stated, but it appears, from section on p. 218, to range from 30 ft. at Lake Erie to 60± ft. at Seneca Lake, to E. of which it corresponds to lower part of Kings Ferry memb.]

Wanakah member (of Morrison formation).

Upper Jurassic: Southwestern Colorado (Ouray district).

W. S. Burbank, 1930 (Colo. Sci. Soc. Proc., vol. 12, No. 6, p. 172). *Wanakah memb. of Morrison fm.*—Basal memb. of Morrison fm. in Ouray dist. Thickness 124.9 ft. Divisible into 3 lithologic units (descending): (1) Sh. div. (the basal "McElmo" of Cross), 47 ft.; (2) ss. ("Upper La Plata" ss. of Cross), 19 ft.; (3) basal sh., ls., and breccia (the "Pony Express beds," called by miners "Pony Express ls." and "Pony Express contact"), 58½ ft. Rests on Upper(?) Jurassic ss. and underlies the thick ss. memb. of the Morrison. Named for exposures in Wanakah mine.

Wanapitei quartzite.

Pre-Cambrian: Ontario.

A. P. Coleman, 1914 (Ont. Bur. Mines Ann. Rept., vol. 23, pt. 1, p. 213).

See *Wahnapitae qtzite*, Coleman, 1915.

†Wando clays and sands.

Pleistocene: Southern South Carolina (Charleston County).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908 publication cited below); 1907 (Summary of mineral resources of S. C., table on p. 12); 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, p. 484, definition). *Wando clays and sands.*—White sands and a layer of drab clay (frequently stained red); successively overlie Accabee gravels. This sequence is established at Corn Hill, above Accabee Flats, on the Ashley, and elsewhere; it occurs most extensively developed along Foster's Creek and Wando River. The base of the drab clay, along its upper limits on the Cooper, attains elevation of 50 ft. (M. L. T.), which declines to low-tide level at Dean Hall, and is exhibited near tide level along Foster's Creek and Goose Creek, from which area it probably sweeps around by Accabee Flats, on the Ashley, and proceeds irregularly to

SW., while from the Cooper exposures it extends northeasterly. The clay fm. is generally missing, but the Wando sands are widely distributed. They are characterized by abundant enclosure of fine black particles, as may be observed at Simmons' Bluff and at base of the bluff along southerly side of Wappoo Cut. Is a marine Pleist. fm.

C. W. Cooke (personal communication, 1935). The beds described are a facies of Pamlico fm.

Named for exposures along Wando River, btw. Charleston and Berkeley Counties.

Wanipigow series.

Pre-Cambrian: Ontario and Manitoba.

W. G. Miller and C. W. Knight, 1914 (Ont. Bur. Mines Rept., vol. 22, pt. 2, p. 138).

†Wann formation.

Pennsylvanian: Northeastern Oklahoma.

D. W. Ohern, 1910 (Okla. State Univ. Research Bull. 4, p. 28). *Wann fm.*—Shales, sss., and lss. occupying interval btw. top of Curl fm. below and top of Stanton ls. memb. above. Divided into Stanton ls. memb., Copan memb., and Hogshooter ls. memb.

These rocks are now divided into (descending) Ochelata fm., Dewey ls., Nellie Bly fm., and Hogshooter ls.

Named for Wann, Nowata Co.

Wanswangoning quartzite.

A misprint (on p. 410 of U. S. G. S. Bull. 191) for *Wauswaugoning qtzite.*

Wapanucka limestone.

Pennsylvanian (Pottsville): Central southern Oklahoma (Arbuckle Mountains) and southeastern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Wapanucka ls.*—In descending order: (1) White massive and often oolitic ls.; (2) cherty sandy lss. and shales; (3) massive white ls., absent in places; (4) calc. and cherty sss. grading into shales and into nearly pure ferruginous sss. Thickness 30 to 200 ft. Underlies Atoka fm. and overlies Caney sh.

E. O. Ulrich, 1927 (Okla. Geol. Surv. Bull. 45, pp. 24–25, 30), proposed redefining Wapanucka ls., stating that it should include the shaly lower beds with essentially the same early Penn. fauna that Morgan (1924) described in his rept on Stonewall quad. as "Upper Caney," and that Caney sh. should be restricted to the Miss. part (middle Meramec) of Caney sh. of the literature. Also that the Wapanucka is of lower Pottsville age and is separated from underlying Caney sh. by a hiatus representing Chester group and upper Meramec.

The fm. that underlies Wapanucka ls. is now known as *Springer fm.*; it was formerly included in Caney sh. The fm. that overlies the Wapanucka is Atoka fm. (See H. D. Miser, A. A. P. G. Bull., vol. 18, No. 8, 1934, pp. 971–1009.)

Named for Wapanucka, Johnston Co., which is located along N. border of the outcrop.

Wapellan series.

A term employed by C. [R.] Keyes to cover most of the pre-Wisconsin Pleist. deposits of Iowa. (See Pan-Am. Geol., vol. 56, p. 349, 1931.)

Wapiabi shale.

Upper Cretaceous: Alberta.

G. S. Malloch, 1911 (Canada Geol. Surv. Mem. 9, p. 37). [Assigned to Cret. Later repts, by other geologists, assign it to Benton, Upper Cret.]

Wapiti formation.

Upper Cretaceous: British Columbia and Alberta.

F. H. McLearn, 1919 (Canada Geol. Surv. Summ. Rept. 1918, pt. C, p. 5). *Wapiti fm.*, Cret., Alberta.

Later writers use the name in B. C. also and assign the rocks to Upper Cret.

Wapiti River sandstones.

Upper Cretaceous: British Columbia and Alberta.

G. M. Dawson, 1881 (Canada Geol. Surv. Rept. 1879–80, p. 15B). *Wapiti River ss.*, Cret., B. C., included in Fox Hill and Laramie.

†Wappinger limestone.

†Wappinger Valley limestone.

Middle Ordovician to Lower Cambrian: Southeastern New York. See under *Barnegat ls.*

Wapsipinicon limestone.

Middle Devonian: Eastern Iowa and southwestern Illinois (Calhoun and Jersey Counties).

W. H. Norton, 1895 (Iowa Geol. Surv. vol. 4, pp. 127, 155–166). *Wapsipinicon stage.*—Various lower beds of Dev. series in Iowa, including (descending) Upper and Lower Davenport beds (described as *Fayette breccia*), Kenwood beds (including Independence sh.), and Otis beds, with possibility future investigations may add to the stage the underlying Coggon beds (here tentatively placed in Sil.) [but in later repts included in Wapsipinicon ls.]. Underlies Cedar Valley ls.

See second entry under *Davenport beds.*

T. E. Savage, 1925 (Jour. Geol.), classified *Wapsipinicon ls.* as Upper Dev.; E. O. Ulrich (1911) as Middle Dev., correlating it with Marcellus and lower Hamilton of N. Y.

Rept. 9th Ann. Field Conf. Kans. Geol. Soc., 1935, fig. 1, divided *Wapsipinicon ls.* into (descending) Davenport, Spring Grove (new name), Kenwood, Otis, and Coggon members and treated Independence sh. as a distinct fm. overlying the Wapsipinicon. "It is not yet certainly known whether Wapsipinicon beds are Upper or Middle Dev. (Stainbrook, p. 248 of this Guidebook)."

Named for Wapsipinicon River, btw. Troy Mills, Linn Co., and Central City, Linn Co., Iowa.

Wapta formation.

Ordovician: Canada.

H. M. Ami, 1900 (Roy. Soc. Canada Proc. and Trans., 2d ser., vol. 6, sec. 4, p. 202).

Wapussakatoo group.

Pre-Cambrian: Labrador.

J. E. Gill, 1935 (Geol. Soc. Am. Proc. 1934, p. 78).

Warclub Lake series.

Pre-Cambrian: Ontario.

E. M. Burwash, 1934 (Ont. Dept. Mines 42d Ann. Rept., pt. 4, p. 47).

Ward limestone.

Middle Ordovician: Central Tennessee.

P. M. Jones, 1892 (Geol. of Nashville and immediate vicinity, pp. 36–38, Univ. Press, June 1892). *Ward ls.*—Dark-blue coarsely crystalline ls., cross stratification shown at a few places. Thickness 25 to 28 ft. Underlies False Dove ls. or *Cyrtodonta* bed. Overlies Dove ls. Contains few fossils. Named for fine exposure in Mrs. Ward's quarry, near the Hudson place on Addison Ave. and Pearl St., Nashville.

These beds were formerly included in Bigby ls., but R. S. Bassler, 1932 (Tenn. Dept. Ed., Div. Geol., Bull. 38), included them and underlying †Dove ls. in Cannon ls.

Ward gypsum.

Permian: Central northern Texas (Stonewall County).

L. W. Storm, 1929 (Tex. Bur. Econ. Geol., geol. map of Stonewall Co.). *Ward gyp.* lies lower in section than Croton gyp. and 40± ft. above Wagon Yard gyp.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 167). Ward gyp. of Storm lies about 300 ft. below Croton gyp. and about 100 ft. above Childress (Wagon Yard) gyp. It may be Eskota gyp. The name *Ward* is preoccupied and is discarded.

Wardner limestone.

Mississippian: British Columbia.

S. J. Schofield, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 160).

Ware schist.

Carboniferous: Central Massachusetts.

E. Callaghan, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, p. 230). A part of Brimfield schist is here designated tentatively as a separate fm., the *Ware*, because it was found to lie below the Paxton schist, which becomes thinner to W. and is feldspathic. The Paxton, Brimfield, and Ware may be Carbf.

E. Callaghan, 1931 (N. Y. Acad. Sci. Annals, vol. 33, pp. 29, 63, 64, 67, 74). *Ware fm.* is proposed for the biotite schist which underlies the Paxton feldspathic schist in anticline in W. part of Wachusett-Coldbrook tunnel. Formerly included in Brimfield schist. Occurs along Ware River near village of Coldbrook, hence name. The area of Brimfield schist (on Emerson's geol. map of Mass.) in which Oakham is located is roughly the area of Ware fm. [*Ware schist* on map.] May be Carbf. Thickness 1,900+ ft.

War Eagle sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 216). *Lower War Eagle ss.*—Massive aren. stratum, 20 to 30 ft. thick, underlying Little Cedar coal and separated from underlying Lower War Eagle coal by 2 to 10 ft. of black laminated sl. Named for association with War Eagle coal. [No Upper War Eagle ss. was described.]

Wark diorite.

Age (?): British Columbia.

C. H. Clapp, 1912 (Canada Geol. Surv. Mem. 13, p. 96).

Wark gneiss.

Jurassic: British Columbia.

C. H. Clapp, 1913 (Canada Geol. Surv. Mem. 36, p. 57).

†Warley Hill marl.

†Warley Hill phase.

Eocene (middle and upper): Western and central South Carolina (Barnwell and Orangeburg Counties).

E. Sloan, 1905 (S. C. Geol. Surv. geognostic map of S. C., advance copies; published in 1908, in S. C. Geol. Surv., ser. 4, Bull. 2); 1907 (Summary of mineral resources of S. C., pp. 12, 16). *Warley Hill marl*, also *Warley Hill phase*.—Along marginal line of Middle Eocene marls this fm. is exhibited in form of a fine-grained argill. yellow-green marl at base of Shell Bluff (observed at extremely low water), at Kennedy's scarp on Tinkers Creek, and along South Fork of the Edisto; in its more typical form it is exposed perhaps at Caw Caw Swamp, then at type loc., Warley Hill, beyond which it is observed slightly N. of Weeks Landing, and at Cave Hill and Poplar Creek. It is exhibited approx. conforming to water level of Edisto River from Tuckers Bridge (near Branchville) to Sullivan's Bridge (about 14 mi. N. of Jacksonboro); its seeming equivalent is also observed underlying Santee marl in bed of Lower Three Runs, at Usserys Bluff (Barnwell Co.). The typical materials consist of highly glauconitic harsh marls.

In a later rept (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 449, 454, 457–459, 1908) Sloan divided his Warley Hill phase into †Upper or Warley Hill fm. and †Lower or Caw Caw fm. and showed it as overlain by Santee and underlain by his Congaree phase.

The Warley Hill phase of Sloan as interpreted by C. W. Cooke (U. S. G. S. Bull. 867, 1936) is partly=McBean fm. (middle Eocene) and partly=Cooper marl (upper Eocene).

Named for exposures at Warley Hill, in E. part of Orangeburg Co.

Warm.

Name applied by C. [R.] Keyes (Pan-Am. Geol., vol. 46, 1926) to 25 ft. of cgl. at base of Kootenai fm. of Mont. Derivation of name unknown.

Warm Creek shale. (In Colorado group.)

Upper Cretaceous: Central northern Montana (Little Rocky Mountain region).

A. J. Collier and S. H. Cathcart, 1922 (U. S. G. S. Bull. 736F, p. 172). *Warm Creek sh.*—Includes all of Colorado group of Little Rocky Mtn region above Mowry sh. The upper 775 ft. consists of dark bluish-black marine sh. containing *Baculites*, *Inoceramus*, etc. The basal 360 ft. consists of dark-blue marine sh. containing very few fossils. Between these two parts lies Mosby ss. memb., a calc. ss., 5 ft. thick, containing many periwinkle-like fossils. The fm. is overlain by Eagle ss. Named for exposures along Big Warm and Little Warm creeks.

Warner basalt.

Tertiary: Northeastern California (Modoc County).

R. J. Russell, 1928 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 17, No. 11, pp. 416–425 and map). *Warner basalt.*—A thin sheet of basalt flows. The most widespread surface rock in Modoc Co., probably covering half the county. Thickness 0 to 600 ft. Named for exposures on sides of Warner Valley and for widespread distribution in Warner Lakes Range and Warner Range. Underlies rhyolite and overlies Cedarville series, the upper part of which contains flora considered to be Mascall (Upper and Middle Mio.). The Warner basalt is therefore considered much younger than Columbia River basalt.

R. E. Fuller, 1931 (Univ. Wash. Pub. in Geol., vol. 3, No. 1, pp. 15–45). Warner basalt of R. J. Russell was indicated by strat. relations to be lower Plio.

Warner sandstone member (of McAlester shale).

Pennsylvanian: Eastern Oklahoma (Muskogee, Haskell, McIntosh, and adjacent counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Warner ss. memb. of McAlester sh.*—Massive, very irregularly bedded ss., of medium texture; friable; brown; cross-bedded; contains clay blebs; very ferruginous; white mica common. Fossil plants. Thickness 40 ft. Overlies McCurtain sh. memb. and lies 8 to 40 ft. below Lequire ss. memb. Named for exposure W. of Warner.

Warren sandstone.

Mississippian: Northeastern Ohio.

H. P. Cushing, 1888 (Am. Ass. Adv. Sci. Proc., vol. 36, pp. 214–215). *Warren ss.*, 6 to 50 ft. thick, underlies Cuyahoga sh. and overlies [so-called] Berea sh. in Ashtabula and Trumbull Counties. Certain equiv. of Sharpsville ss. of I. C. White in Crawford Co., Pa.

Named for Warren, Trumbull Co.

†Warren beds. (In Richmond group.)

Upper Ordovician: Southwestern Ohio, southeastern Indiana, and west-central Kentucky and Tennessee.

J. M. Nickles, 1902 (Cincinnati Soc. Nat. Hist. Jour., vol. 20, p. 86). *Warren or Homotrypa bassleri beds.*—Interbedded lss. and dark-bluish, rather marly shales, the lss. and shales becoming rough and nodular toward top. Thickness 80 ft. Overlain by Richmond group and underlain by Mount Auburn or *Platystrophia lynx* beds [upper part of McMillan fm.].

Preoccupied. Replaced by *Arnheim sh.*, which for many years has been included in Richmond group.

Named for Warren Co., Ohio.

Warren gravel.

Pleistocene: Ontario.

A. P. Coleman, 1909 (Ont. Bur. Mines Ann. Rept., vol. 18, pt. 1, p. 297).

Warren.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Warren stage.

Name applied by W. Upham (Am. Geol., vol. 16, 1895, p. 105) to the stage of the ice during the formation of glacial Lake Warren, of Lake Superior region.

Warren oil sand group.

Drillers' term for a series of sands of Chemung age (Upper Dev.) in NW. Pa. As originally defined by J. F. Carll, 1880 (2d Pa. Geol. Surv. Rept. I_5, Atlas, pl. 11), they are 300 ft. thick, are separated from overlying Venango oil sand group by 300 to 350 ft. of shales and sss. and from underlying Bradford Third oil sand by 400 to 450 ft. of shales and sss. Include Stoneham oil sand at base. The sands have also been called (descending) Warren First sand, Warren Second sand, and Warren Third sand, and these names have been carried S. into W. Va. Named for Warren, Warren Co., Pa.

Warren County stone.

Trade name of a Carbf. ss. quarried in Warren Co., Ind. (See S. S. Gorby, Ind. Dept. Geol. and Nat. Hist. 15th Ann. Rept., 1886, p. 86.)

†Warrendale formation.

Tertiary (lower Miocene or Oligocene): Central northern Oregon (Dalles region).

W. D. Smith and E. L. Packard, 1919 (Univ. Oreg. Bull., vol. 16, No. 7, pp. 97–99; and Jour. Geol., vol. 27, pp. 97–98). *Warrendale fm.* replaces Mio. Eagle Creek fm., preoccupied. [They do not give reference to publication that constitutes priority, and compiler has been unable to find it. U. S. G. S. uses *Eagle Creek fm.* for this Tert. deposit and has discarded *Eagle Creek* as a name for the Triassic fm.] Consists of terrestrial beds of hardened ashy clay, and occurs at or near base of Columbia [River] lavas at Eagle Creek, a tributary of the Columbia in Multnomah Co. Named for town of Warrendale, near Eagle Creek. Thought to be upper Mio.

Warren Point sandstone member (of Gizzard formation).

Pennsylvanian: Southeastern Tennessee (Bledsoe, Franklin, Grundy, Hamilton, Marion, and Sequatchie Counties).

W. A. Nelson, 1925 (Tenn. Dept. Ed., Div. Geol., Bull. 33A, pp. 43, 44, 148–149, and 184). *Warren Point ss. lentil.*—A ss. in upper part of Gizzard fm., varying in thickness from 25 to 175 ft. Is first ss. beneath Sewanee cgl., from which it is in places separated by as much as 135 ft. of beds. In other places the beds btw. Warren Point ss. and overlying Sewanee cgl. thin out, and the Warren is in contact with the Sewanee. The lower ss. members of the Warren Point vary greatly, some being thick and heavy cross-bedded sss., while others are thin, slablike, very fine-grained ripple-marked micaceous sss., often containing partings of yellowish-gray or gray fissile sh. containing white or pink plastic clay bands. Around Sewanee the Warren Point is a fine-grained hard nonconglomeratic ss. In E. part of plateau and N. part of Southern Tenn. coal field it becomes conglomeratic. On Tenn. River it is very conglomeratic in lower part. There is marked erosional uncon. at base of the Warren Point at widely scattered places over entire field. In extreme S. part of field the Etna coal lies at base of the ss. It was called cliff ss. by Safford, as it forms prominent bluffs in southern and central parts of the plateau. The name Warren Point is taken from a point ½ mi. N. of Monteagle, Grundy Co., where this ss. forms a prominent bluff 65 ft. thick.

†Warrensburg group.

Pennsylvanian: Central western Missouri.

G. C. Broadhead, 1873 (Mo. Geol. Surv. Prel. Rept. on Iron Ores, pt. 2, pp. 169, 182). *Warrensburg group.*—Shales and lss. with ss. near top; 75 to 100 ft. thick, including beds 33 to 43 of detailed section of lower Coal Measures from Sedalia to Kansas City. Underlies Lexington group and overlies Knob Noster group.

Comprises upper part of Cherokee sh.

Named for exposures at Warrensburg, Johnson Co.

Warrensburg channel sandstone.

Pennsylvanian: Central western Missouri.

A. Winslow, 1892 (Mo. Geol. Surv. Sheet Rept. 1 (vol. 9), pp. 22, 45–54). *Warrensburg ss.*—Yellowish-gray micaceous ss., aren. and micaceous sh., and in places shaly ss., 200 ft. thick; cuts across Coal Measures in Lafayette Co., and apparently occupies depression which once existed where the ss. now is.

Is channel deposit in Pleasanton fm., and probably of Pleasanton age and= Moberly channel ss. of central Mo.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 43), applied *Warrensburg channel ss.* in Kans., and treated it as=lower part of his Bourbon fm. and as cutting down into basal part of Fort Scott ls. This would make it=lower part of Pleasanton and all of Henrietta of U. S. Geol. Survey and Mo. Geol. Survey.

Named for exposures at Warrensburg, Johnson Co., Mo.

Warrior limestone.

Upper Cambrian: Central Pennsylvania (Huntingdon to Center Counties).

C. Butts, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 528, 534, 537). *Warrior ls.*—Thick- and thin-bedded blue ls. with thin siliceous shaly layers and partings, a few thin qtzite layers, and an occasional bed of ls. full of large rounded quartz grains; some oolite. Fossiliferous. Thickness 250 [1,250] ft. Underlies Gatesburg fm. and overlies Pleasant Hill ls. Named for exposures on Warrior Run, along river bluff 1 mi. W. of Williamsburg, Blair Co., and on Warrior Creek, E. of Warriors Mark, in northern part of Huntingdon Co.

Warsaw shale (also **Warsaw limestone**). (Of Meramec group.)

Mississippian: Iowa, Illinois, Indiana, Kentucky, Tennessee, eastern Missouri, northern Alabama, and northeastern Mississippi.

J. Hall, 1857 (Am. Ass. Adv. Sci. Proc., vol. 10, pt. 2, pp. 54–56). *Warsaw or Second Archimedes ls.*—Series of highly fossiliferous beds of blue "marlites" with intercalations of impure lss., or in some places impure lss. separated by seams of blue marl. Overlain by an aren. bed that sometimes contains small pebbles and is in turn overlain by St. Louis ls. [includes Spergen ls.]. Underlain by 10 ft. of mag. ls. (of local occurrence, probably) succeeded below by "Geode bed" (soft shaly or marly beds with geodes of quartz chalcedony), which rests on Keokuk ls.

Adopted by U. S. Geol. Survey as basal fm. of Meramec group, overlain by Spergen ls. and underlain by Keokuk ls. As defined it includes at base the "geode bed," which in some repts has been included in Keokuk ls. In western Ky. and southern Ind. the Warsaw (formerly called "Harrodsburg ls.") is chiefly ls. and is called *Warsaw ls.*

J. M. Weller, 1934 (Ill. Acad. Sci. Trans., vol. 26, No. 3, p. 106), proposed "to restore *Warsaw fm.* to its early status," assigning to it all beds btw. Keokuk ls. and St. Louis ls. as these are now limited. This definition would include Spergen ls. in the Warsaw. The classification adopted by 9th Ann. Field Conf. Kans. Geol. Soc., Sept. 1935, did not include Spergen ls. in Warsaw, and this proposed change has not been considered by U. S. Geol. Survey for its publications.

See also under *Spergen ls.*

The Ill. Geol. Survey and Rept. 9th Ann. Field Conf. Kans. Geol. Soc. (1935) include the Warsaw in Osage group.

Named for exposures at Warsaw, Hancock Co., Ill. A typical exposure occurs along creek known as Soap Factory Hollow, which joins the Mississippi from the E. about ½ mi. S. of Lower Warsaw, Ill.

Wartburg sandstone. (In Pottsville group.)

Pennsylvanian: Northeastern Tennessee.

A. Keith, 1896 (U. S. G. S. Briceville folio, No. 33). *Wartburg ss.*—Interbedded sss., sandy shales, argill. shales, and coal beds. Perhaps as much as half of fm. is ss., the two beds at top and bottom being specially conspicuous. As many as 5 seams of coal occur with these strata. The ss. beds vary in thickness from a few in. to 50 ft., and sh. beds are of similar size. Thickness of fm. 500 to 650 ft. Underlies Scott sh. and overlies Briceville sh. Named for town of Wartburg, Morgan Co., which is situated upon this ss.

According to L. C. Glenn (Tenn. Geol. Surv. Bull. 33B, pp. 19, 310, 311, 1925) the ss. upon which town of Wartburg is located is a bed, 30 to 40 ft. thick, just below middle of Briceville sh. and from a few ft. to 30 or 40 ft. beneath Poplar Creek coal. He therefore introduced new name *Jellico fm.* for the rocks overlying Briceville sh. and underlying Scott sh., and restricted the name *Wartburg ss.* to the ss. at Wartburg. (See *Wartburg ss. memb.*)

Wartburg sandstone member.

Pennsylvanian: Northeastern Tennessee.

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, p. 311). *Wartburg ss. memb.*—A ss. near middle of Briceville fm., "more massive and more persistent than usual," lying from a few ft. to 30 or 40 ft. below Poplar Creek coal and being the ss. upon which is located the town of Wartburg, Morgan Co. Thickness of ss. 30 to 40 ft. Is basal ss. memb. of Keith's Wartburg ss., but latter name is here abandoned.

Warwick limestone.

Lower Ordovician: New York.

W. W. Mather, 1843 (Geol. N. Y., vol. 1, p. 367), stated that *Warwick ls.* is a synonym of Calciferous group, but compiler has not found any definition of Warwick ls.

Wasatch group.

Wasatch formation.

Eocene (lower): Wyoming, central southern Montana, southeastern Montana, southwestern North Dakota (?), western Colorado, Utah, and northwestern New Mexico.

F. V. Hayden, 1869 (U. S. Geol. Surv. Terr. 3d Ann. Rept., p. 191 of 1873 ed.). Immediately W. of Fort Bridger (Wyo.) commences one of most remarkable and extensive groups of Tert. beds seen in West. They are wonderfully variegated, some shade of red predominating. This group, to which I have given name *Wasatch group*, is composed of variegated sands and clays; very little calc. matter is found in it. In Echo and Weber Canyons (Utah) are wonderful displays of cgls., 1,500 to 2,000 ft. thick. Although this group occupies vast area and attains thickness of 3,000 to 5,000 ft., yet I have never known any remains of animals to be found in it. I regard it, however, as of middle Tert. age. [Does not explain relations to Green River shales, but assigns both to middle Tert. and appears to consider them as in part at least equiv.]

F. V. Hayden, 1871 (U. S. Geol. and Geog. Surv. Terr. 4th Ann. Rept., pp. 147–156). Soon after leaving Carter station [Wyo.] toward the W. the Wasatch group of beds come in. They seem to rise from beneath Bridger group. They consist of red indurated aren. clays, with beds of grayish and reddish-gray sss. alternating. Pinkish and purplish clays are dominant features and give lithological character to the groups as far W. as Echo Canyon [Utah], where cgls. prevail. I have included in this group all variegated beds we have observed W. of Carter's station.

E. D. Cope, 1874 (U. S. Geol. and Geog. Surv. Terr. 7th Ann. Rept., btw. pp. 435 and 444). Hayden named deposits of western area *Wasatch group*, and regarded it as synchronous with Green River group of eastern area. Writer has attained same opinion on paleontological grounds and hence has applied name *Green River* in both areas.

C. King, 1876 (U. S. Geol. Expl. 40th Par., Atlas), divided the Tert. deposits of NE. Utah and adjacent areas into (descending) Wyoming cgl. (Plio.), Uinta (Eo.), Bridger (Eo.), Green River (Eo.), and *Vermilion Creek (Eo.)*. Advance copies of this map were distributed in 1875.

A. C. Peale, 1876 (U. S. Geol. Surv. Terr. 8th Ann. Rept.). I shall use name *Green River group* to include also Wahsatch group of Hayden. Cope restricts name to Green River shales. The Wahsatch group and Green River group occupy two distinct basins, but are considered synchronous by Dr. Hayden and Prof. Cope. [This usage of *Green River* did not prevail, and Peale himself abandoned it in 1878.]

S. F. Emmons, 1877 (U. S. Geol. Expl. 40th Par., vol. 2, pp. 207–250), described the Tert. rocks of Green River region, Bridger Basin, Washakie Basin, and other areas in SW. Wyo. where Hayden had applied the name *Green River group*, and divided them as follows (descending): Wyoming cgl., Bridger group, Green River group, and *Vermillion Creek group*.

F. V. Hayden, 1877 (U. S. Geol. and Geog. Surv. Terr. Bull. 3, No. 1, pp. 181–185). *Wasatch group* of Hayden is same as *Vermilion Creek group* of King, and Wasatch group has priority.

C. A. White, 1877 (p. 608 of Bull. 3 cited just above), gave following sequence of Tert. fms. in Green River region (descending): Brown's Park group, Bridger group, Green River group, and Wasatch group.

C. King, 1878 (U. S. Geol. Expl. 40th Par., vol. 1, pp. 339, 353, 355, 360, etc.). *Vermilion Creek group.*—Same as Wasatch group of Hayden. A conformable series of fresh-water lake deposits of reddish sss., cgls., and clays, 0 to 5,000± ft. thick, uncon. underlying Green River group and uncon. overlying Laramie group (Cret.) except at Black Butte, Wyo., where it is conformable with Laramie. The term *Wasatch* was originally applied by Hayden to the group of cgls. and sss. displayed in Echo Canyon and in the Narrows and at other points in immediate neighborhood of the Wasatch. In attempting to follow his nomenclature in this region [of 40th Par. Surv.] I have been led to reject this name and to apply to these rocks the name *Vermilion Creek group*, because upon Vermilion Creek [SW. Wyo. and NW. Colo.] was exposed the whole thickness of the series, while at the Wasatch the full volume of the group was never seen. Base of Vermilion Creek group is base of Tert.

F. V. Hayden, 1878 (U. S. Geol. Surv. Terr. Mon. 7, pp. iii–ix). It is probable Wasatch group as now defined and Fort Union group are identical as a whole, or in part at least. [Although deposits now recognized as belonging to the true Fort Union fm. have in the past been included in both Wasatch fm. and so-called Laramie fm. of southern Wyo. and NW. Colo., the Wasatch fm. as now recognized overlies Fort Union fm. as now interpreted. See under *Fort Union fm.*]

According to U. S. G. S. Bull. 191, 1902, geologists seem to have unanimously adopted Hayden's name *Wasatch*, instead of King's name *Vermilion Creek*, and the U. S. Geol. Survey has discarded latter name. In SW. Wyo. the Wasatch deposits are now called *Wasatch group*, having been divided by A. C. Veatch (U. S. G. S. P. P. 56, 1907) into 3 fms. (descending)—Knight fm., Fowkes fm., and Almy fm. In other areas they are treated as a single unit and are called *Wasatch fm.* In SW. Utah the southern development of the Wasatch fm. was called "Pink Cliff series" by Dutton.

See under *Green River fm.* for explanation of intertonguing of Green River and Wasatch fms. in Moffat Co., Colo., and Sweetwater Co., Wyo.

Named for exposures in Echo and Weber Canyons, Wasatch Mtns, Utah.

†Wasatch limestone.

Mississippian, Devonian, Silurian, and Upper Ordovician: Northeastern Utah (northern Wasatch Mountains).

C. King, 1876 (Am. Jour. Sci., 3d, vol. 11, pp. 477–479). *Wasatch ls.*—Carbf. and Dev. lss., consisting of: (1) 4,000 ft. of ls. carrying Coal-measure fossils; (2) 1,000 to 1,200 ft. of sub-Carbf. lss. underlain by beds containing fossils that have close resemblance to Waverly group but which are considered by Hall and Whitfield as closely allied to Upper Dev.; (3) lower 1,200 to 1,400 ft. characterized by Dev. (Upper Helderberg and Chemung) fossils and a single group of fossils that seem to have the facies of both Upper and Lower Helderberg. Total thickness in Wasatch Mtns, Utah, 7,000 ft.; in middle Nev. over 8,000 ft.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, p. 407), divided the Wasatch ls. of King in N. part of Wasatch Mtns into (descending): Brazer ls. (upper Miss.), 800 to 1,400 ft.; Madison ls. (lower Miss.), 600 to 1,600 ft.; Threeforks ls. (Upper Dev.), 200 ft.; Jefferson dol. (Middle Dev.), 1,200 ft.; Laketown dol. (Sil.), 1,000 ft.; and Fish Haven dol. (Upper Ord.), 500 ft. The Fish Haven dol. rests on Swan Peak qtzite (Lower Ord.), evidently mistaken by King for the Camb. qtzite in Ogden Canyon.

Wasatchan series.

A term employed by C. R. Keyes instead of *Wasatch group* or *Wasatch fm.* of other geologists.

†Washakie formation.

Eocene (middle and upper?): Southwestern Wyoming (Washakie Basin, Sweetwater County).

F. V. Hayden, 1869 (U. S. Geol. Surv. Terr. 3d Ann. Rept., p. 190 of 1873 ed.; 1869 ed. not available). *Washakee group.*—A series of purely fresh-water beds, with some beds of impure lignite and vast quantities of fossils. The strata are nearly horizontal. I have regarded these beds as separated from the lower tertiary Fort Union or true lignite group.

F. V. Hayden, 1871 (U. S. Geol. and Geog. Surv. Terr. 4th Ann. Rept., pp. 71–73). I am now inclined to believe *Washakie group* is either an extension eastward of Bridger group or synchronous with it.

F. B. Meek, 1873 (U. S. Geol. and Geog. Surv. Terr. 6th Ann. Rept., pp. 455–462). *Washakie group* (Tert.) overlies Bitter Creek group and underlies Green River group.

F. V. Hayden, 1877 (U. S. Geol. and Geog. Surv. Terr, Bull. 3, No. 1, pp. 181–185). *Washakie group.*—E. limit of group is near Creston, extending to point just W. of Bitter Creek Station. Exposures consist of soft clays and sands of various shades of brown and yellow, with here and there a hard ss.; in several places beds of impure lignite occur. Is probably same as Vermilion Creek of King and Wahsatch group of Hayden. [Now known to be much younger than Wasatch group.]

C. King, 1878 (U. S. Geol. Expl. 40th Par. vol. 1, p. 394). Bridger group was deposited in lake which is here named Washakie Lake.

See also W. Granger and W. J. Sinclair, 1909 (Am. Mus. Nat. Hist. Bull., vol. 26, art. 3 and art. 4, pp. 17–27).

H. F. Osborn, 1909 (U. S. G. S. Bull. 361). Typical Bridger fm. of Bridger Basin, Wyo., contains some earlier deposits than Bridger fm. of Washakie Basin.

Now considered essentially same as Bridger fm. (See U. S. G. S. Bull. 702, 1920, by A. R. Schultz.)

Named for exposures at Washaki station, btw. Creston and Bitter Creek, on Union Pacific R. R., in Sweetwater Co. Comprises the Eo. sediments of Washakie Basin (approved spelling).

Washburn sandstone.

Pennsylvanian: Western Arkansas coal field and central eastern Oklahoma.

A. Winslow, 1896 (N. Y. Acad. Sci. Trans., vol. 15, p. 51). *Washburn sss.*—Sss., 500 to 600 ft. thick, forming basal part of Appleton stage. Overlie Danville stage and underlie Russellville shales.

Is a part of Atoka fm.

Probably named for Washburn, Sebastian Co., Ark.

Washburn beds.

Pre-Cambrian (upper Keweenawan): Northwestern Wisconsin (Bayfield County).

F. T. Thwaites, 1912 (Wis. Geol. Nat. Hist. Surv. Bull. 25, p. 34). *Washburn beds.*—Soft red and white sss., with much banding and mottling of colors; beds usually thin, with few pebbles or sh. layers which sometimes show mud cracks. Top memb. of Chequamegon ss. Overlies Quarry or Brownstone beds. Named for exposures in shore cliffs S. of Washburn, Bayfield Co.

Wash Creek slate.

Pre-Cambrian or Paleozoic: Central Alabama.

C. Butts (U. S. G. S. Montevallo-Columbiana folio, No. 226). *Wash Creek sl.*—Chiefly sl., very similar to Waxahatchee sl., but a considerable thickness at bottom is rather more sandy than most slates of the region and has appearance of thin-bedded ss. Generally contains many quartz veins. About 1,000 ft. above bottom is a persistent ferruginous ss. 130± ft. thick. At or near top is a thick stratum of conglomeratic qtzite that may belong to Weisner fm. Thickness of fm. probably 5,000 ft. Overlies Brewer phyllite and underlies Weisner fm.

Named for exposures on Wash Creek, Chilton Co., in Columbiana quad.

Washington formation. (In Dunkard group.)

Permian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K, pp. 44–56). *Washington County group.*—Includes all beds btw. top of Upper Washington ls. and top of Waynesburg ss. below. Thickness 150 to 450 ft. Is an important fm. in Washington Co., Pa. [For many years the Waynesburg ss. and underlying Cassville sh. have been included in *Washington fm.* (the shorter name), the base of which has been drawn at top of Waynesburg coal.]

Is lower fm. of Dunkard group.

The present Pa. Geol. Survey classifies the Washington as a *group* and the Dunkard as a *series*.

Named for exposures in highlands of Washington Co., Pa.

Washington sandstone member (of Washington formation).

Permian: Southwestern Pennsylvania, northern West Virginia, and western Maryland.

J. J. Stevenson, 1876 (2d Pa. Geol. Surv. Rept. K). *Washington ss.*—Thinly laminated micaceous dark-gray to bluish-gray ss., 12 to 18 ft. thick. Included in Washington County group [Washington fm.]. Underlies Washington coal and overlies Little Washington coal.

Washington limestone.

A name that has been applied for many years to 3 lss. in upper part of Washington fm. (Perm.) of western Pa., W. Va., Md., and eastern Ohio, which have been designated *Upper Washington ls.* (top bed of Washington fm.), *Middle Washington ls.*, and *Lower Washington ls.* For definition see under *Upper*, *Middle*, and *Lower*.

†Washington greensand.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72–75, 188). *Washington or High Bluff greensand beds.*—Dull-brown sands with occasional bands of ss., differing in lithologic character from great series above it, being coarser, less argill., free from stratified clay bands, more or less rich in greensand, and containing occasional beds of firmer dark-colored crystalline calc. strata 1 to 2 ft. thick, or round boulderlike sss. resulting from local hardenings and filled with cylindrical tubelike casts of fossils and impressions of *Baculites*. One section shows 120 ft. of the beds. Uncon. underlies Arkadelphia shales and rests conformably on High Bluff blue sands.

C. H. Dane, 1929 (Ark. Geol. Surv. Bull. 1). "Washington greensand beds" are now included in Nacatoch sand [p. 46]. An examination of Hill's rept leaves no doubt that most of the beds included by him in the "Washington or *High Bluff greensand* beds," as well as the underlying "*Blue sands of High Bluff* and of Pate's Creek," were included by Veatch (U. S. G. S. P. P. 46, p. 27, 1906) in upper part of his Marlbrook fm. [p. 115].

Named for exposures in Town Creek Valley at Washington, Hempstead Co.

†Washington shale and sandstone.

Pennsylvanian: Northwestern Arkansas and eastern Oklahoma.

F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. 26, 75–82). *Washington sh. and ss.*—Sh. below and ss. above; or there may be a gradual passage from the sh., through flagging, into the ss. Thickness 40 to 75 ft. Included in Lower Carbf. Overlies Archimedes [Pitkin] ls. and underlies Pentremital [Brentwood] ls.

Preoccupied. Replaced by Hale fm. Is of Penn. age.

Named for Washington Mtn, Washington Co., Ark.

Washington gneiss.

Pre-Cambrian: Western Massachusetts and northern Connecticut.

B. K. Emerson, 1892 (U. S. G. S. Hawley sheet, i. e., proof sheets of geol. maps and text intended for a geol. folio, but never completed and published in that form, although cited in U. S. G. S. Bull. 191, 1902).

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pp. 18, 20, 31–32, pl. 34). *Washington gneiss.*—Rusty biotite gneiss carrying blue quartz, slightly fibrolitic, with thick beds of coarse and highly crystalline lss. Thickness 2,000 (?) ft. Uncon. underlies Becket gneiss. [See also B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 23–24, 150, and map).]

Named for occurrence at Washington and Washington Center, Berkshire Co., Mass.

†Washington limestone.

Ordovician: Northeastern Vermont (Orange, Washington, Windsor, Orleans, Essex, and Caledonia Counties).

C. H. Richardson, 1898 (Am. Ass. Adv. Sci. Proc., vol. 47, pp. 295–296). *Washington ls.*—This name is proposed for the more calc. memb. of Calciferous mica schist of C. H. Hitchcock, which in Washington [Orange Co.], Vt., is sufficiently pure and compact to be catalogued as a crystal-like marble of great economic value. Thickness 2,000–5,875 ft. The noncalc. memb. of Calciferous mica schist is Bradford schist [now known as *Vershire schist*]. In Mass. the calc. memb. is known as *Conway schist.*

C. H. Richardson, 1902 (3d Rept. Vt. State Geol., pp. 61–98). *Washington ls.*, 5,000–6,000 ft. thick, is in general dark-gray siliceous ls., interstratified with 14 bands of sl., outside of the 2 large belts. It is the calc. memb. of old "calciferous mica schist." Contains Lower Trenton fossils and is intimately interstratified with Bradford schist, the noncalc. memb. of the old "calciferous mica schist."

C. H. Richardson, 1906 (5th Rept. Vt. State Geol.). *Waits River ls.* replaces *Washington ls.* (preoccupied).

See *Waits River ls.*

†Washington reds. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania.

J. J. Stevenson, 1906 (Geol. Soc. Am. Bull., vol. 17, btw. pp. 65 and 216). *Washington reds*, the "Big Red" of drillers; lies btw. Ames ls. and Elk Lick ls.

J. J. Stevenson, 1912 (Am. Phil. Soc. Proc., vol. 51). Birmingham sh. replaces *Washington reds* in Pa.

Washington phase (of Waits River limestone).

See 1908 entry under *Waits River ls.* In many subsequent Vt. repts Richardson continued to use this term.

Washington fire clay shale. (In Washington formation.)

Permian: Northern West Virginia.

C. E. Krebs, 1911 (W. Va. Geol. Surv. Rept. Jackson, Mason, and Putnam Counties, p. 117). *Washington fire clay sh.*—Dark greenish yellow, 1 to 8 ft. thick. Lies 5 to 10 ft. below Washington coal.

†Washington County group.

Same as *Washington fm.* (Perm.), the shorter name.

Washingtonville member (of Allegheny formation).

Pennsylvanian: Eastern Ohio, western Pennsylvania, northern West Virginia.

W. Stout and R. E. Lamborn, 1924 (Ohio Geol. Surv., 4th ser., Bull. 28, pp. 175–181). *Washingtonville memb. of Allegheny fm.*—Bony carbonaceous sh., of dark slaty-gray to nearly black color; hard, tough, resistant. Carries marine fauna. Occurs in Allegheny fm. In places lies on and in other places as much as 10 ft.

above Middle Kittanning coal, the average interval being 4 ft. 4 in. of dark fissile sh. or gray siliceous sh. Thickness of Washingtonville memb. varies from 6 in. to 6 ft.; average 2 ft. 2 in. Extends from Muskingum Co., Ohio, to Beaver Co., Pa., and from Mahoning Co., Ohio, to Panhandle of W. Va.

Named for exposures at Washingtonville, Columbiana Co., Ohio.

†Washita limestone.

Lower Cretaceous (Comanche series): Texas and southern Oklahoma.

B. F. Shumard, 1860 (St. Louis Acad. Sci. Trans., vol. 1, pp. 583, 586). *Washita ls.*—Fossiliferous ls. of nearly white, yellow, gray, and blue color; some layers moderately hard, others disintegrating rapidly on exposure. Good exposures near Austin and in Grayson, Fannin, and Red River Counties, Tex. According to G. G. Shumard finely developed at Fort Washita. Underlies *Exogyra arietina* marl [Del Rio clay] and in Grayson Co. overlies Blue marl.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan Co., Okla.

Washita group.

Lower Cretaceous (Comanche series): Texas, southwestern Arkansas, southern Oklahoma, and northwestern Louisiana.

R. T. Hill, 1887 (Am. Jour. Sci., 3d, vol. 33, p. 298). *Upper or Washita div. of Comanche series or Lower Cret.*—Lss., sss., shales, and marls uncon. underlying Timber Creek group [Woodbine sand] and overlying Fredericksburg div. of Lower Cret.

In Am. Jour. Sci., 3d, vol. 34, p. 303, Oct. 1887, Hill placed provisional line of demarcation btw. Washita and Fredericksburg groups at top of "Caprina" (Edwards) ls., which is present generally recognized bdy. In Austin and vicinity Washita group has for many years been divided into Buda ls. (top), Del Rio clay, and Georgetown ls.; in northern Tex. it has usually been divided into Denison fm. (top), Fort Worth ls., Duck Creek fm., and Kiamichi clay. Underlies Woodbine sand and overlies Fredericksburg group.

Named for old Fort Washita, T. 5 S., R. 7 E., about sec. 23, Bryan Co., Okla.

Washita stone.

Commercial term. Same as *Ouachita stone*. Lower Dev., SW. Ark. and SE. Okla.

Wassonville limestone. (In Osage group.)

Mississippian: Southeastern Iowa.

H. F. Bain, 1895 (Am. Geol., vol. 15, p. 322). *Wassonville ls.*—Earthy mag. ls., in places aren.; 35 ft. thick; forms top memb. of Kinderhook in SE. Iowa. Underlies Augusta fm. and overlies English River grits (middle memb. of Kinderhook).

Is of Fern Glen age, according to R. C. Moore, 1928 (Mo. Bur. Geol. and Mines vol. 21, 2d ser.) and 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 245), and younger than Chouteau ls., which is shown as much younger than English River ss. The Fern Glen is now generally included in Osage group, but L. R. Laudon, 1931 (Iowa Geol. Surv. vol. 35, p. 347), called these beds *Wassonville dol. memb. of Hampton fm.*, and included the Hampton in the Kinderhook.

Named for outcrops at old Wassonville mill, Washington Co.

†Watauga shale.

Lower Cambrian: Southwestern Virginia, western North Carolina, eastern Tennessee, and northwestern Georgia.

A. Keith, 1903 (U. S. G. S. Cranberry folio, No. 90, p. 5). *Watauga sh.*—A series of interbedded lss., red, green, and variegated shales, and red sss. The lss. are blue and blue gray in color and show all grades in transition from pure ls. to red sh. Thickness of ls. beds seldom exceeds 10 ft., being usually from 1 to 2 ft. Much the greater part of the fm. is made up of red, brown, purple, and yellow sh., in places calc., in places sandy, and usually argill. When perfectly fresh much of the sh. appears as a blue or drab ls.; slight exposure produces in this the reddish colors and the shaly partings. The beds of red ss. are local and argill. and differ from the sandy sh. chiefly in being more massive. Rather unusual in appearance are a few layers of white ss. near Stone Mtn. The sss. range in thickness up to 6 ft. and are closely interbedded with the sh. Thickness 1,000 to 1,100 ft. Overlies Shady ls. through a few beds of red sh. in upper layers of the Shady. Highest Camb. fm. present. [In other areas this fm. is overlain by Honaker ls.]

Replaced by Rome fm., which has priority, and, according to C. Butts, is same as Watauga sh. of Keith.

Named for development in drainage area of Watauga River, in Carter Co., Tenn.

Watchung basalt. (In Newark group.)

Upper Triassic: Northern New Jersey (Watchung Mountains).

N. H. Darton, 1889 (Am. Jour. Sci., 3d, vol. 38, pp. 134–139) and 1890 (U. S. G. S. Bull. 67). *Watchung trap sheets.*—Three thick sheets of extrusive lava interbedded with the sediments of Newark system [group] in Watchung Mtns.

Being interbedded flows, the Watchung basalt is treated as part of Newark group.

Waterbury gneiss.

Ordovician: Central Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 86, 100, and map). *Waterbury gneiss* is not a distinct geological fm. but a complex of schists, which have been intricately injected with granite and pegmatite and occasionally amphibolite. It is Hartland (Hoosac) schist modified by igneous injections. Occurs in Waterbury and other towns.

Waterford slate.

Ordovician (?): Northeastern Vermont (Caledonia County).

C. H. Richardson, 1906 (5th Rept. Vt. State Geol., p. 97). *Waterford sl.* is here used to locate a narrow belt of sl. that may or may not be = Montpelier sl. It flanks Bradford schist on E. and is separated from the pre-Camb. metamorphic series by a fault. Lithologically it is a sl. graduating into a fine-grained phyllite of the Bradford series to W. In Waterford [village or twp.?] it reaches max. thickness, 400 ft. of workable sl.

†Waterlime.

†Waterlime series.

†Waterlime group.

Terms (lithologic) applied in early N. Y. repts to Helderberg group and underlying lss. above Salina fm.; also to the beds btw. top of Manlius ls. and top of Salina fm. of modern nomenclature. In some repts it included upper part of Salina fm. In other repts it was included in Salina fm. In still other repts it included Manlius ls., Cayuga group, and Lockport dol., and in still other repts it applied to Rondout ls. only. Name derived from fact that hydraulic lime is made from part of the rocks, especially from Rondout ls.

Waterloo quartzite.

Pre-Cambrian (middle? Huronian): Central southern Wisconsin (Jefferson County).

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, pp. 252–256). *Waterloo qtzite.*—Hard, thoroughly metamorphosed red and gray qtzites; metamorphic cgls. in certain portions; in others there is a foliated material of talcose appearance, but seldom sufficient to give the rock a schistose structure. The gray variety of qtzite predominates, especially in more westerly outliers. Exposed at foot of a ridge on border of a marsh in town of Waterloo.

J. H. Warner, 1905 (Min. World, vol. 22, pp. 420–422). *Waterloo qtzite* is a pre-Camb. outlier in the Paleozoic of southern Wis. The several outcrops dip steeply under flat-lying Paleozoic sediments that surround them. The main groups of exposures are separated by distances of a few miles; in all forming a range about 12 mi. long. These knobs lie 30 mi. E. and 10 mi. S. of Baraboo qtzites, with which they have been correlated. The qtzite is in every way similar to Baraboo qtzite. Assigned to middle Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598). *Waterloo qtzite* is possibly middle Huronian.

Waterloo moraine.

Pleistocene (Wisconsin stage): Southern Ontario. Shown on moraine map in Smithsonian Inst. Ann. Rept. 1912, p. 297, 1913.

Waterton dolomite.

Pre-Cambrian: Southern Alberta, Canada.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 50, 178). *Waterton fm. or dol.*—Siliceous dol., massive, dark gray. Thickness 200+ ft. Seen at only one place in Clarke Range, viz, at cliff over which waters of Oil Creek (Cameron Falls Brook of older maps) tumble from hanging valley of Oil Creek into Waterton Lake. [See also R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, map 1).]

C. L. and M. A. Fenton, 1931 (Jour. Geol., vol. 39, No. 7, pp. 670–679). *Waterton fm.* (massive dol.) underlies Altyn fm. at Cameron Falls and other localities near Waterton Lake, Alberta.

Watertown limestone. (Of Black River group.)

Middle Ordovician: Central New York

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 138, p. 72). Black River group as now understood by this [N. Y.] survey, comprises [ascending] Lowville ls., *Watertown ls.* (formerly Black River ls.) and *Amsterdam ls.*

R. Ruedemann, 1910 (N. Y. State Mus. Bull. 145, pp. 79, 84–90, 97). *Watertown ls.*—Massive dark bluish-gray to black ls., 10 ft. thick in Thousand Islands region. Is "Seven-foot tier" or Black River ls. of Hall. Uncon. underlies Trenton ls. and uncon. overlies Lowville ls., the top memb. of which is here named *Leray ls. memb.* Is next to top fm. of Black River group, being older than Amsterdam ls., the top fm. of Black River group in Mohawk and Champlain Valleys and Saratoga region. Named for exposures at Watertown, Jefferson Co.

See also under *Black River group* and *Lowville ls.*

Watertown moraine.

Pleistocene (Wisconsin stage): Northwestern New York. Named for Watertown, Jefferson Co. (See Jour. Geol., vol. 32, pp. 645, 659, 1924.)

Watertown formation.

Pre-Cambrian: Alberta and British Columbia.

G. S. Hume, 1933 (Canada Geol. Surv. Summ. Rept. 1932, pt. B, p. 5).

Waterville shale (also slate).

Silurian: Central southern Maine (Kennebec County).

C. H. Hitchcock, 1861 (Maine Bd. Agric. 6th Ann. Rept., p. 232), mentioned *Waterville slates.*

E. H. Perkins and E. S. C. Smith, 1925 (Am. Jour. Sci., 5th, vol. 9, pp. 204–228). *Waterville shales* [also called *Waterville sl.*].—A series of shales, fine-grained sss., and impure lss.; often pyritiferous. Named for fine exposures at Waterville. On SE. the shales pass into Vassalboro ss. through a series of transition beds consisting of interbedded shales and sss. [Do not state in which fm. they include the transition beds.] Two phases are typical of fm.; the first consists of interbedded bluish calc. shales and gray aren. shales; the second consists of dark-bluish slates interbedded with coarser qtzitic layers. Fossils consist of trails, sea weeds, and graptolites. Ruedemann has determined the graptolites to be of mid-Silurian (Clinton or Lower Wenlock) age, which makes the Waterville the time equiv. of Quoddy sh. of Eastport region.

Watsi shale.

Oligocene: Panama and Costa Rica.

D. F. MacDonald et al., 1919 (A. A. P. G. Bull., vol. 3, p. 364).

Watson limestone.

Silurian (early): Northeastern Missouri (Pike County).

R. R. Rowley, 1916 (Am. Jour. Sci., 4th, vol. 41, pp. 317–320). *Watson ls.*—Brown ls., coarser and heavier than Cyrene ls.; locally bluish and massive. Of considerable thickness. Half a mi. SW. of Vera or Watson station, in first cut along C. & A. R. R., the Cyrene beds are replaced by Watson horizon, which rests on Ord. sh. and yields abundance of fossils. The Watson bed is either very base of Bowling Green ls., with which it agrees lithologically, or should be regarded as another memb. of Edgewood fm.

†Watson sandstone member.

Devonian or Carboniferous: Northwestern Pennsylvania.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Watson ss. memb. of Cattaraugus fm. (Dev.)* is Venango 2d "A." Underlies North Warren sh. memb. (new name) and overlies Amity sh. memb. [All of definition. The U. S. Geol. Survey classifies Cattaraugus fm. as *Dev.* or *Carbf.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 86), replaced this preoccupied name with *Bimber Run cgl. memb.*

Watts Creek shale member (of Moran formation).

Permian: North-central Texas (Colorado River region).

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 387, 419). *Watt's Creek bed.*—Mostly bluish and reddish sandy clay, with thin strata of ls. and ss. Thickness 50 to 75 ft. Memb. of Cisco div. Underlies Horse Creek bed and overlies Camp Colorado bed.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 177, 181, 182, and charts). *Watts Creek sh. memb.*, 50 to 75 ft. thick, is basal memb. of Moran fm. in Colorado River Valley. Underlies Horse Creek ls. memb. of Moran and overlies Camp Colorado ls. memb. of Pueblo fm. Named for Watts Creek, Coleman Co.

Moran fm. was transferred to Permian in 1933.

Waubakee dolomite.

Silurian (Cayugan): Southeastern Wisconsin.

W. C. Alden, 1906 (U. S. G. S. Milwaukee folio, No. 140). *Waubakee fm.*—Gray to brownish-gray, finely laminated mag. ls. splitting readily into slabs ½ to 4 in. thick. The lower strata are more evenly bedded and contain streaks of blue clay. A thickness of 10 to 12 ft. is exposed. The beds lie stratigraphically above Racine ls. and below Milwaukee fm. and are correlated with certain beds exposed about 20 mi. N. of Wauwatosa, near village of Waubakee, Ozaukee Co., which have been correlated on faunal evidence with a portion of Cayuga group of N. Y. Few fossils in Milwaukee quad.

Waucoba series.

A variant of *Waucoban series* proposed by G. H. Ashley, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 1106–1108).

Waucoban epoch (or series).

Geographic name for Lower Cambrian. Proposed by C. D. Walcott (Smithsonian Misc. Coll., vol. 57, No. 10, pp. 305–306, 1912). Replaces †Georgian. For definition see U. S. G. S. Bull. 769, pp. 100–101.

Waucoma limestone.

Silurian (pre-Niagaran): Northeastern Iowa and northwestern Illinois.

T. E. Savage, 1914 (Am. Jour. Sci., 4th, vol. 38, pp. 35–36). *Waucoma ls.*—Fossiliferous light-gray nonmag. ls., 10 to 20 ft. thick, overlying Winston ls. and representing time interval of Sexton Creek ls., but may represent deposition in a northern province. Upper fm. of Alexandrian series.

T. E. Savage, 1916 (Geol. Soc. Am. Bull., vol. 27, pp. 305–324), introduced *Kankakee ls.* for 20 to 39 ft. of hard gray to brown ls. in NE. Ill., western Ill., and eastern Mo. N. of St. Louis, which he stated is contemp. with Sexton Creek ls. but deposited in separate basin.

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 526+). At time writer introduced "Waucoma ls." and "Winston ls." he believed these strata were deposited in basin that had a northern sea connection; but with a better knowledge of the Sil. he now believes all of Alexandrian strata in Ill. and Iowa were deposited in a sea that advanced from S., and thus belong to same province as Alexandrian strata of corresponding age in SW. Ill. "Waucoma ls." is same as *Kankakee ls.* [which he previously stated is same as Sexton Creek ls., an older name] and "Winston ls." is same as *Edgewood ls.*

Named for Waucoma, Fayette Co., Iowa.

Waugh sand.

Drillers' name for a sand of Upper Dev. (Portage?) age in western Pa., southern N. Y., and W. Va. Considered same as Elk sand.

Waukesha limestone.

Silurian (Niagaran): Southeastern Wisconsin (Waukesha County).

I. A. Lapham, 1851 (Rept. of J. W. Foster and J. D. Whitney on geology of Lake Superior dist., pt. 2, S. Ex. Doc. 4, U. S. 32d Cong., special sess., pp. 168–171). *Waukesha ls.*—Hard white or bluish-white ls. occurring throughout Waukesha Co. Few fossils (of Niagara age, according to James Hall). Extends E. along Menomonee River to within 3 mi. of Milwaukee, where it is quarried. Underlies soft yellow ls., which also occurs near Racine.

J. Hall, 1862 (Wis. Geol. Surv. Rept. 1, p. 67). *Waukesha ls.* is overlain by Racine ls. at Waukesha. It consists below of thin-bedded ls. and above of heavy-bedded ls. of same general character but less argill. Thickness 200 to 250 ft. Included in Niagara group. Rests on Geodiferous or Pentamerus and Coralline ls. of Niagara group.

T. C. Chamberlin, 1877 (Geol. Wis., vol. 2, pp. 357–360). *Waukesha beds.*—For the strata that lie btw. Mayville beds below and Racine beds above in southern part of Wis. the term *Waukesha ls.*, which has previously been applied to a portion of them, has been adopted with modifications. The term was selected many years ago by Dr. Lapham to designate the thin-bedded strata that occur at Waukesha and their equivalents elsewhere. Typical Waukesha beds consist of regular even beds of hard, compact, fine-textured crystalline dol., of gray color and conchoidal fracture, characterized by much chert in form of nodules, distributed chiefly in layers. The Waukesha beds seem to be = Upper Coral beds, Lower Coral beds, and Byron beds of Sheboygan region. [The equivalency of Byron beds to basal part of Waukesha beds was published in many subsequent Wis. repts. by different authors.]

E. O. Ulrich, 1924 (Wis. Acad. Sci. Trans., vol. 21, pp. 71–93). *Waukesha dol.* of eastern Wis., 250 to 300 ft. thick, is younger than Byron dol., 100 ft. thick, but both are of Lockport age. [This was a restriction of Waukesha dol.]

A. H. Sutton, 1935 (Rept. 9th Ann. Field Conf. Kans. Geol. Soc., p. 278), states lower part of Waukesha is probably pre-Niagaran, and of Alexandrian age, but fig. 1 of this rept assigns all of Waukesha to Lockport epoch.

Waukesha ls. is now considered by Savage and others as overlying Joliet ls. of Ill. Geol. Survey. (See under *Joliet ls.*)

Waukon sandstone.

Upper Cambrian: Northeastern Iowa.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 320–321, 326). In substituting *Waukon ss.* for the older title Jordan ss., as used in Iowa (not typical Jordan terrane), it is with a keen sense of necessity, because of fact that the term Jordan as originally proposed refers to an entirely different strat. unit. The Waukon ss. underlies Oneota dol. as exposed in NE. Iowa, SE. Minn., and SW. Wis., and uncon. overlies Allamakee dol. [Keyes correlated typical Jordan ss. with New Richmond ss. of Iowa repts.]

Named for exposures in vicinity of Waukon, Allamakee Co.

Waupecan sandstone.

Pennsylvanian: Northeastern Illinois (Morris quadrangle, comprising parts of Kendall and Grundy Counties).

H. E. Culver, 1922 (Ill. Geol. Surv., Extract from Bull. 43, 1923, pp. 53–56). *Waupecan ss.*—Shaly ss. or sandy sh. above and ss. below. Thickness 10 to 25 ft. A development of "millstone" concretions is common if not characteristic of this memb. There seems little doubt this ss. is contemp. with Vermilionville ss.

lentil of Carbondale fm., but it may possibly belong to McLeansboro fm., which, however, so far as known is absent in Morris quad. Uncon. overlain by Pleist. deposits, and underlain by 15 to 25 ft. of sh. belonging to Carbondale fm.

Named for exposures along Waupecan Creek, Grundy Co.

Waupun moraine.

Pleistocene (Wisconsin stage): Southeastern Wisconsin. Shown on moraine map (pl. 23) of U. S. G. S. P. P. 106. Named for Waupun, Fond du Lac Co.

Wausau graywacke.

Pre-Cambrian (middle Huronian): Central northern Wisconsin (Marathon County).

S. Weidman, 1907 (Wis. Geol. Nat. Hist. Surv. Bull. 16, p. 55). *Wausau graywacke.*—Feldspathic qtzite and graywackes occurring in isolated masses within a few miles NE. and NW. of Wausau. Believed to have considerable thickness. It is likely it is conformable with and a part of Hamburg sl. to NW. and with Rib Hill qtzite to SW. Assigned to lower Huronian(?).

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, chart opp. p. 598), assigned this fm. to middle Huronian.

Wausau granite.

Pre-Cambrian: Wisconsin.

C. C. Wang, 1932 (Geol. Soc. China Bull., vol. 11, No. 4, p. 427).

Waushara granite.

Pre-Cambrian (pre-Huronian?): Central southern Wisconsin (Waushara County).

S. Weidman, 1898 (Wis. Geol. Nat. Hist. Surv. Bull. 3, Sci. ser. 2, pp. 47–64). *Waushara granite.*—Fine-grained dull-red granite consisting of feldspar and quartz and a very small amount of fine mica. Outcrops at several places in Marion and Warren Twps, SE. part of Waushara Co., in dist. of Fox River.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 365). *Waushara granite* may be supposed to be pre-Huronian.

Wauswaugoning quartzite.

Pre-Cambrian (Huronian): Northeastern Minnesota.

N. H. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept.). *Wauswaugoning qtzite*, at head of Wauswaugoning Bay, apparently lies at same horizon as Pewabic qtzite, near top [?] of the Animikie.

N. H. Winchell, 1893 (Minn. Geol. Nat. Hist. Surv. Bull. 8, btw. pp. vii and xxxiv). *Wauswaugoning qtzite*, with its slaty qtzites, is probably on same horizon as Pewabic qtzite.

C. R. Van Hise and C. K. Leith, 1909 (U. S. G. S. Bull. 360, p. 409), correlated this qtzite with Pokegama qtzite, which is now classified as middle Huronian by C. K. Leith and other geologists.

†Wautubbee marl. (In Claiborne group.)

Eocene (middle): Mississippi.

E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14, p. 78). *Wautubbee marl.*—Highly calc. and fossiliferous marine marls, gray to almost white, or dark-bluish and greenish tints, due to presence of glauconite. Thickness about 100 ft. in SE. Miss. Underlies Cockfield memb. of Lisbon fm. and overlies, perhaps uncon., Decatur sand memb. of Lisbon.

Later work has shown that these rocks comprise upper and major part of Lisbon fm., and that geographic name is not necessary, because the rocks closely resemble typical Lisbon deposits. (See L. W. Stephenson, W. N. Logan, and G. A. Waring (U. S. G. S. W. S. P. 576, p. 51, 1928.)

Named for exposures near Wautubbee, Clarke Co., on Northeastern R. R., in deep cut beneath highway bridge on Highway 11, sec. 10, T. 3 N., R. 14 E.

†Waverlian.

A variant of †Waverlyan.

†Waverly group.

Mississippian and Devonian (?): Ohio and Kentucky.

W. W. Mather, 1838 (Am. Jour. Sci., 1st, vol. 34, pp. 356, 363); C. Briggs, Jr., 1838 (Ohio Geol. Surv. 1st Ann. Rept., pl. 1, p. 79). *Waverly ss. series.*—Alternating fine-grained ss. and sh., 250 to 300 ft. thick, overlying 200 to 300 ft. of grayish to black slaty argill. rock and underlying 40 to 80 ft. of cgl. [Pottsville] beneath the lower coal series.

This term has been variously used, to include Logan, Black Hand, Cuyahoga, Sunbury, and Berea fms.; Bedford fm. (of Dev. or Carbf. age) also has been included by some writers; and many writers have included the still older Cleveland sh.

Named for Waverly, Pike Co., Ohio.

See also U. S. G. S. Bull. 769, pp. 75–78.

†Waverly conglomerate.

Mississippian: Ohio.

E. B. Andrews, 1871 (Ohio Geol. Surv. Rept. Prog. 1870). *Waverly cgl.*—Coarse ss., often cgl.; exposed at Black Hand; total thickness 50 to 85 or more ft. Underlies Logan ss. (Upper Waverly ss.) and overlies lower sss. and shales of Waverly ss. group. [See also E. B. Andrews, 1870 (Ohio Geol. Surv. Rept. Prog. 1869, pp. 75–80, 135, and "Section of Hocking River," on map of Lower Coal Measures).]

Replaced by *Black Hand fm.*

Named for occurrence within †Waverly group.

†Waverly sandstone series.

Same as †Waverly group. (See U. S. G. S. Bull. 769, pp. 75–78.)

†Waverly black shale.

†Waverly black slate.

Names applied in some early Ohio repts to the Mississippian fm. later named *Sunbury sh.* Named for occurrence in †Waverly group.

†Waverly brownstone.

A term applied in some early Ohio repts to a part of Buena Vista ss. memb. of Cuyahoga fm.

†Waverly shale.

†Waverly blue shale.

Names applied in some early Ohio repts to *Bedford sh.*

†Waverly quarries.

†Waverly sandstone.

Names applied in some early Ohio repts to *Berea ss.*

Waverly formation.

Mississippian: British Columbia.

W. A. Johnston and W. L. Uglow, 1926 (Canada Geol. Surv. Mem. 149, p. 21).

†Waverly flags.

Pennsylvanian: Eastern Kansas, southeastern Nebraska, and northwestern Missouri.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 36, 39, 45). [See 1st entry under *Kereford ls.*]

†Waverlyan system.

E. O. Ulrich, 1905 and 1911. (See explanation under †*Tennesseean system.*)

Has also been called *Waverlyan series* and *Waverlian series.*

Wawa tuff.

Pre-Cambrian (Keewatin): Western Ontario (Michipicoten district).

A. P. Coleman and A. B. Willmott, 1902 (Toronto Univ. Studies, geol. ser., No. 2, p. 9; Ont. Bur. Mines Ann. Rept. 1902, p. 156). *Wawa tuffs*, Huronian.

C. R. Van Hise and C. K. Leith, 1911 (U. S. G. S. Mon. 52, p. 151), included *Wawa tuff* in Keewatin.

Waxahatchee slate.

Pre-Cambrian or Paleozoic: Central Alabama.

C. Butts (U. S. G. S. Montevallo-Columbiana folio, No. 226). *Waxahatchee sl.*—Chiefly grayish, greenish, and bluish sl., including, near top, Sawyer ls. memb. and a bed of ss., also several beds of ss. at lower horizons. Contains much bluish fine-grained sl. Thickness probably about 5,000 ft. Underlies Brewer phyllite and is oldest fm. exposed in these quads. Named for exposures on Waxahatchee Creek, Shelby Co., in Columbiana quad.

Wayan formation.

Upper Cretaceous (and Lower Cretaceous ?): Southeastern Idaho.

G. R. Mansfield and P. V. Roundy, 1916 (U. S. G. S. P. P. 98G, p. 83). *Wayan fm.*—Sss., shales, lss., and some cgls. Neither top nor bottom of fm. is known, but 11,800± ft. appears to be exposed thickness. Confined to NE. part of Wayan quad. and region to N. Rests uncon. on Gannett group. Named for settlement of Wayan, Bannock Co., in NW. part of Wayan quad. Occupies hills immediately E. of Wayan and appears to be broadly divisible into two units, the upper 9,000± ft. being composed chiefly of alternating sss. and shales with some conglomeratic beds, and the lower 2,800 ft. comprising some 8 subdivisions, including several thick beds of ls. Assigned to Cret. (Lower? Cret.).

Later definitely Upper Cret. fossils were found in upper part of Wayan fm., and the accumulated evidence (mainly physical) regarding the lower part suggested that that part also is Upper Cret. Age was therefore changed (in March 1936) to *Upper Cret. (and Lower Cret.?)*. (See American Cret. ferns of genus *Tempskya*, by C. B. Read and R. W. Brown, U. S. G. S. P. P. 186F, 1937.)

Wayland shale member (of Graham formation).

Pennsylvanian: Central and central northern Texas.

F. B. Plummer and R. C. Moore, 1922 (Jour. Geol., vol. 30, pp. 24, 31; Univ. Tex. Bull. 2132, pp. 127–158). *Wayland sh. memb. of Graham fm.*—Very fossiliferous sh. composing top memb. of Graham fm. in most places in Brazos River and Colorado River Valleys. Varies in thickness from 0 to 100 ft. In section 1½ mi. E. of Avis, Jack Co. [Brazos River region], it consists of 75 ft. of light-gray sandy sh. underlain by 10 ft. of yellowish-gray sh. with ferruginous concretions. In some sections the basal bed is black carbonaceous sh. 5 ft. thick. Discon. underlies Avis ss. memb. of Thrifty fm. and overlies Gunsight ls. memb. of Graham fm.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 103), treated *Wayland sh.* as top memb. of Graham fm., overlain by Avis ss.

F. M. Bullard and R. H. Cuyler, 1935 (Univ. Tex. Bull. 3501, pp. 197+), expanded *Wayland sh.* to include, in Colorado River region, all beds up to base of Speck Mtn ls. and defined it as resting on Gunsight ls.

Wallace Lee and C. O. Nickell (rept completed and soon to be published by Tex. Geol. Surv.) define Wayland sh. of type region (Brazos River) as underlying Avis ss. and as in places separated from Gunsight ls. memb. by 200± ft. of deposits.

Named for exposures at and near Wayland, Stephens Co., Brazos River region.

Wayne formation.

Silurian (Niagaran): Western Tennessee and northeastern Mississippi.

N. F. Drake, 1914 (Tenn. Geol. Surv. Resources of Tenn., vol. 4, No. 3, p. 103). *Wayne fm.*—Name proposed by H. D. Miser from fact the rocks to which it is applied are widely exposed and typically developed in Wayne Co. Consists of 5 members (descending): Dixon earthy ls. memb. (10 to 45 ft. thick); Lego ls.

memb. (25 to 36 ft. thick); Waldron clay memb. (2½ to 5 ft. thick); Laurel ls. memb. (19 to 32 ft. thick); and Osgood earthy ls. memb. (10 to 17 ft. thick). Underlies Brownsport fm. and overlies Brassfield ls.

Named for Wayne Co., Tenn., in NW. part of which all of the members are well developed.

Wayne.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Waynesboro formation.

Lower Cambrian: Central and southern Pennsylvania, western Maryland, and northern Virginia north of Rockbridge Co.

G. W. Stose, 1906 (Jour. Geol., vol. 14, p. 209). *Waynesboro fm.*—Purple sh. and flaggy calc. sss., hard, siliceous, and ripple-marked. About 600 ft. thick. Underlies Elbrook ls. and overlies Tomstown ls. Outcrops in ridge just N. of Waynesboro, Franklin Co., Pa.

G. W. Stose, 1909 (U. S. G. S. Mercersburg-Chambersburg folio, No. 170), gave thickness of Waynesboro fm. as 1,000 ft., and later repts give thickness up to 1,750 ft.

Waynesburg group.

H. D. Rogers, 1858 (Geol. Pa., vol. 2, pt. 1, pp. 474–477), mentioned, but did not define, *Waynesburg group.*

Waynesburg sandstone member (of Washington formation).

Permian: Southwestern Pennsylvania, southeastern Ohio, northern West Virginia, and western Maryland.

J. J. Stevenson, 1873 (Am. Phil. Soc. Trans., vol. 15, n. s., p. 16). The "Upper Barren group" [Dunkard group of present nomenclature] includes all above the *Waynesburg ss.*, if I may so term it. This ss. is separated from underlying Waynesburg coal by 1 to 15 ft. of sh. [later named Cassville sh. memb.]. [For many years the Waynesburg ss. and Cassville sh. have been included in Washington fm., the lower fm. of Dunkard group, although they were excluded in this original definition. W. M. Fontaine and I. C. White transferred them to the higher fm. in 1880 (2d Pa. Geol. Surv. Rept. P_2).]

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 40, 41). *Waynesburg ss.*—Generally massive and conglomeratic grayish-white ss., but in places represented by sandy shales and flaggy sss., with an occasional ls. stratum. Thickness 50 to 100 ft. Lies 2 to 5 ft. below Mount Morris ls. and rests on Cassville plant sh. Named for fine development near [on Tenmile Creek just E. of] Waynesburg, Greene Co., Pa.

Waynesburg limestone member (of Monongahela formation).

Pennsylvanian: Southwestern Pennsylvania, western Maryland, eastern Ohio, and northern West Virginia.

J. J. Stevenson, 1877 (2d Pa. Geol. Surv. Rept. K2). In Fayette and Westmoreland dist. of Pa. the *Waynesburg ls.*, 8 to 35 ft. thick, underlies Little Waynesburg coal and is separated from underlying Uniontown coal by 50 to 80 ft. of sh. and shaly ss. [the ss. is Uniontown ss. memb.].

Named for Waynesburg, Greene Co., Pa.

Waynesburg clay.

Name applied to the clay associated with Waynesburg coal, the upper bed of Monongahela fm. (Penn.) in southwestern Pa., northern W. Va., and eastern Ohio.

Waynesburg member. (In Monongahela formation.)

A term employed by Pa. Geol. Surv. (M. E. Johnson, Topog. and Geol. Atlas Pa. No. 27, Pittsburgh quad., p. 31, 1929) to include (descending) Waynesburg coal, Browntown ss., Little Waynesburg coal, and Waynesburg ls.

Waynesville shale. (In Richmond group.)

Upper Ordovician: Southwestern Ohio, southern Indiana, and north-central Kentucky.

J. M. Nickles, 1903 (Am. Geol., vol. 32, p. 205). *Waynesville or Bythopora meeki beds.*—Dove-colored to blue lss. interbedded with blue or greenish-blue clay; 50 ft. thick. Conformably overlies Warren beds [Arnheim fm.] and underlies Liberty beds.

Adopted by U. S. Geol. Survey to exclude at base beds called by A. F. Foerste *Fort Ancient div. of Waynesville,* which according to E. O. Ulrich and C. Butts more appropriately belong to underlying Arnheim sh. In introducing *Fort Ancient,* Foerste also stated that the lamellibranchs suggest that Fort Ancient belongs to Arnheim. In his subsequent repts, however, he included it in Waynesville and placed an uncon. at its base. According to E. O. Ulrich and C. Butts there is an uncon. at top of Fort Ancient of Foerste. In SW. Ohio the Waynesville is chiefly sh. and is called *Waynesville sh.;* in southern Ind. and north-central Ky. it is chiefly ls. and is called *Waynesville ls.*

Named for Waynesville, Warren Co., Ohio.

Waynesville limestone. (In Richmond group.)

Upper Ordovician: Southern Indiana and north-central Kentucky.

See under *Waynesville sh.*

Wayside sandstone and shale member. (In Pottsville formation.)

Pennsylvanian: Southwestern Illinois (Carbondale quadrangle).

J. E. Lamar, 1925 (Ill. Geol. Surv. Bull. 48, pp. 23, 84–85, and map). *Wayside ss. and sh. memb.*—The Wayside memb. of the Pottsville in Carbondale quad. is defined as the strata lying above the ls. beds of the Kinkaid and below the massive conglomeratic ss. beds of the Lick Creek memb. Most of its beds seem to be lenticular. The sss. vary from thin-bedded to massive, from fine to locally coarse-grained, and from relatively pure to very argill. The shales show wide textural and compositional range. In places thin bands of quartz-pebble cgl. occur. A few small thin lenses of coal are present. Argill. dark-colored ls. found in places also probably belongs to this memb. Contains one massive ss. about 45 ft. thick, which forms waterfalls and cliffs. Average thickness of the Wayside is probably about 70 ft. Lies uncon. on Kinkaid ls. and is overlain, probably conformably, by Lick Creek ss. memb. of the Pottsville. Named for village of Wayside, Union Co., which is a few mi. NW. of best exposures.

Wayside sand.

A subsurface sand, of Penn. age, in central northern Okla., that is correlated with Cleveland sand and with part of Nowata sh. In Wiser pool, Osage Co., it is 20 to 25 ft. thick and lies at 750 ft. depth, the Bartlesville sand lying at 1,475 ft. Is supposed to be same as Wayside sand of Wayside, Kans.

Wea shale.

Pennsylvanian: Eastern Kansas, northwestern Missouri, and southwestern Iowa.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 91, 97). *Wea sh. memb.* underlies DeKalb ls. and overlies Block ls., all members of Cherryvale sh.

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, pp. 18, 38). *Wea sh.*—Argill. or calc. sh., greenish or gray, 10 to 30+ ft. thick, overlying Block ls. and underlying Westerville ls., all in Kansas City group. Named for Wea Creek, in NE. part of Miami Co. Type exposures at SE. cor. sec. 31, T. 16 S., R. 24 E., and at center of E. side of sec. 12, T. 18 S., R. 22 E.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

Weatherford dolomite.

Permian: Northwestern Oklahoma (Dewey and Custer Counties).

R. L. Six et al., 1930 (Okla. Geol. Surv. Bull. 40UU, map). "*Day Creek or Weatherford dol.* (Not always present.) Weatherford horizon is 50± ft. below the Day Creek."

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4). *Weatherford dol.* closely resembles Relay Creek dolomites. It lies 25 to 60 ft. below Cloud Chief gyp. and in Rush Springs ss. It was called *Day Creek dol.* by Gould in 1924, when he first defined Cloud Chief gyp.

See also under *Day Creek dol.* and *Cloud Chief gyp.*

D. A. Green, 1936 (A. A. P. G. Bull., vol. 20, No. 11, p. 1472). Evans (1931) [publication cited above] described Weatherford dol. as in upper part of Rush Springs ss., with which all geologists who have worked in Weatherford area agree. From Weatherford N. and W. through Custer Co. the Weatherford dol. horizon occurs as a gyp. bed 3 to 5 ft. thick, except a few local patches in vicinity of Arapaho, where it is a thin dol.

Weatherford lime rock.

A term applied by drillers to Lower Cret. lss. occurring at various horizons in Main Street ls., Denton clay, and Goodland ls. of Dallas Co., NE. Tex. (See E. W. Shuler, Tex. Univ. Bull. 1818, pp. 11-26, 1918.)

Weaver rhyolite.

Triassic (Middle?): Northwestern Nevada (Rochester district).

A. Knopf, 1924 (U. S. G. S. Bull. 762). *Weaver rhyolite.*—Chiefly flows of rhyolite lavas, with small amount of intercalated tuffs and breccias. In places rests on rhyolite tuff and in places on the lower (70± ft.) Nenzel rhyolite breccia. Thickness 720+ ft. Of Triassic (Middle? Triassic) age. Exposed at head of Weaver Canyon.

Weaverton sandstone.

Same as Weverton ss., the approved spelling.

Weaverville formation.

Eocene: Northern California (Klamath Mountains).

N. E. A. Hinds, 1933 (Calif. Jour. Mines and Geol., vol. 29, Nos. 1 and 2, pp. 79, 115). Diller, Hershey, and MacDonald have described deposits of "auriferous gravels" from a number of small basins in western Klamath Mtns. Under this heading of "auriferous or gold gravels" deposits of such different ages and types are included that the term has no strat. significance. The *earliest or first-cycle group*, for example, are the Cret. marine cgls. which at certain localities contain detrital gold. The *second series* includes fine-textured flood-plain sediments (ss., shaly sss., and sandy shales), lake beds, lignitic shales and lignites, tuffs, and coarse stream gravels. The fossil plants present toward base of the series at various localities are of Eo. age, but whether all the beds belong to a single sequence has not been determined. For this series of beds writer proposes *Weaverville fm.* from extensive exposures near Weaverville, Trinity Co. The gravels most important as a source of gold are coarse channel deposits of Pleist. age. The deposits of second cycle have been preserved by down-faulting of small blocks into the much more resistant bedrock of the region, and in these basins the soft unconsolidated sediments were protected from rapid erosion. The principal deposit extends from short distance S. of Weaverville for about 20 mi. to NNE., and has width of 1 to 3 mi. Plants found in the tuff and tuffaceous sediments on Redding Creek and near Hayfork and Hyampon were considered by F. H. Knowlton to be Mio. and = fossil floras of Sierra Nevada auriferous gravels. According to H. MacGinitie (personal communication), who has worked on this flora under direction of R. W. Chaney, the fossil plants are Eo. and probably to be correlated with the floras of auriferous gravels of Sierra Nevada.

In 1935 (Geol. Soc. Am. Proc. 1934, p. 316) Hinds assigned this fm. to Eo. or Mio.

†Webb Bluff.

Eocene: Southern Texas.

E. T. Dumble, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 224, 228, 230). *Webb Bluff Tertiary.*—Underlies Reynosa beds (Neocene) and overlies Escondido beds. Assigned to Eocene. [Not fully described, but seems to consist of 7 to 8 ft. of greensand marls with many Tert. fossils, nodules of carbonate of lime, and specks of glauconite.]

Same as Midway fm.

Named for Webb Bluff, Webb Co., 3 mi. below Maverick Co. line.

Webbers Falls sandstone member (of Atoka formation).

Pennsylvanian: Eastern Oklahoma (Muskogee and McIntosh Counties).

C. W. Wilson, Jr., 1935 (A. A. P. G. Bull., vol. 19, No. 4, pp. 503–520). *Webbers Falls ss. memb. of Atoka fm.*—Impure bluish limy ss., containing angular quartz grains and argill. and carbonaceous matter. In S. part of area the lower part outcrops as a thin-bedded blocky impure ss. of fine texture and dark-blue color. Fossils. Thickness 35 ft. Separated from underlying Dirty Creek ss. memb. by 40 ft. of dark-blue sh. and from overlying Blackjack School ss. memb. by 150 to 350 ft. of sh. Named for exposures in secs. 10 and 15, T. 15 N., R. 20 E., about 2 mi. W. of Webbers Falls.

†Webberville beds.

Upper Cretaceous (Gulf series): Central Texas (Travis and Burnet Counties).

R. T. Hill, 1889 (Tex. Geol. Surv. Bull. 4, pp. xiii, xxx). *Navarro-Webberville beds* of *Exogyra ponderosa* marls or Blue Bluffs div.; seen in Colorado section from Montopolis Bridge to Webberville, especially at blue bluffs of Colorado River. Consist of clays underlying the Glauconitic div. of the Cret. or the Lignitic or Basal div. of Eo. Exposed at and near Webberville [Travis Co.].

R. T. Hill, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. 115, 132). *Webberville beds* [on p. 115] also *Navarro-Webberville beds* [on p. 132 and included in *Exogyra ponderosa* marls or Blue Bluffs div. (Taylor marl)].—Slightly aren. and very fossiliferous concretionary clays indicating transition into Glauconitic div. Along Colorado River overlain by Eocene Lignitic deposits.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 124–127, 344). *Webberville beds.*—Black clay shales with occasional aren. layers and indurations. Thickness 400 ft. Differs from underlying Taylor marl in presence of many glauconite or greensand grains and by different fossils. The beds represent Navarro fm., which author in previous repts has called *Glauconitic div.* They grade into Taylor marl.

Now considered to be essentially the same as Navarro fm., the older name.

Weber quartzite.

Pennsylvanian: Northeastern Utah (Weber Canyon region).

C. King, 1876 (Am. Jour. Sci., 3d, vol. 11, pp. 477–479). *Weber qtzite.*—Qtzite with a few beds of red ss. at base and occasional fine beds of sh. interspersed at 3 or 4 horizons, varied to considerable extent by thin sheets of cgl. and rounded quartz pebbles. Named for Weber Canyon of Wasatch Range. No fossils but is certainly referable to middle of Coal measures. Rests conformably on Wasatch ls. and is conformably overlain by Upper Coal measures. Thickness 6,000 to 10,000 ft. [The use of the name *Weber* was extended by the early workers into Colo. and Wyo., to include great thicknesses of rocks that are probably older than Weber qtzite.]

E. Blackwelder, 1910 (Geol. Soc. Am. Bull., vol. 21, pp. 517–542). In upper canyon of Weber River the conspicuous *Weber qtzite* is separated from the dark Miss. lss. by a Penn. fm. of red ss. and sh. with intercalated thin lss., having a total thickness of about 500 to 2,000 ft. This fm. was noted by geologists of Survey of 40th Par. but was not named. Weeks [F. B.], in an unpublished ms. on geol. of NE. Utah and adjacent regions, calls it *Morgan fm.*, and in present paper that name is adopted. In Weber Canyon the Park City fm. overlies Weber qtzite. Writer traced Weber qtzite N. from its type loc. and found that it grows thinner and finally disappears 7± mi. N. of Weber River, and that it is missing where the Penn. rocks reappear 4 to 5 mi. to NW., where the Penn. phosphatic series (Park City fm.) rests on Miss. ls. In Big Cottonwood Canyon the Weber is 1,200 to 1,500 ft. thick. It is uncertain whether Weber qtzite is a fm. of local extent, or once far more extensive than now and removed by erosion from N. part of Wasatch region. There is probably an uncon. btw. Weber qtzite and overlying Park City phosphatic series. [The Morgan fm. was included in Weber qtzite of King.]

In repts of early geologists the name *Weber* was applied to Carbf. rocks in Colo. whose relations to the type Weber still remain undet., but which are believed to be older; and it was also applied in some areas to rocks now known to be Camb. The typical rocks in Weber Canyon are of Penn. age, but in many parts of northern Utah the name has in recent years been incorrectly used to include at base several hundred ft. of lss., sh., and sss. that apparently correspond to Morgan fm. of NE. Utah and are older than the typical Weber qtzite.

†Weber grits.

Pennsylvanian: Central Colorado (Leadville and neighboring regions).

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215-230), 1883 (U. S. G. S. Leadville Atlas), and 1886 (U. S. G. S. Mon. 12). [A name applied, on questionable correlation with Weber qtzite of Utah, to 940 ft. of coarse-grained arkose, micaceous sss., and qtzites alternating with beds of sandy micaceous, argill., and sometimes bituminous sh., overlying so-called "Weber shales." The name was also used by Emmons to include "Weber grits" and "Weber shales."]

†Weber shales.

Pennsylvanian: Central Colorado (Leadville and neighboring regions).

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215-230), 1883 (U. S. G. S. Leadville Atlas), and 1886 (U. S. G. S. Mon. 12). [A name applied, on questionable correlation with Weber qtzite of Utah, to 300 ft. of thin-bedded black bituminous sh. underlying so-called "Weber grits" and overlying "Blue" (Leadville) ls.]

G. H. Girty, 1903 (U. S. G. S. P. P. 16). *Weber* should be abandoned in Colo. Correctness of correlation of shales and grits in Colo. with Weber qtzite (the type fm.) of Wasatch Mtns, Utah, is very doubtful.

Weber conglomerate.

A name applied in some repts to a cgl. in Eureka and other dists of Nev. that is doubtfully correlated with Weber qtzite of Weber Canyon, Salt Lake region, Utah.

†Weberan series.

†Weberian series.

Terms applied by C. [R.] Keyes to Weber qtzite of Utah and supposedly contemp. deposits.

Webster group.

Devonian: Southwestern Missouri (Greene County).

E. M. Shepard, 1905 (Drury Coll. Bradley Geol. Field Sta. Bull. 1, p. 57). *Dev. (Webster group) cherts.*—Very hard chert, passing from ss. on one side into qtzite on the other, imperfectly banded and agatized, rarely oolitic (containing minute egg-shaped particles), in extremely irregular layers or masses. [Derivation of name and strat. position of the cherts not stated.]

Webster formation.

A term proposed by E. O. Ulrich in an unpublished chart exhibited before Geol. Soc. Am. in Dec. 1932, for beds in Okla. said to be of late Black River and early Trenton age and to overlie his Bromide fm. [restricted] and underlie Viola ls. The term has not been defined or published by Ulrich, but has been published by F. C. Edson (A. A. P. G. Bull., vol. 19, No. 8, pp. 1122–1130, 1935), who asks "What is the Webster fm?"

Webster sand.

A subsurface sand, 30 ft. thick, in Eocene Cook Mtn fm. (of Claiborne group) of southern Tex. Lies 500 ft. below Mirando sand and higher than Carolina-Texas sand.

Webster Springs sandstone. (In Bluefield formation.)

Mississippian: Southern West Virginia.

D. B. Reger, 1920 (W. Va. Geol. Surv. Rept. Webster Co., pp. 214, 227–228). *Webster Springs ss.*—Massive current-bedded greenish-gray micaceous medium-hard ss., 20 to 150 ft. thick. Basal memb. of Mauch Chunk. Rests on Greenbrier ls. and is separated from overlying Hinton ls. by 20 to 50 ft. of red or green sh. with lenticular sss. Exposed on N. side of Elk River at SE. edge of town of Webster Springs. May be same as Hinton ss. of Krebs.

D. B. Reger, 1926 (W. Va. Geol. Surv. Rept. Mercer, Monroe, and Summers Counties, pp. 301, 432). *Webster Springs ss.* is underlain by Glenray ls. (44 to 125 ft. thick) and overlain by Bickett sh.

Weches greensand member (of Mount Selman formation).

Eocene (middle): Eastern Texas (Houston to Sabine Counties) and northwestern Louisiana.

A. C. Ellisor, 1929 (A. A. P. G. Bull., vol. 13, pp. 1339–1346). *Weches memb. of Claiborne fm.*—Name proposed by E. A. Wendlandt and G. M. Knebel, for the massive greensand beds below Sparta sand memb. and above Queen City sand memb. The following section is exposed on Crockett road 1½ mi. SW. of Weches, in Houston Co., Tex. (descending): (1) Glauconitic, calc. fossiliferous clays, with small calc. concretions, 28 ft.; (2) very light fine quartz sand, clay, and sandy clay with ferruginous partings, 5 ft.; (3) much weathered greensand, sandy near top, 5 ft.; (4) gray to chocolate-gray glauconitic clay, 4 ft.; (5) greensand with fossil casts and streaks of clay, ironstone concretions at top, 4 ft.; (6) glauconitic gray sh. with sand streaks and fossil casts, 7 ft. Thickness 160 ft. in Angelina, Trinity, and Houston Counties; disappears opposite Sabine River in La.; in Cherokee and Smith Counties is 40 or less; in NW. La. it is 80± ft. thick in Palmer Corp. Crichton No. 1 well. Writer has found this memb. in wells in Cleveland and Bradley Counties, Ark. Not observed in wells in La. to E. and SE. of Sabine uplift. In some areas *Ostrea sellaeformis* and *Scutella caputsinensis* characterize this memb., especially near *San Augustine*, Tex., "which name formerly was applied to this memb. but dropped because of priority." In NW. La. the Queen City beds are absent and Weches memb. underlies Sparta sand and overlies Reklaw memb.

E. A. Wendlandt and G. M. Knebel, 1929 (A. A. P. G. Bull., vol. 13, pp. 1351, 1356–1360). *Weches memb. of Mount Selman fm.*—A remarkable deposit of rather pure clayey glauconite whose av. thickness is approx. 50 ft. throughout basin proper, but thicker in Nacogdoches and San Augustine Counties. At top is a zone of laminated iron ore few in. to 4 ft. thick. To NE., particularly in Cass Co., the Weches greensand becomes more sandy and cross-bedded and the iron ore occurs irregularly throughout the fm. It is this fm. which gives to East Texas its characteristic red color. Overlies Queen City memb., and underlies Sparta sand. Is top memb. of Mount Selman fm.

Adopted as *Weches greensand memb. of Mount Selman fm.* In NW. La. these beds form upper part of Cane River fm.

Wedington sandstone member (of Fayetteville shale).

Mississippian (Chester): Northern Arkansas and northeastern Oklahoma.

G. I. Adams, 1904 (U. S. G. S. P. P. 24, p. 27). *Wedington ss.*—A ss. fm., 50 to 150 ft. thick, thin-bedded and heavy-bedded, carrying some interstratified sh. Overlies Fayetteville sh. [restricted sense].

E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, p. 108). According to available evidence the Wedington ss. is a wedge, thickening westward and possibly eastward, lying on Fayetteville sh. Whether these underlying shales are of upper or lower part of Fayetteville fm. is not known. If upper bed is not present in any sections containing the Wedington ss., then this ss. must be a later fm., probably overlapping northwardly and westwardly, during time there represented by uncon. btw. the Fayetteville and Pitkin. On other hand, it may be an extension and expansion of the fossiliferous intermittent ss. memb., 3 to 60 ft. thick, which divides Fayetteville fm. into three parts, and if so it should be treated as memb. of Fayetteville. Writer inclines to latter interpretation. Same as Batesville ss. of Simonds [not true Batesville ss.].

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville folio, No. 119), treated Wedington ss. as a memb. of Fayetteville sh. This is still the approved definition of Wedington ss. In Okla. this ss. lies near middle of the Fayetteville; in Ark. it lies 0 to 70 ft. below top of the Fayetteville.

Named for Wedington Mtn, Washington Co., Ark.

Wedowee formation.

Cambrian to Carboniferous: Eastern Alabama.

G. I. Adams, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, p. 36). *Wedowee fm.*—Slates, phyllites, qtzites, and schists, characterized in many places by occurrence of amorphous graphite, which renders the rocks black or grayish black where weathered. Much of fm. is without graphite but contains such metamorphic minerals as mica, garnet, staurolite, and cyanite. No calc. rocks have been found in the fm. May comprise upward of 10,000 ft. of variable altered sediment. The black graphitic phase reaches thickness of 2,000 ft. in places. Age tentatively placed from Carbf. downward into Camb., but lower limit cannot be stated with any definiteness. [Adams repeated this age designation in Jour. Geol., vol. 41, No. 1, p. 166, 1933, but A. I. Jonas considers the fm. to be pre-Camb., and it is thus tentatively mapped on 1932 geol. map of U. S.]

Named for exposures at and around Wedowee, Randolph Co.

Weedon schist.

Ordovician (?): Quebec.

F. R. Burton, 1931 (Quebec Bur. Mines Ann. Rept. 1930, pt. D, p. 111).

Weed Patch member.

Mississippian: Southern Indiana.

P. B. Stockdale, 1931 (Ind. Dept. Cons., Div. Geol., Pub. 98, pp. 76, 119, 189, 202, 218, 280, etc.). *Weed Patch memb. of Edwardsville fm.*—Calc. zone, very sandy, irregular, buff to chocolate-colored, with chert. Thickness 5 to 8½ ft. At Kelly Hill lies 17 ft. below top of Edwardsville fm. and 21 ft. above base of Edwardsville. Along road SE. of Weed Patch Hill, 3½ mi. SE. of Nashville, it is 5 ft. thick and lies 17 ft. above Floyds Knob ls. and 81 ft. below top of Edwardsville fm. The underlying beds are ss., the lower part of which is in thick, irregular, wavy beds; the immediately overlying beds consist of 45 ft. of siltstone. [In pl. 5, opp. p. 212, author places Weed Patch memb. 6± ft. above Cutright ss. memb.]

Weeks limestone.

Upper Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 10). *Weeks fm.*—Thin-bedded shaly lss. with a few bands of oolitic and aren. lss., 1,390 ft. thick. Underlies Orr fm. and overlies Marjum fm. Type loc. is N. side of Weeks Canyon, N. of Orr Ridge.

Weeping Water limestone. (In Oread limestone.)

Pennsylvanian: Southeastern Nebraska, eastern Kansas (?), and northwestern Missouri.

C. S. Prosser, 1897 (Jour. Geol., vol. 5, pp. 154–172). *Weeping Water ls.*—Massive light-gray ls., 9 ft. thick, forming top memb. of Wabaunsee fm. in Cass Co.

G. E. Condra and N. A. Bengston, 1915 (Nebr. Acad. Sci. Pub., vol. 9, No. 2, pp. 6, 10, 19). *Weeping Water ls.*, lying 18 ft. below top of Andrew (Lawrence) sh. and 16 to 18 ft. above Oreapolis ls. memb. of the Andrew, is 11 to 12 ft. thick in exposures W. of La Platte and Oreapolis, in Platte section, and 6 to 8 ft. thick near Plattsmouth, in Missouri River section. Is light-colored. In Platte section it consists of 2 beds separated by 1 ft. of light-colored calc. sh.

R. J. Scarborough, 1915 (p. 34 of book cited above). *Weeping Water ls.* (in Andrew sh.), is exposed in valley sides of Weeping Water Creek in secs. 4, 5, 6, 9, and 10, T. 10 N., R. 12 E., and along W. side of North Branch Valley about

1 mi. NW. of Nehawka [Cass Co., Nebr.]. Thickness 6 ft. Is light-colored, massive, breaks down in large blocks, and shows tendency to weather into rough, nodular forms. Is overlain and underlain by sh.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 32, 36). *Weepingwater ls.* is now known to be lowest unit of Oread ls. The overlying sh. is here named *Snyderville sh.* The underlying beds are Lawrence sh. [This definition was adhered to by R. C. Moore and G. E. Condra in their Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans., and by Condra in his 1935 classification (Nebr. Geol. Surv. Paper No. 8, p. 12).]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 163). There is sufficient doubt as to equiv. of "lower Oread" ls. of Kans. and Weeping Water ls. of Nebr. to make use of latter name undesirable for a subdivision of Kans. Oread. The basal memb. of Kans. Oread is therefore here named *Toronto ls. memb.*, a name introduced by Haworth and Piatt in 1894.

Wehrum flint clay.

A clay bed in lower part of Mahoning ss. memb. of Conemaugh fm. in western Pa. Lies lower than Mahoning ls. Probably named for occurrence at Wehrum, Indiana Co.

Weir sand.

An oil-bearing ss., 30 to 60 ft. thick, in New Providence fm. (Miss.) of eastern Ky. The name has also been applied to a sand of Miss. or Upper Dev. age in Kanawha Co., W. Va., and it has been misspelled Wier. It is first producing sand (oil and gas) near Weir, Kanawha Co., W. Va.

Weiser sand.

See *Wiser sand.*

Weisner quartzite (also **formation**).

Lower Cambrian: Northern central and northeastern Alabama and northwestern Georgia.

E. A. Smith, 1890 (Ala. Geol. Surv. Rept. Cahaba coal field, p. 149). *Weisner quartzite.*—Great beds of qtzite and cgl. in E. part of Coosa Valley, many hundred ft. thick, but often of very limited extent geographically. Interpolated in Coosa and Montevallo shales, at no definite horizon but most commonly in their lower parts, as local masses of lenticular shape and often of very great thickness. The qtzites always form high and rugged mtns, sometimes stretching for miles in an unbroken range, but as often forming detached and isolated peaks.

C. W. Hayes, 1891 (Geol. Soc. Am. Bull., vol. 2, geol. section of NW. Ga. on p. 143), showed *Weisner qtzite* underlying Rome ss. and overlying Coosa sh.

E. A. Smith, 1894 (Ala. Geol. Surv. geol. map of Ala. with explanatory text), excluded Weisner qtzite from †Montevallo sh., treated it as a distinct fm. overlying the crystalline rocks, and described it as consisting of 2,000 to 4,000 ft. of massive light-colored cgls., sss., and sandy yellowish sh.

C. W. Hayes, 1895 (U. S. G. S. 16th Ann. Rept., pt. 3, pp. 554–559), described Weisner qtzite as in places separated from overlying Rome fm. by a blue siliceous ls., which he correlated (erroneously) with Beaver ls. of Tenn. This ls. is now known as *Shady dol.*, 800 to 1,200 ft. thick. This is present approved definition of Weisner qtzite, which in parts of Ala. attains a thickness of 5,500 ft. (See L. LaForge, Ga. Geol. Surv. Bull. 35, 1919, pp. 43–45; also C. Butts, Ala. Geol. Surv. Spec. Rept. No. 14, 1926, p. 64.)

Named for fact it forms Weisner Mtn. Cherokee Co., Ala.

Weiss sand.

A subsurface sand, probably in Yegua fm. (Eocene), of Pettus area, Bee Co., SE. Tex.

Weitchpec schists.

Age (?): Northwestern California (Humboldt County).

O. H. Hershey, 1904 (Am. Geol., vol. 33, p. 357). The *Weitchpec schists* resemble the most highly metamorphosed Calaveras schists.

O. H. Hershey, 1906 (Am. Jour. Sci., 4th, vol. 21, p. 63). In approaching W. border of the belt the strata are bent up, and presently there appears under them a fm. made up of white sericite and green chloritic schists that are evidently sheared rhyolites and andesites. In a very short distance another fault brings down the Bragdon slates. This may be repeated several times in 20 mi., but far the larger part of area is Bragdon. The shearing becomes more pronounced toward W. until traces of bedding planes are virtually destroyed. I now consider *Weitchpec schists*, formerly classed as pre-Bragdon, as a portion of this series. Indeed, the apparent ancient schists of Redwood Mtn in Korbel-Hoopa trail are probably Bragdon, although undoubted pre-Dev. schists occur in South Fork Mtn.

Probably refers to schist exposed at or near Weitchpec, Humboldt Co.

Wekusko group.

Pre-Cambrian: Manitoba.

F. J. Alcock, 1920 (Canada Geol. Surv. Mem. 119, p. 16).

Wekwemikongsing beds.

Upper Ordovician: Ontario (Manitoulin Island).

A. F. Foerste, 1912 (Ohio Nat., vol. 13, p. 44). *Wekwemikongsing beds*.—A series of strata overlying Sheguindah beds (of Eden age) and underlying Waynesville beds or Lower Richmond. Contain fauna of Lorraine age. Total thickness may be 100 ft. in Cape Smyth area. Well exposed for about 2 mi. along shore btw. Wekwemikongsing and the Richmond Clay Cliffs on E. side of Cape Smyth.

Welch formation. (In Pottsville group.)

Pennsylvanian: Southern West Virginia and southwestern Virginia.

M. R. Campbell, 1897 (U. S. G. S. Tazewell folio, No. 44). *Welch fm*.—Ss. and sh. with many workable coal seams. Thickness 700 ft. Overlies Pocahontas [No. 3] coal (top bed of Pocahontas fm.) and underlies Raleigh ss. Named for exposures at Welch, McDowell Co., W. Va.

Welch sandstone. (In Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and R. M. Gawthrop, 1915 (W. Va. Geol. Surv. Rept. Wyoming and McDowell Counties, p. 198). *Welch ss*.—Massive to current-bedded, medium-grained to coarse, grayish white to light gray, 0 to 70 ft. thick. Lies 5 to 40 ft. below Sewell ("Davy") coal and 0 to 5 ft. above Welch coal. Exposed at Welch, McDowell Co.

Welch chert. (Buried.)

Pennsylvanian (early): Central Kansas.

R. C. Moore, 1926 (A. A. P. G. Bull., vol. 10, No. 3, pp. 208–211). *Welch chert*.—Mostly white chert, ranging in thickness to nearly 200 ft., encountered in well logs in Marion, McPherson, Reno, Rice, Ellsworth, and probably adjoining counties of central Kans. A part of the chert is much weathered, rotten, and deeply stained by iron oxide. The red material associated with the chert occurs below it, above it, or intermingled with it and is mostly a very deeply oxidized ferruginous clayey material, but part of it is a typical geest. The chert is evidently a secondary deposit. If evidences of clastic character of the [chert] deposit are substantiated it may be desirable to use the designation "*Welch chert gravel*." The deposit is underlain by over 200 ft. of fine-grained light bluish-gray clay sh., the middle part of which has yielded Penn. fossils and which probably corresponds to some part of Cherokee sh. The chert and at least the upper part of underlying sh. are definitely assigned to Penn. The overlying beds may belong to Marmaton fm. Named for fact it was producing horizon of Welch well, in sec. 35, T. 20 S., R. 6 W., Rice Co.

Welden limestone.

Mississippian: Central southern Oklahoma (Arbuckle Mountains).

C. L. Cooper, 1931 (Okla. Geol. Surv. Bull. 55, map of Arbuckle Mtns), shows: (1) In SW. part of mtns, Sycamore ls. overlain by Caney sh. and underlain by Woodford fm.; (2) in SE. part of mtns, Caney sh. resting on Woodford fm.; and (3) in NE. part of mtns, *Welden ls*. overlain by Caney sh. and underlain by Woodford fm. In latter area Welden Creek cuts across his *Welden ls*. [According to G. H. Girty (personal communication) the faunas of typical Sycamore ls. and Cooper's

Welden ls. differ. The bull. cited above is devoted to strat. and physical characteristics of Simpson group, and the text does not mention *Welden ls.*]

R. H. Dott, 1934 (A. A. P. G. Bull., vol. 18, No. 5, table on p. 579), showed the Miss. of Hunton arch area divided into (descending) Lower Caney, *Welden*, and Woodford; and on map on p. 583 of his paper, which is "after Geo. D. Morgan," appears *Welden ls.* (*Sycamore*).

C. L. Cooper, 1936 (letter dated June 30). Definition of *Welden ls.* has never been published. Am at present working on conodont fauna of this fm.

D. L. Hyatt, 1936 (A. A. P. G. Bull., vol. 20, No. 7), showed (p. 954) the following downward succession of fms. in Fitts oil pool, Pontotoc Co., Okla.: Penn. Caney, Miss. Caney, Mayes, Welden, and Woodford. On p. 958 he treated Mayes and Welden as part of "Miss. Caney," and stated that the Welden consists of 5 to 10 ft. of grayish white, finely crystalline ls.

Weldon series.

Carboniferous: New Brunswick.

W. J. Wright, 1922 (Canada Geol. Surv. Mem. 129, pp. 7, 15).

Weldon formation.

Mississippian: New Brunswick.

G. W. H. Norman, 1932 (Canada Geol. Surv. Econ. Geol. ser., No. 9, p. 170).

†Wellborn sandstone.

Eocene (upper): Eastern Texas.

W. Kennedy, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 39, 45). Gray sss. and gray sands, 65 to 90 ft. thick, forming top part of Eocene in Brazos Co. and tentatively denominated *Wellborn beds*. Underlie Navasota beds and overlie Yegua or lignitic div. of Claiborne.

For many years regarded same as Fayette ss., but F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 685, 686), states that it is basal part of McElroy memb. of Tex. Surv. (the middle memb. of Fayette ss. as Tex. Surv. now divides that fm.).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1298, 1302, 1305, etc.). *Wellborn sands* are middle memb. of McElroy fm., and are underlain by 250 to 300 ft. of Wooley's Bluff clays and overlain by Manning beds.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and pp. 23–32). *Wellborn fm.* [expanded] conformably underlies Manning fm., conformably overlies Caddell marl, and is here divided into 3 mappable units (descending): (1) Carlos ss. memb., 5 to 22 ft.; (2) middle Wellborn, 10 to 120 ft.; and (3) Bedias ss. memb., 0 to 30 ft. The Carlos ss. of this rept. is approx.=the Wellborn of Miss Ellisor's 1933 paper. It is apparent from Kennedy's description that the Wellborn fm. must include Carlos ss. and Bedias ss. [See also Renick 1936 entry under *Wooley's Bluff clays*.]

Named for Wellborn, Brazos Co.

Weller horizon.

Weller sandstone.

Tertiary (Miocene ?): Northwestern Colorado (Moffat County).

O. A. Peterson, 1928 (Mem. Carnegie Mus., vol. 11, No. 2, pp. 90–94). Browns Park fm. of Douglas Mtn, Moffat Co., is divisible into (1) an upper part, consisting of soft, almost chalklike sands and sss. cemented with lime and sometimes intercalated with slightly argill. bands; and (2) a lower part, here named *Weller horizon*, consisting of hard *Weller ss.*, 6 to 15 ft. thick, underlain by very soft ss. which weathers into sandy ridges. Total thickness of Weller horizon 736± ft. It is exposed at northern flanks of Douglas Mtn, on Weller ranch, near Gray Stone P. O. The Weller ss. is a hard bed which forms tablelands.

Wellersburg limestone. (In Conemaugh formation.)

Pennsylvanian: Western Maryland and southern Pennsylvania.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pp. 65, 114, pl. 6). *Wellersburg ls.*—A ls. occurring locally beneath Wellersburg coal horizon in Castleman and Georges Creek Basins, Md. Overlies Barton ss. [Wellersburg coal was named for occurrence at Wellersburg, Pa.] [On p. 114 he shows 7 ft. of *Wellersburg ls. and fire clay* underlying Wellersburg coal and resting on Barton ss. and sh.]

Wellersburg clay. (In Conemaugh formation.)

Name applied to clay underlying Wellersburg coal in western Pa.

Wellesley formation.

Mississippian: Eastern Alaska.

A. H. Brooks, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 470–472, 479, 483). *Wellesley fm.*—Upper part almost entirely blue clay sl., locally altered to phyllite; several hundred ft. thick. Lower part coarse massive cgl. interlarded with a few beds of blue clay sl.; thickness 1,000 to 1,500 ft. Schuchert identifies the fossils as Dev. or Carbf. [Map shows it composes Wellesley Mtn. btw. Tanana and White Rivers.]

A. H. Brooks, 1911 (U. S. G. S. P. P. 70, p. 82). *Wellesley fm.* occurs in series of isolated hills through broad alluvial flat that separates central part of White River Basin from Chisana or east fork of Tanana River. It may have thickness of 1,000 to 2,000 ft. at type loc. Rests uncon. on Birch Creek schist.

This fm. is now classified as early Miss.

Wellington formation. (In Sumner group.)

Permian: Central and southern Kansas and northern Oklahoma.

F. W. Cragin, 1885 (Washburn Coll. Lab. Nat. Hist. Bull., vol. 1, No. 3, pp. 85–86; and Kansas City Rev., vol. 8, pp. 678–682), in a description of glacial deposits, casually alluded to *Wellington shales*, the age of which was undet., as no fossils were found.

F. W. Cragin, 1896 (Colo. Coll. Studies, vol. 6, pp. 3, 16). *Wellington shales.*—Bluish-gray clay shales, 250 to 450 ft. thick, including beds of impure ls. and calc. shales, with occasional beds of gyp. and dol. Top fm. of Big Blue series and Sumner div. Overlies Geuda salt measures and underlies, probably uncon., Harper sss., basal fm. of Cimarron series.

C. S. Prosser, 1897 (Kans. Univ. Geol. Surv. vol. 2). [See under †*Marion fm.*]

L. C. Wooster, 1905 (The Carboniferous rock system of eastern Kans.), included the salt measures in Wellington and made Abilene cgl. top memb. of Marion, as did J. W. Beede, 1909; R. C. Moore and W. P. Haynes, 1917; L. C. Snider, 1920 (Oil and gas in Mid-Continent fields); and C. N. Gould, 1925, 1927; but R. C. Moore, 1920, stated that Abilene cgl. is Tert. He included the salt measures in Wellington, however, and gave thickness of latter fm. as 500 to 799 ft. (See under †*Marion fm.*)

Subsequent repts treated Pearl sh. as top memb. of Marion fm. and included the salt beds in overlying Wellington fm.

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, in cooperation with U. S. Geol. Survey), redefined *Wellington fm.* to include all beds below "Red Beds" and above Herington ls., and "Marion fm." was abandoned. Thickness 680 to 1,140 ft., of which only 80 ft. is exposed in Cowley Co., Kans. This is present approved definition of U. S. Geol. Survey. Includes beds formerly called "Pearl sh. memb." (now discarded by U. S. Geol. Survey).

The Tert. age of Abilene cgl. is now considered as established.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), divided the Perm. beds above Herington ls. into (descending): (1) Wellington sh. [greatly restricted], 62± ft. thick; (2) Donegal ls., 15 ft. thick (new); and (3) Pearl sh. [revived], 30± ft. thick.

See Kans.-Nebr. Perm. chart compiled by M. G. Wilmarth, 1936.

Top fm. of Sumner group.

Named for exposures at Wellington, Sumner Co., Kans.

†Wellington marble.

Popular term for marble quarried from beds in Sumner group (Perm.) of Sumner Co., Kans., that are older than Wellington fm., of Sumner group.

†Well Rock.

Pennsylvanian: Eastern Kansas.

G. C. Swallow and F. Hawn, 1865 (Kans. Geol. Surv. Rept. on Miami Co., p. 10). *Well Rock.*—Fossiliferous lss., 15 to 20 ft. thick, forming bed No. 20 of geol. section of Miami Co. Whitish-gray soft mag. ls. in upper part; bluish-gray and drab hard, compact, or crystalline ls. in middle; and usually bluish-gray cherty subcrystalline ls., weathering brown and parting into small angular masses, in lower part.

Not a definite geologic unit, but confused with several units, and not a geographic name.

†Well Rock series.

Pennsylvanian: Eastern Kansas.

G. C. Swallow, 1866 (Kans. Geol. Surv. Prel. Rept., pp. 21-22). *Well Rock series.*—Series of lss. and shales, 238½ ft. thick, including beds Nos. 167 to 177, inclusive, of geol. section of eastern Kans. Includes the Well Rock (bed No. 169). Underlies Spring Rock series and overlies Marais des Cygnes coal series.

Not a definite geologic unit, but confused with several units, and not a geographic name.

†Wells limestone.

Middle Ordovician (Lowville): North-central Tennessee.

A. F. Foerste, 1903 (Jour. Geol., vol. 11, pp. 557, 705). *Wells ls.*, belonging to upper part of the Stones River; exposed in central part of Wells Creek Basin; identified by Safford as Knox dol. The Black River absent in Tenn. River Valley. [On p. 705 is given a list of "Wells (Upper Stones River) fossils" collected 1¼ mi. SW. of Cumberland City.]

The fossils listed by Foerste are now considered by E. O. Ulrich to be of Lowville age, and the fm. to be same as Carters ls.

Named for Wells Creek Basin, Stewart and Houston Counties.

†Wells chert.

Lower Ordovician (Beekmantown): North-central Tennessee (Stewart and Houston Counties).

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 671, pl. 27). *Wells chert.*—In Wells Creek Basin, in NW. part of middle Tenn. [Stewart and Houston Counties], the low domelike elevation at center of the small but sharply defined uplift is formed by a highly cherty mag. ls. of Canadian [Beekmantown] age but undet. thickness. The prevailing type of the chert, which strews the surface and with a deep residual clay covers the light-gray fine-grained mag. ls. from which it is derived, is porous—even spongy—rather soft and sandy under the hammer and of red or brown color. With these occur harder, nearly white blocks. This cherty mag. ls. is overlain—not, as one might naturally suppose, by some Stones River ls.—but by Lowville ls. Contact concealed. The Lowville has hitherto been mistaken for Stones River, but the fossils are Lowville. As a distinct name for this cherty zone of Canadian rocks in Miss. Valley is desirable, especially in Tenn., the name *Wells chert* is here proposed.

Conflicts with Foerste's prior use of *Wells ls.* for a younger fm., which is now known as *Carters ls.* The Wells chert of Ulrich appears to be the same as the *Wells Creek* of R. G. Lusk, a name used by Lusk in a table of Lower Ord. rocks overlying Knox dol. in Wells Creek Basin, but not further defined. (See A. A. P. G. Bull., vol. 11, No. 9, p. 908, 1927.) Lusk probably introduced the name because of prior use of *Wells* in Tenn. and because of the later but established usage of the name *Wells* for a Carbf. fm. in Idaho and Utah.

Wells formation.

Pennsylvanian: Northeastern Utah, eastern Idaho, and southwestern Wyoming.

R. W. Richards and G. R. Mansfield, 1912 (Jour. Geol., vol. 20, pp. 683, 684, 689, 693). *Wells fm.*—The Phosphoria fm. is normally underlain by 2,400 ft. of sandy lss.,

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calc. sss., and qtzites of somewhat variable character. These beds are here grouped in a fm. whose name is derived from Wells Canyon, in T. 10 S., R. 45 E., Bannock Co., Idaho, on N. side of which a detailed section [p. 690] was measured. The strat. interval is probably same as represented by Morgan, Weber, and lower part of Park City fm. of NE. Utah. In Idaho, however, these rocks show such variable lithologic features that it has been found impracticable to apply successfully the names *Weber* and *Morgan* over a major part of area (Bannock overthrust area of NE. Utah and SE. Idaho). Faunas also do not justify correlation. In detailed section given it is possible to subdivide Wells fm. into 3 parts: (1) An upper calc. ss. or siliceous ls. 0 to 75 ft. thick; (2) a middle sandy series, consisting of 1,700 to 1,800 ft. of nonfossiliferous sandy ls. with occasional thin beds of qtzite and sss., weathering white, red, or yellow; and (3) a lower sandy and cherty ls. series 750± ft. thick. The lower two divisions, however, do not correspond to Weber and Morgan fms. in Weber Canyon, Utah. Where upper ls. is absent the Phosphoria is uncon. on Wells fm. [Fossils listed.] In SE. Idaho Wells fm. rests conformably on ls. of upper Miss. age, but in Utah Blackwelder has observed uncon. at this horizon.

Wellsburg sandstone member (of Chemung formation).

Upper Devonian: Central and west-central New York.

H. S. Williams, 1906 (Sci., n. s., vol. 24, pp. 365–372) and 1907 (Am. Ass. Adv. Sci. Proc., vol. 56, pp. 265–267). Chemung fm. of Ithaca section divided into (descending): Fall Creek cgl. lentil, 0 to 10 ft. (interpreted to be=the cgl. of that name in Bradford and Tioga Counties, Pa.); *Wellsburg ss. memb.*, 600 to 650 ft.; and Cayuta sh. memb., 600 ft. Wellsburg memb. is characterized by Ashland *Leptostrophia* zone at top, and named for outcrop at Wellsburg [Chemung Co.].

H. S. Williams, 1909 (U. S. G. S. Watkins Glen-Catatonk folio, No. 169). *Wellsburg ss. memb.*—Thin-bedded ss. and drab shales, the ss. predominating. Flaggy ss. at top with 2 cgl. lentils and thin ls. Thickness 600 to 700 ft. Underlies Catskill fm. and overlies Cayuta sh. memb. [Wellsburg ss. memb. of this folio constituted a redefinition, because it included at top the 10 ft. of beds previously called *Fall Creek cgl. lentil*. The *Leptostrophia* zone is therefore stated in the folio to occur *near*, instead of *at*, top of the Wellsburg.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 86). *Wellsburg memb. of Chemung* contains in upper part several layers of cgl., the highest of which is supposed to represent Fall Creek cgl., which outcrops farther S., in Pa.

According to H. S. Williams, 1913 (U. S. G. S. P. P. 79), the Wellsburg memb. extends from Watkins Glen quad. eastward into Chenango Valley.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Wellsburg ss.* of Steuben Co. includes equivalents of Laona ss., Westfield sh., Shumla ss., Northeast sh., and (?) Volusia sh., all of Chautauqua Co.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10). *Wellsburg ss.* included in Chemung.

Wells Creek limestone.

Lower Ordovician (Beekmantown): North-central Tennessee (Stewart and Houston Counties).

R. G. Lusk, 1927 (A. A. P. G. Bull., vol. 11, No. 9, p. 908). [See last paragraph under †*Wells chert*.]

Welsh stray sand.

Drillers' term for a Miss. sand in SE. Ohio (Monroe Co.) that is correlated with Buena Vista ss. by W. Stout et al. (Geol. of nat. gas, A. A. P. G., 1935, p. 904).

Wenas basalt.

Miocene (early): Central Washington (Ellensburg region).

G. O. Smith, 1903 (U. S. G. S. P. P. 19 and U. S. G. S. Ellensburg folio, No. 86). *Wenas basalt.*—Lava flows interbedded in lower part of Ellensburg fm. (Mio.), which overlies Yakima basalt (also Mio.). Thickness 20 to 200 ft. Of only local importance. Type loc., valley of Wenas Creek.

Wendell Grade basalt.

Pleistocene: Southern Idaho (Gooding County).

H. T. Stearns, 1932 (Correlation chart of Idaho compiled by M. G. Wilmarth, dated Sept. 1, 1932) and 1936 (Jour. Geol., vol. 44, No. 4, p. 434). *Wendell Grade* *basalt.*—Black aphanitic pahoehoe basalt containing fresh green olivine phenocrysts and nearly bare of loess. Thickness 25± ft. Of Pleist. age, and younger than Minidoka basalt. Named for Wendell Grade in road in Gooding Co., NW. of town of Wendell. Three small branches of this flow cascaded over rim of Hagerman Valley, but elswhere it is conformable to the older basalts of the plains.

Weno clay member (of Denison formation).

Lower Cretaceous (Comanche series): Northeastern Texas and central southern Oklahoma.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 121, 247, 269–280). *Weno fm.*—Very ferruginous brownish clay marls and marly clays, with some impure ls. Thickness 92 ft. Included in Weno subgroup of Denison beds. Underlies Pawpaw fm. [The "Quarry ls.," a massive aren. ls., blue exteriorly but oxidizing yellow, quarried at East Denison, is both included in and excluded from this fm. in rept cited.] Overlies *Gryphaea washitaensis* aggl., in top of Denton subgroup of Denison beds.

The U. S. Geol. Survey treats †Quarry ls. as basal bed of Pawpaw sandy memb. of Denison fm. (See L. W. Stephenson, U. S. G. S. P. P. 120H, 1918.)

Named for Weno, Grayson Co., Tex.

†Weno subgroup.

Lower Cretaceous (Comanche series): Northeastern Texas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, pp. 121, 247, 269–280). *Weno subgroup.*—Middle subgroup of Denison beds. Divided into (descending) Pawpaw fm., Quarry ls. [on some pages included in Weno fm.], and Weno fm. Underlies Main Street ls. and overlies Denton subgroup, the top of which consists of *Gryphaea washitaensis* aggl.

Named for Weno, Grayson Co.

Wenonah sand. (Of Matawan group.)

Upper Cretaceous: New Jersey.

G. N. Knapp, as reported by R. D. Salisbury, 1899 (N. J. Geol. Surv. Ann. Rept. State Geol. 1898, pp. 35, 36). *Wenonah bed.*—Sand overlying Marshalltown bed and forming top div. of Clay Marl series [Matawan group].

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv. vol. 6, p. 154). *Wenonah sand.*—Reddish-brown or black sand, with thin seams of black or chocolate-colored clay. Thickness 50 to 60 ft. Overlies Marshalltown clay marl and underlies Navesink marl [original usage of Navesink, which included Mount Laurel sand of present nomenclature].

Named for occurrence at Wenonah, Gloucester Co.

Weskan shale member (of Pierre shale).

Upper Cretaceous: Northwestern Kansas (Wallace County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7). *Weskan sh. memb. of Pierre sh.*—*Upper 80 ft.* consists of gray clayey sh. with few thin beds of bentonite; large tough ls. concretions; rusty cone-in-cone lenses, and thin streaks of concretionary limonite. *Lower 90 ft.* consists of gray clayey sh. with comparatively abundant beds of bentonite; large ls. concretions common; here and there thin streaks of purple-brown limonite. Underlies Lake Creek sh. memb. of Pierre sh. and overlies Sharon Springs sh., basal memb. of the Pierre. Type loc. 5 mi. N. of town of Weskan, Wallace Co. Type loc. of *Upper Weskan* is on a small creek N. of Swisegood ranch, in SE¼ sec. 2, T. 13 S., R. 42 W., and best exposure of *Lower Weskan* is on S. side of Goose Creek, in SW¼ sec. 4, T. 13 S., R. 40 W.

Weskeag quartzite member (of Rockland formation).

Cambrian or Ordovician: Central southern Maine (Knox County).

E. S. Bastin, 1908 (U. S. G. S. Rockland folio, No. 158, pp. 3–4). *Weskeag qtzite memb.*—Qtzite which differs from Battie qtzite in total absence of conglomeratic forms and in being for most part thin-bedded. Prevailing color is yellowish gray on freshly fractured surfaces and buff brown on weathered surfaces. Locally somewhat shaly beds are present, but sheared phases were not observed. Thicknecs 250 to 300 ft. Basal memb. of Rockland fm. Named for development on Weskeag River, Knox Co.

West Baden. (In Chester group.)

Mississippian: Indiana, Illinois, Kentucky.

E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, p. 514, footnote). *West Baden* suggested to Professor Weller in 1920 for lower Chester, including all rocks btw. top of Beech Creek ls. above and base of Paoli ls. (restricted) below, but Weller preferred to use *lower Chester*.

Probably named for village of West Baden, Orange Co., Ind.

West Bath slate.

Name applied (without description) by M. Billings in Feb. 1933 (Am. Jour. Sci., 5th, vol. 25, No. 146, p. 149) to the pre-Sil. fm. immediately underlying his Fitch fm. in Littleton and Moosilauke quads., Ammonoosuc River region, NW. N. H. In Dec. 1934 (Am. Jour. Sci., 5th, vol. 28, pp. 412+) he called this sl. *Partridge sl.* Village of West Bath is in Woodsville quad., N. H.

Westboro quartzite.

Pre-Cambrian: Eastern Massachusetts and northern Rhode Island.

B. K. Emerson and J. H. Perry, 1903 (Geol. of Worcester, with map). *Westboro qtzite.*—Light-colored, nearly white fine-grained sugary qtzite. Overlies Northbridge gneiss. Named for town of Westboro, Worcester Co., Mass.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 24–25, 27, 30–31, and map). *Westboro qtzite.*—A shoreward bed of sugary qtzite, in places actinolitic or biotitic. Is same as "Grafton" qtzite and has priority, so "Grafton" is abandoned. Overlies Northbridge gneiss and underlies Marlboro fm.

See also L. LaForge, 1932 (U. S. G. S. Bull. 839).

West Branch shale.

Pennsylvanian: Southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 74, 82, 89, 111, 113). *West Branch sh.*—Greenish-blue argill. massive and crumbly sh.; dark near top; calc. bladed material above middle, and calc. lensing material near base. Thickness 26± ft. Top bed of Admire sh. memb. of Wabaunsee fm. Overlies Falls City ls. and underlies Americus ls. Named for exposures in West Branch Twp, Pawnee Co.

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification chart of Penn. rocks of Nebr. and Kans.), divided Admire sh. into (descending) Oaks sh., Houchen Creek ls., Stine sh., Five Point ls., West Branch sh., Falls City ls., Hawxby sh., Aspinwall ls., and Towle sh. Whether this is a restriction of West Branch sh. is unknown. The Stine sh. and Houchen Creek ls. were named by Condra in 1927 publication cited above, where they were defined as belonging to lower part of Elmdale sh., which overlies Americus ls.; but their 1932 chart includes them in Admire sh., which underlies Americus ls. R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), transferred all beds above Brownville ls. to Perm. (See Kans-Nebr. chart compiled by M. G. Wilmarth, 1936.)

West Branch morainic system.

Pleistocene (Wisconsin stage): Northern Mich. Shown on moraine map (pl. 32) of U. S. G. S. Mon. 53. Named for West Branch, Ogemaw Co.

Westbrook granite.

Pre-Carboniferous (?): Southwestern Maine.

F. J. Katz, 1917 (U. S. G. S. P. P. 108, p. 175). *Westbrook granite.*—Gneissoid granite, of medium-gray color and fine, even texture; contains conspicuous crystals of biotite. Presumably pre-Carbf. Intrudes Berwick gneiss. Named for exposures in Westbrook Twp, Cumberland Co.

On 1933 geol. map of Maine, by A. Keith, the rocks of Westbrook Twp are mapped as pre-Camb.

West Brook member.

Upper Devonian: Central New York (Onondaga County).

G. A. Cooper and J. S. Williams, 1935 (Geol. Soc. Am. Bull., vol. 46, pp. 790–813). *West Brook memb.*—Top memb. of Tully fm. In Tully region it consists of 10± ft. of dark-gray shaly and nodular lss.; near Sherburne it is 28 ft. 2 in. thick, and is chiefly dark-gray sandy and calc. sh. with 2 thin lss. (1 and 4 ft. thick); near Laurens it is 54 ft. 6 in. thick and is almost wholly sandy sh. and ss.; near Perrytown it is 67 ft. thick and consists of sh. and ss.; near New Berlin it is 97 ft. thick and consists of sh. and ss. Upper half of memb. is characterized by *Lopholasma;* lower half contains many Hamilton sp., especially *Elytha fimbriata.* Overlain by Geneseo sh. Btw. Canandaigua Lake and Unadilla Valley it rests on Apulia memb. of the Tully; in Butternut, Otego, and Susquehanna Valleys and at Schenevus it rests on Laurens memb. of the Tully. Type loc. is on West Brook, 3 mi. S. of Sherburne.

Westchester gneisses and granites.

Pre-Cambrian: Southeastern New York and northern New Jersey.

F. J. H. Merrill, 1901 (Geol. map of N. Y.). *Westchester (gneisses including granites).* [Mapped across SE. N. Y. and northern N. J. Apparently named for Westchester Co., N. Y., of which it forms a large part. Probably same in part as the paragneiss parts of Fordham gneiss.]

West Chicago moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. See M. M. Leighton, 1932 (16th Int. Geol. Cong. Guidebook 26, pp. 47, 50, pl. 2).

West Dummerston granite.

Devonian: Southeastern Vermont (Windham County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of eastern Vt., but without definition. Quarried at village of West Dummerston, Dummerston Twp, Brattleboro quad., Windham Co.

West Elk breccia.

Tertiary (Miocene?): Western central Colorado (Anthracite-Crested Butte region).

W. Cross, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *West Elk breccia.*—Coarse volcanic breccia alternating with finer ash and tuff. Lower part of what is mapped as West Elk breccia may possibly be more properly considered a sedimentary fm., but observations made do not permit a distinction btw. such material and the breccia. Forms West Elk Mtns and extends S. to Gunnison River. Is overlain by rhyolitic lavas near Gunnison.

West End rhyolite.

Tertiary: Central Nevada (Tonopah district).

J. E. Spurr, 1911 (Min. and Sci. Press, vol. 102, pp. 560–561; also Rept. on geol. of property of Montana-Tonopah Min. Co., Tonopah, Nev., published privately; also Econ. Geol., vol. 10, pp. 713–769, 1915). *West End rhyolite.*—A new fm. not exposed at time of original investigation [U. S. G. S. P. P. 42, 1905]. Does not outcrop at surface in surveyed or mapped dist., and was originally mistaken for Tonopah rhyolite-dacite, but is now known to be of distinctly greater age than the Tonopah. Intrudes Mizpah trachyte proper. Thickness 0 to 450 ft.

T. B. Nolan, 1930 (Univ. Nev. Bull., vol. 24, No. 4, p. 19). *West End rhyolite* is intrusive, and not a series of flows, as believed by J. A. Burgess (Econ. Geol., vol. 4, p. 692, 1909), who called it the "upper rhyolite." Is best exposed in Tonopah Extension and West End mines, where it is a westward-dipping mass separating Tonopah fm. and Mizpah trachyte. Max. thickness appears to be at least 600 ft. Intrudes Tonopah fm., Mizpah trachyte, and Extension breccia and is uncon. overlain by Fraction breccia.

Westerly granite.

Late Carboniferous or post-Carboniferous: Southeastern Connecticut and southwestern Rhode Island.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 136, 152, 154). *Westerly granite.*—Finely crystalline gray rock, which shows minor variations in color and texture but which is petrographically the same. This is Westerly gray granite of the trade. Is quarried at Westerly, R. I. Where typically exposed is massive, with no indication of gneissoid structure, but is cross-jointed and broken into blocks. Intrudes Sterling granite gneiss and the pegmatites that cut the Sterling granite gneiss and is youngest fm. in SE. Conn. Sterling granite gneiss is Westerly red granite of the trade. J. F. Kemp has described petrography of both types in Bull. Geol. Soc. Am., vol. 10, pp. 367–370, 1899.

†Western sandstone.

Pre-Cambrian (Keweenawan): Northeastern Wisconsin and Apostle Islands.

R. D. Irving, 1883 (U. S. G. S. Mon. 5, pp. 153, 154, 365, 366). The *Western ss.* occurs on Apostle Islands and adjoining coast of Bayfield Co., Wis. It has not been traced to any point where its relation to any of Mississippi Valley fossiliferous fms. can with certainty be made out, although the appearances in NW. Wis. and NE. Minn. are decidedly in favor of its being the downward continuation of Mississippi Valley Camb. or Potsdam ss., 1,000 ft. thick, and at a lower horizon than any met with in Mississippi Valley.

Replaced by *Bayfield group*. For many years was believed to be same as Camb. †Eastern ss. (Jacobsville ss.).

Westernport sandstone. (In Allegheny formation.)

Pennsylvanian: Western Maryland and adjacent parts of West Virginia.

I. C. White, 1882 (The Virginias, vol. 3, pp. 141–143). *Westernport ss.*, the massive coarse yellowish-gray rock which is usually found 290 to 300 ft. above Pittsburg coal [not Pittsburgh coal], and which caps summit of Westernport Hill, near Westernport, Md.

C. K. Swartz, W. A. Price, and H. Bassler, 1919 (Geol. Soc. Am. Bull., vol. 30, p. 572). *Westernport ss.* underlies fire clay beneath Piney Mtn coal and overlies Middle Kittanning (Luke) coal.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pls. 6, 7, pp. 47–48). *Westernport ss.*— Massive ss., gray, coarse-grained and cross-bedded at many places; contains interbedded lenses of sh. Rests on Luke (Middle Kittanning) coal, and underlies fire clay beneath Piney Mtn coal. Forms bold cliffs along the Potomac W. of Westernport, Allegany Co., Md., where it is 40 ft. thick.

Western Valley gravel.

A term applied by J. M. Safford (Am. Jour. Sci., 2d, vol. 37, pp. 360–362, 1864) to beds of gravel bordering the valley of Tennessee River in western Tenn., which, according to W. H. Monroe (personal communication) are in part Tuscaloosa fm. and in part high-level terrace deposits of Tennessee River, of Plio. (?) and Pleistocene age.

Westerville limestone member (of Kansas City formation).

Pennsylvanian: Southwestern Iowa, northeastern Kansas, and northwestern Missouri.

H. F. Bain, 1898 (Am. Jour. Sci., 4th, vol. 5, pp. 437–439). *Westerville ls.*— Fossiliferous ashy-gray fine-grained thin-bedded ls., 10 ft. thick, occurring "some little distance" above DeKalb ls. Included in Bethany ls., although probably it more properly belongs with next higher div. of Missourian series.

For further explanation, see *DeKalb ls.*

For several years Westerville ls. was regarded as probably same as Cement City ls. bed in Chanute sh. memb. of Kansas City fm. of Mo. R. C. Moore and G. E. Condra (Oct. 1932 revised classification chart of Penn. rocks of Kans. and Nebr.) showed it as separated from overlying Cement City ls. by Quivira sh. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936. Named for exposures at Westerville, Decatur Co., Iowa.

Westfield serpentine.

Ordovician: Western Massachusetts (Hampden County).

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 92), applied name *Westfield serpentine* to an outcrop of serpentine in W. edge of Westfield.

Westfield phase (of Otis limestone).

Middle Devonian: Central eastern Iowa.

W. H. Norton, 1921 (Iowa Geol. Surv. vol. 27, p. 377). *Westfield phase of Otis ls.*—A fourth distinct type of Otis ls., a basal cgl. resting on the Sil. At Westfield Bridge at Fayette [Fayette Co.] it consists of about 8 ft. of mag. ls. or dol. in heavy beds distinguished by aren. bands with rounded grains of fine quartz sand and angular bits of white chert. The same aren. bed is seen in Bremer Co., SE. of Waverly. These beds have essential relations of a basal cgl. In both counties they are succeeded by nonmag. lss. of Cedar Valley phase of the Otis.

Westfield shale.

Upper Devonian: Western New York (Chautauqua County).

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). [*Westfield sh.* applied in table to beds of Chemung age overlying Laona ss. and underlying Shumla ss. in Chautauqua Co.]

G. H. Chadwick, 1924 (N. Y. State Mus. Bull. 251, p. 151). For the beds btw. Laona [below] and Shumla sss. the name *Westfield sh.* may be used. Lithologically indistinguishable from Gowanda beds, they contain, like those at W., a persistent Portage cephalopod element in their fauna, yielding eastward wholly to Chemung brachiopods. East of Cattaraugus these beds appear to maintain their identity as far as Elton, beyond where they are gradually merged in [lower part of] Wellsburg [ss.] memb. Thickness 120 ft. on Lake Erie, 160 ft. at Laona, and perhaps 200 ft. near Perrysburg. [Probably named for exposures at or near Westfield, Chautauqua Co.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369), included all of above-mentioned beds in the Chemung, but G. H. Chadwick (1933, etc.) transferred them all to his Canadaway group.

Westfield lime.

Drillers' name for oil-bearing beds in Spergen (Salem) ls. or in Osage group of the Miss. of Clark Co., Ill. (See Ill. Geol. Surv. Bull. 54, index.)

West Fork formation.

Upper Devonian or Mississippian: Northern Alaska (Wiseman-Chandalar region).

F. C. Schrader, 1900 (U. S. G. S. 21st Ann. Rept., pt. 2, p. 475). *West Fork series.*—Fine-grained dark-gray qtzite, dark flint, calc. black sh., and impure ls. Cut by dikes. May be Paleozoic. So far as known it crosses Chandalar River Valley in belt 15± mi. wide from below Granite Creek to above West Fork [of Chandalar River], and probably has much wider distribution. Seems to overlie Lake qtzite schists on NW. and granite on SE.

These rocks are now considered to be either Upper Dev. or Miss.

West Franklin limestone.

Pennsylvanian: Southwestern Indiana.

J. Collett, 1884 (Ind. Dept. Geol. and Nat. Hist. 13th Ann. Rept., pp. 61–62). *West Franklin ls.*—Fossiliferous calc. sh. and black ls., 2 to 25 ft. thick, in Coal Measures of Posey Co. Overlain by either thin-bedded ls. or thin-bedded schistose ss., and underlain by argill. sh.

R. E. Esarey, 1927 (A. A. P. G. Bull., vol. 11, No. 6, pp. 601–610). *Somerville or West Franklin ls.*

R. R. Shrock and C. A. Malott, 1929 (A. A. P. G. Bull., vol. 13, pp. 1301–1314). *West Franklin fm.*—Consists of (descending): (1) Dense gray crystalline ls. about 3 ft. thick, rarely brecciated; (2) sh., 25 ft. max.; (3) hard blue to gray brecciated ls., 5± ft. Consistently occurs 280 to 315 ft. above coal V. Overlain by 0 to 30 ft. of sh. and ss. which uncon. underlies Merom ss. Is same as Somerville ls. and has priority. Is of post-Allegheny age.

Named for exposures at West Franklin, Posey Co.

West Haven moraine.

Pleistocene (Wisconsin stage): Central Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for West Haven, Shiawassee Co.

Westheimer member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 15). *Westheimer memb.* of Hoxbar fm. lies 800 ft. above base of the Hoxbar. Includes a 10-foot pinto ls. cgl. of variegated pebbles of chert, sh., and ls. in a ls. matrix, together with a calc. ss. or sandy ls. About 600 ft. above Westheimer memb. occurs Crinerville ls. memb.

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 42). *Westheimer memb.* consists at top of a pinto ls. cgl. 10 ft. thick, and at base of 10 ft. of calc. ss. or sandy ls., the two being separated by a few ft. of beds. Lies 400 to 500 ft. below Crinerville memb. and 800± ft. above Union Dairy memb. of Hoxbar fm. Well exposed on property of Westheimer & Daube, in NW¼SE¼ sec. 7, T. 6 S., R. 2 E., and about 200 yds E. of asphalt prospect belonging to that firm.

C. W. Tomlinson (1934) stated that recent detailed mapping showed this ls. is same as Confederate ls., and he discarded Westheimer. (See 1934 entry under *Confederate ls. memb.*)

West Hill formation.

Upper Devonian: West-central New York.

J. M. Clarke, 1903 (N. Y. State Mus. Hdb. 19, p. 23). *Westhill flags*, a subdivision of Naples beds in Ontario Co. and in Genesee Valley and Lake Erie sections.

J. M. Clarke and D. D. Luther, 1903 (N. Y. State Mus. Bull. 69, map). *West Hill sands* overlie Grimes ss. and underlie Dunkirk black shales.

J. M. Clarke, 1904 (N. Y. State Mus. Mem. 6, pp. 199–204). *Westhill sss.*—Heavy-bedded sands, flags, and few shales. Thickness 600 ft. in Naples section, where they overlie Grimes ss. and underlie Highpoint ss. Belong to Portage. Fossils scarce but chiefly indicative of Ithaca fauna or possibly earliest stages of Chemung fauna. Included in Gardeau of Genesee River section, which contains no Ithaca fossils but a Naples fauna.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63). *West Hill flags and sh.*—Light bluish-gray sss. or flags 2 to 12 in. thick, separated by beds of dark-blue, olive, or black sh. Thickness 550 ft. in Canandaigua and Naples quads. Sharply distinguished from underlying Grimes ss. by thinner bedding and bluish color. Fauna is continuation of Grimes brachiopod fauna, with some interesting additions, but none specially distinctive of Chemung, and therefore considered as belonging to Ithaca invasion. Underlie Highpoint ss. *Named for West Hill, Ontario Co.*

D. D. Luther, 1910 (N. Y. State Mus. Bull. 137). *West Hill flags and shales* of Auburn and Genoa quads. contain species belonging to both Naples and Ithaca faunas.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 77). *West Hill flags and sh.* in part=Gardeau of Genesee Valley, but different faunally in that the West Hill is characterized by Ithaca fauna, while Gardeau contains Naples fauna. The fm. is recognized as far E. as Schuyler Co., where it contains species of both Ithaca and Naples faunas. Assigned to Portage.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Westhill sh.* of Steuben Co. overlies Grimes ss. and underlies Highpoint ss. (=Nunda ss.). Is=Gardeau sh. of Cattaraugus and Allegany Counties. The Dunkirk sh. is much younger than Westhill sh.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *West Hill flags* underlie High Point ss. and overlie Grimes ss. All included in Portage group.

The U. S. Geol. Survey uses *West Hill fm.* for this unit, which is overlain by Nunda ss. and underlain by Grimes ss. (See U. S. G. S. Bull. 899 A, on Steuben and Yates Counties, N. Y., by W. H. Bradley and J. F. Pepper, in course of publication.)

West Index andesitic series.

Tertiary (Eocene or Miocene): Central Washington (Snohomish County).

C. E. Weaver, 1912 (Wash. Geol. Surv. Bull. 7, pp. 34–50). *West Index andesitic series.*—Intercalated layers of fine-grained andesitic breccias, cgls., and badly altered lavas; gray, often with greenish tint. Thickness 2,500 to 3,000 ft. Uncon. underlies Howard arkose fm. No fossils. May be Eo. or of same age as Howard arkose fm. (Mio. ?). Named for Mount West Index.

West Jefferson sandstone.

Middle Devonian: Central Ohio.

E. Orton, 1888 (Ohio Geol. Surv. vol. 6, pp. 4, 21). *West Jefferson ss.*—Sharp sand, few ft. thick, underlain by and interstratified with Lower Corniferous or Columbus ls.

Named for West Jefferson, Madison Co.

Westkettle quartz diorite.

Jurassic (?): British Columbia.

L. Reinecke, 1915 (Canada Geol. Surv. Mem. 79, pp. 41, 46).

West Ledge formation.

Pre-Cambrian: Southwestern South Dakota (Lawrence County).

J. O. Hosted and L. B. Wright, 1923 (Eng. and Min. Jour.-Press, vol. 115, pp. 793–799, 836–843, with maps). *West Ledge fm.*—Gray-green siliceous, chloritic, dolomitic ls., grading into impure calc. phyllite. Contains some cummingtonite and much white quartz. Usually weathers red from iron oxides. Thickness 100 ft. Underlies Northwestern fm. and overlies Ellison fm. Believed to be of Keewatin age.

Derivation of name not stated, but occurs in Lead dist., Lawrence Co.

West Mead limestone member.

Mississippian: Northwestern Pennsylvania.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, p. 132), proposed *West Mead ls. memb.* to replace so-called *Lower Meadville ls.* of early repts on NW. Pa. Named for West Mead Twp, Crawford Co., where the ls. is especially well developed in gullies, runs, and ravines. [This is middle part of Sharpsville ss. memb. of previous repts.]

West Minesota conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 21). We next [above West Minesota trap] find a belt of cgl. 150 ft. wide, known as *West Minesota cgl.*

Named for occurrence on property of West Minesota Mining Co., in Ontonagon Co.

West Minesota trap.

Pre-Cambrian (Keweenawan): Northern Michigan (Ontonagon County).

S. H. Broughton, 1863 (Remarks on the mining interest and details of the geology of Ontonagon County, pam. of 24 pp. and map, Phila., 1863; map and p. 21). After this [the copper vein overlying †Oneida cgl.] succeeds alternately belts of compact and highly amygdaloidal traps 2,160 ft. in width. Lithology peculiar. Carry copper. Have been thoroughly explored and some of them worked by West Minesota Mining Co. Overlain by West Minesota cgl.

Weston limestone.

Pennsylvanian: Northwestern Missouri.

J. A. Gallaher, 1898 (Mo. Bur. Geol. and Mines Bien. Rept., p. 52). *Weston ls.*—Massive argill. ls., with abundant *Fusulina cylindrica*, resting on coal No. 3 near Weston.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, pp. 139, 140). Weston ls. of Gallaher abandoned. Not properly defined. Evidently refers to Iatan ls.

Named for exposures at Weston, Platte Co.

Weston shale. (In Douglas group, Kansas.)

Weston shale member (of Douglas formation, in Missouri).

Pennsylvanian: Southwestern Iowa, northwestern Missouri, southeastern Nebraska, and eastern Kansas.

C. R. Keyes, 1899 (Am. Geol., vol. 23, p. 306). *Weston sh.*—Basal memb. of Lawrence shales in Mo. and eastern Kans. Underlies Iatan ls. memb. of Lawrence and overlies Plattsburg (Garnett) ls. [Lawrence sh. as used above is a broader unit than Lawrence sh. of generally accepted usage. See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.]

H. Hinds and F. C. Greene, 1915 (Mo. Bur. Geol. and Mines vol. 13). *Weston sh. memb.*—Basal memb. of Douglas fm.; underlies Iatan ls. memb. and overlies Stanton ls. memb. of Lansing fm. [This definition was followed for many years.]

In 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. chart) R. C. Moore transferred Weston sh., Iatan ls., and basal part of overlying Lawrence sh. to Lansing fm., divided the rest of Lawrence sh. into 3 units (to which he restricted *Douglas group*), and transferred Oread ls. to overlying Shawnee group. (See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.) In 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook) Moore restricted Lansing group to beds below Weston sh., and assigned Weston sh., Iatan ls., and Hardesty sh. (a new name applied to basal part of Lawrence sh. of previous usage) to his Pedee group (new name). This classification was followed by N. D. Newell, 1935 (Kans. Geol. Soc. Bull. 21, pp. 17, 81). Newell stated that in some areas Iatan ls. and Hardesty sh. of Moore are absent and Weston is uncon. overlain by Stranger fm. The U. S. Geol. Survey has not yet had occasion to consider, for its publications, these recent innovations.

Named for Weston, Platte Co., Mo.

Weston sandstone. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, p. 124). *Weston ss.*—Along Town Run, at SE. edge of village of Weston, Lewis Co., it consists at top of shaly sand layers 10 ft. thick; in middle of 7 ft. of sh.; at base greenish-gray and harder sand layer 10 ft. thick. Overlies Redstone ls. and lies 5 ft. below Redstone coal.

Weston shale. (In Monongahela formation.)

Pennsylvanian: Northern West Virginia.

D. B. Reger, 1916 (W. Va. Geol. Surv. Rept. Lewis and Gilmer Counties, p. 128). *Weston sh.*—Gray sh., 10 ft. thick, used for brickmaking. Underlies Redstone ls. and overlies Pittsburgh coal. Exposed in vicinity of Weston, Lewis Co.

Westphalia limestone.

Pennsylvanian: Eastern Kansas.

R. C. Moore and N. D. Newell, 1936 (Kans. Geol. Surv. Bull. 22, pp. 145, 146, 150). *Westphalia ls. memb. (of Stranger fm.).*—Thin ls. containing fusulinids. Underlies Vinland sh. [restricted] and appears to lie just above horizon of Sibley coal, which, however, is not present at Westphalia type loc. Was included in Vinland sh. as first defined. In NW. part of Anderson Co. is overlapped by channel filling of Ireland ss., and in S. part of Franklin Co. is cut out by this ss. Named for village in W. part of Anderson Co. Typical outcrops are in roadside exposures along N. part of sec. 12, T. 21 S., R. 17 E., and at NE. cor. sec. 20, T. 21 S., R. 18 E. Not definitely recognized in outcrops N. of T. 19 S.

West Point formation. (In Chaleur series.)

Silurian (Niagaran): Quebec (Gaspe Peninsula).

C. Schuchert and J. D. Dart, 1926 (Canada Geol. Surv. Bull. 44, p. 51).

S. A. Northrop, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 1, p. 271). Faunas of Bouleaux, West Point, and Indian Point fms. of middle Sil. Chaleur series are of Lockport and Guelph age.

West Point member.

Mississippian: Western Kentucky (Hardin County).

A. H. Sutton, 1931 (Ky. Geol. Surv. ser. 6, vol. 37, p. 281). Some 50 or 60 ft. of cherty and argill. ls. are included in lower part of Warsaw ls. of Hardin Co., Ky. These beds contain some fossils found at other localities only in the Keokuk, together with typical Warsaw forms. Because it seems more reasonable to consider the Keokuk species as having carried over in an area where there was no break in sedimentation, and to take the introduction of the Warsaw forms as marking beginning of Warsaw time, it is proposed to designate these beds *West Point memb.* and include them in the Warsaw. For a more detailed discussion of these doubtful beds reader is referred to work of C. Butts in his repts on Miss. of Ky. Above these doubtful beds lies main body of Warsaw fm., which consists of gray to bluish ls. of typical Warsaw (Harrodsburg) character, together with some shaly and siliceous beds. [Derivation of name not stated, but there is a village called West Point in Hardin Co., Ky.]

West Point shale. (In Admire shale.)

Pennsylvanian: Kansas.

R. C. Moore, Sept. 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. correlation chart). Misprint for *West Branch sh.*

West Princeton sand.

A subsurface sand in Brazil fm. (Penn.) of Ind.

West Prospect basalt.

Age(?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 21, No. 8, pp. 214–376, map), applied following names to volcanic rocks in Lassen Nat. Park, arranged in following downward order on map: *West Prospect basalt; Crescent Crater dacites; Manzanita dacites; Prospect Peak basalts; Raker Peak pyroxene andesites; Brokeoff andesites; Eastern basalts; Twin Lakes andesites; Juniper and Flatiron andesites; Willow Lake basalts.* (The latter 5 units are described in the text; the others are not.)

West Range limestone.

Upper Devonian: Eastern Nevada (Pioche district).

L. G. Westgate and A. Knopf, 1927 (Am. Inst. Min. and Met. Engrs. Trans., No. 1647, p. 7). *West Range ls.*—Several hundred ft. of thin- and thick-bedded lss., certain layers of which are nodular and weather yellow. At several levels abundant fossils [of Upper Dev. age]. Composes, with underlying Silverhorn ls., the whole of West Range, which lies W. of Bristol Range.

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171, pp. 7, 16, map, etc.). *West Range ls.*—Blue-gray medium- and heavy-bedded fine-grained lss., in places nodular, commonly weathering yellow. Thickness 500± ft. Conformably underlies Bristol Pass ls. (Miss.) and conformably overlies Silverhorn dol. (Middle Dev.).

West River shale. (In Genesee group.)

Upper Devonian: Western and west-central New York.

J. M. Clarke and D. D. Luther, 1904 (N. Y. State Mus. Bull. 63, p. 28). *West River sh.*—Fine blue-black or dark-gray shales with thin bands of black slaty sh. at intervals of 2 to 6 ft. Are lighter and less bituminous than underlying Genesee sh. [restricted]. Fauna is return of Genesee sh. [restricted] fauna with a few additional species. Named for exposures in West River Valley, Yates Co. Overlies Genundewa ls. and underlies Standish flags and shales. Included in Genesee beds or group [broad sense]. Previously called "upper Genesee sh." [In N. Y. State Mus. Bull. 101, 1906, Luther gave thickness of West River sh. in Penn Yan and Hammondsport quads. as 100 to 110 ft.; and in N. Y. State Mus. Bull. 99, 1906, he gave thickness in Buffalo quad. as 12 ft. In N. Y. State Mus. Bull. 137, 1910, he applied *West River sh.* to all beds in Auburn and Genoa quads. btw. Genundewa ls. and Cashaqua sh.]

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 73). *West River sh.* is recognized from Cayuga Lake to Erie Co. In region of Seneca and Cayuga Lakes and farther E. it embraces all strata btw. Genundewa ls. and Cashaqua sh. Included in Genesee.

See further explanation under *Genesee sh.*

†West Roxbury slate.

Carboniferous or Devonian: Eastern Massachusetts (Boston region).

W. W. Dodge, 1881 and 1882 (Boston Soc. Nat. Hist. Proc., vol. 21, pp. 208–210), called the "slates on each side of the tract near West Roxbury station" the *West Roxbury sl.*

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), and L. LaForge, 1932 (U. S. G. S. Bull. 839), mapped the slates of West Roxbury as *Cambridge sl.*, a name which has priority and is better established.

West Rutland marble.

Lower Ordovician (Chazy): Southwestern Vermont (Rutland County).

E. J. Foyles, 1929 (16th Rept. Vt. State Geol., pp. 281–288). *West Rutland marble belt* is thought to be in large part of Chazy age because it contains obscure Chazy fossils. [*West Rutland ls.* had long been in use as a quarry term.]

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 398). *West Rutland marble.*—Best known from its use as ornamental stone, West Rutland [Castleton quad.] having long been the principal center of the marble industry. There is considerable variation in the beds of marble, and different quarries make a specialty of particular beds. A long line of quarries, old and new, lies along E. side of the marble belt, and there are a few quarries on W. side of belt. Prevailing colors are white, more or less banded with dark blue, mottled blue, and light gray; a few beds have a pale-green banding, and in the quarries on W. side of the belt mottled cream-colored marbles are produced. In the 2 northerly areas of the fm. btw. Brandon and West Rutland the synclines in which fm. lies are shallower than that at West Rutland and only lower part of fm. appears. In these areas the marbles are in the main dark blue, and there is a thin memb. of blue-banded lss. at base. This memb. also appears in West Rutland area but is thinner and poorly exposed. The lower lss. contain a brachiopod fauna and many crinoid stems; the upper marbles, particularly the bluish or blue-banded ones, have many large Maclureas that have always been considered to be of Chazy age. Several small areas of the marble (containing fossils) occur along E. side of Taconic Range, coming in and out against the Taconic overthrust. The marble rests uncon. on Ira sl., of Beekmantown age.

West Spring Creek formation.

Middle Ordovician: Central southern Oklahoma (Arbuckle and Wichita Mountains).

In ms. chart dated April 1928 (but not published by him) E. O. Ulrich divided Simpson fm. of Taff into (descending): (1) *West Spring Creek fm.*, *Criner memb.* (of Trenton and Black River age); uncon. on (2) Bromide fm.; and (3) Oil Creek fm., the latter having great uncon. at base. At Dec. 1928 meeting of Geol. Soc. of Am., in N. Y., Ulrich exhibited a ms. chart (which he did not publish) in which he divided Simpson fm. into (descending) *Bromide*, *Criner*, *Tulip Creek*, McLish, Falls, Nebo, and *Joins Ranch*, as reported by Dr. C. N. Gould. In Feb. 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 73) Ulrich divided Simpson fm. into (descending): *Bromide* (of Trenton and Black River age) uncon. on *Criner; Tulip Creek*, Falls, McLish, *Oil Creek*, and *Joins*. Ulrich's 1928 list of names as reported by Gould was published by C. E. Decker in Dec. 1930 (A. A. P. G. Bull., vol. 14, No. 12, p. 1495).

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55–57). Simpson group of Arbuckle and Wichita Mtns divided into (descending) Bromide fm., Tulip Creek fm., McLish fm., Oil Creek fm., Joins fm., *West Spring Creek fm.*, Alden ls. (Ceratopia bed), and Cool Creek ls.

Above are only recorded uses of *West Spring Creek fm.*

Named for West Spring Creek, in SW. corner of Murray Co., 4 or 5 mi. SE. of Pooleville.

West Sutton slate.

Cambrian (Lower): Southern Quebec.

T. H. Clark, 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 225–226), listed the following fms. beneath Cheshire qtzite in southern Quebec: West Sutton sl., 40 ft.; White Brook dol., 40 ft.; Pinnacle graywacke, 400 ft.; and Call Mill sl., 25 ft.

West Union limestone.

Silurian (Niagaran): Southwestern Ohio.

E. Orton, 1871 (Ohio Geol. Surv. Rept. Prog. 1870, pp. 271, 274, 301, and fig. 1, opp. p. 310). *West Union* or *Lower Cliff*.—Yellowish impure mag. lss., rather massive, 45 to 89 ft. thick, in Highland and Adams Counties. Overlies Niagara shales and underlies Springfield stone or *Blue Cliff*. All included in Niagara group. Contains Niagara fossils.

A. F. Foerste, 1900 (Ind. Dept. Geol. and Nat. Res. 24th Ann. Rept.). *West Union cliff rock* cannot be distinguished N. or W. of Greene Co., Ohio. Seems to replace ls. at top of Osgood in Ind.

C. S. Prosser, 1903 (Jour. Geol., vol. 11, pp. 519–546), J. A. Bownocker, 1915 (Ohio Geol. Surv., 4th ser., Bull. 18), and W. Stout, 1916 (Ohio Geol. Surv., 4th ser., Bull. 20), applied *Osgood beds* to beds underlying *West Union ls.* in Ohio.

C. S. Prosser, 1915 (Outlines of field trips in geol. in central Ohio), applied *Alger sh.* to beds underlying *West Union ls.* and overlying Brassfield ls. in Ohio.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, pl. 3). *West Union ls.* is=Osgood ls. of Ind.

A. F. Foerste, 1917 (Ohio Jour. Sci., vol. 17, No. 6), applied *West Union fm.* to beds underlying Cedarville ls. and overlying Crab Orchard sh. in Highland and Adams Counties, Ohio, and divided it into two faunal horizons, called Lilley memb. (above) and Bisher memb. (below). In 1919 (Ohio Jour. Sci., vol. 19, pp. 367–375) he gave thickness of his Lilley memb. as 20 to 30 ft. and thickness of his Bisher memb. as 45 ft., and stated that Lilley memb. corresponds to Upper or Blue Cliff of Orton, and Bisher memb. to Lower or West Union Cliff of Orton. In 1923 (Denison Univ. Bull., Sci. Lab. Jour., vol. 20, pp. 41–49) Foerste applied *Euphemia dol.* to the beds underlying Springfield dol. and overlying "so-called Laurel ls." from Wilmington, Clinton Co., Ohio, northward, and stated that the beds called Euphemia dol. are those included by Prof. Orton in his West Union bed, when using that name for tier of counties here named; also that *Lilley fm.* includes that part of section erroneously identified many years ago by Orton as *Springfield stone*, but that Springfield dol. is younger than the Lilley; also that his Bisher fm. corresponds approx. to West Union or Lower Cliff of Orton, and that this name would have been retained if Prof. Orton ever had described any section from West Union area, or had designated at Hillsboro the same boundaries btw. West Union and Springfield beds as those adopted later btw. Bisher and Lilley fms. Also that the Bisher is of upper Clinton age, and overlies Alger clay sh.

Named for exposures at West Union, Adams Co.

Westville shale.

Pennsylvanian: Southeastern Massachusetts.

J. B. Woodworth, 1899 (U. S. G. S. Mon. 33, p. 134). [*Westville shales and Seekonk sss.* are shown in table on p. 134 as top div. of Rhode Island Coal Measures and as underlying Seekonk cgl. and overlying Tenmile River beds, but they are not described by name in the text.]

Westville formation.

Carboniferous: Nova Scotia.

H. M. Ami, 1900 (Canadian Rec. Sci., vol. 8, pp. 162–163).

Westwater gneisses and schists.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 39, 281). *Westwater gneisses and schists.*—Schists and gneisses composing earliest known pre-Camb. rocks in Colo. Of pre-Archeozoic or Azoic age. Exposed in bed of Grand River at Utah-Colo. line. [Derivation of name not stated.]

Westwater Canyon sandstone member (of Morrison formation).

Upper Jurassic: Southeastern Utah (San Juan country).

H. E. Gregory (U. S. G. S. P. P. 188, in press). A ss. that appears to lie in position of Salt Wash ss. memb. of Lupton stands as cliffs and forms base of many canyon walls. Along the San Juan N. and NW. of Bluff, btw. Brushy Basin and middle Cottonwood Wash, and at other places where the overlying variegated shales have been removed, this ss. appears as mesas, ridges, and the tops of broad platforms. Is tentatively here named *Westwater Canyon ss. memb.*, because its exact equivalency to typical Salt Wash ss. has not been satisfactorily established. Is essentially a series of white sss. (composed of rounded medium to coarse grains of quartz cemented by calcium carbonate and arranged in lenticular, irregular beds 1 to 30 ft. thick) interbedded with red earthy soft fine-grained sandy shales or mudstones; also a few thin short lenses of gray ls. cgl. Underlies Brushy Basin sh. memb. and overlies, with local uncon., Recapture sh. memb. Thickness 222 to 295 ft. Named for exposures in canyon of Westwater Creek, San Juan Co.

Wetmore conglomerate member.

Devonian or Carboniferous: Northwestern Pennsylvania and southwestern New York.

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 61, 111–112). *Wetmore cgl. memb. or lens.*—Lower cgl. of Knapp formational suite. Is less persistent of the two Knapp cgls. Found only, so far as known, in McKean, northern Forest, northern Elk, and eastern Warren Counties, Pa., and in typical Knapp area, in vicinity of Knapp Creek, N. Y. Is a flat-pebble rock, varying in thickness, possibly suggestive of a broad depression filling. Is 20± ft. thick at Ludlow and about 15 ft. at East Kane. Underlies East Kane sh. memb. and overlies Kushequa sh. memb. Replaces Ludlow cgl. of writer's 1933 paper. Named for exposures along face of the hills btw. Wetmore and Ludlow, McKean Co., Pa.

Wetumka shale.

Pennsylvanian: Central, central eastern, and central southern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Wetumka sh.*—Clay shales, 120 ft. thick, with thin shaly ss. layers near center. Overlies Calvin ss. and underlies Wewoka fm.

Named for exposures at or near Wetumka, Hughes Co.

Weverton sandstone.

Lower Cambrian: Virginia, West Virginia, Maryland, and southeastern Pennsylvania.

A. Keith, 1893 (as reported by G. H. Williams and W. B. Clark, in Maryland, its resources, industries, and institutions, chap. 3, p. 68. The fm. was described, but not named, by Keith in Am. Geol., vol. 10, p. 365, 1892). *Weaverton ss.*—Gray massive ss., often coarse and feldspathic. Thickness 1,000 to 1,200 ft. Underlies Harper's Ferry shales [Harpers sh.] and overlies Loudon shales [Loudoun fm.].

Named for exposures at Weverton [correct spelling], Washington Co., Md.

Wewe slate.

Pre-Cambrian (lower Huronian): Northwestern Michigan (Marquette district).

C. R. Van Hise and W. S. Bayley, 1895 (U. S. G. S. 15th Ann. Rept., pp. 530+). *Wewe sl.*—Chiefly sl., but contains some graywackes, cgl., mica sl., and in places mica schists. Thickness 500 ft. Rests conformably on Kona dol. Underlies Ajibik qtzite, usually conformably but in one place uncon. Typical development on Wewe Hills, W. of Goose Lake. [Later repts give thickness 0 to 1,050 ft.]

A. C. Lane, 1907 (Mich. State Bd. Geol. Surv. Rept. 1906, p. 500), used *Wewe or Goose Lake slates*, and elsewhere in same publication described the fm. as *Wewe sl.*, "the slates of Goose Lake, *Wewe* being Chippewa name for *Goose*."

Wewoka formation.

Pennsylvanian: Central, central southern, and central eastern Oklahoma.

J. A. Taff, 1901 (U. S. G. S. Coalgate folio, No. 74). *Wewoka fm.*—Massive brown friable ss., with interstratified soft blue clay sh. and thin ls. lentil in lower part. Thickness 700 ft. Underlies Holdenville sh. and overlies Wetumka sh.

Named for Wewoka Creek, Seminole and Hughes Counties, which crosses the fm.

Weymouth formation.

Lower Cambrian: Eastern Massachusetts.

L. LaForge, 1909 (Sci., n. s., vol. 29, pp. 945–946). *Weymouth fm.*—Name proposed for the fossiliferous beds of Lower Camb. age. Older than Braintree sl., which is Middle Camb.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, p. 37 and map). *Weymouth fm.*—At Weymouth, where exposed N. and E. of Mill Cove, it consists of reddish, brownish and greenish cherty sl. with greenish epidotic and calc. lenses and nodules and thin beds of white ls. At Nahant the few ft. of exposed beds are cherty greenish sl. and gray lydite with a few layers of white ls. Lower Camb. fossils.

See also L. LaForge, 1932 (U. S. G. S. Bull. 839).

†Weyquosque series.

Pleistocene: Southeastern Massachusetts.

N. S. Shaler, 1888 (U. S. G. S. 7th Ann. Rept., pp. 303-363 and maps). *Weyquosque series.*—Gray and blue clays and whitish sands, 1,500 to 2,000 ft. thick. Appears to overlie (uncon.) Vineyard series; underlies glacial deposits. Believed to have been deposited during first stages of glacial period, but may belong to an age btw. that of Vineyard series (Tert.) and the glacial epoch. Well exposed in W. part of Chilmark or Weyquosque Cliffs, Marthas Vineyard. [See also Shaler, 1890 (Geol. Soc. Am. Bull., vol. 1, pp. 443-452) and 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 959-974).]

J. B. Woodworth, 1896 (U. S. G. S. 17th Ann. Rept., pt. 1, pp. 975-988) and 1897 (Geol. Soc. Am. Bull., vol. 8, pp. 197-212). The *Weyquosque series of Shaler* (1888) is in this rept divided into Tisbury beds above and Sankaty beds below.

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). Shaler's *"Weyquosque series"* extended from top of Dukes gravel bed below to top of Manhasset fm. above.

Weyquosque formation.

Pleistocene: Southeastern Massachusetts (Marthas Vineyard) and Rhode Island (Block Island).

J. B. Woodworth and E. Wigglesworth, 1934 (Harvard Coll. Mus. Comp. Zool. Mem., vol. 52). *Weyquosque fm.*—Name *Weyquosque* restricted to 0 to 50 ft. of glacial gravels and sand forming basal bed of Shaler's "Weyquosque series" (which extended from top of Dukes gravel bed below to top of Manhasset fm. above). As restricted is older than Mannetto fm. and younger than Dukes boulder bed. Correlated with Nebraskan stage of Pleist. Present on Marthas Vineyard and Block Island. Named for exposures at E. end of Nashaquitsa Cliffs, on S. shore of Marthas Vineyard, "at a locality known to inhabitants from earliest days as Weyquosque."

Whalen group.

Pre-Cambrian: Southeastern Wyoming (Hartville uplift).

W. S. T. Smith and N. H. Darton, 1903 (U. S. G. S. Hartville folio, No. 91). *Whalen group.*—Qtzite, schist, siliceous ls., and gneiss, of Algonkian age. Oldest fm. in quad. Uncon. underlies Guernsey fm. (Miss.). Is intruded by granites of Algonkian(?) age. Typical occurrence along walls of Whalen Canyon.

Wharncliffe sandstone. (In middle of Pottsville group.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, p. 222). *Wharncliffe (Dotson?) ss.*—Massive current-bedded medium-grained pebbly grayish-white ss. Thickness 75 to 130 ft. Lowest surface rock in these counties. Lies 5 to 10 ft. below Gilbert coal [Lower Douglas coal?]. *Is top memb. of Middle Pottsville or New River series.* "Seems=Dotson ss. of Campbell." Named for town in Mingo Co.

Whately bed.

Name applied by B. K. Emerson (U. S. G. S. Mon. 29, 1898, pp. 190, 193) to a band of amphibolite that crops out beneath the sands of the valley in Whately, Old Hampshire Co., Mass., and runs SW. across Whately and into Williamsburg.

Wheaton River volcanics.

Tertiary: Yukon Territory.

D. D. Cairnes, 1910 (Canada Geol. Surv. Summ. Rept. 1909, p. 51).

Wheeler formation.

Middle Cambrian: Western Utah (House Range).

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804, pp. 9, 10). *Wheeler fm.*—Alternating bands of thin shaly ls. and calc. sh., 570 ft. thick. Underlies Marjum fm. and overlies Swasey fm. Type loc. is center of Wheeler Amphitheater, SE. of Antelope Springs.

Wheeler sand.

A subsurface sand, of Penn. age, in Okla., that has been correlated with the whole and with the lower part of Oswego lime. Named for Wheeler farm, pool, and dome, Carter Co.

Wheeler lime.

A subsurface ls., of Penn. age, in central northern Okla. that is believed to correspond to Pawnee ls.

Wheeling group.

Pennsylvanian: Appalachian Basin.

J. J. Stevenson, 1907 (Geol. Soc. Am. Bull., vol. 18, p. 178). [See quotation under *Athens group*.]

Whepley shale.

Miocene (middle): Southern California (Kettleman Hills).

H. V. Dodd and E. J. Kaplow, 1933 (Calif. Oil Fields, Calif. Dept. Nat. Res., Div. Oil and Gas, vol. 18, No. 4, pp. 12, 14, pls. 1, 2). *Whepley sh.*, 0 to 40± ft. thick, lies at base of fifth oil and gas zone in North Dome of Kettleman Hills. Formerly considered by some geologists to be top of Kreyenhagen sh., but now generally conceded to be either Temblor or Vaqueros, and underlying 650± ft. of strata (mostly sand, with increasing amount of sh. near base) are also believed to be either Temblor [middle Mio.] or Vaqueros [lower Mio.]. The Whepley is found in only 2 areas. Lies at 2,935± ft. depth. To NW. of 41-3P area it is absent; to SE. the wells have not been drilled deep enough to encounter it. Underlies Felix siltstone and overlies "Mollusk-boring sand."

Named for occurrence in wells on Whepley lease.

Whetstone Branch shale.

Upper Devonian: Northeastern Mississippi (Tishomingo County).

W. C. Morse, 1928 (Jour. Geol., vol. 36, pp. 31–43). *Whetstone Branch sh.*—Largely black sh., but contains some sandy sh. and a few thin sss. At a number of places is represented by a rather prominent ss. layer with a conglomeratic base resting uncon. on older fms., but at other places typical black sh. underlies and overlies the ss. Contains Dev. fossils. Belongs to lower and greater part of Chattanooga sh. of type loc. Uncon. underlies Carmack ls. and uncon. overlies Island Hill fm. Named for picturesque tributary of Tenn. River.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23), gave many details of this fm. Thickness 0 to 31½ ft. Type loc. is mid portion of Whetstone Branch, which enters Tenn. River about 3½ mi. above Tenn. State line and mouth of Yellow Creek.

Whetstone Gulf formation.

Upper Ordovician: Northern New York (Black River Valley) and southern Canada.

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258). The term "Frankfort" could not very well be applied to the whole of the lower Lorraine shales. Therefore the lower Lorraine shales should receive a separate name (*Whetstone Gulf sh.*). The Frankfort, being of the same age as the lower portion of the lower Lorraine sh. and merging into it, could be incorporated into the Lorraine, as the New York Survey has done from its beginning, but not as its characteristic development but only as a local shore facies of the lower Whetstone Gulf horizons. (Page 147.) For the lower Lorraine shales we have selected the name "*Whetstone Gulf beds*," from the fine exposure of the lower Lorraine shales in the picturesque Whetstone Gulf near Martinsburgh in Lewis Co., N. Y. Here also the contact with both the *underlying* Atwater Creek and *overlying* Pulaski beds is shown. (Page 148.) [In some parts of this rept the name *Whetstone Gulf* is applied to the beds *between* Atwater Creek sh. and Pulaski sh.; in other parts of rept the Atwater Creek is included in the Whetstone Gulf. The beds btw. Atwater Creek and Pulaski shales are also divided into two faunal zones, called *Moose Creek beds* (above) and *Wood Creek beds* (below).]

Whetstone Run sand.

Drillers' name for a sand of late Upper Dev. (Catskill) age in W. Va. Lies at or near same horizon as Gordon sand.

Whirlpool sandstone member (of Albion sandstone).

Silurian (early): Western New York and Ontario.

A. W. Grabau, 1909 (Jour. Geol., vol. 17, p. 238). *Whirlpool ss.*—White quartzose ss., 25 ft. thick, forming basal bed of *true or Upper Medina* [i. e. Medina restricted, later named *Albion ss.*]. Overlain by red sss. and green and gray sss. and sh. and underlain by Queenston sh., of Richmond age.

In 1912 (N. Y. State Mus. Hdb. 19) C. A. Hartnagel included Queenston sh. in Medina, and treated Whirlpool ss. as an overlying part of Medina.

In 1913 (12th Int. Geol. Cong., Canada, pp. 26, 27, 30, 36, 49) E. O. Ulrich and J. M. Clarke replaced "Upper Medina" with *Albion ss.* (a name suggested by Clarke); and A. W. Grabau (Geol. Soc. Am. Bull., vol. 24, pp. 431, 460) applied *Whirlpool qtzite* to basal 25 ft. of that fm., to which, however, he applied *Medina* in a restricted sense. He described *Whirlpool qtzite* as hard white quartz ss., and stated that it occurred at Niagara and for some distance E. and W., but not as far E. as Rochester. In U. S. G. S. Niagara Falls folio (No. 190, 1913) the form of the name was changed to *Whirlpool ss. memb.*, and the beds were described as consisting of 20 ft. of coarse white ss., forming basal memb. of Albion ss. and resting on Queenston sh. In Canada Geol. Surv. Guidebook 4, 1913, W. A. Parks proposed that *Whirlpool ss. of Grabau* (consisting, at Hamilton, Ont., of 10 ft. of gray ss.) be treated as basal memb. of Schuchert's Cataract fm. [a name introduced by Schuchert in Geol. Soc. Am. Bull., vol. 24, p. 107, 1913], "which represents an invasion from N. and W. at commencement of Sil. time" [but which, according to Schuchert, 1913, corresponds to lower 50 ft. of the 135 ft. of Albion ss. at Niagara Falls]. Parks also restricted Medina to the beds above Cataract fm., or to uppermost part (60–70 ft. according to F. B. Taylor on pp. 22–24 of same volume) of beds formerly included in the Medina. The type loc. of Cataract fm. is a town in interior of Ontario, where it is also exposed at the cataract of Credit River. In 1914 (Geol. Soc. Am. Bull., vol. 25, pp. 277–320) Schuchert treated *Whirlpool ss. memb.* as basal bed of his Cataract fm. (and of Sil. system), and described it as consisting of 0 to 22 ft. of coarse cross-bedded white, red, or mottled ss., extending from Lockport, N. Y., to near Collingwood, Ont. He also stated that the white sss. at base of Medina E. of Lockport are not of same age as Whirlpool ss. The calc. beds overlying the Whirlpool ss. he designated *Manitoulin ls. memb.*, a name introduced by M. Y. Williams in 1913. E. M. Kindle, 1914 (Sci., n. s., vol. 39, pp. 915–918), endorsed Grabau's restriction of *Medina* and treated Whirlpool ss. as basal bed of that fm. M. Y. Williams, 1919 (Canada Geol. Surv. Mem. 111), treated Whirlpool ss. as basal memb. of *Medina-Cataract fm.*, as did A. F. Foerste, 1924 (Canada Dept. Mines Geol. Surv. Mem. 138), who stated that Whirlpool ss. extends from Niagara River to vicinity of Duntroon, about 8 mi. S. of Collingwood, and that it has not been traced as far E. as Rochester, N. Y. In 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21) E. R. Cumings proposed that Albion ss. be restricted to beds btw. Whirlpool ss. and Thorold ss., and that Whirlpool be treated as basal fm. of *Medinan series.*

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 317), treated Whirlpool ss. as basal bed of Albion ss., as did H. L. Alling and J. E. Hoffmeister, 1932 (16th Int. Geol. Cong. Guidebook 4). This is the definition still followed by U. S. Geol. Survey.

Named for occurrence at the Whirlpool of Niagara River.

†White limestone.

Oligocene and Eocene: Alabama.

A descriptive term applied, in a titular sense, in early repts to the white ls. in vicinity of St. Stephens, Ala., later called "St. Stephens ls.," but now known to be divisible into Vicksburg group (Olig.) and Jackson fm. (upper Eo.).

†White limestone.

Lower Ordovician (Beekmantown): Leadville district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept. pp. 215-230), 1883 (U. S. G. S. Leadville Atlas), and 1886 (U. S. G. S. Mon. 12). [A color term applied in a titular sense to 160 ft. of light-gray to dark-gray dolomitic ls., with shaly layers, overlying the Camb. (Sawatch) qtzite and underlying Parting qtzite.]

Same as Manitou ls.

White porphyry.

Eocene: Leadville district, Colorado.

S. F. Emmons, 1882 (U. S. G. S. 2d Ann. Rept., pp. 215-230), 1883 (U. S. G. S. Leadville Atlas), 1886 (U. S. G. S. Mon. 12, p. 76), and 1927 (U. S. G. S. P. P. 148) used *White porphyry* in a titular sense. This is a color term applied to a "white or granular compact, homogeneous-looking rock, composed of quartz, feldspar, and muscovite," and of earlier age than the Gray porphyry group of Leadville dist. Is also called "White or Leadville porphyry." Petrographic description, by W. Cross, on p. 324 of Mon. 12. For convenience of mining public this descriptive term is still used in a titular sense in the Leadville dist.

White Sands.

A geographic descriptive term applied to part of the Tularosa quad., N. Mex., the surface of which is composed of granular gyp. and other white deposits of loose sand, mostly silica.

Whitean series.

A name employed by C. R. Keyes instead of *White River group.*

White Beach sandrock.

Miocene (lower): Central Florida.

W. H. Dall, 1892 (U. S. G. S. Bull. 84, pp. 114, 337). *White Beach sand rock.*—A yellowish ls., much water-worn and covered in places with a thin layer of recent sandrock. It contains distorted molds of many species which cannot be recognized, but in some places these molds have become filled with a pseudomorph in lime of the original shell. About half of species collected have been studied sufficiently to show their near equivalence to *Orthaulax* bed of Tampa and Chipola marl bed of Alum Bluff. It is certainly to be included in Tampa group, and may possibly be a little younger than either *Orthaulax* bed ["so-called silex bed" of Tampa ls.] or Chipola marl.

Named for exposures at a locality known in 1892 as "White Beach," at northern and western extreme of Little Sarasota Bay, S. of Tampa Bay, on W. coast of Fla.

White Bluff marl.

Eocene (upper): Jefferson County, southeastern Arkansas.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 343 and table opp. p. 334). *White Bluff marl.*—White Bluff, Jefferson Co., Ark. See Harris, Ann. Rept. Geol. Surv. Ark. for 1892, vol. 2, 1894, p. 87. [In chart opp. p. 334 Dall placed

"White Bluff marl" at top of Claibornian and above "Claiborne sand." In Harris' rept cited in above quotation Harris gave following section of rocks present at White Bluff, but did not use *White Bluff marl.*]

Soil
Sand and clay } 10 ft.
Gravel

Thin-banded light-gray clay, alternating with sand, 10 ft.

Green marly clay, with fossils, underlain by light- and dark-colored marls, highly fossiliferous, 60 ft.

The fossils found in above section (some of which are figured on pl. 9, accompanying this rept) belong to Eocene Tertiary.]

The beds referred to belong to Jackson fm., to which they were assigned by Harris.

White Brook dolomite.

Cambrian (Lower): Southern Quebec.

See under *West Sutton sl.*

Whitecap schist series.

Devonian, Carboniferous: British Columbia.

C. W. Drysdale, 1916 (Canada Geol. Surv. Summ. Rept. 1915, p. 79).

White Caps limestone member (of Gold Hill formation).

Cambrian? (Upper Cambrian?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *White Caps ls. memb.*—Pure blue-gray crystalline ls., 30± ft. thick. Lies at about middle of Gold Hill fm. and nearly 200 ft. above Morning Glory ls. memb. Is the bed that contains the ore deposit at White Caps mine.

White Church zone.

A name applied by H. S. Williams (Jour. Geol., vol. 15, p. 97) to a zone of *Tropidoleptus* assigned to Chemung fm. of Ithaca region, N. Y.

†White Cliff limestone.

Upper Jurassic: Southwestern to northeastern Utah and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 51, 152). A bed of ls. has been found at base of Flaming Gorge group wherever it has been studied, varying in thickness from 10 to 250 ft. In southern Utah it caps an extensive escarpment known as the White Cliffs, and we have called it the *White Cliff ls.* In vicinity of Flaming Gorge [NE. Utah] it also forms basal part of Flaming Gorge group and rests on White Cliff ss. The ls. is bluish buff, compact, sometimes shaly, and interstratified with orange shales and thin beds of gyp.

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed White Cliff ls. of Powell=Twin Creek ls. of SW. Wyo.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 40). White Cliff ls. of Powell is=Curtis fm., which is=Twin Creek ls.

†White Cliff sandstone.

†White Cliff group.

Jurassic (?): Southwestern to northeastern Utah and northwestern Colorado.

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 51, 52, 151). *White Cliff group.*—Massive, obliquely laminated ss., often of beautiful white or golden color, sometimes red; in a few places rather heavily bedded sss. are found. Of lighter color than Vermilion Cliff group. Thickness 0 to 1,100 ft. Underlies Flaming Gorge group and overlies Vermilion Cliff group. Type loc., escarpment known as White Cliffs, in southern Utah, in Paria, Kanab, and Rio Virgen region [Kane Co.].

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 33), showed that the ss. of the White Cliffs of Kane Co., southern Utah, is Navajo ss. (Jurassic?); and (chart opp. p. 40) showed that the White Cliff ss. of Powell in eastern Uinta Mtns region, NE. Utah, is=(descending) Entrada ss. (Upper Jurassic), Carmel fm. (Upper Jurassic), and upper part of Navajo ss. (Jurassic?).

†White Cliffs chalk.

Upper Cretaceous (Gulf series): Southwestern Arkansas and northwestern Louisiana.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 72, 87–88, 188). *White Cliffs chalk.*—Purest-white chalk at bluffs of Little River, sec. 35, T. 11 S., R. 29 W. Thickness 135 to 150 ft. Underlies Brownstown marl [not Brownstown but Marlbrook marl] and overlies White Cliffs subchalk.

Preoccupied. Replaced by *Annona chalk*. Represents upper part of Annona chalk, and is all of Annona present at White Cliffs, according to 1925 and 1926 studies of L. W. Stephenson and C. H. Dane. Overlies Ozan fm. (See C. H. Dane, U. S. G. S. Press Bull. 8823, Sept. 10, 1926; L. W. Stephenson, A. A. P. G. Bull., vol. 11, No. 1, Jan. 1927; and C. H. Dane, Ark. Geol. Surv. Bull. 1, 1929.)

Named for exposures at White Cliffs of Little River, Little River Co., Ark.

†White Cliffs subchalk.

Upper Cretaceous (Gulf series): Southwestern Arkansas.

R. T. Hill, 1888 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 2, pp. 7, 88–89, 188). *White Cliffs subchalk.*—Highly fossiliferous impure chalk, composed of glauconite and aren. grains cemented by calc. matrix. Basal 60 ft. of White Cliffs of Little River. Lowest Upper Cret. horizon seen in Ark. Underlies White Cliffs chalk.

Included in Annona chalk.

White Cloud shale. (In Scranton shale.)

Pennsylvanian: Eastern Kansas and southeastern Nebraska.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 40, 41, 58). *White Cloud sh.* is here named from exposures W. of White Cloud, Kans., where it is 100± ft. thick. It underlies Rulo ls. and overlies Howard ls. The salmon-colored ls. in White Cloud sh., about 26 ft. below overlying Rulo ls., is here called *Happy Hollow ls.*, from exposures in bluffs at mouth of Happy Hollow Creek, located below mouth of Big Nemaha River. [On p. 40 a thickness of 1 ft. 9 in. is given for Happy Hollow ls.]

G. E. Condra, 1930 (Nebr. Geol. Surv. Bull. 3, p. 53). The Nebr. Geol. Survey now restricts *White Cloud sh.* to that part of Scranton sh. below Happy Hollow ls., and applies *Cedar Vale sh.* to beds above Happy Hollow ls. and below Rulo ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), dropped Scranton sh. and treated White Cloud as a fm. in his Wabaunsee group redefined.

White Cone series.

Tertiary or Pleistocene: Northeastern Arizona.

See 1932 entry under *Bidahochi fm.*

Whiteface anorthosite.

Pre-Cambrian: Northern New York (Essex County).

J. F. Kemp, 1898 (N. Y. State Mus. 52d Ann. Rept., vol. 1, pp. 51–63). *Whiteface type of anorthosite* forms summit of Mount Whiteface and southern portion of mtn. Contains large amounts of hornblende and pyroxene, together with milky-white feldspar. Assigned to pre-Camb. (?).

H. P. Cushing, 1899 (N. Y. State Geol. 18th Ann. Rept.). Kemp's *Whiteface type of anorthosite* is assigned to pre-Camb.

W. J. Miller, 1919 (N. Y. State Mus. Bull. 213, 214, p. 33). *Whiteface anorthosite* mapped. Is a more or less well-defined border development of the pre-Camb. anorthosite series and is finer-grained and of lighter color than Marcy anorthosite.

J. F. Kemp, 1921 (N. Y. State Mus. Bull. 229, 230, p. 33 and map). *Whiteface type of anorthosite* is characterized by white plagioclase. Assigned to pre-Camb. Algoman intrusives.

W. J. Miller, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 400–462). Around the borders of the great body of anorthosite, and in some places a number of miles within it, there is generally a notable increase in femic minerals, causing the rocks to be anorthosite-gabbro or even gabbro. Almost invariably medium-grained and therefore notably finer-grained than typical Marcy anorthosite, though at some places a few scattering labradorite individuals occur. A foliated structure is generally well developed. Although they are more or less variable in general appearance and composition, I here propose that these border phases of the anorthoclase be classed as *Whiteface anorthoclase*, a name given by Prof. Kemp to a type of anorthoclase which occurs abundantly on Mount Whiteface. The typical Marcy anorthosite is not so gabbroid, is very coarse-grained, light to dark bluish gray, and generally not well foliated. Both Whiteface and Marcy types are certainly differentiation phases of same cooling magma, the Whiteface doubtless representing a chilled border portion. The two types grade into each other. Intrusive into Grenville rocks.

G. H. Chadwick, 1930 (Geol. Soc. Am. Bull., vol. 41, p. 82). [See under *Adirondack anorthosyte*.]

Whitehall moraine.

Pleistocene (Wisconsin stage): Western Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Belongs to Port Huron morainic system. Named for Whitehall, Muskegon Co.

Whitehead granite.

Pre-Cambrian: Southwestern Colorado.

W. Cross and E. Howe, 1905 (U. S. G. S. Needle Mtns folio, No. 131). *Whitehead granite*.—Reddish pink biotite granite. Intrudes Archean schists but does not intrude the Algonkian rocks, and is therefore assumed to be older than Algonkian. Named for occurrence about mouth of Whitehead Gulch, this quad.

Was assigned to Algonkian by E. S. Larsen in U. S. G. S. Bull. 843, 1933. The terms "Algonkian system" and "Archean system" were discarded by U. S. Geol. Survey in 1934. For 1935 Colo. geol. map this fm. was included in Front Range granite group and assigned to pre-Camb.

Whitehead formation.

Upper Ordovician: Quebec (Percé).

C. Schuchert, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 161–170). *Whitehead or Cape Blanc fm.*—Younger than Cape Canon fm., which is probably a part of the younger series. Is 2,000 or more ft. thick and of Upper Ord. age.

Whitehorse sandstone.

Permian: Northwestern, southwestern, and central southern Oklahoma, and central southern Kansas.

C. N. Gould, 1905 (U. S. G. S. W. S. P. 148, p. 55). *Whitehorse ss. memb. of Woodward fm.*—[Introduced to replace preoccupied name "Red Bluff ss." Quotes Cragin's definition of "Red Bluff."] Extends from vicinity of Whitehorse Springs, Woods Co., Okla., SW. across the Cimarron to high divides beyond. Overlies Dog Creek sh. and underlies Day Creek dol.

R. W. Sawyer, 1924 (A. A. P. G. Bull., vol. 8, No. 3), proposed restricting *Whitehorse ss.* to upper part of the Whitehorse, and named lower part *Marlow fm.* This usage did not prevail, and in 1929 Sawyer named his restricted Whitehorse ss. the *Rush Springs memb. of Whitehorse*, and called the lower part the *Marlow memb.*

N. Evans, 1931 (A. A. P. G. Bull., vol. 15, No. 4), stated that Day Creek dol. overlies (instead of underlies) Cloud Chief gyp., and treated the Cloud Chief as a memb. of the Whitehorse. [These proposed innovations are still under investigation.]

Is middle fm. of Woodward group of Okla. In Kans. is in Cimarron group. The name has also been used by Tex. Geol. Surv. in Tex.

†White Iron granite.

Pre-Cambrian (Laurentian): Northeastern Minnesota (Vermilion district).

A. Winchell, 1888 (Minn. Geol. Nat. Hist. Surv. 16th Ann. Rept.). *White Iron granite* (Laurentian) occupies all shores of White Iron Lake except those of northern extremity, and is continuous with Saganaga granite.

†White Medina.

Name applied in some early repts to Albion ss. of N. Y. and to Tuscarora qtzite of Pa., Md., etc.

†White Mesa sandstone.

Jurassic (?): Northeastern Arizona.

H. F. Lunt, 1904 (Am. Inst. Min. Engrs. Trans., vol. 34, pp. 989–990). *White Mesa ss.*—White ss. which gives the name of "White Mesa" to that locality. Shows all phases of cross-bedding in great complexity. Prevailing color white or gray, but occasionally is red. Composed of well-worn grains of quartz sand, from which most of cementing material has been leached out, leaving it soft and friable; possibly the cement was ferruginous. Thickness 200 to 250 ft.

According to H. E. Gregory (U. S. G. S. P. P. 93, p. 141, 1917) the ss. described by Lunt is Navajo ss.

White Mountain series.

Pre-Cambrian (?) and later: Northern New Hampshire (White Mountains region).

C. H. Hitchcock, 1869 (1st Rept. on geol. and min. N. H.), in a rept on Ammonoosuc gold field, applied the term *gneissic or White Mtn series* to rocks older than those he termed *Quebec group*.

C. H. Hitchcock, 1870 (2d Rept. on geol. and min. N. H., map and pp. 31–32). *White Mtn or gneissic series.*—In our last rept this term was used to indicate the general mass of gneissic and granitic rocks of the State. It occupies four-fifths of State. Includes normal gneiss, ferruginous gneiss, granitic gneiss, feldspathic mica schist, andalusite gneiss, chiastolite slates, granite, sienite, porphyritic granite, qtzites, lss., and soapstones. Little doubt remains as to pre-Sil. age of this entire series. [On 1932 geol. map of U. S. most of rocks here mapped as *White Mtn series* are mapped as *pre-Camb.*, but Billings now questions any pre-Camb. in N. H.]

C. H. Hitchcock, 1871 (Geol. Surv. N. H. Rept. 1870). *White Mtn series.*—Gneissic rocks—various imperfect gneisses, verging into mica schists, a few beds of genuine gneiss, granitic gneiss, andalusite gneiss—and granite, both bedded and in veins. Has a great development in middle and southern parts of State, perhaps embracing everything not included in Exeter, Merrimack, and Coos groups. It uncon. underlies Coos group. It is not certain whether it is=Laurentian of Canada or Camb. of Great Britain as restricted by Govt. Survey.

C. H. Hitchcock, 1872 (Geol. Surv. N. H. Rept. for 1871). *White Mtn or andalusite gneiss* occupies great part of White Mtn area E. of Saco.

C. H. Hitchcock, 1874 (Geol. N. H., pt. 1, btw. pp. 508 and 545), called the rocks *Montalban or White Mtn series*.

C. H. Hitchcock, 1877 (Geol. N. H., pt. 2), changed *White Mtn series* to *Montalban group*, and included in it Franconia breccia, fibrolite schists with gigantic granite veins, ferruginous schists, Concord granite, and gneisses and feldspathic mica schists. In the 1878 Atlas of N. H. he did not use either *White Mtn series* or *Montalban group*, but in 1884 he used *Montalban* in different parts of N. H.

C. H. Hitchcock, 1884 (Am. Mus. Nat. Hist. Bull., vol. 1, No. 5, pp. 178–179, pls. 16 and 17). *Montalban* typical loc., as shown by the name, lies within our territory. It is same as my "White Mtn series," adopted as a matter of convenience. A different use of equiv. term *Montalban* was proposed by T. S. Hunt in 1871. It was applied to a somewhat similar series of schists overlying the Huronian and expressly stated to include Coos group and calciferous mica schists of our repts. In our belief he has included under this designation rocks of different age, one a system below the Huronian and the other a system above Huronian. We invariably employ the term in its original significance of pre-Huronian and post- or upper Laurentian, including the schists holding the coarse granite veins carrying merchantable mica.

C. H. Hitchcock in 1896 (Jour. Geol.) continued to use *Montalban* instead of *White Mtn series*, as did M. Billings (1928).

This term seems to be no longer used. On 1932 geol. map of U. S. the rocks of the White Mtns are mapped as pre-Camb. over large areas, but other large areas are mapped as Carbf. and Sil. intrusives. M. Billings (Sci., Jan. 19, 1934, pp. 55–56) now, however, doubts presence of any pre-Camb. rocks in N. H. See his *White Mtn magma series*, which he assigned to late Dev. or late Carbf.

White Mountain magma series.

Late Devonian or late Carboniferous: Central and northern New Hampshire.

M. Billings, 1934 (Sci., Jan. 19, vol. 79, No. 2038, pp. 55–56). [See under *Highland Croft magma series.*]

M. P. Billings and C. R. Williams, 1935 (Geology of Franconia quad., N. H., pp. 11, 21, map). *White Mtn magma series* includes a group of volcanic and intrusive igneous rocks with definite mineralogical peculiarities. Distinctly younger than New Hampshire magma series and abundant in Franconia, Crawford Notch, North Conway, Mount Chocorua, Percy, and Mount Washington quads., as well as Red Hill, Ossipee Mtns, and Belknap Mtns. Includes both intrusive and extrusive phases, the latter being called *Moat volcanics.* In Franconia quad. it includes, besides Moat volcanics, diorite, quartz diorite, syenite, Mount Lafayette granite porphyry, Mount Garfield porphyritic quartz syenite, and Mount Osceola and Conway granites, named in ascending order of age. Age is late Dev. or late Carbf.

M. Billings, 1935 (letter dated July 19). "There is no one type loc. for *White Mtn magma series.* It refers to a group of comagmatic igneous rocks that are exposed all over central and northern N. H. If there must be a type loc. it would be the North Conway quad."

M. P. Billings, 1935 (Geology of Littleton and Moosilauke quads., N. H., p. 28 and Moosilauke map). In Littleton and Moosilauke quads. the Landaff granite and certain dikes and sills are related to White Mtn magma series. [For fms. included see N. H. correlation chart.]

D. Modell, 1936 (Geol. Soc. Am. Bull., vol. 47, pp. 1895–1931). The chronology of *White Mtn magma series* in Belknap Mtns, N. H., is as follows (ascending): Moat volcanics, Gilford gabbro, Endicott diorite, Ames monzodiorite, Gilmanton monzodiorite, Belknap syenite, Sawyer quartz syenite, Lake quartz syenite, Albany quartz syenite, Conway granite, and Rowes vent-aggl.

Whitemud formation.

Upper Cretaceous: Saskatchewan.

N. B. Davis, 1918 (Canada Dept. Mines, Mines Branch, Rept. clay resources southern Saskatchewan, p. 9). Assigned to Eo. Included in Fort Union beds.

All subsequent repts, by several other authors, assign this fm. to Cret.

Whiteoak sandstone.

A name applied by E. O. Ulrich (12th Int. Geol. Cong., Canada, 1913, advance copy, pp. 16, 48, and chart, =pp. 614, 651, and chart of Compte rendu, 1914) to the ss. which he called *Whiteoak Mtn ss.* in description of map 7, on p. 666 of latter publication. On p. 614 he stated Whiteoak ss. of Tenn. corresponds to lower part of upper Medina of N. Y. On p. 651 he stated: "The post-Richmond hiatus in Ohio represents *White-oak ss.* (400 ft. thick) plus a part or all of the smaller hiatus which separates this ss. from underlying Sequatchie fm. (=Queenston of N. Y., Juniata of Pa., and Richmond of Ind. and Ohio)." His chart placed *Whiteoak ss.* opp. Albion of N. Y. and Tuscarora ss. of Pa.

White Oak sand.

Drillers' name for a sand, of Lower Ord. age, that outcrops on White Oak Creek, Estill Co., Ky

White Oak Mountain sandstone.

Silurian: Southeastern Tennessee and northwestern Georgia.

N. Sayler, 1866 (Geol. map of Tenn.). *Clinch and White Oak Mtn ss. and sh.*; 800 to 1,000 ft.; of Medina age. Underlies Dyestone and overlies Nashville group.

J. M. Safford, 1869 (Geol. Tenn., pp. 151, 161, 299–302). *White Oak Mtn ss.*—Variegated sss. with some sh. Thickness 500 ft. in Tenn.; at least 600 ft. in gap at Ringgold, Ga. The sss. are mostly fine-grained, thin- and even-bedded, sometimes thick-bedded, fossiliferous, generally reddish brown but also greenish gray, buff, and other colors; some layers highly ferruginous. Shales are reddish brown, pale green, and other colors, alternating in beds of various thicknesses with the sss. Not observed either E. or W. of belt including White Oak and its spurs. Underlies Dyestone group, and overlies Clinch Mtn ss. Included in Niagara group.

Included in Rockwood fm. of C. W. Hayes, in U. S. G. S. Ringgold folio, No. 2, 1894. Probably corresponds to Rockwood ss. memb. of Rockwood fm. of Ringgold folio, a name that has been discarded.

See also *Whiteoak ss.*

Named for White Oak Mtn, James and Bradley Counties, Tenn.

White Pine shale.

Mississippian (lower and middle): Northern Nevada and eastern California (Inyo County).

A. Hague, 1883 (U. S. G. S. 3d Ann. Rept., pp. 253, 266–267). *White Pine sh.*—Black argill. shales, more or less aren., with intercalations of red and reddish-brown friable ss., changing rapidly with locality. Plant impressions. Thickness 2,000 ft. Conformably overlies Nevada ls. and is overlain by Diamond Peak qtzite. Named for exposures in White Pine mining dist. [now known as Hamilton], White Pine Co., Nev.

This fm., with a thickness of 1,000 ft., has been identified by E. Kirk (U. S. G. S. P. P. 110, 1918) in Inyo Range of eastern Calif.

White Prairie d'Ane clay.

See under *Prairie d'Ane clay.*

White Ranch limestone. (In Graham formation.)

Pennsylvanian: Central Texas (McCulloch County).

F. M. Bullard and R. H. Cuyler, 1936 (Tex. Univ. Bull. 3501, pp. 197, 222). Varying from 35 to 45 ft. above base of Bluff Creek sh. memb. of Graham fm. is a persistent and distinctive impure reddish-brown ferruginous ls. 2 to 3½ ft. thick, that proved to be quite persistent and valuable in both geol. and structural mapping. It is here designated *White Ranch ls.*, after the White ranch, on which it is typically exposed along W. side of Bluff Creek. It is separated from overlying Bunger ls. memb. of Graham fm. by a sh. bed, 15 to 20 ft. thick, of same general character as sh. bed underlying White Ranch ls. [to which they, in detailed section on p. 222, restrict the name *Bluff Creek sh.*, but on other pages they designate the sh. separating Bunger ls. from the younger Gunsight ls. as *Upper Bluff Creek sh.*, and the sh. underlying White Ranch ls. as *Lower Bluff Creek sh.*]

White Raven quartz monzonite.

Eocene: Central northern Colorado (Boulder County).

P. G. Worcester, 1921 (Colo. Geol. Surv. Bull. 21, pp. 33–34). There are 22 dikes of this rock (*White Raven quartz monzonite porphyry*) in Ward region, nearly all of them btw. Sunset and Sunnyside and northward, in a belt less than 2 mi. wide, to Ward. Named for White Raven mine.

White Ridge limestone member.

Middle Devonian: Northwestern Montana.

C. F. Deiss, 1933 (Mont. Bur. Mines and Geol. Mem. 6, pp. 42 and passim). *White Ridge ls. memb.*—Basal memb. of Jefferson ls. Rests uncon. on Devils Glen dol. (Camb.) and underlies Glenn Creek sh. memb. of Jefferson ls. Thickest (150 ft.) on Gordon Mtn; thinnest (50 ft.) on Spotted Mtn. Has no one distinguishing characteristic, but varies considerably in composition at different places, being buff shaly aren. ls. on Pentagon Mtn, Monitor Mtn, and Wall Creek-Juliet Creek Ridge; changing until it is massive white-gray sandy siliceous ls. on Nannie Basin Ridge, Gordon Mtn, and Spotted Bear Mtn. Named for White Ridge. Forms lower part of slope above saddle on S. side of peak forming W. end of White Ridge, in S½ sec. 16, T. 22 N., R. 11 W. On White Ridge it is 63 ft. thick and consists of 39 ft. of massive brown thin-bedded argill. fine-grained ls. that weathers to shaly light gray-buff fragments; underlain by 24 ft. of thin-bedded steel-gray calc. ss. that weathers drab, gray-buff.

White Rim sandstone member (of Cutler formation).

Permian: Southeastern Utah.

A. A. Baker and J. B. Reeside, Jr., 1929 (A. A. P. G. Bull., vol. 13, No. 11, pp. 1444 and 1445, also 1423, 1425, 1436, 1446). *White Rim ss. memb. of Cutler fm.*—White ss., 0 to 100± ft. thick, at top of Cutler fm. in Moab region and adjacent areas of SE. Utah. Exposed in escarpment, btw. Green and Colorado Rivers, known as the White Rim. In earlier repts called De Chelly (?) ss.

White River group (also **White River formation**).

Oligocene (upper, middle, and lower): Wyoming, North Dakota, South Dakota, eastern Montana, Nebraska, northeastern Colorado.

F. B. Meek and F. V. Hayden, 1858 (Phila. Acad. Nat. Sci. Proc. 1857, vol. 9, pp. 119, 133). *White River* (Mio.) deposits in places crown summits of hills on E. side of the Missouri near mouth of White River. The *Titanotherium* bed of White River Basin is oldest memb. We have no evidence that any Tert. deposits now known in Nebr. are older than Mio.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc., vol. 13, pp. 433, 434). *White River group.*—White and light-drab clays with some ss. beds and local layers of ls. Thickness 1,000+ ft. Fossils contain no brackish-water or marine forms. Occurs on Bad Lands of White River, on Niobrara, and across the country to the Platte. Overlies Fort Union group on North Platte River above Fort Laramie. [No Fort Union fm. is now recognized in vicinity of Fort Laramie, Goshen Co., Wyo. To E. of Fort Laramie the White River group rests on Lance fm., but to NW., in parts of Converse and Niobrara Counties, Wyo., the Fort Union fm. underlies the White River.] Underlies Loup Fork beds (Plio.).

F. B. Meek, 1876 (U. S. Geol. and Geog. Surv. Terr. Mon. 9, pp. lxi–lxiv). *White River group.*—Most interesting fm. because of great numbers and fine state of preservation of mammalian and chelonian remains. No marine or brackish-water remains have been found in it. It is evidently an extensive fresh-water lacustrine deposit. Spreads out over extensive space S. of Black Hills in Nebr. and extends into Colo., NW. corner of Kans., narrowing rapidly southward after passing into those States. Overlies Fort Union group uncon. and underlies Plio. lake deposit on Loup River and at other places in Nebr., the latter filling depressions in White River group.

In many areas is treated as a *group*, divided into Brule clay (above) and Chadron ss. (below). Where not divided is called *White River fm.*

†White River limestone.

Lower Ordovician: Southwestern Missouri.

A. Winslow, 1894 (Mo. Geol. Surv. vol. 6, pp. 331, 338–340). *White River ls.*—Mag. lss. and interbedded sss., 375 or more ft. thick, comprising all of Ozark series in SW. Mo. Overlain uncon. by Lower Carbf.

The 1926 geol. map of Mo. shows that the rocks along White River in southern Mo. consist of Jefferson City, Cotter, and Powell.

Named for White River, SW. Mo.

†White River limestone.

A name applied in some early Ind. repts to Spergen ls. (Mississippian), which has been quarried on White River and sold under trade name of "White River stone."

Whiterock quartzite.

Cambrian or pre-Cambrian: Nova Scotia.

E. R. Faribault, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 336).

White Rock moraine.

Pleistocene (Wisconsin stage): Northeastern Illinois. See M. M. Leighton, 1932 (16th Int. Geol. Cong. Guidebook 26, p. 48, pl. 2).

Whiterock Bluff shale member (of Santa Margarita formation).

Miocene (upper): Southern California (Cuyama Valley).

W. A. English, 1916 (U. S. G. S. Bull. 621, pp. 191–215). *Whiterock Bluff sh. memb.*—Middle memb. of Santa Margarita fm. Conformably overlies Redrock

Canyon ss. memb. of Santa Margarita fm. and is uncon. overlain by Morales memb. of Santa Margarita. Near Whiterock Bluff, on N. side of Cuyama Valley, it consists of not less than 1,500 ft. of white "chalky" diatomaceous sh., which rests (uncon., it is believed) on Monterey group. On S. side of Cuyama Valley it consists of interbedded white clay sh., diatomaceous sh., and ss., and apparently grades into underlying ss. and sh. beds mapped as *Maricopa sh.*, the line of separation being drawn at lowest horizon at which Santa Margarita echinoderms occur. Three zones of white ss. and two zones of sh. are present, aggregating 2,000 to 2,500 ft., of which about one third is sh.

White Sage formation.

Tertiary (Eocene?): Western Utah (Gold Hill district).

T. B. Nolan, 1935 (U. S. G. S. P. P. 177). *White Sage fm.*—Fresh-water, rather impure, very fine-grained lss., generally brownish, with basal cgl., 1 to 50 ft. thick, containing pebbles of Penn. and Perm. rocks. Is everywhere uncon. overlain by lava or recent gravels. Occurs only in NW. part of Gold Hill quad. Rests on Triassic, Perm., and Penn. rocks. Few fossils; of probable Eo. age. May correspond to Wasatch or Green River fm. to E., both of which are said by Reeside to contain identical lss. Named for White Sage Flat (Gold Hill quad.), which is just W. of most southerly outcrops of the fm.

Whites Bend limestone.

Silurian (Niagaran): Western Tennessee.

A. F. Foerste, 1901 (Geol. Soc. Am. Bull., vol. 12, pp. 397, 402). *Whites Bend ls.*—Overlies South Tunnel bed (Osgood shaly clay) and underlies Newsom (Waldron) shaly clay in Tenn. Same as Laurel ls. of Ind. Included in Clifton ls. and also in Centerville ls. Thickness 0 to 24½ ft.

Named for Whites Bend, Davidson Co.

Whitesburg limestone. (In Blount group.)

Lower Ordovician (Chazy): Northeastern Tennessee and western Virginia.

E. O. Ulrich, 1924 (Tenn. Dept. Ed., Div. Geol., Bull. 28, p. 34, and Bull. 31, p. 16). [*Whitesburg ls.* shown in table as 50 to 600 ft. thick, underlying Athens sh., and uncon. overlying Lenoir ls. in Athens trough of Tenn., and as younger than Holston marble. Type loc. not stated.]

E. O. Ulrich, 1930 (U. S. Nat. Mus. Proc., vol. 76, art. 21, p. 2). The term *Whitesburg ls.* has been used by me for many years and is now formally proposed for the dark crystalline ls. that at many places in Appalachian Valley S. of Staunton, Va., underlies the dark calc. Athens sh. or ls. At most places it rests on Lenoir ls., but at Lexington and in the belt that runs along W. base of Walker Mtn just E. of Bland, Va., the Holston marble lies btw. the Whitesburg and the Lenoir. Type loc. is at and particularly 2 mi. SE. of Whitesburg [Hamblen Co.], Tenn., and 1½ mi. SW. of Bulls Gap, Tenn. At latter place it is 500± ft. thick and rests on Lenoir. NW. of Whitesburg the fm. pinches out completely in 2 mi. Its fauna (distinctive) aggregates about 100 sp.

Whiteside granite.

Late Carboniferous (?): Northwestern South Carolina and western North Carolina.

A. Keith, 1907 (U. S. G. S. Pisgah folio, No. 147, p. 4). *Whiteside granite.*—Composed mainly of orthoclase and plagioclase feldspar, quartz, muscovite, and biotite, enumerated in order of importance. Mostly of fine or medium grain. One variety is marked by a decided flow banding. Intrusive into all rocks in which it comes in contact except Triassic diabase.

Named for development in cliffs of Whiteside Mtn, Jackson Co., N. C., in Cowee quad.

White Spot sandstone.

Lower Cambrian: Southeastern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, pp. 165, 166). *White Spot ss.*, at Reading. Same as Chiques ss. At the White Spot on mtn behind Reading it has been famous since early settlement of Great Valley.

Whitetail conglomerate.

Tertiary: Central Arizona (Globe region).

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Whitetail fm.*—Fluviatile deposit, usually composed of rather angular fragments of diabase and ls. Older than Gila cgl. and younger than Globe ls.

Named for exposures in Whitetail Gulch and Whitetail Spring, Globe quad.

†White Wall sandstone.

Jurassic (?): Southeastern Utah (San Juan County).

B. S. Butler, 1920 (U. S. G. S. P. P. 111, p. 619). In Abajo (Blue) Mtns, San Juan Co., Utah, M. R. Thorpe has described (unpublished ms.) the *White Wall ss.*, 300 to 400 ft. thick, as underlying McElmo fm. and overlying 75 to 100 ft. of shales and sss. which separate it from Vermilion Cliff ss.

A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, chart opp. p. 36), show this ss. to be Navajo ss.

Whitewater formation. (In Richmond group.)

Upper Ordovician: Southeastern Indiana and southwestern Ohio.

J. M. Nickles, 1903 (Am. Geol., vol. 32, pp. 208, 218). *Whitewater or Homotrypa wortheni beds.*—Thin-bedded ls. and sh., usually brownish or yellowish but at some localities bluish, presenting roughish concretionary, nodular appearance. Thickness 45 to 50 ft. Underlain by Liberty or *Strophomena planumbona* beds and overlain by Madison [Saluda] fm., all included in Richmond group.

Some more recent repts describe *Saluda* as a wedge in lower part of Whitewater fm. (see *Saluda ls.*), and define *Whitewater* as resting on Liberty fm., but most geologists, including U. S. Geol. Survey, still treat the Saluda deposits as a distinct fm.

J. J. Wolford, 1930 (Ohio Jour. Sci., vol. 30, No. 5, p. 304). Base of Turkey Track ls. layer has been designated by Dr. Geo. M. Austin as plane of division btw. Whitewater and Liberty fms. in SW. Ohio.

Named for Whitewater River, at Richmond, Ind.

Whitewater series.

Pre-Cambrian (Huronian): Ontario.

W. H. Collins, 1913 (12th Int. Geol. Cong., Canada, advance copy, pp. 5, 7).

Whitewater Creek rhyolite.

Tertiary: Mogollon district, New Mexico.

H. G. Ferguson, 1927 (U. S. G. S. Bull. 787). Light purple; breaks with platy fracture. Several flows and beds of white tuff mark periods of explosive activity. Thickness 700± ft. Oldest fm. in dist.

Named for exposures in steep canyons along lower reaches of Whitewater and Mineral Creeks, Mogollon dist.

Whitewood limestone.

Upper Ordovician (pre-Richmond): Western South Dakota and northeastern Wyoming.

N. H. Darton, 1904 (Geol. Soc. Am. Bull., vol. 15, p. 383). *Whitewood ls.*—Massive buff ls., 0 to 80 ft. thick, of Ord. age, underlying Englewood ls. and overlying Deadwood fm. in Black Hills uplift.

Named for exposures in Whitewood Canyon, below Deadwood, S. Dak. See 1936 entry under *Deadwood fm.*, for suggested redefinition.

Whitian series.

A term used by C. [R.] Keyes instead of *White River group* of other geologists.

Whiting sand.

A subsurface sand, of Penn. age, in central northern Okla., which is correlated with Cleveland sand and with part of Nowata sh.

Whitingham schist.

Upper Cambrian (?): Southeastern Vermont (Windham County).

Geo. D. Hubbard, 1924 (14th Rept. Vt. State Geol., pp. 276–278 and map). *Whitingham schist.*—Quartz-biotite schist with calcite; nearly half the rock is quartz in small even grains, and nearly half is even-grained biotite. Calcite occurs in crystals in many parts of the rock. Is believed to be of sed. origin. Thickness 40 to more than 100 ft. Immediately overlies Sherman marble, with gradation from the marble to the schist through several ft. of rock. Underlies Heartwellville schist, into which it passes through a transition zone 5 to 20 ft. thick. Assigned to Ord. through correlation of associated fms. with those of Mass.

Named for exposures in Whitingham Twp. Windham Co.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned this fm. to Upper Camb., but without discussion.

Whitlash sands.

Three sands called *Whitlash* have been recognized in Blackleaf sandy memb. of Colorado sh. in Whitlash dome, central northern Mont., as follows: (1) *First Whitlash sand* (10 to 40 ft. thick), lying 430 ft. below top of the Blackleaf; (2) *Second Whitlash sand* (5 to 40 ft. thick), lying 220± ft. lower; and (3) *Third Whitlash sand* (0 to 35 ft. thick), lying 100± ft. lower.

Whitmores Ferry amphibolite.

Name applied by B. K. Emerson (U. S. G. S. Mon. 29, 1898, pp. 190, 194) to a bed of dark amphibolite that crops out in midst of Triassic shales at Whitmores Ferry, in North Sunderland, Old Hampshire Co., Mass.

Whitney sand.

A subsurface sand, of Perm. age and 10 ft. thick, in central northern Okla. In Garber pool, Garfield Co., it is reported to lie at 800 ft. depth, the Kisner sand at 700 ft., and the Hoy sand at 1,100 ft.

Whitsett limestone lentils (in Myrtle formation).

Lower Cretaceous: Southwestern Oregon (Roseburg quadrangle).

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Whitsett ls. lentils.*—Variegated gray and red foraminiferal ls. and marble interbedded in Myrtle fm. One of lentils, 60 ft. thick, occurs near J. H. Whitsett's, secs. 14 and 15, T. 28 S., R. 5 W.

†Whitsett beds.

Oligocene (?) and Eocene: Southwestern Texas coastal plain.

E. T. Dumble, 1924 (A. A. P. G. Bull., vol. 8, pp. 424–436). *Whitsett beds.*—Greenish-gray and yellow waxy or carbonaceous clays and sandy clays, with some of chocolate color, interbedded with yellow, gray, pink, and brown sands; beds of volcanic ash occur. The fm. is characterized by opalized wood and chalcedony; aragonite is common; dark septarial concretions occur throughout. Uncon. underlie Frio group and uncon. overlie and overlap true Fayette ss., but were included in Fayette ss. as defined by writer. [These beds were included in Frio clay as mapped by A. Deussen in U. S. G. S. P. P. 126.]

Exposed S. of town of Whitsett, Live Oak Co., southern Tex., but town is built on Fayette ss.

This name was in 1929 discarded by U. S. Geol. Survey for its publications, the upper part having been included in Frio clay as mapped by Deussen in U. S. G. S. P. P. 126, and the lower part being the upper part of Fayette ss. (See J. Gardner and A. C. Trowbridge, A. A. P. G. Bull., vol. 15, 1931, No. 4, p. 470.)

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 680, 685, 686–687, 694, 695, 696). *Whitsett memb.*—Upper memb. of Fayette fm. (Jackson Eocene). Definitely limited at base by top of McElroy or Lipan memb. of Fayette and overlain by

Frio or Catahoula fms. [He restricted McElroy memb. to eastern Tex. and Lipan memb. to central and southern Tex.]

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, pp. 1310+). *Whitsett fm.*—Upper third of Jackson group. Includes all beds from top of Manning beds of McElroy fm. to base of Frio; therefore it includes Lipan beds and overlying Whitsett beds of Dumble. Unfortunately Dumble did not give type loc. for his Whitsett beds. The section he described in 1902, in bluff 90 ft. high on E. bank of Atascosa River, near Whitsett's house in sec. 48, Reiffert & Forbese 109-acre tract of Juan Houligan survey, is included within Whitsett fm. (in Dubose zone) as is here used, and is selected by writer for type loc. of Whitsett fm. The fm. varies in lithologic character across the State, and can be divided on the surface into lithologic as well as paleontologic zones. In SW. Tex. these zones have been named (descending): Olmos sand, Fashing clays, Calliham sand, Dubose sands and sh., Stone's Switch sand, Falls City sh., and Dilworth sand. In E. Tex. the zones below Calliham sand have been named *Glendale beds, Mitchell's Ferry beds,* and *Dilworth sand.* Jackson group of southern Tex. is here divided into (descending) Whitsett fm., McElroy fm., and Cadell fm., which are=Fayette fm. of U. S. Geol. Survey.

A. Deussen, 1934. [See Deussen 1934 entry under *Fayette ss.*]

A. Deussen and E. W. K. Andrau, 1936. [See 1936 entry under *Fayette ss.*]

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17 and pp. 43–55), restricted *Whitsett fm.* to beds above his expanded Manning fm. and below Catahoula ss., and defined it as consisting of 75 to 132 ft. of cross-bedded sand and ss. interbedded with some tuffaceous sh. and containing opalized logs and fossil leaves. In Brazos Co. contains fine sandy tuff beds. Is mostly nonmarine but contains a few marine lentils in Fayette and Gonzales Counties. His restricted Whitsett fm. is placed 0 to 25 ft. above his Yuma ss., which he states may possibly be same as Dilworth sand of Ellisor, but which he places 25 to 40 ft. above the Dilworth. Ellisor treated Dilworth sand as basal memb. of Whitsett.

A. C. Ellisor, 1936 (Gulf coast oil fields, A. A. P. G., pp. 475, 487), continued to apply *Whitsett fm.* to all beds from base of Dilworth sand up to base of the Vicksburg, and divided it into (descending) Olmos sand, Fashing clays, Calliham sand, Dubose sands and clays, Stone's Switch sand, Falls City shales, and Dilworth sand.

Whittlesey.

Name applied to a glacial lake, of Pleist. age, in Great Lakes region. (See U. S. G. S. Mon. 53, 1915, p. 469.)

Whitwell shale. (In Lee group.)

Pennsylvanian (lower Pottsville): Central Tennessee.

C. Butts and W. A. Nelson, 1925 (Tenn. Geol. Surv. Bull. 33D, pl. 4 and p. 7). *Whitwell sh.*—Dark-colored sh., partly clayey and partly sandy, containing some thin ss. layers, and two, possibly three, coal beds, including Sewanee coal at base. Thickness 75 to 100 ft. Overlies Sewanee cgl. Underlies Bonair ss. Named for Whitwell mines near Whitwell, Marion Co., where the main Sewanee coal has long been mined.

W. A. Nelson (Tenn. Geol. Surv. Bull. 33A, pp. 48, 49, 1925) gave thickness of 50 to 175 ft., and on p. 25 of Bull. 33C a thickness of 0 to 70 ft. in Herbert Domain.

†Whyte formation.

Lower Cambrian: Alberta.

C. D. Walcott, 1908 (Canadian Alpine Jour., vol. 1, pp. 240–242). Lower Camb. of Mount Stephen divided into *Whyte fm.* (above) and St. Piran fm. (below). The Whyte fm. consists of (descending): (1) Thin-bedded bluish-black and gray fossiliferous ls., 3 ft.; (2) gray siliceous sh. with interbedded gray fossiliferous ls. in layers 5 in. to 2 ft. thick in upper part, 108 ft.; (3) thin-bedded compact, hard dark bluish-gray ls. with a little interbedded gray siliceous sh. and a few beds of coarser gray ls., 6 to 10 in. thick, 52 ft.; (4) brownish-gray qtzitic ss. in layers 2 to 4 in. thick, 32 ft.; (5) gray siliceous sh., 102 ft.; (6) bluish-black and gray ls., 18 ft. [Fossils from all members listed.] Underlies Cathedral fm. (Middle Camb.). [Derivation of name not indicated.]

C. D. Walcott, 1908 (Smithsonian Misc. Coll., vol. 53, No. 1804), applied *Mount Whyte fm.* to the Lower Camb. fm. underlying Cathedral fm. in Alberta and B. C., which is the name in current use.

Wichita formation (also **Wichita group**).

Permian (early): Northern and central Texas and western Oklahoma.

E. T. Dumble and W. F. Cummins, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. lxix and 188). *Wichita beds.*—Fossiliferous red, gray, and variegated massive and shaly sss. and sandy shales, red and bluish clays, and a peculiar cgl., the sss. and sandy shales often containing large oval concretions, the sss. often ripple-marked and in places cross-bedded. Underlie Clear Fork beds and overlie Coleman-Albany series of the Coal Measures. [Misinterpretation. See below.]

W. F. Cummins, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 361, 373, 400–402). Permian of NW. Tex. divided into (descending) Double Mtn beds, Clear Fork beds, and *Wichita beds*. The Wichita consists of sss., clay beds, and a peculiar cgl. There are no lss. from top to bottom. The sss. are of various colors; the clays are red and bluish. Iron concretions occur in the red clays. The cgl. is composed of clay, or clay ironstone, in a ferruginous matrix. The Wichita beds do not extend S. of Brazos River. They are heaviest along Big Wichita River, where they attain thickness of 2,000± ft. [In table on p. 361 the Wichita is shown as resting on "Albany beds," and the "Albany" is excluded from Perm. In table on p. 373 the Wichita of northern field (1,800 ft. thick) is shown as contemp. with "Albany beds" of central field (1,180 ft. thick), and the "Albany" is included in Perm.] "The Albany beds not occurring N. of Brazos River, the Wichita beds rest directly upon and are conformable with Cisco beds."

W. F. Cummins, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, btw. pp. 222–232), stated that Wichita "may be a different phase of the Albany."

E. T. Dumble, 1897 (Tex. Acad. Sci. Trans., vol. 2, pp. 93–98). "Wichita and Albany are simply different facies of the same beds," and they rest on Cisco fm. [This is present generally accepted opinion, and "Albany" has been discarded by U. S. Geol. Survey. In Okla. the Wichita rests on Pontotoc group.]

Some geologists include Arroyo fm. of Beede and Waite in Clear Fork group, but Beede, Waite, and Wrather include it in Wichita group. The U. S. Geol. Survey includes it in Clear Fork group. E. H. Sellards, 1933 (Univ. Tex. Bull. 3232) transferred Putnam and Moran fms. from Cisco group (Penn.) to overlying Wichita group, and this transfer has been adopted by U. S. Geol. Survey.

Named for Wichita River and Wichita Co., Tex.

†Wichita conglomerate. (In Clear Fork formation.)

Permian: Central northern Texas.

E. C. Case, 1907 (Am. Mus. Nat. Hist. Bull. 23, pp. 662–664). *Wichita cgl.*—Hard pebbly cgl., 6 in. to 1 ft. thick, nonfossiliferous, varying in color from dark to light but through most of its extent is of deep purplish-red color. Underlies massive ss., in places 100 ft. thick, of red and brilliant shades of orange, yellow, and blue colors. Overlies 20 to 30 ft. of gray and red clay filled with concretions. Included near top of Clear Fork div. of Big Wichita River region.

Named for Big Wichita River, near Seymour-Vernon road, Baylor Co.

Wichitan series.

A provincial series term applied by C. [R.] Keyes to late Carbf. rocks of Tex. region that correspond to his Oklahoman series. (See Pan-Am. Geol., vol. 49, pp. 130, 133, 1928.) In 1932 (Pan-Am. Geol., vol. 57, p. 355) he showed *Wichitan* as younger than his Oklahoman, and as covering Wichita fm. only.

Wickcliff sandstone. (In Chester group.)

Mississippian: Southern Indiana and western central Kentucky.

C. A. Malott, 1925 (Ind. Acad. Sci. Proc., vol. 34, pp. 108–132). *Wickcliff ss.*—A ss., ranging in thickness from a few ft. to max. of 35 or 40 ft., that occurs in the shales above Tar Springs ss. and below Siberia ls. in Perry and Crawford Counties, Ind., also at Buffalo Wallow, Breckinridge Co., Ky. It is usually bedded and very hard or qtzitic where its thickness is but a few ft.; where its thickness exceeds 10 or 15 ft. it is usually quite massive and often laminated or cross-bedded. Well developed along Middle Fork of Anderson Creek above Bristow to Doolittle, in Perry Co · also along Anderson Creek northward from mouth of

Sigler Creek and N. of Southern Railway and S. of Patoka River. Probably does not extend beyond Patoka River. Top lies about 35 ft. below Siberia ls., and base is separated from underlying Tar Springs ss. by sh., usually 50 to 60 ft. thick but varying in thickness from 20 to over 100 ft. Belongs to upper Chester.

Named for good exposures in ravines about Wickcliff, Crawford Co., Ind.

†Wicker formation.

Pliocene: Florida.

H. F. Osborn, 1907 (Am. Mus. Nat Hist. Bull., vol. 23, pl. opp. p. 249). [Evidently a misprint for Archer fm., because on p. 251 author uses *Archer fm.* for Plio. of Fla. Latter name is now replaced by *Alachua fm.*, the older term.]

Wickett oolitic zone.

A subsurface oil-producing zone in upper part of Trinity group (of Comanche age) of Bellevue dist., Bossier Parish, La., and Pine Island dist., Caddo Parish, La. Lies higher than Dillon oolitic zone.

Wicomico formation. (Of Columbia group.)

Pleistocene: Atlantic Coastal Plain from Delaware to Florida.

G. B. Shattuck, 1901 (Johns Hopkins Univ. Circ., vol. 20, No. 152, pp. 73–75). *Wicomico fm.*—What has just been said regarding the materials which enter into underlying Sunderland fm. applies equally well to those comprising Wicomico terrace, except that it possesses perhaps a larger proportion of sand and loam derived from its subterrane. In southern Md. the base of Wicomico terrace lies at about 40 or 50 ft., and the top, where it borders its ancient sea cliff, at about 90 ft. Wicomico River, in St. Marys and Charles Counties, suggested the name for this fm. Separated from underlying Sunderland fm. and from overlying Talbot fm. by erosion uncon. Is middle fm. of Columbia group.

G. B. Shattuck, 1902 (Md. Geol. Surv. Cecil Co. Rept., pp. 171+). *Wicomico fm.*—Clays, loam, sands, and gravels, 0 to 70± ft. thick. Terrace and off-shore deposits. Older than Talbot fm., which extends from tide to 30 or 40 ft., and younger than Sunderland fm. Occupies entire surface of Eastern Shore of Md. above 35 or 40 ft., and is developed as a terrace, usually a mile or more wide. Its limits are btw. 90 and 100 ft. and 30 and 40 ft.

C. W. Cooke, 1931 (Wash. Acad. Sci. Jour., vol. 21, Dec. 19), restricted Talbot fm. to deposits on 40-foot level (Talbot terrace), restricted *Wicomico fm.* to deposits on 100-foot level (Wicomico terrace), and recognized as a distinct fm. the deposits on 70-foot level (Penholoway terrace). The deposits on 70-foot level were not then given a distinct fm. name, but are now known as *Penholoway fm.* They have heretofore been included in Wicomico fm. to N. and in †Chowan fm. to S. These rstricted definitions have been adopted by U. S. Geol. Survey.

The terrace fms. of the Columbia group (including the Wicomico) now recognized by Cooke from Del. to southern Ga. and probably into Fla., are enumerated herein under *Columbia group.*

Widder beds.

Devonian: Ontario.

C. R. Stauffer, 1915 (Canada Geol. Surv. Mem. 34, p. 10).

Wier sand.

See *Weir sand*, the correct spelling of this subsurface sand.

Wigdon sand.

A subsurface sand, of Penn. age, in Henryetta dist., central eastern Okla., lying lower than so-called Calvin sand and higher than Oswego lime.

Wigwam formation.

Pre-Cambrian: Southern British Columbia and northwestern Montana (Galton Range).

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines, Mem. 38, maps 2, 3, 4). *Wigwam fm.*—Thin- to thick-bedded red ss. and metargillite. [Wigwam River is on map 2, and the fm. appears to be exposed on it.]

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 103, 178). Chiefly red or brownish-red sss. and metargillite, 1,200 ft. thick. Conformably underlies Siyeh fm. and overlies MacDonald fm. Named for river.

Wilbarger Creek bed. (In Strawn formation.)

Pennsylvanian: Central Texas.

N. F. Drake, 1893 (Tex. Geol. Surv. 4th Ann. Rept., pt. 1, pp. 374, 384). *Wilbarger Creek bed.*—Ss., 75 to 200 ft. thick, in places very massive. Memb. of Strawn div. Underlies Comanche Creek bed and overlies Buffalo Creek bed.

Named for Wilbarger Creek, San Saba Co.

Wilberns formation.

Upper Cambrian: Central Texas.

S. Paige, 1911 (U. S. G. S. Bull. 450, p. 23). *Wilberns fm.*—Lss. and shales, the shales occupying approx. upper third of fm., 170 to 220 ft. thick. Overlies Cap Mtn fm. and underlies Ellenburger ls. without any detected uncon.

S. Paige, 1912 (U. S. G. S. Llano-Burnet folio, No. 183). [Same definition as above. For faunal subdivisions of Wilberns fm. and Ellenburger ls. and for inconstant bdy btw. the two fms. as mapped, see C. L. Dake and J. Bridge, Geol. Soc. Am. Bull., vol. 43, pp. 725–748, 1932.]

Named for Wilberns Glen, Llano Co.

†Wilbraham gneiss.

Late Carboniferous or post-Carboniferous: Southern central Massachusetts.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, p. 116), stated that Glastonbury granite gneiss of Conn. extends into Mass. and is = *Wilbraham gneiss of Emerson.* B. K. Emerson stated (letter dated Oct. 1, 1914) he never published *Wilbraham.* Gregory is of opinion he took the name from Emerson's notebooks. Emerson (U. S. G. S. Bull. 597, 1917) mapped the extension of Glastonbury granite gneiss in Mass., across Wilbraham Twp, as *Monson granodiorite.*

Wilbur tuff lentils.

Eocene: Southwestern Oregon (Roseburg quadrangle).

J. S. Diller, 1898 (U. S. G. S. Roseburg folio, No. 49). *Wilbur tuff lentils.*—Chiefly volcanic material with some calc., siliceous, and organic sediments, interstratified with Umpqua fm. Of small thickness and extent. Occurs in patches. Been traced from 2 mi. W. of Wilbur to Calapooya, a distance of 13± mi.

R. Arnold and H. Hannibal, 1913 (Am. Phil. Soc. Proc., vol. 52). *Wilbur tuff* is a lithologic phase of the Arago.

Wilbur limestone member (of Salina formation).

Silurian: Eastern New York.

J. M. Clarke, 1903 (N. Y. State Mus. Bull. 69, pp. 855–867). *Wilbur ls.* is not = typical or Schoharie Co. Cobleskill, but its fauna carries a much stronger impress of Niagaran age. We are compelled, for purposes of correlation E. and W., to designate this bed by a distinctive term and shall call it *Wilbur ls.* Underlies waterlimes of considerable thickness [in Hdb. 19, 1903, Clarke called these *Salina waterlime*], and overlies soft gray Salina shales. [On a later page of Bull. 69 C. A. Hartnagel gave thickness of *Wilbur ls.* as 8 ft., and stated that it has also been erroneously called "Coralline ls." In that bull. it was described as dark argill. ls.]

C. A. Hartnagel, 1905 (N. Y. State Mus. Bull. 80, pp. 342–357). *Wilbur ls.*, fossiliferous band of shaly ls., underlying Rosendale cement and overlying Binnewater qtzites, all of which are included in *Salina beds.*

In 1913 (Md. Geol. Surv. Lower Dev. vol.) C. K. Swartz, C. Schuchert, and C. S. Prosser classified *Wilbur ls.* as Lower Dev.; but present N. Y. State Geol. Survey includes it in Salina (Sil.). (See W. Goldring, N. Y. State Mus. Hdb. 10, p. 343.)

Named for exposures at Wilbur, Ulster Co.

See also under *Bertie ls. memb.*

Wilbur zone.

A petroliferous zone, about 200 ft. thick, lying 1,000 ft. below top of Fernando group in Long Beach field, Los Angeles Basin, Calif.

Wilburton group.

Pennsylvanian: Kansas and Oklahoma.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). Des Moines series is divided into 2 uncon. groups, Okmulgee group (above) and *Wilburton group* (below). Latter includes McAlester fm., Hartshorne ss., and Atoka fm. and equiv. rocks in Kans., Mo., and Nebr. [Derivation of name not stated. Not used in 1932 or later classifications of R. C. Moore up to and including Kans. Geol. Surv. Bull. 22, Aug. 31, 1936.]

Wilcox group.

Eocene (lower): Gulf Coastal Plain from Georgia to southern Texas, inclusive, also southeastern Missouri, western Tennessee and Kentucky, and southwestern Illinois.

The term *Wilcox*, as the geographic name to replace the nongeographic term "Lignitic" in its typical region (Ala. and Miss.), was formally adopted by U. S. Geol. Survey March 23, 1905, in connection with repts then in preparation on geology and underground water resources of Miss. (under supervision of E. C. Eckel) and Ala. (by E. A. Smith). This name was selected after correspondence (by E. C. Eckel) with the State Geologist of Ala. (E. A. Smith), and type loc. was specifically stated in the records to be Wilcox Co., Ala., "which affords good exposures of the entire 'Lignitic' section." At the time the name *Wilcox* was adopted the Survey also had in course of preparation (by A. C. Veatch) a rept (U. S. G. S. P. P. 46) on geology and underground water resources of La. and northern Ark., and it was decided that if the author of that rept was unwilling to correlate the †Lignitic of that area with the typical †Lignitic of Ala., the name *Sabine* would be acceptable W. of Miss. River. On April 2, 1906, the mss. for U. S. G. S. W. S. P. 159 (underground water resources of Miss., by A. F. Crider and L. C. Johnson) and U. S. G. S. Bull. 283 (Geology and mineral resources of Miss., by A. F. Crider) were sent to the Govt. Ptg Office. The geol. map in both repts is by E. C. Eckel and A. F. Crider. The bulletin contains an introduction by Eckel and the W. S. P. states that the work was under the supervision of Eckel and M. L. Fuller.

The W. S. P. was completed and delivered Aug. 20, 1906, and the Bull. was delivered Sept. 25, 1906. E. A. Smith's rept was published by Ala. Geol. Surv. in 1907.

A. F. Crider and L. C. Johnson, 1906 (U. S. G. S. W. S. P. 159, pp. 5, 9). *Wilcox fm.*—called Lignitic by Hilgard, but that is not a locality name. Has also been called LaGrange, but LaGrange of Safford included present Lafayette and portions of the Cret. and has been discarded. The name Wilcox was first given in some unpublished work by E. A. Smith, State Geologist of Ala., for reason that typical strata of former Lignitic of Hilgard are exposed at Wilcox, Ala. [This is a misapprehension, because the U. S. G. S. records distinctly state that the fm. was named for Wilcox Co.] The name has been adopted by U. S. Geol. Survey to include the complex mass of sands, clays, lignites, marls, etc., btw. Porters Creek clays below and Tallahatta buhrstone (of Claiborne group) above. Thickness (est. from width of outcrop) 750 to 800 ft. [The records of U. S. Geol. Survey do not contain any reference to a town of Wilcox, Ala., but specifically state that the type loc. is Wilcox Co. The 1918 and 1931 Rand McNally atlases, however, show a small town of that name in Conecuh Co. (S. of Wilcox Co.), about 1 mi. NE. of Gregville, but it is on Citronelle fm. (Plio.) of 1926 Ala. geol. map.]

A. F. Crider, 1906 (U. S. G. S. Bull. 283, pp. 7, 25–28). *Wilcox fm.*—Originally named *Lignitic* by Hilgard and termed *Lagrange* by Safford. A recent decision of the committee on nomenclature of the United States Geological Survey has substituted the name *Wilcox*, which is that of a locality in Alabama where the fm. is typically exposed. [Defined by Crider as underlying Tallahatta buhrstone of Claiborne group and overlying Porters Creek clay (of Midway group).]

Since its introduction the name *Wilcox* has been the generally accepted designation for the deposits overlying the Midway and underlying the Claiborne in the Gulf Coastal Plain, and has been used in more than 100 repts.

H. V. Howe, 1933 (A. A. P. G. Bull., vol. 17, No. 6, pp. 617–621), proposed the revival of *Sabine group* and the abandonment of *Wilcox group*.

A. F. Crider, 1933 (A. A. P. G. Bull., vol. 17, pp. 654–655). Dr. Howe has pointed out two objections to use of *Wilcox*. These are (1) lack of priority, and (2) better type loc. of Sabine. In Wilcox Co., Ala., the present type loc. for what has been called "Lignitic" by Hilgard and Smith, the entire Wilcox group as then known is exposed. Veatch recognized the type section in Ala. as being all that could be wished for and admitted the Sabine section occupies same relative position as Ala. section. The faunal assemblage of the Lignitic was well known, and he added nothing new to this phase of the fm., and there was nothing new added to the near-shore deposits. All that Veatch ever claimed for the name *Sabine* was that it was same as the old term *Lignitic*. My description of type section of the Wilcox may not have been as clear and complete as it should have been, but it was not the fault of the type loc. It does not seem justifiable, at this late date, to change the name of Wilcox to Sabine because of better type loc. of latter. Recent drill cores, far down the dip from the outcrop of the Wilcox, show that only a small part of the Wilcox is exposed at surface from Ala. to Tex. Approx. 1,700 ft. of Wilcox has been recognized in a well in southern Ala. and in wells drilled far down the dip of Sabine uplift, while Veatch places thickness of fm. at his type loc. as only 900 ft. New beds come in down the dip from the outcrop, so that the Wilcox, far down the dip, differs more from what it is at Veatch's type loc. than the original Lignitic in Ala. differs from Veatch's type loc. of the Sabine in La. In all of the literature since 1906 the type loc. of the Wilcox has been referred to Wilcox Co., Ala. There has been no confusion in minds of geologic writers on this point. If the question of substitution of name *Sabine* for *Wilcox* is to be considered at this late date, after the name Wilcox has been in general use in the literature of all the States where the fm. is exposed at the surface, in U. S. G. S. publications and in foreign publications, let it be on priority alone and not because of better type loc. of Sabine.

In Ala., Miss., western Tenn., western Ky., and southern Ill. the Wilcox deposits are now treated as a group. In Ala. they are divided into (descending) Hatchetigbee, Bashi, Tuscahoma, Nanafalia, and Ackerman fms. The 1926 geol. map of Ala. shows that the Hatchetigbee, Bashi, Tuscahoma, and Nanafalia fms. are all present in Wilcox Co. The Ackerman fm. of Miss. has been identified by C. W. Cooke as extending a short distance into Ala. In Miss. the Wilcox is divided into (descending) Hatchetigbee (to E. and contemp. Grenada to N.), Bashi, Holly Springs, and Ackerman fms. In SW. Tex. the deposits formerly assigned to the Wilcox have been divided into (descending) Bigford, Carrizo, and Indio fms., but the Bigford and Carrizo are now generally assigned to Claiborne group. In western Tenn. and Ky. the Wilcox group is represented by Grenada fm. and Holly Springs sand. The Wilcox contains deposits of both marine and nonmarine origin. The following thicknesses of Wilcox group have been given: Ala., 609 ft.; Miss., 1,435 ft.; western Tenn., 600± ft.; La., 1,000 ft.; Tex., 950 to 3,000 ft. (in wells). The name *Wilcox group* is the well-established name of this geol. unit, having been used in more than 100 repts on the Coastal Plain States, while *Sabine* has been used in only 9 repts (the last in 1920), and in 1920 the name was adopted by the Canadians for a Camb. fm. of B. C.

See also under †*Sabine fm.*

Named for extensive development in Wilcox Co., Ala. See 1926 geol. map of Ala.

Wilcox sand.

A term that has been variously applied to subsurface Ord. sands in Okla. said by some geologists to lie in approx. position of Tyner fm. and by other geologists to lie in upper part of Simpson fm. In U. S. G. S. Tahlequah folio (No. 122) the sand was included in upper part of typical Tyner fm. as mapped. It was named for H. F. Wilcox, who drilled the first well to it in a pool about 6 mi. W. of Beggs, in NW. part of Okmulgee Co. The Wilcox pool was named for the sand. The terms "First Wilcox sand" and "Second Wilcox sand" have also been applied to sands in approx. this strat. position. It was originally called "deep sand."

Wildcat series.

Pliocene: Northern California (Humboldt County, along the coast to Eureka).

A. C. Lawson, 1894 (Calif. Univ. Pub., Dept. Geol. Bull., vol. 1, pp. 255–263). *Wildcat series.*—Evenly bedded yellow and brown clays, silty clay shales, sandy clays, argill. sands, compact yellow sss., and pebbly cgls., 4,000 ft. thick. Contain Plio. fossils and are correlated with Merced fm. The region occupied by the terrane is commonly known to the people of Humboldt Co. as the "Wild-cat Country." Occupies large part of Humboldt Co. to N. of Bear River Ridge and E. of Humboldt Bay, and is also doubtless extensively developed in coastal region N. of Eureka.

†Wild Cat coquinite.

Upper Devonian or Miss.: Northwestern Pennsylvania (McKean County).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). Oswayo sh. memb. of Riceville fm. [restricted], Dev., includes *Wild Cat coquinite.* [All.]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, p. 61), replaced his *Wild Cat coquinite* with *Roystone coquinite memb.*, which he excluded from Oswayo sh. memb. On p. 97 he stated that *Roystone coquinite zone* is well shown on Wild Cat Creek at Ludlow, McKean Co., Pa. Assigned to Dev.

The U. S. Geol. Survey classifies Oswayo fm. as Dev. or Carbf.

Wild Cat Mountain conglomerate.

Pennsylvanian: Southeastern Kentucky.

C. J. Norwood, 1877 (Ky. Geol. Surv., 2d ser., vol. 2, pt. 6, btw. pp. 201 and 243). *Wild Cat Mountain cgl.*—Soft, disintegrating pink, drab, and light-colored conglomerated ss., 20 to 120+ ft. thick. Forms top of Wild Cat Mtn and extends to hills around London, which it covers.

Wildhorse limestone. (In Nelagoney formation.)

Pennsylvanian: Central northern Oklahoma (Osage County).

F. C. Greene, 1918 (A. A. P. G. Bull., vol. 2, pp. 121–122). *Wild Horse ls.*—Most conspicuous outcrop is in W. half of T. 22 N., R. 10 E., and it forms a good marker in well logs around Hominy, where it is 5 to 40 ft. thick. North of T. 23 N. it is either very thin or absent, although its position is indicated by a massive ss. which is believed to be that exposed at Quapaw. In many places the base of this sand is extremely coarse, containing pebbles up to ¼ in. diam. The section above Quapaw ss. contains no well-marked beds for about 200 ft. Assigned to Penn. Lies about 220 ft. below Rock Creek ls. and from 80 to 125 ft. above Bull Creek ls. in eastern Osage Co. [Type loc. not stated.]

H. T. Beckwith, 1928 (Okla. Geol. Surv. Bull. 40T, p. 24). *Wildhorse ls. (lentil) memb.*—Yellowish to light-gray very fossiliferous ls., sandy and rather soft where thin, but a hard, nearly pure ls. in its thickest part. Thickness 1 ft. or less at N. end of its outcrop to 20 ft. in thickest part. Most of following data obtained from R. H. Wood (personal communication): Its most northerly outcrop is in the shales btw. top of Bigheart ss. and base of Fourmile sss. in sec. 27, T. 23 N., R. 10 E., where it occurs as a thin yellowish sandy ls. Thickens rapidly to S. to 20 ft. in cliff-like escarpments on each side of Hominy Creek Valley in NW. part of T. 22 N., R. 10 E. To S., in T. 21 N., R. 10 E., it thins, becomes very sandy locally, and finally disappears or merges with overlying sss. Near N. end of its outcrop it lies 30 to 50 ft. below top of overlying shales. To S., as it thickens, the overlying shales gradually pinch out, and in T. 22 N., R. 10 E., the overlying sss. lie close to or directly upon the ls. Included in Nelagoney fm. It is possible it lies at nearly same horizon as Labadie ls.

Wildhorse sandstone.

Permian: Central southern Oklahoma (Garvin and Carter Counties).

E. R. Brockway and H. J. Owens, 1923 (Univ. Okla. Bull., n. s., No. 271, pp. 95-96). The *Wildhorse ss.* makes a ridge on N. side of and parallel with Wildhorse Creek in R. 1 W. [Garvin Co.]. West of that the ss. curves around the mtns to SW., with one irregularity, namely, a large nose is folded in it extending westward toward town of Tatums [Carter Co.]. Assigned to Perm.

Wildhorse formation.

Pleistocene: Southeastern Oregon.

W. D. Smith, 1926 (Oreg. Univ. Commonwealth Rev., vol. 8, pp. 207-214). *Wildhorse fm.*—Glacial morainal material, consisting of gravel and sand of varying thickness. Occurs at altitudes above 8,000 ft. Typically exposed in Kieger and Wildhorse Canyons, Harney Co.

Wildie sandstone member (of Warsaw formation).

Mississippian: Southeastern Kentucky.

C. Butts, 1922 (Ky. Geol. Surv., ser. 6, vol. 7, pp. 89, 102). *Wildie ss. memb.*—Thick-bedded, very uniformly fine-grained bluish ss. of medium hardness. Known to trade as "Rockcastle freestone." Thickness 0 to 6 ft. Rests on 15 in. of highly glauconitic sh. with black nodules. Is overlain by a few ft. of sh. and ss., above which lies 20 ft. of thick-bedded yellow ls. Lies near base of Warsaw fm. Extends for about 16, possibly 20, mi. in NE.-SW. direction. Best developed and extensively quarried in vicinity of Wildie, Rockcastle Co.

Wildrose formation.

Lower Paleozoic (?): Southeastern California (Inyo County).

F. MacMurphy, 1930. [See under *Telescope group*. Derivation of name not stated.]

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July-Oct. 1932, pp. 329-356). *Wildrose fm.*—Largely cgl. qtzite with widely scattered elongated pebbles, up to 4 in. diam., of qtzite, granite, and granite gneiss in a dark-gray to black matrix of round to angular quartz grains, completely cemented by complex metamorphic aggregates; also finely banded brown to gray biotite schist and some crystalline ls. Thickness 500± ft. Conformably overlies Mountain Girl cgl.-qtzite and conformably underlies Sentinel dol.—all included in Telescope group (lower Paleozoic?), of S. part of Panamint Range. [Derivation of name not stated, but it is mapped near Wildrose Canyon.]

Wildwood limestone.

Permian: Northern California (Trinity County).

J. P. Smith, 1910 (Jour. Geol., vol. 18, chart opp. p. 217 and p. 218). *Wildwood ls.*—Limestones of Trinity Co. with Guadalupian fauna, *Stacheoceras*, etc. Assigned to Perm.

Named for Wildwood (Landis' ranch), on Hay Fork.

Wiles limestone member (of Graford formation).

Pennsylvanian: Central northern Texas (Brazos River region).

C. E. Dobbin, 1922 (U. S. G. S. Bull. 736C, p. 60). *Wiles ls. memb. of Graford fm.*—Massive dark-gray ls., 8 to 10 ft. thick. Lies 136 ft. above Palo Pinto ls. Named for exposure near Wiles, Stephens Co.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 48). Graford fm. of Palo Pinto Co. is divided into (descending): (1) Merriman ls.; (2) Wolf Mtn sh. [new name]; (3) *Wiles ls.*, consisting of 3 to 8 ft. of gray (blue when freshly broken) hard ls.; and (4) Posideon sh., 50± ft., which rests on Palo Pinto fm.

Wiley cyclical formation.

A name applied by H. R. Wanless (Ill. Geol. Surv. Bull. 60, 1931, pp. 179-193) to a portion of upper part of Pottsville fm. (Penn.) of central western Ill., based upon the rhythmic-cycle theory of sedimentation. Derivation of name not stated.

Wiley dolomite.

A name casually applied by C. [R.] Keyes (Pan-Am. Geol., vol. 59, No. 2, 1933, p. 136) to dol. of Wiley Mtns, E. of Van Horn, Tex., which he stated replaces the Delaware Mtn sss. of Richardson. According to P. B. King (personal communication April 1937) this fm. is Hueco ls. (Perm.).

†Wiley's Landing bed.

Miocene (lower): Southwestern Georgia and northern Florida.

A. F. Foerste, 1894 (Am. Jour. Sci., 3d, vol. 48, pp. 50–51). *Wiley's Landing bed.*—Peculiar white ls., about 20 ft. thick, resembling upper Vicksburg; brecciated toward base. Position and lithology seem to be upper Vicksburg, but fossils seem to have Chattahoochee facies. Included in Chattahoochee series, as basal bed.

According to C. W. Cooke (personal communication) this bed is part of Tampa ls. (†Chattahoochee fm.). At Wiley's Landing it is underlain by Flint River ls., which contains corals and other fossils.

Named for exposures at Wiley's Landing, on Flint River, in Decatur Co., Ga.

Wilgus clay.

A name applied to the shaly clay, 1 ft. thick, underlying Wilgus coal in Conemaugh fm., Ohio.

Wilhite slate.

Lower Cambrian: Eastern Tennessee and western North Carolina.

C. D. Walcott, 1894 (Geol. Soc. Am. Bull., vol. 5, pp. 196–198). Named *Wilhite sl.* by A. Keith. Rarely exceeds 700 ft. in thickness. Is capped by siliceous Citico cgl. of Keith. Within Wilhite sl., especially in upper 200 ft., numerous beds of ls. occur. Usually a ls. cgl. is found in same section, above the bedded ls. Exceptional to find a bedded ls. above the cgls. in the Wilhite slates, but large boulders of ls. were observed above main cgl. bed in Wilhite slates on Wilhite Creek, Tenn.

Defined by Keith in U. S. G. S. Knoxville folio (No. 16, 1895) and Loudon folio (No. 25, 1896). In Knoxville quad. it consists of ls. cgls. and sandy ls. in upper part and bluish-black argill. and calc. sl. in lower part; reaches a thickness of 1,000 ft.; underlies Citico cgl.; and is oldest fm. in area.

Is considered=lower part of Hiwassee sl.

Named for exposures on Wilhite Creek, Sevier Co., Tenn.

Wilkeson [coal] series.

Eocene: Western central Washington (Puget Sound region).

B. Willis, 1886 (U. S. 10th Census, vol. 15, pls. 81, 84). [See under *Evans Creek coal series.* This appears to correspond, in a general way at least, to Wilkeson fm. of Willis, 1898.]

Wilkeson formation. (In Puget group.)

Eocene: Western Washington (Puget Sound region).

B. Willis, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 400–436). *Wilkeson fm.* (also *Wilkeson sss.*).—Massive sss., with some sh. beds and a few coal beds, which lie at base of Pittsburg fm. and indeed form part of it. Separated from Pittsburg or South Prairie fm. [later renamed by him *Burnett fm.*] because of essentially distinctive characteristics and importance as key rock. Thickness 1,000 ft. Typical occurrence upon the eastern dip, either in quarries along South Prairie Creek immediately E. of Burnett or in bluffs ¼ mi. E. of Wilkeson, Pierce Co., on N. side of valley. Overlies Carbonado fm.

B. Willis and G. O. Smith, 1899 (U. S. G. S. Tacoma folio, No. 54). *Wilkeson fm.* (*Wilkeson ss.* on map).—Massive sss., some sh., few coals. Thickness 1,024 ft. Lies at base of Burnett fm. and indeed forms part of it. Includes Burnett coal at base.

Willamette group.

Miocene: Northwestern Oregon.

T. Condon, 1902 (The two islands). The following 3 groups represent the sea beaches in their relation to each other in the order of their occurrence: (1) *Rogue River group* (Cret.), named for Rogue River Valley [SW. Oreg.]; (2) *Umpqua group* (Eocene), named for association with Umpqua Valley [SW. Oreg.]; (3) *Willamette group* (Miocene), named for Willamette region [NW. Oreg.].

Willamettian stage.

Pleistocene: Central northern Oregon.

E. T. Hodge, 1930 (Monthly Weather Rev., vol. 58, pp. 405-411). *Williamettian* [Willamettian] *stage* (*Pleistocene*).—An epoch of aggradation and comparably small precipitation in Oreg., separating Jeffersonian epoch of glaciation from Cascadian epoch of glaciation. Possibly correlates with Puyallup interglacial epoch of Wash. Willamette Valley at Portland was aggraded to 300 ft. above present river level. Along the valley near Portland are important terraces.

Willard shale. (In Wabaunsee group.)

Pennsylvanian: Eastern Kansas, southeastern Nebraska, northwestern Missouri, and southwestern Iowa.

J. W. Beede, 1898 (Kans. Acad. Sci. Trans., vol. 15, p. 31). *Willard sh.*—Sh., 55 ft. thick, included in Upper Coal Measures of Shawnee Co., Kans. [From statement on p. 28 appears to underlie Chocolate ls. of Swallow and to overlie Elmont ls.]

J. W. Beede, 1902 (Kans. Univ. Sci. Bull., vol. 1, pp. 163-181). *Willard shales*, 55 to 85 ft. thick, overlie Barclay ls. (=Burlingame ls. and=Wyckoff ls.) and underlie Chocolate ls., 7 to 10 ft. thick.

E. Haworth, 1908 (Univ. Geol. Surv. Kans., vol. 9), defined *Willard sh.* as underlying Emporia ls. and overlying Burlingame ls., and that definition was followed for many years.

G. E. Condra, 1927 (Nebr. Geol. Surv. Bull. 1, 2d ser., pp. 61, 62, 71, 78, 90, 226). Kans. Geol. Surv. applies *Willard sh.* to beds below Emporia ls. and above Burlingame ls. The Willard sh. and so-called Emporia ls. have been difficult to work out. The beds called by these names in Kans. need redefining in order to establish a basis for correlation in Nebr. [p. 61]. The top of Willard sh. as defined by Beede in 1898 is at base of what is now known to be Tarkio ls. and the base at top of our div. 3 of Nebr. section of Nemaha beds or to Emporia ls. as that name should be defined if used. The Elmont ls. is one [the upper] bed of the unit which Kirk may have meant to call Emporia ls. [pp. 66, 71]. As here defined *Willard sh. memb. of Wabaunsee fm.* underlies Tarkio ls. memb. and overlies Emporia ls. memb. Its thickness is 30 ft. or more in Nebr., Iowa, and Mo., and 50 to 60 ft. in Kans. It consists of bluish and reddish argill. sh. with some calc. material and sand. Named for exposures S. of Willard [Shawnee Co., Kans.].

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3, p. 96). Willard sh. underlies Tarkio ls. and overlies *Emporia ls.* The Willard sh. of Haworth, Hinds, and Greene underlies Emporia ls., overlies Burlingame ls., and is replaced by *Humphrey sh.*

R. C. Moore and G. E. Condra, 1932 (Oct. 1932 revised classification of Perm. and Penn. rocks of Kans. and Nebr.), followed above 1932 classification, as did Condra, 1935 (Nebr. Geol. Surv. Paper No. 8), and R. C. Moore, 1936.

The U. S. Geol. Survey has not yet had occasion to consider, for its publications, the modified definition of Willard sh.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Williams Brook coquinite member.

Upper Devonian: Central New York (Ithaca region).

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 202). *Williams Brook coquinite memb.*, 15 to 25 ft. thick, characterized by *Spirifer mesistrialis* fauna. Underlies Marathon ss. memb. and overlies Cascadilla sh. memb., all included in Ithaca facies subgroup of Ithaca-Enfield group of fms. in Ithaca region.

Williamsburg granodiorite.

Late Carboniferous or post-Carboniferous: Central Massachusetts.

B. K. Emerson, 1898 (U. S. G. S. Holyoke folio, No. 50; also U. S. G. S. Mon. 29, pl. 34). *Williamsburg granite.*—Coarse muscovite-biotite granite with veins of pegmatite and albitic granite. [In text heading misspelled *Williamstown.*]

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 253–254). *Williamsburg granodiorite*, named for its development at Williamsburg, Mass., extends S. from Goshen into Conn., forming E. rim of Berkshire Hills.

†Williamsburg marl.

†Williamsburg pseudobuhr.

Eocene (lower): Eastern South Carolina (Williamsburg County).

E. Sloan, 1908 (S. C. Geol. Surv., ser. 4, Bull. 2, pp. 449, 451, 452). *Williamsburg Pseudo-Buhr.*—Consists of a heavy mantle of red and yellow sands mixed with glauconite and enclosing a hard silicified ledge about 2 ft. thick, in which casts of *Ostrea arrosis* and *Venericardia planicosta* occur. Included in Upper Black Mingo. Overlies Rhems sh. and underlies Lang Syne beds. Named for exposures in Williamsburg Co. near Rhems, but more extensively as a mantle covering ridge btw. Black River and Santee River, notably on scarp of swamp SW. of Gourdin Station and on crest of ridge 3 mi. N. of Salters.

C. W. Cooke, 1936 (U. S. G. S. Bull. 867). Above beds are part of Black Mingo fm. and name is abandoned. Deposits of kind described by Sloan as Williamsburg pseudobuhr make up greater part of Black Mingo fm., and are interbedded with dark clay, sh., or fuller's earth resembling †Rhems sh.

Williamsburg sand.

Drillers' name for a sand in Pottsville group of Whitley Co., SE. Ky.

Williams Canyon limestone.

Devonian (?): Eastern Colorado (El Paso County).

A. E. Brainerd, H. L. Baldwin, Jr., and I. A. Keyte, 1933 (A. A. P. G. Bull., vol. 17, No. 4, pp. 381–396). *Williams Canyon ls.*—About 30 ft. of thin-bedded lss. and calc. shales occur in section along Front Range uncon. below Madison ls. (Miss.) and uncon. above Ord. beds (Manitou, Harding, or Fremont). Typically exposed near Cave of Winds, in Williams Canyon at Manitou. Excellent exposures in Manitou Park, at Perry Park, in Canyon City embayment, and at Beulah, on E. slope of Wet Mtns. Consists of thin white to gray lss. 2 to 6 in. thick, with partings of gray calc. sh. and occasional thin sss. Occurs in all sections measured except btw. Manitou Springs and Oil Creek section. Max. thickness (65 ft.) at Missouri Gulch, in Manitou Park. W. Cross (U. S. G. S. Pikes Peak folio, No. 7) applied *Millsap ls.* to 30 ft. of thin-bedded dolomitic ls. with a few thin ss. layers exposed btw. Oil and Millsap Creeks, NE. of Canyon City; chert nodules in upper part carry fossils identified as Carbf. This series is believed by writers to be=the thin-bedded section in Williams Canyon and the chert nodules derived from erosion of overlying Madison and deposited in the basal Penn., which in this area overlies the thin-bedded lss. The name *Millsap* might be applied to the thin-bedded section at Beulah were it not preoccupied in Tex. Careful search revealed no fossils, either macro or micro, but writers are inclined to believe the Williams Canyon ls. is=the Parting and of Dev. age. [The application in this rept. of *Madison ls.* (Miss.) to 100 ft. of light-gray, very dense, massive ls., containing much brecciated material but practically without bedding, separating their Williams Canyon ls. from the overlying Fountain fm., is explained as follows:] "The massive lss. below the Pennsylvanian Fountain fm. NW. of Beulah, at Manitou Springs, and in Manitou Park and some distance northward have been recognized as true Miss. and essentially equiv. to the Madison of Wyo. and Mont. Although this is largely a lithologic correlation, a number of Miss. fossils have been found at Beulah and in Manitou Park, and a crinoid (*Actinocrinus marcoui* Collignon) of Kinderhook age was found by Marcou in the ls. in Williams Canyon." "The Madison is the equiv. of Leadville ls. of the west slope and is essentially equiv. to the Madison of Wyo., Idaho, and Mont."

Williams Fork formation. (In Mesaverde group.)

Upper Cretaceous: Northwestern Colorado.

Named by E. T. Hancock, but publication of his rept. was delayed, so that name first appeared in U. S. G. S. Press Memo. 16037, Oct. 1, 1923, on map of Hamilton and Seeping Spring Gulch domes and vicinity, Moffat Co., Colo.; and it was also used by J. D. Sears (but credited to Hancock) in U. S. G. S. Bull. 751, 1924, p. 290.

E. T. Hancock, 1925 (U. S. G. S. Bull. 757). *Williams Fork fm.*—Alternating beds of ss., sandy sh., and coal through nearly its entire thickness of 1,600 ft. Includes Twentymile ss. memb. about 900 ft. above base. Is upper fm. of Mesaverde group in Axial and Monument Butte quads. Rests conformably on Iles fm., lower fm. of Mesaverde group. Is conformably overlain by Lewis sh. Exposed on Williams Fork Mtn and along Williams Fork near its junction with Yampa River.

Williams Island limestone.

Devonian: Ontario.

E. M. Kindle, 1924 (Canada Geol. Surv. Summ. Rept. 1923, pt. C_1, p. 34).

Williamson shale member (of Clinton formation).

Silurian: Central and western New York.

J. M. Clarke, 1906 (N. Y. State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12). [See under *Irondequoit ls.*]

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114, pp. 5–35). *Williamson sh.*—Not of so uniform green color as older Sodus sh., and has interbedded a number of purple bands and 2 or 3 bands of pearly ls. Thickness in Rochester and Ontario Beach quads. 24 ft. Included in Clinton fm. Overlain by Irondequoit ls. and underlain by Wolcott ls.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368), stated that at both Williamson, Wayne Co. (type loc. of Williamson sh.) and at Wolcott (type loc. of Wolcott ls.) true Williamson sh. rests on true Wolcott ls., but that at Rochester true Wolcott ls. is absent and *Williamson sh.* was applied by Hartnagel to all beds btw. Irondequoit ls. and Reynales ls., a much older ls. than Wolcott. He restricted *Williamson* to upper or graptolite-bearing part (6 ft. thick) of what Hartnagel called *Williamson sh.* at Rochester, and identified lower part (18 ft.) of Hartnagel's Williamson sh. at Rochester as true Sodus sh., Hartnagel's Sodus being the much older Maplewood sh. At Brewerton [Onondaga Co.] the Williamson sh. is overlain by Brewerton sh., which is=lower part of Irondequoit ls. Chadwick gave thicknesses of his true Williamson sh. as 33–105 ft.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347), and W. Goldring, 1931 (N. Y. State Mus. Hdb. 10). [See under *Phoenix or Schroeppel sh.*]

Williamson sandstone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen and D. B. Reger, 1914 (W. Va. Geol. Surv. Rept. Logan and Mingo Counties, pp. 84, 165). *Williamson ss.*—Massive, medium-grained, dull gray, micaceous. Thickness 5 to 25 ft. Lies 1 to 5 ft. below Dingess coal and 1 to 30 ft. above Dingess ls. Exposed on Williamson Creek at Williamson, Mingo Co.

†Williamsport sandstone.

Mississippian: Central western Indiana (Warren County).

A. Winchell, 1870 (Am. Phil. Soc. Proc., vol. 11, pp. 414–415), and S. S. Gorby, 1886 (Ind. Dept. Geol. and Nat. Hist. 15th Ann. Rept., p. 86). [No definition except that *Williamsport gritstone* is of Kinderhook age.]

According to E. R. Cumings, 1922 (Hdb. Ind. Geol., pt. 4, Sep. Pub. 21, pp. 489–490), this is same as Riverside ss. and an unnecessary name. Apparently named for Williamsport, Warren Co., according to S. S. Gorby (Ind. Dept. Geol. and Nat. Hist. 15th Ann. Rept., 1886, p. 86), who calls it *Williamsport ss.*

Williamsport sandstone.

Silurian: Mineral and Grant Counties, West Virginia.

D. B. Reger, 1924 (W. Va. Geol. Surv. Rept. Mineral and Grant Counties, pp. 395–398). *Williamsport ss.*—Hard, compact greenish-brown or reddish-brown ss., massive, fine-grained. Marine fossils. Thickness 5 to 50 ft. Included in Bloomsburg red sh. In places (due to erosion of overlying beds of the Bloomsburg) it lies just below Rondout waterlime; in other places it rests on Niagara ls. In rare instances it is the only Bloomsburg stratum present in the section. Is the only ss. present in Bloomsburg sh. of this region. Named for exposure on a short branch of Patterson Creek, 0.6 mi. E. of Williamsport, Grant Co., at a point where a short private road turns NE. from main Williamsport-Moorefield highway.

W. F. Prouty, R. C. Tucker, P. H. Price, 1927 (W. Va. Geol. Surv. Rept. Hampshire and Hardy Counties, p. 258). For most of Hardy Co. the Bloomsburg is of one type, a brownish-red ss., but for some of western outcrops there is a shaly upper portion. Where the shaly portion is conspicuous, in Grant Co., Mr. Reger has called the ss. portion the *Williamsport ss.*

Williamstown granite.

A misprint (in heading on p. 6 of U. S. G. S. Holyoke, Mass., folio, No. 50, 1898, and on p. 433 of U. S. G. S. Bull 191) for the granite mapped in Holyoke folio as *Williamsburg granite* (Carbf.).

Williamstown granite.

Devonian: Northeastern Vermont (Orange County).

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), listed this name in Dev. of "central Vt.," but without definition. Probably named for Williamstown Twp, or village within that twp, NW. part of Orange Co.

Williamsville waterlime and shale.

Silurian (Cayugan): Western New York.

G. H. Chadwick, 1919 (as reported by M. Y. Williams, Canada Geol. Surv. Mem. 111, pp. 85, 93). "Chadwick (Bull. Geol. Soc. Am., No. 1, vol. 28, p. 173) has divided the upper part of the Cayugan group in western N. Y. as follows: [See 1917 entry under *Bertie ls. memb.*] In the criticism [unpublished?] of this memoir, however, Chadwick has omitted the term *Buffalo* and used in its place 'Williamsville'." (p. 85). On p. 93 Williams stated: "Prof. G. H. Chadwick disagrees with the above conclusions and offers the following alternative correlation. His table (for western N. Y.) is as follows:" * * * Akron dol., *Williamsville waterlime and sh.*, Scajaquada limy sh., Falkirk dol., and ?Oatka dol.

Probably named for exposures at Williamsville, Erie Co.

See also under *Akron dol.*

Williamsville clay.

Tertiary: Trinidad.

V. C. Illing, 1928 (Geol. Soc. London Quart. Jour., vol. 84, p. 17).

Willimantic gneiss.

Probably Carboniferous or post-Carboniferous: Eastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 115, 140, 141, 142). *Willimantic gneiss.*—Alternating light and dark bands. In general coarse-grained, often times even porphyritic in structure, usually considerably crumpled and folded. The dark variety has a relatively small amount of feldspar and quartz with a large amount of biotite and some hornblende. The light stock is granitic and contains quartz, feldspar, and biotite in proportions of normal granite. The gneiss extends about 4 mi. in all directions from city of Willimantic. It is merely a more injected phase of Hebron gneiss, which forms an irregular band almost completely encircling the Willimantic gneiss, into which it grades.

H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7, p. 36 and map). *Willimantic gneiss* is of igneous origin and Hebron gneiss is believed to be sedimentary.

Willis sand.

Tertiary? (Pliocene?): Southeastern Texas and southern Louisiana.

J. Doering, 1935 (A. A. P. G. Bull., vol. 19, No. 5, pp. 655, 656, 660). *Willis fm.*—Proposed by writer for the fm. of sand and gravelly sand occurring at or near base of post-Fleming group in SE. Tex. and S. La. Called "unnamed Pliocene sand" and "Upper Citronelle sand" by Plummer, in Univ. Tex. Bull. 3232, 1933, pp. 530 and 749-763. Is in general red sand, coarse and gravelly in part, and slightly indurated. Exposed in a dissected hilly belt 15 to 20 mi. wide, paralleling and just S. of Fleming belt of outcrop. Rests uncon. on clay beds which are in part Fleming and which may be in part Goliad. Highly probable the Willis is younger than Goliad sand, but upper memb. of Goliad (the Labahia) may be=lowest memb. of the Willis, the *Willis gravel*. Is overlapped uncon. by Lissie fm. and locally by the [later] Beaumont and Recent. Divided into 3 members (all of which are present in both SE. Tex. and SW. and SE. La.), named (descending): (1) *Hockley Mound sand memb.*, 20–25 ft.; (2) *Willis ferruginous sand memb.* 30 to 60 ft.; and (3) *Willis gravelly sand memb.*, 30 to 40 ft. Named for town of Willis, 10 mi. N. of Conroe, Montgomery Co., Tex., which is located on top of N. end of a ridge held up by the fm. No fossils. Is late Plio. or early Pleist. Tentatively correlated with upper part of Citronelle fm.

Willis sand.

A subsurface sand of Chester (upper Miss.) age in Ind. that has been correlated with Elwren ss. of Malott.

†Willis ferruginous sand member.

†Willis gravelly sand member.

See under *Willis sand* of Tex., of which they are members. The U. S. Geol. Survey does not apply the name of a fm. to its members.

Williston limestone.

Upper Cambrian: Northwestern Vermont (Chittenden County).

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 117+). *Williston ls.*—Light- or dark-blue ls. and marbleized ls., interbedded with some layers of shaly blue ls. and a very little calc. sh. and with scattered beds of dolomitic ls., usually dark blue or gray. Beds are fine-grained. Fossils very scarce. Thickness probably 500 ft. No precise contacts btw. this ls. and underlying Shelburne marble, but differences are marked and change is probably abrupt. In towns of Williston and St. George the ls. is overlain by a fine black phyllite, which appears to be conformable, but its age relation to the Williston is unknown.

A. Keith, 1932 (Wash. Acad. Sci. Jour., vol. 22, pp. 360, 377). Fossils collected from Williston ls. in Williston and South Burlington are pronounced by C. Schuchert to be Upper Camb. The fm. is named for its exposures in W. part of Williston Twp about 5 mi. SE. of Burlington. In Burlington region it overlies Highgate sl. (Upper Camb.); in Brandon-Rutland region it rests on Shelburne marble, a much older fm. [here assigned to Lower Camb., but now believed to be Middle Camb.], from which it is separated by a hiatus.

†Willow limestone.

An abbreviation of †Willow River ls. of Wooster (Lower Ord., upper Miss. Valley) employed by C. R. Keyes.

Willow limestone.

Lower Ordovician: Eastern Nevada (Ely region).

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 53) and 1924 (Pan-Am. Geol., vol. 41, p. 78). *Willow lss.*, 100 ft. thick, uncon. underlie Eureka sss. and overlie Cherry shales. [His 1924 definition states that these lss. are uppermost memb. of *Mid* Ordovicic section.] Named for exposures on E. flank of Egan Range along Willow Creek.

Upper part of Pogonip ls.

Willowbunch member (of Ravenscrag formation).

Eocene (early): Saskatchewan.

F. H. McLearn, 1930 (Canada Geol. Surv. Summ. Rept. 1929, pt. B, p. 58).

In later repts McLearn assigned this fm. to "Paleocene," which is included in Eocene by American geologists.

Willow Creek formation.

Upper Cretaceous: Northwestern Montana and southwestern Alberta.

G. M. Dawson, 1883 (Canada Geol. Surv. Rept. 1880–82, pp. 3B–6B). In Belly River region, E. of belt of disturbed rocks, a series of reddish and purplish clays with gray and yellow sss., which may be named provisionally *Willow Creek series*, appears to be very persistent in Laramie of this region. Overlies, conformably, St. Mary River beds and conformably underlies sss. and shales of Porcupine Hills. [Mentions fossils obtained from the fm. on Old Man River, a few mi. below mouth of Willow Creek, SW. Alberta.]

E. Stebinger, 1916 (U. S. G. S. Bull. 621, pp. 124–128). *Willow Creek fm.*—Variegated clay and soft ss., chiefly maroon to chocolate brown, with subordinate gray, yellow, and greenish-gray beds; the clay in many places contains thin lenticular beds of purplish-gray ls. Thickness 720+ ft. in northern Teton Co., Mont. Top not seen. Mainly continental. Overlies St. Mary River fm. and underlies glacial drift. Is lithologically identical with underlying St. Mary River fm. except that Willow Creek rocks are characterized by dominantly red color instead of light-grayish tints of coal-bearing St. Mary River fm. It is not coal-bearing in Teton Co. Change to St. Mary River fm. occurs in transition zone 50 ft. thick, in which red beds alternate with gray and white beds. To N., in Alberta, the red color disappears and the strata at same position are coal-bearing.

†Willow Creek beds.

Upper Cretaceous: Eastern Colorado (Denver Basin).

G. H. Eldridge, 1888 (Colo. Sci. Soc. Proc., vol. 3, pt. 1, pp. 86–112). *Willow Creek beds.*—Consist of 600 to 1,200 ft. of gray argill. or aren. shales with lenticular masses of hard quartzose ss. and an occasional ironstone, underlain by 200 ft. of cgl. or gritty ss., which may become bulk of fm., as in type locality, or may thin to merest edge, as in northern limit along Platte River near Brighton. This fm. contains pebbles from every fm. that lies beneath it in Denver field, as well as from others far beyond, especially the Carbf. Uncon. overlies Laramie fm. and uncon. underlies Denver beds, described by Cross. Contains dinosaur remains. Named for Willow Creek, in S. part of field, 1 to 3 mi. SE. of mouth of Platte Canyon, where it has its greatest and most typical development. [In footnote on p. 97 Eldridge withdrew "Willow Creek beds," because of preoccupation in Canada, and substituted *Arapahoe*.]

Willow Creek rhyolite. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). The thick series of flows of fluidal felsitic rhyolites characteristically exposed above Creede in the canyons of both forks of Willow Creek is here named *Willow Creek rhyolite*. Thickness 0–2,000+ ft. Is a fm. in Alboroto group, of Potosi volcanic series. Uncon. underlies Campbell Mtn rhyolite and uncon. overlies Outlet Tunnel quartz latite. It is possible latter fm. represents a lens btw. flows of Willow Creek rhyolite, but this is not believed probable.

Willow Lake basalts.

Age(?): Northern California (Lassen National Park).

H. Williams, 1932 (Calif. Univ. Pub., Bull. Dept. Geol. Sci., vol. 21, No. 8, pp. 214–376, map). *Willow Lake basalts.*—Blue-black vesicular pyroxene basalt flows, including a small outcrop of coarse basaltic aggl. on N. slope of Kelly Mtn. Earliest volcanic activity in the park. Exposed around margins of Willow Lake and thence over the divide into Warner Valley.

Willow Point limestone. (In Palo Pinto formation.)

Pennsylvanian: Central northern Texas (Wise and Jack Counties).

J. M. Armstrong, 1929 (Tex. Bur. Econ. Geol., geol. map of Jack Co.). *Willow Point ls.*, in lower part of *Graford fm.*, lies 40± ft. above Bridgeport coal.

J. M. Armstrong and G. Scott, 1930 (Tex. Bur. Econ. Geol., geol. map of Wise Co.). *Willow Point ls.*, 15± ft. thick, lies 105± ft. below Rock Hill ls. and 40± ft. above Bridgeport coal, all included in Graford fm.

E. H. Sellards, 1931 (Sept. 1931 News Letter from Bur. Econ. Geol. Univ. Tex.). [See 1931 entry under *Boone Creek memb.*] Included in Palo Pinto fm.

G. Scott and J. M. Armstrong, 1932 (Tex. Univ. Bull. 3224, p. 27). *Willow Point ls.* included in Palo Pinto fm. Is about 4 ft. thick. Consists almost entirely of broken fragments of crinoid stems and many other reworked fossils. When fresh it is light to dark gray, hard, and crystalline but weathers easily to yellowish color and breaks down into a "rotten" ls. Named for Willow Point, SW. part of Wise Co. Also well exposed at Bridgeport and other places in W. part of Wise Co. Was originally called *Bridgeport ls.* by Böse, but since he had already spoken of the coal in connection with Bridgeport it is thought best to retain that name for the coal. It lies 32 to 55 ft. above Bridgeport coal.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 105). *Willow Point ls.*, in Palo Pinto fm., replaces *Bridgeport ls.* (preoccupied).

†Willow River limestone.

Lower Ordovician (Beekmantown): Central western Wisconsin.

L. C. Wooster, 1882 (Geol. Wis., vol. 4, pp. 106, 123–129). [See 1882 entry under *New Richmond ss.*]

Later work proved these beds to be same as Shakopee dol., by which name they have been universally designated in Wis., Minn., Iowa, and Ill. repts for 50± years.

E. H. Powers, 1935 (Geol. Soc. Am. Proc. 1934, p. 102). "The revised and redefined term *Willow River* is preferred to the controversial term *Shakopee* for upper dol. memb." [of Prairie du Chien "fm."].

According to 1935 Rept. Ann. Field Conf. Kans. Geol. Soc., the Wis., Minn., Iowa, and Ill. Geol. Surveys continue to use *Shakopee*, as does U. S. Geol. Survey.

See also under *Shakopee dol.*

Named for exposures on Willow River, St. Croix Co.

Willow Spring granite.

Mesozoic (?): Central Arizona.

F. L. Ransome, 1903 (U. S. G. S. P. P. 12). *Willow Spring granite.*—Gray fine-grained granite; exact petrological relationship in doubt. Intrudes Pinal schist. Exposed in Willow Spring Gulch, Globe quad.

F. L. Ransome, 1919 (U. S. G. S. P. P. 115), assigned this fm. to "Mesozoic (?), probably early Mesozoic."

Wills Creek shale. (In Cayuga group.)

Silurian: Western Maryland to central Pennsylvania and western Virginia.

P. R. Uhler, 1905 (Md. Acad. Sci. Trans., vol. 2, pp. 20–25). *Wills Creek fm.*—Yellowish shales (black when fresh), argill. and calc., with a few thin layers of dark-purple ss. and 2 ft. of coarse dark-purple unfossiliferous ss. at base. Underlies Lower Helderberg and overlies Water Lime. Thickness 150± ft. Appears to constitute an unrecorded fm. Named for creek next to which it is conspicuously exposed [at Cumberland, Md.]. Might be regarded as the upper memb. of the Water Lime were it not for the difference in the fauna.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pp. 522, 541, pl. 28). *Wills Creek fm.*—Overlies Bloomsburg ss. and underlies Tonoloway ls. in Pa. and Md. Is middle fm. of Cayugan series.

G. W. Stose, 1912 (U. S. G. S. Pawpaw-Hancock folio, No. 179). *Wills Creek sh.*—Chiefly greenish sh., with some sss. (greenish) and lss., and, at base, Bloomsburg red ss. memb., 52–80 ft. thick. Thickness of fm. 445 ft. Underlies Tonoloway ls. and overlies McKenzie fm.

C. K. and F. M. Swartz, 1931 (Geol. Soc. Am. Bull., vol. 42, No. 4, pp. 622–660), treated *Bloomsburg red beds* as a distinct fm., underlying Wills Creek fm. and overlying McKenzie fm.; and on pp. 651–660 they extended the name into SE. N. Y. as far as Otisville, Orange Co. On p. 657 they state: It is manifest the Bloomsburg is a lithological phase—not a geological age. It accumulated on the continental margin to E. while different marine deposits were formed to W. On p. 660 they show Bloomsburg red beds to NE. to be the time equivalent of lower part of Tonoloway ls., Wills Creek sh., and upper part of McKenzie, its basal bed to S. (called Rabble Run red bed) interfingering with middle part of McKenzie, while a higher heavy bed of the Bloomsburg wedges in btw. the McKenzie and the Wills Creek. This higher bed, however, they show as representing an early part of the Bloomsburg to east.

G. W. Stose and C. Butts, 1932 (16th Int. Geol. Cong. Guidebooks of Appalachian region). *Wills Creek sh.* restricted to beds above Bloomsburg sh. [This is present approved definition.]

Wills Point formation. (In Midway group.)

Eocene: Eastern Texas Coastal Plain.

R. A. F. Penrose, Jr., 1890 (Tex. Geol. Surv. 1st Ann. Rept., pp. xlii, 17, 19). *Basal or Wills Point clays.*—Great beds of stiff stratified clays of various colors interbedded with sand and containing some ls. concretions. Thickness 250 to 300 ft. Underlie Timber Belt or Sabine River beds and uncon. overlie Upper Cret.

In 1896 G. D. Harris (Bulls. Am. Pal., vol. 1, No. 4, p. 155) applied *Wills Point clays and sand* to upper part only of Wills Point clay of Penrose. The Penrose definition, however, was generally adopted, and btw. 1890 and 1907 *Wills Point clay* was name applied to basal Eo. deposits of Tex. Coastal Plain, which are now generally agreed are same as the Midway of E. part of Gulf Coastal Plain, and are called by latter name.

H. J. Plummer, 1933 (Univ. Tex. Bull. 3201—issued in Feb. 1933, according to footnote on p. 51, p. 54, footnote). In forthcoming Univ. Tex. Bull. 3232 the "upper Midway" will be called *Wills Point fm.* of Midway group, and a new name will be applied to "basal Midway."

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, p. 555). In 1927 the work of Mrs. [H. J.] Plummer on the Foraminifera and that of Miss [Julia] Gardner on the large fossils demonstrated that the Midway is composed of two easily mappable units containing distinctly different faunas. The U. S. Geol. Survey on prel. ed. of geol. map of Tex. published in 1932, proposed to restrict Penrose's name and to apply it to upper div. only of the Midway. Wills Point fm. as now defined includes all strata below Wilcox group and above Tehuacana ls. lentil [of Kincaid fm., p. 532] or its equiv. horizon. Its base is drawn at base of the upper glauconite, which appears to be uncon. on underlying beds. [See Plummer, 1933, under *Kincaid fm.*]

Named for Wills Point, Van Zandt Co.

†Wilmington beds.

Eocene (upper) and Miocene (lower): Southeastern coast of North Carolina.

W. H. Dall, 1898 (U. S. G. S. 18th Ann. Rept., pt. 2, p. 344 and chart opp. p. 334). *Wilmington beds.*—See Clark, U. S. G. S. Bull. 83, 1891, pp 48–50; also note under E22. [The note under E22 is:] This [the Shark River beds of N. J.], like the Eocene of N. C., is regarded by Harris as newer than that of Md. and Va., which has been included under name Pamunkey by Darton. [Assigned to Clairbornian in table opp. p. 334.]

On pp. 48–50 of U. S. G. S. Bull. 83 W. B. Clark described the Eocene deposits of N. C. but did not apply a geographic name to them. In region described by Clark the deposits are now divided into Castle Hayne marl (of upper Eocene, Jackson, age) above and Trent marl (lower Mio.) below, both of which were evidently included in "Wilmington beds."

Apparently named for exposures at Wilmington, N. C.

Wilmington group.

Late Pleistocene: Southern California.

R. T. Hill, 1929 (Sci., n. s., vol. 69, pp. 379–380). *Wilmington group.*—Has hitherto included Lower San Pedro, Upper San Pedro, and [Los] Cerritos stages of Arnold, or their equivalents. Contains Pleist. marine invertebrate fossils. Structural and physiographic evidence proves these beds are older than the Pleist. invertebrate-bearing beds of La Brea pits, but both belong to Later Pleist. stage, and not to Earlier Pleist. [Derivation of name not stated.]

Wilmington limestone.

Upper Ordovician (Richmond): Northeastern Illinois.

See under *Aux Sable ls.*

Wilmore sandstone member (of Conemaugh formation).

Pennsylvanian: Western Pennsylvania (Cambria County).

C. Butts, 1905 (U. S. G. S. Ebensburg folio, No. 133). *Wilmore ss.*—Varies from thin-bedded and micaceous to thick-bedded and coarse. Thickness 20 to 30 ft.

Is a memb. in upper part of Conemaugh fm. Its base is about 60 ft. above Summerhill ss. or 520 ft. above Upper Freeport coal. Exposed at top of first railroad cut W. of Wilmore, also on hillside W. of Wilmore [Cambria Co.], about 3 mi. SW. of Wilmore, and at other places.

†Wilmore limestone.

Middle Ordovician (Trenton): Central Kentucky.

J. M. Nickles, 1905 (Ky. Geol. Surv. Bull. 5, p. 15), used *Wilmore*, in table only, without any description or thickness, for fm. in Lexington group underlying Paris and overlying Logana.

According to A. F. Foerste (Ky. Geol. Surv. Bull. 7, 1906) the †*Wilmore* is 125 ft. thick. According to E. O. Ulrich (Geol. Soc. Am. Bull., vol. 22, pp. 416–417, 1911) it underlies Bigby ls. and overlies Hermitage. According to A. F. Foerste (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, pp. 389, 429–430, 1913) it is 70 ft. thick, consists of lss., frequently argill. and usually interbedded with thin clay layers, and is underlain by Logana and overlain by Bigby.

The name "Wilmore" being preoccupied, A. M. Miller replaced it with *Jessamine ls.*

Named for exposures at Wilmore, Jessamine Co.

Wilmot.

Name applied to a subsurface sand in Cisco group (Penn.) of Archer Co., Tex., lying from 160 to 200 ft. above Gose sand and probably not far above Breckenridge ls. memb. of Thrifty fm.

Wilson formation.

Pennsylvanian: Southeastern Kansas and northeastern Oklahoma.

F. C. Schrader and E. Haworth, 1905 (U. S. G. S. Bull. 260, p. 447). *Wilson fm.*—Lss. and shales, 280 ft. thick, underlying Buxton fm. and overlying Drum fm. in SE. Kans. Includes Piqua ls., Vilas sh., Iola-Allen ls., and Chanute sh.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 124). †*Wilson fm.* of Schrader and Haworth included strata from base of Chanute sh. to top of Stanton ls., and is abandoned.

Named for Wilson Co., Kans.

Wilson sand.

A subsurface sand, 0 to 30± ft. thick, in Carbondale fm. of Centralia region, SW. Ill., in SW. part of Marion Co., lying 1,110± ft. below Herrin coal.

Wilson sand.

A subsurface gas sand in lower part (Hiawatha memb. of Nightingale) of Wasatch fm. of Vermilion Creek gas area, on Wyo.-Colo. State line in Sweetwater Co., SW. Wyo., and Moffat Co., NW. Colo. Lies higher than Newberger sand. (See W. T. Nightingale, A. A. P. G. Bull., June 1935.)

Wilson sand.

A subsurface sand in central southern Okla., which is reported to occur at base of Perm.

Wilson diorite.

See *Mount Wilson quartz diorite.*

Wilson Ranch beds.

Pliocene: Western California (Sonoma County).

V. C. Osmont, 1904 (Calif. Univ. Pub., Dept. Geol. Bull. vol. 4, p. 74). *Wilson Ranch beds.*—West of Santa Rosa Valley, sss. and small proportion of shales and fine volcanic cgl., with marine fauna. East of Santa Rosa Valley, sss., shales, and a large proportion of coarse volcanic cgl.; no fossils; coarseness of gravel and close bedding indicating fluviatile origin. Believed to be older than St. Helena rhyolite and younger than Sonoma tuff.

Probably named for exposures on a ranch in Sonoma Co.

†Wilton formation.

Pre-Cambrian (?): Southwestern Connecticut (Fairfield County).

J. G. Percival, 1842 (Conn. Geol. Surv. Repts., pp. 51–53, 63, and map). *Wilton fm.* (*No. 4 of Eastern Primary system*).—Chiefly dark subporphyritic, more rarely porphyritic rock similar to that of Greenwich fm., and like that generally more or less subhornblendic. Includes subordinate beds of white granitic rock. Covers considerable part of Wilton.

Included in Danbury granodiorite gneiss as mapped by H. E. Gregory and H. H. Robinson, 1907 (Conn. Geol. and Nat. Hist. Surv. Bull. 7).

Wilton's Run.

P. Frazer, Jr. (2d Pa. Geol. Surv. Rept. C., p. 82, 1876) applied *Wilton's Run ls. belt* to a belt of ls., 500 to 1,000± ft. thick, in vicinity of Wilton's Run, near Wrightsville, York Co., Pa.

Wimer beds.

Miocene (upper), Pliocene, or Pleistocene: Northwestern California (Del Norte County).

J. S. Diller, 1902 (U. S. G. S. Bull. 196, pp. 32–35, 47). Neocene marine deposits occur on edge of plateau at elev. of about 2,200 ft., along old Wymer stage road, in sec. 20, about 13 mi. NE. of Crescent City. North of old Harvey place, where Thomas Haley now lives, a thin coating of the soft iron-stained, slightly indurated shaly sands is exposed on banks of road for several miles, and has furnished numerous imperfect casts of mollusks as well as impressions of leaves. A short distance farther E., in an excavation made by Mr. Williamson near his barn, in sec. 22, a very fine soft gray sandy clay, very slightly indurated, is rich in shells. The deposits of the two localities just mentioned will be called for distinctness *Wymer beds*. They are very thin, resting on schists, peridotite, ss., and other rocks. [Fossils described.] Flora said by F. H. Knowlton to be upper Mio. W. H. Dall says fauna is not characteristic but not older than Tert. If on further study the Wymer beds should turn out to be Plio. or Pleist. the age of the Klamath peneplain would be correspondingly reduced.

According to J. H. Maxson (letter dated Jan. 5, 1933) this name should be spelled *Wimer*, as it is derived from the man who built the stage road on which the fm. is exposed.

Winchell member (of Graford formation).

Pennsylvanian: Central northern Texas (Colorado River to Brazos River).

C. O. Nickell (rept completed and soon to be published by Tex. Geol. Survey). *Winchell memb. of Graford fm.*—The group of thin lss. separated by thick sh. beds and thin sss. in the Winchell area, Brown Co., which to W. develop into a conspicuous ls. bed, as recorded in well logs drilled in central Coleman Co. This group of lss. includes "Clear Creek ls." of Drake and of Plummer and Moore, plus the ls.-bearing part (55 ft. thick) of overlying Placid sh. memb. of Brad fm. of Plummer and Moore. The lowest ls. of the memb. is the ls. that caps the escarpment W. of Winchell, and the top bed of the memb. is the ls. that forms the broad bench about 1 mi. NW. of Winchell on which U. S. G. S. benchmark is set at elev. 1,417. Thickness of memb. ¾ mi. N. of Winchell is 72 ft., but the beds thicken to W. Is top memb. of Graford fm. as here redefined.

Winchester limestone.

Upper and Middle Ordovician: Central Kentucky.

M. R. Campbell, 1898 (U. S. G. S. Richmond folio, No. 46). *Winchester ls.*—Thin-bedded crystalline blue ls. with bands of calc. sh., 200 to 230 ft. thick. Overlain by Garrard ss. and underlain by Flanagan chert.

A. M. Miller, 1905 (Ky. Geol. Surv. Bull. 2, pp. 8–23). *Winchester substage* [restricted].—Blue and gray knotty ls. with some sh. Thickness 40 ft. Underlies 200 ft. of blue sh. and thin lss. forming lower part of Eden stage [and named Million sh. by Nickles in 1905]. Overlies Flanagan chert phase of Lexington group.

The approved definition of Winchester ls. is for beds underlying Eden group and overlying Flanagan ls.

Named for Winchester, Clark Co.

Windegokan series.

Pre-Cambrian: Ontario (east of Lake Nipigon).

T. L. Tanton, 1926 (Canada Geol. Surv. Summ. Rept. 1924, pt. C, p. 4).

E. S. Moore, 1929 (Geol. Soc. Am. Bull., vol. 40, p. 553). Highly folded cgl. found E. of Lake Nipigon, Ont.

Windfall sand.

A subsurface sand of Upper Dev. age in Bradford dist., NW. Pa. (See under *Lewis Run sand.*)

Windigokan.

See *Windegokan.*

Windom shale.

Middle Devonian: Western New York (Lake Erie region).

A. W. Grabau, 1917 (Geol. Soc. Am. Bull., vol. 28, p. 946). In western N. Y. the Tichenor ls. is not seen, and Moscow and Ludlowville shales are together reduced to thickness of 17 ft. at Eighteen Mile Creek. For this 17-foot fm., which has commonly but erroneously been called Moscow sh., I propose *Windom sh.*, from exposures near village of Windom, Erie Co. In western N. Y. the Tully is scarcely represented, although there is a very persistent calc. bed, 4 in. thick and only a few in. below top of Windom sh. at Eighteen Mile Creek and on Lake Erie shore, which may indicate Tully type of sedimentation. The Windom is succeeded at Eighteen Mile Creek by an in. or two of Genesee sh. In western Ont. the beds equiv. to Moscow and Ludlowville shales thicken to 150 ft. In northern Ohio they have been eroded away.

G. A. Cooper, 1930 (Am. Jour. Sci., 5th, vol. 19, p. 232). *Windom memb. of Moscow fm.*—Grabau used this name for the soft gray sh. on Smokes Creek at Windom [Erie Co.] extending from Tichenor ls. (his Morse Creek ls.) upward to the "Pyrite." Traced eastward this sh. comes to overlie the beds here named *Kashong memb. of Moscow fm.*, and greatly increases in thickness, from 17 ft. on Eighteenmile Creek to 50 ft. at type section, 52 ft. in Genesee Valley, 120 ft. in Portland Point Ravine, Cayuga Lake, 165 ft. in Bucktail Ravine at Spafford Valley, and 265 ft. in Unadilla Valley at New Berlin.

Windom member.

Lower Cretaceous (Comanche series): Central Kansas.

W. H. Twenhofel, 1924 (Kans. Geol. Surv. Bull. 9, pp. 31–32). *Windom memb.*—Thin marine lss. near base of Belvidere fm. Two 6-in. layers of gray shell ls. separated by gray sh. The ls. consists almost wholly of shells. Fossils identical with those of Kiowa sh. Thickness 3 ft. Underlies Marquette memb. and overlies Natural Corral memb. All included in Belvidere fm.

Named for extensive occurrence NE. of village of Windom, McPherson Co.

Wind River formation.

Eocene (lower): Western Wyoming (Wind River Basin).

F. V. Hayden, 1862 (Am. Phil. Soc. Trans., n. s., vol. 12, pp. 125–127). *Wind River Valley deposits.*—Throughout Wind River Valley is series of beds, 1,500 to 2,000 ft. thick, which seems to be intermediate in character btw. the true lignite beds of the Tert. and the White River Tert. deposits. From divide btw. the North Platte and the Wind River they occupy greater portion of Wind River Valley. Differ from the other deposits in great predominance of aren. sediments and in absence of vegetable remains, but they contain fragments of turtles and numerous fresh-water and land shells. Rest on the true lignite beds with slight discordance.

F. V. Hayden, 1862 (Am. Jour. Sci., 2d, vol. 33, pp. 310–311). We have already expressed view, in a previous paper, that *Wind River group* is intermediate in age btw. lignite Tert. and White River beds. There is no strict uncon. btw. the lignite beds and Wind River group, but latter incline in same direction, only at a much smaller angle.

F. B. Meek and F. V. Hayden, 1862 (Phila. Acad. Nat. Sci. Proc. 1861, vol. 13, pp. 433, 434, 447). *Wind River group.*—Light-gray and ash-colored sss. with more or less argill. layers. Thickness 1,500 to 2,000 ft. Fossils listed. No marine or brackish-water fossils. Found in Wind River Valley and W. of Wind River Mtns.

Considered older than White River group and younger than Fort Union or Great Lignite group, but not seen in contact with any other Tert.

F. V. Hayden, 1867 (U. S. Geol. Geog. Surv. Terr. 1st Ann. Rept., pp. 162–177 of Rept. of Comr. Gen. Land Office). *Wind River deposits* consist of 1,500 to 2,000 ft. of light-gray and ash-colored sss. with more or less argill. layers. Occur in Wind River Valley, also W. of Wind River Mtns. Fossils listed. Underlie White River group and overlie Fort Union or great lignite deposits.

F. V. Hayden, 1869 (U. S. Geol. Geog. Surv. Terr. 3d Ann. Rept., pp. 89–92). *Wind River deposits* are limited, so far as we now know, to Wind River Valley.

O. St. John, 1883 (U. S. Geol. Geog. Surv. Terr. of Wyo. and Idaho for 1878, pt. 1, pp. 228–269). *Wind River fm.* of Wind River Range contains *Viviparus paludinaiformis*, which elsewhere characterizes Wasatch Tert. horizons. Hence the variegated deposits to which Dr. Hayden gave name *Wind River group*, recognizing their probable Mio. age, are either emphasized variegated upper Wasatch strata or a much later and actually nonconformable memb. of Tert. series peculiar to region N. of Gros Ventre Mtns and E. of Wind River Range.

W. D. Matthew, 1900 (Am. Mus. Nat. Hist. Bull., vol. 12, pp. 20–21). All sediments of Wind River Basin, Wyo., are later than Wasatch and earlier than Bridger. The Wind River fm. (*Bathyopsis* zone) is 800 ft. thick; the Wasatch fm. (*Coryphodon* zone) of Bighorn Basin, Wyo., is 2,000 ft. thick.

W. B. Scott, 1907 (Textbook geol., pp. 731–732). Wind River fauna is a development of the Wasatch, apparently without admixture of foreign elements by immigration.

H. F. Osborn, 1907 (Am. Mus. Nat. Hist. Bull., vol. 23, art. 11, fig. 1, p. 242) and 1909 (U. S. G. S. Bull. 361, pp. 23, 43–48), showed lower 500 ft. (*Lambdotherium* beds) of Wind River fm. = upper part of Wasatch fm., and upper 800 ft. (*Eotitanops* beds) of Wind River to be of post-Wasatch but pre-Bridger age, and reported *Coryphodon* from both upper and lower parts of Wind River fm.

W. J. Sinclair and W. Granger, 1911 (Am. Mus. Nat. Hist. Bull., vol. 30, pp. 87+), divided the Tert. of Wind River Basin into:

Oligocene, 210–528. Eocene: Uinta fm., 90–260	[Probably = White River of early repts.]
Discon. (?). so-called Bridger fm., 20–325 ft. No fossils. Conformable. Wind River group: Lost Cabin fm. (*Lambdotherium* zone). Conformable. Lysite fm., 350+ ft. Wasatch fm. absent.	[Apparently = Wind River of previous repts.]

W. D. Matthew, 1924 (Geol. Soc. Am. Bull., vol. 35, pp. 749–750), divided Wasatch fm. of Bighorn Basin as follows (descending):

Lost Cabin, Lysite } = Wind River group.
Gray Bull.
Sand Coulee.

H. F. Osborn, 1929 (U. S. G. S. Mon. 55), divided *Wind River fm.* of Wind River Basin into (1) Wind River B ("Lost Cabin"), 450 ft., containing *Eotitanops* and *Lambdotherium*; and (2) Wind River A ("Lysite"), 350 ft., consisting of *Heptodon* zone (300 ft. thick) underlain by nonfossiliferous clays with gyp.; and he showed Wind River fm. = upper two faunal zones of Wasatch fm. This is present approved definition of U. S. Geol. Survey.

Wind River Valley deposits.

See 1st entry under *Wind River fm.*

Windrock sandstone.

Pennsylvanian: Northeastern Tennessee (Morgan County).

L. C. Glenn, 1925 (Tenn. Geol. Surv. Bull. 33B, pp. 327–328). [Shows, in cross-country sections from Windrock to American Knob, *Windrock ss.*, a ss. or grit at top of Anderson fm. On American Knob the top of this ss. is 18 ft. below summit; it is 40 ft. thick, and contains occasional gritty quartz pebbles of size of wheat grains.]

Windrow formation.

Cretaceous or Tertiary: Southwestern Wisconsin (Monroe County, Sparta and Tomah quadrangles).

F. T. Thwaites and W. H. Twenhofel, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 133; see also vol. 32, pp. 293–311, 1921). *Windrow fm.*—Widely scattered patches of quartz and chert gravels, with associated limonite deposits, which occur on tops of high elevations throughout the driftless area of upper Miss. Valley and adjacent glaciated area to W. and S. The chert pebbles contain fossils, the youngest of which are certainly Sil. The fm. was river-deposited at a time far antedating the Pleist. and not necessarily connected with peneplanation, but no definite age can be assigned to it.

Named for exposure on top of Windrow Bluff, near Tomah.

Windsor group.

Mississippian: New Brunswick and Nova Scotia.

H. M. Ami, 1900 (Can. Rec. Sci., vol. 8, p. 160). *Windsor fm.*, Carbf.

C. Schuchert and C. O. Dunbar, 1933 (Textbook geol., pt. 2, p. 227). *Windsor group* corresponds to Mauch Chunk sh. (of Chester age) of Appalachian region.

Windy Arm series.

Age (?): Yukon Territory.

D. D. Cairnes, 1908 (Canada Dept. Mines, Geol. Surv. Branch, Pub. 982, pp. 23, 29).

Windy Gap limestone member (of Greene formation).

Permian: Southwestern Pennsylvania and northern West Virginia.

I. C. White, 1891 (U. S. G. S. Bull. 65, pp. 24, 30). *Windy Gap ls.*, 4 to 5 ft. thick, lies 25 to 30 ft. above Windy Gap coal in Greene Co., Pa. Included in Dunkard Creek series [Dunkard group].

Named for Windy Gap, a divide separating Laurel Run branch of Fish Creek from waters of Wheeling Creek, in Springfield Twp, Greene Co., Pa.

Windy Gulch rhyolite breccia. (In Potosi volcanic series.)

Miocene: Southwestern Colorado (Creede district).

W. H. Emmons and E. S. Larsen, 1923 (U. S. G. S. Bull. 718). A rhyolite breccia, made up of light-colored rhyolite, in part an ordinary tuff, in part a normal flow rock, but chiefly a breccia, probably a flow breccia, in lower part of Piedra group of Potosi volcanic series. Underlies the tridymite latite of Piedra group in drainage basin of Windy Gulch and to W. Characterized by porous character and abundant fragments of pumice. Thickness 100 to 200+ ft.

Windy Point granite.

Pre-Cambrian: Eastern Colorado (Pikes Peak region).

G. I. Finlay, 1916 (U. S. G. S. Colorado Springs folio, No. 203). *Windy Point granite.*—Holocrystalline and fine-grained. Forms summit of Pikes Peak. Appears to have been intruded into Pikes Peak granite. Does not extend into Colorado Springs quad.

Winfield limestone. (In Chase group.)

Permian: Eastern Kansas, southeastern Nebraska, and central northern Oklahoma.

C. S. Prosser, 1897 (Kans. Univ. Geol. Surv. vol. 2, pp. 64–66). *Winfield concretionary ls.*—Ls., 13 ft. thick, heretofore called Marion concretionary ls. Top memb. of Chase fm.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 715). *Winfield fm.*—Massive concretionary ls. [Winfield concretionary ls. of previous repts] at top; yellowish shales in middle; and cherty ls. [†Marion flint] at base. Thickness 25 ft. Overlies Doyle shales and underlies Marion fm. [This expanded definition of Winfield ls. was followed by Kans. Geol. Survey and U. S. Geol. Survey until 1929.]

N. W. Bass, 1929 (Kans. Geol. Surv. Bull. 12, p. 87, in cooperation with U. S. Geol. Survey), applied *Winfield ls.* to 10 or 11 ft. of massive ls. in Cowley Co., Kans., which "probably corresponds to the 'massive concretionary ls.' of Prosser, which he described as occurring at the top of his Winfield fm. The lower part of his Winfield fm. may then correspond to upper part of Doyle sh. as herein described, the basal cherty ls. ('Marion flint') being absent in southern Kans."

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser.), divided *Winfield fm.* into 3 members (descending)—Cresswell ls. ("concretionary ls." of early repts), Grant sh., and Stovall ls.—with a combined thickness of 26 ft., apparently following Prosser's definition. They also divided underlying *Doyle fm.* into 3 named members, aggregating 66 ft. in thickness.

R. C. Moore, 1936 (Kans. Geol. Soc. 10th Ann. Field Conf. Guidebook, p. 12), treated Luta ls. as top memb. of Winfield ls. and treated Condra's members of Doyle sh. as fms., dropping *Doyle*.

These recent reports (which apparently follow Prosser's 1902 definitions of *Winfield* and *Doyle*) have not yet been considered by U. S. Geol. Survey for its publications.

Named for exposures around Winfield, Cowley Co., Kans.

†Winfield formation.

See under *Winfield ls.*

†Winfield dolomite.

Lower Ordovician: Central eastern Missouri and southwestern Illinois.

C. R. Keyes, 1898 (Iowa Acad. Sci. Proc., vol. 5, pp. 59, 60). *Winfield dol.*—Deep buff, somewhat earthy mag. ls., rather heavily bedded and containing some sandy material; apparently unfossiliferous. Thickness 40 ft. Oldest bed exposed along the Mississippi btw. Missouri River and northern Iowa. Underlies Cap au Gres [St. Peter] ss. in Lincoln Co., Mo., and across the river in Ill.

Now classified by Mo. Geol. Surv. as same as Cotter dol.

Named for Winfield, Lincoln Co., Mo.

Wing conglomerate.

Lower Ordovician (Beekmantown): Northwestern Vermont (Champlain Valley).

H. M. Seely, 1906 (5th Rept. Vt. State Geol., pp. 174–187). *Wing cgl.* is the "cgl. bed" of Rev. A. Wing. Belongs to Beekmantown, but exact horizon uncertain. Believed to lie near top of Div. D.

Wingate sandstone. (In Glen Canyon group.)

Jurassic (?): Western New Mexico, northeastern Arizona, southeastern Utah, and southwestern and western Colorado.

C. E. Dutton, 1885 (U. S. G. S. 6th Ann. Rept., pl. 16, p. 136). *Wingate sss.*—Bright-red sss., 450 ft. thick. Underlie Zuni sss. in Zuni Plateau, N. Mex., and are separated from underlying Shinarump cgl. by 1,450 to 1,550 ft. of red sh. and sandy sh. [later named *Chinle fm.*].

H. E. Gregory, 1917 (U. S. G. S. P. P. 93), gave detailed description of Wingate ss. in Navajo country, and applied *Todilto fm.* to the beds separating it from the younger Navajo ss., and *Chinle fm.* to the underlying beds.

Subsequent work showed that the Todilto at its type loc. in NW. N. Mex. is basal memb. of Morrison fm., but that in SE. Utah and parts of SW. Colo. the Morrison is separated from the Wingate ss. by several intervening fms., in descending order Summerville, Curtis, Entrada, Carmel, Navajo, and Kayenta. (See A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., U. S. G. S. P. P. 183, 1936.)

Winifrede sandstones. (In Kanawha formation.)

Pennsylvanian: West Virginia.

I. C. White, 1908 (W. Va. Geol. Surv. vol. 2A, pp. 271, 430). *Upper Winifrede ss.*—Massive yellowish-gray ss., coarse in upper half but close and fine-grained below; 50 to 80 ft. thick. Lies 10 to 20 ft. below Coalburg coal and rests on Winifrede coal. *Lower Winifrede ss.*—Grayish-white hard, often massive ss., 20 to 40 ft. thick. Rests uncon. on Chilton ss. and lies 5 to 15 ft. below Winifrede coal. [Probably named for occurrence at Winifrede, Kanawha Co.]

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Winifrede limestone. (In Kanawha formation.)

Pennsylvanian: Southern West Virginia.

R. V. Hennen, 1914 (W. Va. Geol. Surv. Rept. Kanawha Co., pp. xxvi, 641). *Winifrede ls.*—Impure ls., ½ to 1 ft. thick, containing fossil shells. Overlies Upper Chilton ss. and is separated from overlying Chilton A coal by 5 to 19 ft. of fire clay and sh. The weathered ls., not in place, was found 1 mi. S. of Winifrede, on Fields Creek, North Hollow, 100 yds. E. of mouth of South Hollow, Kanawha Co.

Winkler Ford limestone member (of Grape Creek formation).

Permian: Central Texas (Concho County).

W. Kramer, 1934 (A. A. P. G. Bull., vol. 18, No. 12, p. 1581). A 1-ft. bed of dark-gray ls. lying 670 ft. above Coleman Junction ls. makes a ledge btw. Millersview and Concho River. This bed might be called *Winkler Ford memb.*, for it crops out (0.1 mi. S. of NW. corner Elizabeth Aurand survey No. 1861) on road 1.2 mi. SE. of that crossing on Concho River.

Winnebago shale.

Pennsylvanian: Southeastern Nebraska and northeastern Kansas.

See under *South Fork ls.*

Winneshiek limestone.

Lower Ordovician: Iowa.

C. [R.] Keyes, 1934 (Pan-Am. Geol., vol. 61, No. 3, p. 240). The Willow [River] beds at type loc. may possibly therefore represent only not more than ¼ of southern section, the rest being removed through planation before the Peter [St. Peter] ss. was laid down. In its max. development in Iowa, some such term as *Winneshiek dol.* would be really more appropriate.

†Winnfield limestone.

Upper Cretaceous (?): Northwestern Louisiana.

G. D. Harris and A. C. Veatch, 1899 (La. Geol. Surv. pt. 5, Rept. for 1899, pp. 56–59). *Winnfield ls.*—Highly crystalline ls., full of cracks, pockets, and joints, shows whitish and bluish bands of various shades. No fossils found, but included in Ripley stage of Upper Cret.

Named for Winnfield, Winn Co., where it is quarried.

According to M. I. Goldman (personal communication, Dec. 1936) the rock to which this name was applied is a calcite cap rock.

Winnipeg sandstone.

Ordovician: Manitoba.

D. B. Dowling, 1896 (Ottawa Field Nat. Club Trans. 1895–96, vol. 11, pp. 67–68).

Winnipeg limestone.

Ordovician: Ontario.

A. C. Lawson, 1912 (Canada Geol. Surv. Summ. Rept. 1911, p. 243).

Winnipegosan formation.

Winnipegosis formation.

Devonian: Manitoba.

J. B. Tyrrell, 1893 (Canada Geol. Surv., n. s., vol. 5, pt. 1, pp. 144E–199E). Winnipegosan fm., Dev., Manitoba.

R. C. Wallace, 1915 (Canada Geol. Surv. Summ. Rept. 1914, p. 77). [Both spellings are used in this rept., which states that the beds are exposed at Graves Point, Lake Winnipegosis.]

Winnipeg River granite.

Pre-Cambrian: Ontario.

E. M. J. Burwash, 1923 (Ont. Dept. Mines 32d Ann. Rept., pt. 2, p. 7).

†Winnipesaukee gneiss.

See under *Lake Winnipesaukee gneiss.*

[library stamp]

Winoka gravel.

Pliocene: Southwestern Missouri.

Emma J. Park, Mabel Hays, and E. M. Shepard, 1904 (Bradley Geol. Field Sta. Drury Coll. Bull. 1, pt. 1, pp. 14, 19, 41). *Winoka gravel.*—Scattered deposits of orange-brown to grayish-yellow river gravel, 50 ft. thick, occurring for most part on hilltops and hillsides far above present stream beds. Rests on Upper Burlington ls. except in one area, where it rests on Chouteau ls. Assigned to Tert. [Later rept by E. M. Shepard assigned this gravel to Plio. and stated it is same as so-called "Lafayette."]

Named for exposures at Winoka, Greene or Christian Co.

Winona conglomerate.

Pre-Cambrian (Keweenawan): Northern Michigan.

A. C. Lane, 1911 (Mich. Geol. and Biol. Surv. Pub. 6, geol. ser. 4, pp. 547, 563, 566, 576, 982, fig. 42). *Winona cgl.* is same as Marvine's cgl. No. 8.

Is generally regarded as same as Bohemia cgl., top fm. of Bohemian Range group.

Named for occurrence in Winona mine, Houghton Co.

Winona amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Probably same as Isle Royale amygdaloid. The mineralized part is the Winona lode. Named for occurrence in Winona mine, Houghton Co. Belongs to Central Mine group.

Winona flow.

Includes Winona amygdaloid and underlying trap.

Winona sand member (of Lisbon formation).

Eocene (middle): Mississippi.

E. N. Lowe, 1919 (Miss. Geol. Surv. Bull. 14, p. 73). *Winona sand.*—In NW. Miss. consists of approx. 350 ft. of highly glauconitic marine sands and clayey sands, locally abundantly fossiliferous. In eastern Miss. the materials change to white and yellowish coarse sand, frequently cross-bedded and nonfossiliferous. Near Meridian only 75 to 100 ft. thick. Especially well developed around Winona, Vaiden, and eastward in adjacent counties. Included in Tallahatta fm., as basal memb. Conformably underlies Basic claystone.

C. W. Cooke, 1925 (U. S. G. S. P. P. 140). *Winona sand memb.* redefined so as to include typical Winona sand of Montgomery Co. and typical "Enterprise marl" of Clarke Co., but to exclude the sands at base of Tallahatta fm. in Lauderdale Co., Miss., which were formerly erroneously supposed to be same as the much younger sand at Winona. Is basal memb. of Lisbon fm. in Miss.

Named for development at Winona, Montgomery Co.

Winooski marble.

Lower Cambrian: Northwestern Vermont (Chittenden County).

E. Hitchcock, 1861 (Rept. Geol. Vt., vol. 1), designated the basal 40 ft. of his Red Sandrock series as *Winooski marble*, "not to multiply local designations, but to designate a peculiar variety of the Red Sandrock series, using the name by which it is known in economic geol." Subsequent repts on geol. of Vt. frequently contained references to *Winooski marble*.

G. H. Perkins, 1885 (Am. Nat., vol. 19, pp. 128-136), in a description of Swanton, Vt., described the *Winooski or Wakefield marble* as consisting of 370 ft. of white and red dol. with sandy layers, some strata mottled rose red and white and a few brick red or Indian red, and as containing fossils.

A. Keith, 1923 (Am. Jour. Sci., 5th, vol. 5, p. 108). *Winooski marble.*—Outcrops in nearly continuous belts from Snake Mtn to Canada. The name is a very old one, given for fine exposures along Winooski River in Burlington, where marble was first quarried from the fm. and is still obtained from other quarries near Swanton. The fm. is mainly dol., of prevailing red or pink mottled color; interbedded with these colored beds are considerable layers of light-gray dol. A few of gray beds are rather coarsely crystalline, but most of the dolomites, both gray and colored, are very dense and have marked conchoidal fracture. The characteristic feature of the dol. is a very marked wavy, lumpy surface for the individual layers. At base the dol. is interbedded with qtzite layers for 50 ft., forming transition into underlying Monkton qtzite. Just below top of the Winooski there is a marked horizon, 9 ft. thick, of red, buff, and purple qtzite layers interbedded with pink and buff mottled fine-grained dol. In the pink dol. just above this qtzite there are a few inches of edgewise cgl. containing thin, flat dol. pebbles. The qtzite layers at this horizon form broad, flat surfaces like those of Monkton qtzite, which they strongly resemble, and also show ripple marks, mud cracks, and annelid trails. These beds and the underlying mottled pink or purple dolomites aggregating 85 ft. are well exposed at Winooski Falls in Burlington. There is abrupt change above topmost qtzite of the fm. to the massive gray beds of overlying Mallett dol. Thickness of fm. 100± on E. side of Snake Mtn to 400 ft. about 12 mi. N. of Burlington.

†Winslow formation.

Pennsylvanian: Northwestern Arkansas and northeastern Oklahoma.

G. I. Adams, 1904 (U. S. G. S. P. P. 24, p. 29). *Winslow fm.*—The rocks in northern Ark. which have usually been called *Millstone grit.* Base of fm. at most localities characterized by presence of quartz pebbles. Attains great thickness in Boston Mtns. Upper limit not definitely determined. Contains much more ss. than underlying Morrow fm., and the beds are often massive and exposed in heavy ledges which give rise to escarpments. No persistent ls. beds so far as known. The sss. have not yielded fossils, although they undoubtedly contain fossils in some places.

G. I. Adams and E. O. Ulrich, 1905 (U. S. G. S. Fayetteville, Ark., folio, No. 119) gave thickness of *Winslow fm.* in that quad. as 100+ ft., and stated that it appeared to be uncon. on underlying Morrow fm. and that its top was eroded.

J. A. Taff, 1905 (U. S. G. S. Tahlequah, Okla., folio, No. 122), mapped *Winslow fm.* in eastern Okla., where he applied the name to 1,100 ft. of strata uncon. overlying Morrow fm. and composing the youngest fm. in that area. In 1906 (U. S. G. S. Muscogee, Okla., folio, No. 132) Taff mapped as *Winslow fm.* 800 to 1,000 ft. of strata underlying what he mapped as Boggy fm. and uncon. overlying Morrow fm. In latter folio he stated that his Winslow fm. was = Atoka, Hartshorne, and McAlester fms. of other areas in Okla.

A. H. Purdue, 1907 (U. S. G. S. Winslow, Ark., folio, No. 154), mapped *Winslow fm.* in its type area, gave its thickness as 2,300± ft., stated that it rested conformably on the Morrow, and that it was overlain by alluvium.

The strata included in Winslow fm. are of late Pottsville and early Allegheny age. That it is a blanket term covering rocks susceptible of subdivision into several fms. has long been recognized by J. A. Taff, C. Croneis (Ark. Geol. Surv. Bull. 3, 1930), and other geologists. According to field work of B. Parks and T. A. Hendricks, all of it that is present in Fayetteville quad. is now known to belong to Atoka fm. In Winslow quad. it included Atoka fm., Hartshorne ss., and lower part of McAlester fm.; and as used in some other areas it included, in addition, upper part of McAlester fm., the overlying Savanna ss., and at least the lower part of Boggy sh. This blanket name has therefore been discarded. (See references under *Akins sh. memb.*)

Named for exposures at and around Winslow, Ark.

Winslow shale.

Lower Triassic: Northeastern Arizona.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 250, 339). Name *Winslow shales* is given to 3d sh. bed of Ward's Moenkopian series, exposed in Rio Chiquito Colorado Valley, at mouth of Rio Puerco, Navajo and Coconino Counties, Ariz. Thickness 200 ft.

Derivation of name not stated. Mouth of Rio Puerco is in Navajo Co., near Holbrook, a considerable distance E. of Winslow.

Winston dolomite.

Silurian (pre-Niagaran): Northeastern Iowa and northwestern Illinois.

T. E. Savage, 1914 (Am. Jour. Sci., 4th, vol. 38, pp. 34–37). *Winston ls.*—Yellow earthy fine-grained dol., in rather thin even layers, 22 ft. thick, with 6 in. of conspicuously laminated bluish calc. and shaly ss. at base. Uncon. overlies Maquoketa sh. and underlies Waucoma ls. Represents about same period of deposition as Edgewood fm. but thought to belong to a northern province. Lower fm. of Alexandrian series.

T. E. Savage, 1926 (Geol. Soc. Am. Bull., vol. 37, pp. 526+), discarded his *Winston ls.*, being satisfied it is same as Edgewood ls., which has priority. (See 1926 entry under *Waucoma ls.*)

Named for Winston, Jo Daviess Co., Ill.

Winters clay. (In Allegheny formation.)

Name applied to plastic clay, 3 ft. 7 in. thick, underlying Winters coal in Vinton Co., Ohio. (See W. Stout, Ohio Geol. Surv., 4th ser., Bull. 31, 1927.)

Winterset limestone. (In Kansas City group, Kansas.)

Winterset limestone member (of Kansas City formation, Missouri).

Pennsylvanian: Western Iowa and Missouri, eastern Kansas, and southeastern Nebraska.

J. L. Tilton, 1897 (Iowa Acad. Sci. Proc., vol. 4, pp. 48–54). *Winterset ls.*—Alternating lss. and shales, with some ss., representing Missourian stage in Madison Co., Iowa. Thickness about 30 ft.

J. L. Tilton and H. F. Bain, 1897 (Iowa Geol. Surv. vol. 7, pp. 517–519). *Winterset ls.*, 12 ft. thick, is separated from overlying *Fusulina* [DeKalb] ls. by a sh. bed and from underlying Earlham [Bethany Falls] ls. by 8 ft. of sh. [Galesburg sh. memb.].

For many years the generally accepted definition of Winterset ls. was a memb. of Kansas City fm. underlying Cherryvale sh. memb. and overlying Galesburg sh. memb.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 91, 97), stated that *Winterset ls.* of his present revised classification of rocks of Kans. is "the same as previously recognized in Kans. and Mo.;" it is top memb. of Dennis ls. as here defined; the sh. underlying it is younger than Galesburg sh. and is here named Stark sh.; the Stark sh. is separated from true Galesburg sh. by a ls. here named *Canville ls.*

See under *Dennis ls.*

Named for exposures at Winterset, Madison Co., Iowa

Winthrop sandstone.

Cretaceous: Central northern Washington.

I. C. Russell, 1900 (U. S. G. S. 20th Ann. Rept., pt. 2, pp. 100–137). *Winthrop ss.*—Nearly white massive arkose ss. and light-gray sandy shales. Thickness 2,000+ ft. Fossil leaves (Cret.). Finely exposed on N. border of Methow Valley, 5± mi. NW. of Winthrop, Okanogan Co.

Winzeler shale.

Pennsylvanian: Eastern Kansas, southwestern Iowa, and southeastern Nebraska.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 94, 96). [See under *Bachelor Creek ls.* On p. 20 *Winzeler sh.* is described as consisting of 5 ft. of light-bluish sandy sh.; on p. 21 it is described as 3.15 ft. of yellowish-gray clayey calc. sh.]

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 208). *Winzeler sh.* overlies Church ls. and underlies Utopia ls. It is 3 to 8 ft. thick, bluish gray or yellowish and clayey to calc. Marine fauna in lower part. Is recognizable from Nebr. and Iowa to Okla., but locally, where Utopia ls. disappears, the beds immediately overlying Church ls. are classed as White Cloud sh. Type loc., Winzeler farm, sec. 4, T. 26 S., R. 11 E., Greenwood Co., Kans.

Wirtemburg limestone.
Wirtemburg sandstone.
See *Wurtemburg*.

Wisconsin stage of glaciation, also **Wisconsin drift** (Pleistocene).

Wisconsin stage is name applied to last stage of glaciation, which has usually been divided into two substages, called *early Wisconsin* and *late Wisconsin*. Three substages (early, middle, and late Wisconsin) are, however, now recognized by Leverett (Moraines and shore lines of Lake Superior Region, U. S. G. S. P. P. 154A, 1929). The name was proposed by T. C. Chamberlin (Great ice age, by James Geikie, 3d ed., pp. 754–775, 1894) in the form *East Wisconsin stage of glaciation* for the time, and *East Wisconsin fm.* for the deposits, because of their development in eastern Wis. In 1895 (Jour. Geol., vol. 3, pp. 270–277) Chamberlin, upon the suggestion of Upham, shortened the name to *Wisconsin*. In 1931 (Jour. Geol., vol. 39, pp. 51–53) M. M. Leighton proposed to "reclassify the Iowan and Wisconsin drifts" by including in the Wisconsin the Peorian loess and the underlying Iowan drift. He also introduced *Hudsonian substage* for the late Wisconsin drift, *Quebecan substage* for the early and middle Wisconsin drift, and applied the new name *Manitoban substage* to the Iowan drift. (See under †*Manitoban substage*.) In 1933, however (Sci., vol. 77, p. 168), he withdrew his proposed names Hudsonian, Quebecan, and Manitoban, and proposed the following subdivisions of his Wisconsin (or fourth) glacial "age": Mankato (late Wisconsin), Cary (middle Wisconsin), Tazewell (early Wisconsin), and *Iowan* (oldest Wisconsin). F. Leverett, 1933 (Sci., vol. 77, p. 560), objected to introduction of Mankato, Cary, and Tazewell. (See under *Mankato substage*.) In 1931 (Geol. Soc. Am. Bull., vol. 42, pt. 1, pp. 449+) G. F. Kay introduced *Eldoran epoch* to include Wisconsin, Peorian, and Iowan. In 1933 (Geol. Soc. Am. Bull., vol. 44, pp. 669–673, August 31) Kay and Leighton proposed the following classification for Mississippi Valley:

- Pleistocene or Glacial period (system):
  - Eldoran epoch (series): [Redefined to include Recent.]
    - Recent age (stage).
    - Wisconsin age (stage):
      - Mankato substage (Late Wisconsin).
      - Cary substage (Middle Wisconsin).
      - Tazewell substage (Early Wisconsin).
      - Iowan substage.
  - Centralian epoch (series):
    - Sangamon age (stage).
    - Illinoian age (stage).
  - Ottumwan epoch (series):
    - Yarmouth age (stage).
    - Kansan age (stage).
  - Grandian epoch (series):
    - Aftonian age (stage).
    - Nebraskan age (stage).

Regarding Peorian they stated: The name *Peorian* will continue to be used in Iowa for the widespread loess which lies on the Iowan drift and around its border and beneath the Mankato (Late Wisconsin) drift; and in Ill. for the widespread loess which lies above the Late Sangamon loess outside of Tazewell drift. Within the border of Tazewell drift the *loess* which immediately underlies it may be called *Iowan*, as originally proposed, and the loess which overlies it the *Tazewell* loess. These two loesses are indistinguishable outside of the Tazewell drift border and compose the Peorian loess.

†Wisconsin Valley slates.

Pre-Cambrian (Huronian): Central northern Wisconsin (upper part of Wisconsin River).

C. R. Van Hise, 1892 (U. S. G. S. Bull. 86, pl. 3, map), and R. D. Irving, 1892 (U. S. G. S. Mon. 19, pl. 1, map). *Wisconsin Valley slates* mapped along upper part of Wisconsin River and assigned to Huronian.

The U. S. Geol. Survey does not now use this name, but uses *slates of Wisconsin Valley*, in a geographic sense.

Wiscoy shale (also **Wiscoy sandstone**).

Upper Devonian: Western and west-central New York.

J. M. Clarke, 1899 (N. Y. State Mus. 16th Ann. Rept., pp. 31–41). *Wiscoy beds*.—Shales and sands overlying Portage [Nunda] sss. in Genesee River section. Contain normal Portage or Naples fauna.

D. D. Luther, 1902 (N. Y. State Mus. Bull. 52, p. 619). *Wiscoy shales*.—Mainly soft sh., bluish and argill., or olive and sandy, with, occasionally, thin black layers, a few flags or thin sss., and calc. concretions. Thickness 150 ft. Top fm. of Portage or Nunda group. Overlain by band of flags and thin sss. that form "Long Beards riffs" [Long Beards Riffs ss.] and contain fossils of Chemung group in Genesee River section. Underlain by Portage [Nunda] sss.

J. M. Clarke and D. D. Luther, 1904. See 1904 item under *Prattsburg*.

J. M. Clarke and D. D. Luther, 1905 (N. Y. State Mus. Bull. 81). *Wiscoy sh.* can be traced W. to Lake Erie, showing little change in lithologic character and fauna, but eastward the fauna is more aren., and S. of Dansville, 25 mi. E. of Wiscoy, the fm. is mainly laminated ss. crowded with brachiopods. So conspicuous is its development from Dansville eastward, and so profuse and striking its development of *Chemung* brachiopod fauna, that on map of Naples quad. it was deemed advisable to apply to it the term *Prattsburg ss. and sh.*, inasmuch as there has been this fundamental change in nature of fauna.

Later repts by Luther give thickness of 170 to 190 ft. in Wyoming and Erie Counties.

See Luther, 1906, under *Prattsburg*.

C. A. Hartnagel, 1912 (N. Y. State Mus. Hdb. 19, p. 79). *Wiscoy sh. and sands*.—Top div. of Portage beds in western and west-central N. Y. Named from exposure at falls of Wiscoy Creek, Allegany Co.

G. H. Chadwick, 1923 (Geol. Soc. Am. Bull., vol. 34, p. 69). *Wiscoy sh.* is overlain by Canaseraga ss. in Allegany Co. and by equiv. Dunkirk sh. (including Long Beard Riffs ss. in lower part) in Cattaraugus Co. Is of Portage age.

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, p. 369). *Wiscoy sh.* underlies Dunkirk sh. (of Chemung group) and overlies Nunda ss. Is top fm. of Portage group.

G. H. Chadwick, 1933 (Pan-Am. Geol., vol. 60, pp. 193, etc.). *Wiscoy sh.* is = Hanover sh. (above) and Pipe Creek sh. (below). Included in Nunda [Portage] group.

In Steuben and adjacent counties of south-central N. Y. the Wiscoy is ss. and is called *Wiscoy ss.* To W. it is sh. and is called *Wiscoy sh.*

Wise formation. (In Pottsville group.)

Pennsylvanian: Southeastern Kentucky and southwestern Virginia.

M. R. Campbell, 1893 (U. S. G. S. Bull. 111, pp. 28, 34). *Wise fm.*—Shales and sss., with clays and coal beds, 1,270 ft. thick, in upper part of Coal Measures of Bigstone Gap coal field of Va. and Ky. Underlain by Gladeville ss. and overlain by Harlan ss.

Belongs to upper part of Pottsville group.

Named for Wise Co., Va.

Wiser sand.

A subsurface sand, of Penn. age and 0 to 60 ft. thick, in central northern Okla., which is correlated with a part of Oologah ls. In Wiser pool.

Osage Co., the producing sands are called Wayside (at 750 ft. depth), Bartlesville (at 1,475 ft. depth), and Burgess (at 1,700 ft. depth).

Wissakickon schist.

Wissahickon formation.

Pre-Cambrian (Glenarm series): Southeastern Pennsylvania, northern Maryland, and across Virginia.

F. Bascom, 1902 (Md. Geol. Surv. Cecil Co. Rept., pp. 104-108). *Wissahickon mica gneiss.*—The gneisses of Phila. belt of crystallines (Chestnut Hill, Manayunk, and Philadelphia schist and gneisses) are divisible into a mica gneiss of sed. origin and several presumably intrusive igneous bodies—peridotites and pyroxenites, largely represented now by serpentines, gabbro, and norite, and two granite gneisses. The fm. into which these igneous rocks have been intruded is a mica gneiss, provisionally named *Wissahickon gneiss*, from creek along banks of which it is finely exposed.

F. Bascom, 1904 (U. S. G. S. W. S. P. 106). *Wissahickon mica gneiss and mica schist (Hudson).*—A crystalline bedded fm., which outcrops in a NE.-SW. belt. The mica gneiss extends from Delaware River to Chestnut Hill. Toward N. the fm. becomes a mica schist, which forms the south Chester Valley hills and immediately overlies Chester Valley ls.

F. Bascom, 1909 (U. S. G. S. Phila. folio, No. 162), introduced *Octoraro schist* to replace Wissahickon mica schist, which was stated to be younger than Wissahickon mica gneiss, to overlie Shenandoah ls., and to be of Ord. age, while Wissahickon mica gneiss was assigned to pre-Camb.

A. I. Jonas and E. B. Knopf, 1921 (Wash. Acad. Sci. Jour., vol. 11, p. 447). An upper memb. of Wissahickon fm. that is less highly anamorphosed than the Wissahickon itself has been separated and named by the writers the *Peters Creek schist.*

E. B. Knopf and A. I. Jonas, 1923 (Am. Jour. Sci., 5th, vol. 5, pp. 40-62). *Wissahickon fm.* (as now restricted) consists of two contemp. facies, one here called the oligoclase-mica schist facies and the other here called the albite-chlorite schist facies. Overlying the oligoclase-mica schist and grading into it through a phyllitic zone is fm. named by writers *Peters Creek schist.* It is a series of chloritic and sericitic qtzites interbedded with chlorite-muscovite schist and grading toward top into mildly anamorphosed quartzose and conglomeratic sediments. It comprises part of what was originally mapped as *Wissahickon gneiss* and part of *Octoraro schist.* The *Peters Creek schist* grades upward into Cardiff cgl. The Wissahickon fm. rests on Cockeysville marble. All included in Glenarm series.

A. I. Jonas, 1928 (Va. Geol. Surv. prel. ed. of geol. map of Va.), mapped *Wissahickon schist* entirely across Va., to N. C. line.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, p. 34). Work by writers in Md. and Pa., along Susquehanna River section, shows that the pre-Camb. Wissahickon gneiss N. of Phoenix anticline in Md., where the fm. is oligoclase-biotite schist, dips under a synclinal fold of Peters Creek schist and reappears from under N. limb of the syncline in a different mineralogic facies, the albite-chlorite schist. It was thus shown that "Octoraro schist" is not a strat. unit and that the fms. which made up the old "Octoraro schist" are part of a conformable sequence of pre-Camb. rocks of Glenarm series.

In southern Pa., on Susquehanna River, the Peters Creek schist is 2,000 ft. thick and the Wissahickon restricted is estimated to be 8,000 to 10,000 ft. thick. The fm. was formerly classified by U. S. Geol. Survey as of Algonkian age, but that term having been discarded as a time term the fm. is now classified as *pre-Camb.*

Witnet formation.

Tertiary (pre-Miocene): Southern California (northeastern part of Kern County).

J. P. Buwalda, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 310). *Witnet fm.*—Many hundred ft. of arkosic cgl. and coarse ss., overturned and overthrust by pre-Cretacic crystalline rocks from the SE. Is pre-Mio. Tert. Occurs NE. of Monolith [NE. part of Kern Co.]. At type section, along N. side of lower Oil Canyon, overlain with strong angular uncon. by Kinnick fm. (Lower Mio.). [Derivation of name not stated.]

Wittenberg shale.

Middle Devonian: Southeastern Missouri.

C. Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, p. 253). *Wittenberg terrane.*—Shales, 30 ft. thick, uncon. underlying Callaway ls. and uncon. overlying Grand Tower ls.

Probably named for Wittenberg, Perry Co.

Wittenberg conglomerate.

Upper Devonian: Southeastern New York (Ulster County?).

See Feb. 1935 entry (G. H. Chadwick) under *Slide Mtn cgl.*

Wizard Wells limestone. (In Graford formation.)

Pennsylvanian: Central northern Texas (Wise County).

J. M. Armstrong and G. Scott, 1930 (Tex. Bur. Econ. Geol. map of Wise Co.). *Wizard Wells ls.* is top part of Graford fm. Overlies Rock Hill ls.

E. H. Sellards, 1933 (Tex. Univ. Bull. 3232, p. 105). *Wizard Wells ls.* is same as Devils Den ls. and is discarded.

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, p. 24), showed *Wizard Wells ls.* of Wise Co. as much older than Clear Creek ls., as somewhat older than Merriman ls., as=basal part of Brad fm. of Colorado River Valley, and as, in part of its area, extending downward to a thickness, locally, of 370 ft., with its base slightly higher than Rock Hill ls.

Woburn formation.

Pre-Cambrian: Eastern Massachusetts (Boston quadrangle).

L. LaForge, 1932 (U. S. G. S. Bull. 839). *Woburn fm.*—A complex of felsic igneous rocks, probably chiefly volcanic, and interbedded siliceous sediments. Most of the igneous rocks are highly siliceous and well laminated and have frequently been taken for and mapped as qtzite, for which reason the fm. has often been confused with Westboro qtzite. Rhyolite and dacite are predominating rock types, although there are some sparsely porphyritic varieties that are probably andesitic. Seems to overlie Marlboro fm. and to be youngest of supposed pre-Camb. fms. of Boston region. Thickness uncertain, but average is probably about 500 ft. Named for good exposures in SW. part of Woburn.

Wolcott limestone member (of Clinton formation).

Silurian: Central and western New York and Ontario.

J. M. Clarke, 1906 (N. Y. State Mus. 2d Rept. Dir. Sci. Div., 1905, p. 12). [See under *Irondequoit ls.*]

C. A. Hartnagel, 1907 (N. Y. State Mus. Bull. 114, pp. 5–35). *Wolcott ls.*, 14 ft thick in Rochester and Ontario Beach quads., has appearance of crystalline ls. Included in Clinton fm. Underlies Williamson sh. and overlies Furnaceville ore. Named for Wolcott, Wayne Co. [In Niagara quad. is 6–10+ ft. thick.]

G. H. Chadwick, 1908 (Sci., n. s., vol. 28, pp. 346–348). Furnaceville ore bed lies *in* and not *below* Wolcott ls. [See under *Furnaceville iron ore.*] The true *Pentamerus* ls. of Wolcott Furnace must inherit the name *Wolcott ls.*

C. Schuchert, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 314), identified 8 ft. 8 in. of *Wolcott ls.* at Hamilton, also at other places in Ont., underlying Irondequoit ls.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368), showed *true Wolcott ls.* absent at Rochester, where the much older Reynales ls. was mistaken for the Wolcott by Hartnagel. See further explanation under *Williamson sh.*, 1918 entry.

E. O. Ulrich, 1923 (Md. Geol. Surv. Sil. vol., pp. 191, 347, etc.), placed *Wolcott ls.* uncon. below Williamson sh. and above Sodus sh., which is position assigned to it by W. Goldring, 1931 (N. Y. State Mus. Hdb. 10).

Wolcott Furnace iron ore.

Silurian: Central New York.

G. H. Chadwick, 1918 (Geol. Soc. Am. Bull., vol. 29, pp. 327–368). Ore bed that crops out at old Wolcott Furnace on Wolcott Creek, 1 mi. N. of Wolcott village [Wayne Co.]. Is of limited extent even in wells. Lies btw. true Williamson sh. above and true Wolcott ls. below. [Is a memb. of Clinton fm.]

W. Goldring, 1931 (N. Y. State Mus. Hdb. 10, pp. 317, 326), stated that *Wolcott Furnace ore bed* occurs at base of Williamson sh.

Wolf porphyry.

Post-Cretaceous: Central northern Montana (Fort Benton quadrangle).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Wolf porphyry.*—Typical granite porphyry, white to pinkish when fresh, weathering greenish or rust-colored. Forms intrusive mass of Wolf Butte, the peak S. of it, and Mixes Baldy, E. of Barker. Differs from Barker porphyry.

Wolf formation.

Pre-Cambrian: Southern British Columbia and northeastern Washington.

R. A. Daly, 1912 (Canada Geol. Surv., Dept. Mines Mem. 38, map 7, 117° to 117°30'). *Wolf fm.*—Massive gray grit and arkose in very thick beds; subordinate ss.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 150, 178, 194). *Wolf fm.*—Siliceous heavy-bedded grits, sss., and fine-grained cgls. 2,900 ft. thick. Exposed from Mount Ripple N. to headwaters of Wolf Creek, in Selkirk Mtns, B. C., N. of 49th par. Underlies Dewdney fm. conformably and overlies Monk fm. conformably. All belong to Summit series.

Wolf Butte type (of granite porphyry).

A term used by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, p. 498, 1900) for an area of intrusive granite porphyry on Wolf Butte and peak to S., in Little Belt Mtns of central southern Mont. On preceding pp. of above rept W. H. Weed used name *Wolf porphyry.*

Wolfcamp formation.

Permian: Western Texas (Marathon region).

J. A. Udden, 1917 (Univ. Tex. Bull. 1753, p. 41, pl. 3). *Wolfcamp fm.*—Mostly sh., varying from almost black to gray and greenish gray. Interbedded are several layers of ls. which are cemented shell breccias, in places conglomeratic. There are also layers of calc. ss. At Wolfcamp is 92 percent sh., 6 percent ls., and 2 percent calc. cgl. Thickness 500 ft. at Wolfcamp, which is greatest known thickness in Glass Mtns. Uncon. underlies Hess fm. and overlies Gaptank fm., with uncon., E. Böse and J. W. Beede believe. Fossils from basal part [listed; include *Uddenites minor*] indicate, in Böse's opinion, considerable time interval btw. Gaptank and Wolfcamp. Named for Wolfcamp, the site of an old dwelling place just S. of the two buttes located 6½ mi. E. and 2 mi. N. of E. end of Leonard Mtn, and now marked by an old open well 100± ft. deep.

J. A. Udden, 1917 (Univ. Tex. Bull. 1762, p. 16, footnote). *Wolfcamp fm.* was named by Böse, Baker, and Udden. Includes *Uddenites* zone.

E. Böse, 1917 (Univ. Tex. Bull. 1762, pp. 15–22), included *Uddenites* zone in Wolfcamp fm.

In subsequent repts the *Uddenites* zone has been included in Wolfcamp fm. by some writers and in Gaptank fm. by other writers. See under *Gaptank fm.*

C. Schuchert, 1927 (Am. Jour. Sci., 5th, vol. 14, pp. 383–400). Wolfcamp fm. does not have a basal cgl. at type loc., where it is 475 ft. thick, but to SW., where it overlaps upon much-folded fms., its thickness attains 600 ft., of which 400 ft. are cgls. Writer believes *Uddenites* zone belongs to Wolfcamp, but Keyte, Blanchard, and Baldwin believe it belongs to Gaptank. Absent in Del Norte Mtns but present throughout Glass Mtns.

E. H. Sellards, 1933 (Univ. Tex. Bull. 3232, p. 148). *Uddenites* and overlying ls. members are in this rept. included in Gaptank fm. (Penn.) instead of in Wolfcamp fm. (Perm.).

P. B. King, 1934 (Geol. Soc. Am. Bull., vol. 45, pp. 697–798), tentatively drew base of Wolfcamp fm. at top of *Uddenites* zone, and treated the overlying gray ls. as basal bed of Wolfcamp fm. He believed the uncon. reported at top of the gray ls. is debatable.

Wolf Creek conglomerate lentil (of Cattaraugus formation).

Devonian or Carboniferous: Southwestern New York.

C. S. Prosser, 1892 (Rochester Acad. Sci. Proc., vol. 2, pp. 54–57, 64, 93–95). *Wolf Creek cgl.*—Flat-pebble cgl. overlain by 300 ft. of Upper Dev. beds, which separate it from Little Genesee cgl. (believed=Olean cgl.), and underlain by 1,150+ ft. of Chemung rocks along Genesee River.

J. M. Clarke, 1902 (N. Y. State Mus. Bull. 52, pp. 524–528). *Wolf Creek cgl.* underlies Cattaraugus beds, overlies beds containing common Chemung species, and contains certain well-defined aspect of Carbonic life, while leading features of Chemung fauna abruptly disappear with its incoming.

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 967–989). *Wolf Creek cgl. lentil* (basal bed of Cattaraugus beds) varies in thickness from few in. to 20 ft. Assigned to Dev. [On pp. 696–699 of same bull. J. M. Clarke assigned Cattaraugus beds to Carbf.]

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203), says Wolf Creek cgl. is same as Panama cgl. and LeBoeuf cgl. and older than Salamanca cgl. This is also the correlation of N. Y. State Survey. (See W. Goldring, 1931, N. Y. State Mus. Hdb. 10, p. 425.)

Whether Cattaraugus fm. is late Dev. or early Carbf. is still a debated question.

Named for occurrence on Wolf Creek, W. of West Clarksville, Allegany Co.

Wolf Creek dolomite.

Ordovician: Southern Oklahoma (Arbuckle and Wichita Mountains).

C. E. Decker, 1933 (Tulsa Geol. Soc. Digest, pp. 55–57). [See this entry under *Arbuckle group*.]

Wolf Creek sand.

A subsurface sand in NW. part of Washington Co., SE. Ohio. Seems to be only a local development of Morgantown ss. memb. of Conemaugh fm. (W. Stout et al., Geol. of nat. gas, A. A. P. G., 1935, p. 900.)

Wolfe City sand member (of Taylor marl).

Upper Cretaceous: Northeastern Texas.

L. W. Stephenson, 1918 (U. S. G. S. P. P. 120H, p. 155). *Wolfe City sand memb. of Taylor marl.*—Fine calc. gray sand or sandy marl with a few round, oval, or irregular concretions of calc. ss. Near middle a more or less persistent layer of highly fossiliferous calc. ss. of varying thickness. Some beds of calc. clay occur in upper part of the memb. Thickness 75 to 100 ft. Wolfe City, Hunt Co., is situated on the sand, but only small, poor exposures were seen within town limits. Lies in upper part of Taylor marl, and underlies Pecan Gap chalk memb. of the Taylor. [The Pecan Gap was later made a memb. of Annona chalk. (See C. H. Dane and L. W. Stephenson, A. A. P. G. Bull., vol. 12, No. 1, 1928. See also 1929 entry under *Pecan Gap tongue*.)]

Wolff porphyry.

A misprint in U. S. G. S. Bull. 191, p. 433, for porphyry mapped and described as *Wolf porphyry* in U. S. G. S. Fort Benton folio, No. 55.

Wolf Lake schist.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Gogebic County).

R. C. Allen and L. P. Barrett, 1915 (Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, pp. 131–139). *Wolf Lake schists.*—Green schist or amphibolite, uniformly dark green to black, approaching sl. in appearance, and mica schist. The conclusion that the Paint sl. and mica schist of Wolf Lake area are same fm. is almost inescapable.

Wolf Lake granite.

Pre-Cambrian (upper Huronian): Northwestern Michigan (Gogebic County).

R. C. Allen and L. P. Barrett, 1915 (Mich. Geol. and Biol. Surv. Pub. 18, geol. ser. 15, pp. 131–139). *Wolf Lake granite.*—Mainly white, pink, and gray, with typical granitic, pegmatitic, and porphyritic textures. Intrudes Paint sl.

Named for occurrence in vicinity of Wolf Lake, Gogebic Co.

Wolf Mountain shale member. (In Graford formation.)

Pennsylvanian: Central northern Texas (Palo Pinto County).

F. B. Plummer and J. Hornberger, Jr., 1936 (Univ. Tex. Bull. 3534, pp. 48–55, map). *Wolf Mtn sh.*—A memb. in upper part of Graford fm. in Palo Pinto Co., underlying

Merriman ls. memb. of the Graford and overlying Wiles ls. memb. Consists of bluish-gray soft fossiliferous sh. containing numerous hard small brown limonitic concretions and a few lentils or layers of ss. Typically exposed below the capping Merriman ls. in slopes of Wolf Mtn, 4 mi. W.-NW. of Palo Pinto.

Wolfpen tonalite.

Devonian (?): Eastern central Massachusetts.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 170–171 and map). *Wolfpen tonalite.*—A belt of tonalite or quartz diorite which extends from Sudbury Reservoir southwestward across northern part of Southboro and Westboro and is seemingly a SW. extension of the mass of Dedham granodiorite that extends from Lincoln to Southboro. Well exposed in Wolfpen Hill, in Southboro.

Wolf Ridge sandstone member (of Pottsville formation).

Pennsylvanian: North-central Alabama.

C. Butts, 1927 (U. S. G. S. Bessemer-Vandiver folio, No. 221). *Wolf Ridge ss. memb.*—Hard qtzitic ss., 50 to 100 ft. thick, in Pottsville fm. of Cahaba and Coosa fields. Lies about 1,200 ft. above Pine ss. memb. and about 800 ft. below Straight Ridge cgl. memb. Named for fact that it forms Wolf Ridge.

Wolf River limestone.

Pennsylvanian: Northwestern Missouri, eastern Kansas, southwestern Iowa, and southeastern Nebraska.

G. E. Condra and E. C. Reed, June 1937 (Nebr. Geol. Surv. Bull. 11, 2d ser., pp. 7, 12, 16, 20, 24, 26, 30, 33, 51–52, figs. 1, 2). *Wolf River ls.* is a new name here applied to lower memb. of Topeka ls. fm. Where typically developed consists of a thin-bedded, very fossiliferous upper zone, a middle heavy-bedded massive brownish middle zone, and a thin blocky bed at base separated from the middle zone by a few inches of sh. To N. the ls. is a single bed. Thickness 4 ft. 9 in. NE. of Topeka, 5½ ft. near Iowa Point and Curzen Station, 1 ft. 4 in. N. of Thurman, 1 ft. 2 in. at Jones Point, less than 2 ft. at Weeping Water, 1 ft. 3 in. NE. of Greenfield. Type loc. at mouth of Wolf River, Doniphan Co., Kans. Writers feel they are justified in introducing this new name notwithstanding Moore's use of "Dashner ls." [See further explanation under *Dashner ls.*]

Wolfville sandstone.

Triassic: New Brunswick and Nova Scotia.

S. Powers, 1915 (Geol. Soc. Am. Bull., vol. 26, p. 93).

Wolsey shale.

Middle Cambrian: Central northern Montana (Fort Benton quadrangle), central western Montana (Helena-Big Belt Mountain region), and central southern Montana (Little Belt Mountains quadrangle and to southeast).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). *Wolsey sh.*—Purple and green micaceous shales holding small ls. nodules containing fossils. Thickness 125 ft. Rests on Flathead ss. and underlies Meagher ls., all included in Barker fm.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Wolsey sh.*—Micaceous sh. containing small ls. concretions near base and interbedded calc. shales higher up. Overlies Flathead qtzite and underlies Meagher ls., all included in Barker fm.

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 285). *Wolsey sh.*—Dark-gray or greenish, often micaceous sh., carrying oval concretions of ls., a few in. thick and seldom over 6 in. long, containing Middle Camb. fossils. Average thickness 150 ft. Well exposed at old dam on Sheep Creek near Wolsey, also in Keegan Butte and on hill S. of it, which rises above the open and nearly level surface of Belt Park.

Wolverine sandstone.

Pre-Cambrian (Keweenawan): Northern Michigan.

L. L. Hubbard, 1898 (Mich. Geol. Surv. vol. 6, pt. 2, pp. 77, 81, 93). *Wolverine ss.*—According to Capt. Hodgson this bed is an altered cgl., chiefly of dark-colored ss., 40 ft. wide, with 2 ft. of fluccan on footwall. It may correspond to Marvine's cgl. No. 9 exposed (?) near Portage Lake. It may at other points be an amygdaloid cgl. Underlies Wolverine ophite [a bed of ophite forming footwall of Kearsarge amygdaloid in Wolverine and Kearsarge mines].

Belongs to Central Mine group. Is older than Kearsarge amygdaloid and younger than Old Colony amygdaloid.

Named for outcrops near Wolverine mine, Houghton Co.

Wolverine amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Local name for Kearsarge amygdaloid in Wolverine mine.

Womack gneiss.

Pre-Cambrian: Eastern Colorado (Pikes Peak quadrangle).

L. C. Graton, 1906 (U. S. G. S. P. P. 54). *Womack gneiss.*—Rather dark brownish gray, medium-grained, of fairly uniform texture; abundance of red feldspar and deep-brown mica; not much quartz. No evidence that it is related to Pikes Peak granite. Is certainly older than Cripple Creek granite. Probably derived from a third distinct granite, which is thought to be older than either of the others. Named for Womack Hill, at E. edge of town of Cripple Creek. Underlies most of town.

Womble shale (in Arkansas).

Womble schistose sandstone (in Oklahoma).

Lower and Middle Ordovician: Southwestern Arkansas and southern Oklahoma.

H. D. Miser, 1917 (U. S. G. S. Bull. 660, p. 67). *Womble sh.*—Black graphitic sh. with thin beds of ss. near base and beds of ls. near top. The sh. near base is composed of black and green layers that split at an angle with the bedding and thus show ribboned cleavage surfaces. Thickness 1,000 ft. Underlies Bigfork chert and overlies Blakely ss. Named for town of Womble, Ark. [now called Norman], part of which is on the base of this sh. The Womble forms upper part of "Ouachita sh." of previous repts.

H. D. Miser and A. H. Purdue, 1923 (U. S. G. S. Hot Springs folio, No. 215). *Womble sh.* includes "Stringtown sh." and upper part of "Ouachita sh." of previous repts on Ark. geology.

The Womble sh. of Ark. has yielded Beekmantown, Chazy, and Black River fossils. The Womble sh. of Okla. has yielded Chazy and Black River fossils, but no fossils in lower part. The fm. is at present classified as of Lower Ord. (Beekmantown and Chazy) and Middle Ord. (Black River) age. The name is now employed by U. S. Geol. Survey to replace "Stringtown sh." of both Ark. and southern Okla.

Type section of Womble sh. is at Crystal Mtn, Ark., according to H. D. Miser, March 1937.

Wompats limestone.

Permian: Northern Arizona (Grand Canyon region).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 339). *Wompats ls.*—Highly fossiliferous white subcrystalline lss. immediately underlying surface of Kaibab Plateau. Thickness 225 ft. Younger than Havasupai sss. Included in Aubreyan series. Named for Wompats Spring, NE. of great Shinumo Amphitheater, Grand Canyon, Ariz.

May apply to upper part only or to all of Kaibab ls. Is probably upper part of Kaibab, according to N. H. Darton (personal communication).

Wonah quartzite.

Ordovician: British Columbia.

C. D. Walcott, 1924 (Smithsonian Misc. Coll., vol. 75, pp. 14, 32, 49). [In this rept. and in a 1928 rept. Walcott assigned this fm. to Sil. Several other repts, by others, assign it to Ord.]

Wonder rhyolite.

Tertiary: Central western Nevada (Wonder, Churchill County).

J. A. Burgess, 1917 (Econ. Geol., vol. 12, No. 7, pp. 589–593). *Wonder rhyolite.*—Oldest Tert. eruptive in dist. Is a basic type of rhyolite that might well be called a quartz latite, but it has so commonly been known as Wonder rhyolite that it seems better not to change this name. Contains the ore-bearing veins of Wonder dist., which are quarried in Nevada Wonder mine.

Wood shale.

Triassic(?): Southeastern Idaho.

G. R. Mansfield, 1915 (Wash. Acad. Sci. Jour., vol. 5, p. 492) and 1916 (vol. 6, p. 41). *Wood sh.*, 220 to 250 ft. thick, is memb. of Nugget ss. in Fort Hall Ind. Res., underlying the main ss. memb. of the Nugget and overlying Deadman ls.

G. R. Mansfield, 1916 (Wash. Acad. Sci. Jour., vol. 6, pp. 32, 41). *Wood sh. memb.*—Bright-red sh. that weathers to red soil. Thickness 200 to 250 ft. Memb. of Nugget ss. in Fort Hall Ind. Res. Underlies main ss. memb. of Nugget and overlies Deadman ls. memb. Named for Wood Creek, T. 3 S., R. 38 E., Boise meridian, in NE. part of reservation, which cuts across entire Nugget fm.

G. R. Mansfield, 1920 (U. S. G. S. Bull. 713, pp. 29, 52), treated Wood sh., Deadman ls., Higham grit, and "main ss. memb." of above-cited rept as distinct fms., and restricted Nugget ss. to the "main ss. memb." of his previous repts. This is the present generally accepted definition of Wood sh.

Woodbine sand (also **Woodbine clay**).

Upper Cretaceous (Gulf series): Texas, central southern and southeastern Oklahoma, western Louisiana, and southwestern Arkansas.

R. T. Hill, 1901 (U. S. G. S. 21st Ann. Rept., pt. 7, p. 293). *Woodbine fm.*—Ferruginous argill. sands, in places unconsolidated, accompanied by laminated, usually sandy clays, in some places bituminous. Thickness 45 to 600 ft. Divided into (descending): (1) Sands and clays [now known to belong to Eagle Ford clay]; (2) Lewisville beds; and (3) Dexter sands, including Basal clay of Taff. Underlies Eagle Ford fm. and uncon. overlies Washita div. Replaces Timber Creek group and Lower Cross Timbers fm. Basal fm. of Upper Cret. of Tex.

Named for exposures at Woodbine, Cooke Co., Tex., but best exposures are at Denison, Tex., in southern half of city.

Woodbridge fire clay.

Economic term for a bed of clay, 50 to 80 ft. thick, in lower part of Raritan fm. in NE. N. J. Lies 15 to 35 ft. higher than Raritan fire-clay bed. See G. H. Cook and J. C. Smock, 1877 (N. J. Geol. Surv. map of clay dist. of Middlesex Co.), and G. H. Cook, 1878 (N. J. Geol. Surv. Rept. on clays, p. 34). Is worked S. of Woodbridge.

Woodburn phosphatic memb. (of Flanagan limestone).

Middle Ordovician: North-central Kentucky.

A. M. Miller, 1913 (Ky. Geol. Surv., 4th ser., vol. 1, pt. 1, p. 326). *Woodburn bed.*—Thin-bedded granular phosphatic ls., 30 to 40 ft. thick, constituting remainder of Flanagan memb. (of Lexington ls.) above Brannon bed.

Adopted by U. S. Geol. Survey as *Woodburn phosphatic memb. of Flanagan ls.*

Named for celebrated Alexander estate in Woodford Co.

†Woodbury formation.

Upper Cretaceous: Northwestern Iowa.

C. A. White, 1870 (Iowa Geol. Surv. vol. 1, pp. 26, 291–293). *Woodbury sss. and shales.*—Alternating sss. and shales, the latter sometimes sandy and sometimes clayey, with more or less calc. material intermixed. Max. thickness 150± ft. Overlies Nishnabotany ss. and underlies Cret. *Inoceramus* beds. Not observed outside of Woodbury Co.

Corresponds to lower part of Benton sh. and name not in use since 1893.

Named for Woodbury Co.

Woodbury clay. (In Matawan group.)

Upper Cretaceous: New Jersey.

G. N. Knapp, as reported by R. D. Salisbury, 1899 (N. J. Geol. Surv. Ann. Rept. State Geol. 1898, p. 35). *Woodbury bed.*—Dove-colored clay underlying Columbus bed [Englishtown sand] and overlying Merchantville bed. All included in Clay Marl series [Matawan group].

H. B. Kümmel and G. N. Knapp, 1904 (N. J. Geol. Surv, vol. 6, p. 157). *Woodbury clay.*—Thick black clay which weathers to dove or light chocolate color. Thickness 55± ft. Underlies Columbus sand and overlies Merchantville clay.

Named for exposures in railway cut at Woodbury, Gloucester Co.

Woodbury granite.

Devonian: Northeastern Vermont (Washington County).

See under *Knox Mtn granite.* Quarried in Woodbury Twp, Washington Co.

C. H. Richardson, 1908 (6th Rept. Vt. State Geol.). *Woodbury granite,* Dev., intrudes Waits River ls.

E. J. Foyles and C. H. Richardson, 1929 (16th Rept. Vt. State Geol., table opp. p. 288), assigned *Woodbury granite* to Dev.

Wood Canyon formation.

Lower Cambrian: Southeastern Nevada.

T. B. Nolan, 1928 (Am. Jour. Sci., 5th, vol. 17, pp. 461–472). *Wood Canyon fm.*—Thin-bedded qtzitic sss., sandy shales, and, near top, a few ls. beds. Cross-bedding, ripple marks, and sun cracks common. Thickness 2,100 ft. Lower Camb. fossils about 150 ft. below top. Grades into underlying Stirling qtzite and is uncon. overlain by Bright Angel sh. Named for exposures in Wood Canyon, about 4 mi. S. of Crystal Springs, on W. side of Spring Mtns, Clark Co.

Woodchopper volcanics.

Middle Devonian: Northeastern Alaska (Eagle-Circle district).

J. B. Mertie, Jr., 1930 (U. S. G. S. Bull. 816, pp. 75–80, map). *Woodchopper volcanics.*—Basaltic greenstone interbedded with minor amounts of ls., sl., and chert. Complexly folded and faulted. Thickness 7,700± ft. Contains late Middle Dev. fossils (17 collections). Exposed on Woodchopper Creek at and below Woodchopper.

Woodcock sandstone.

Devonian or Carboniferous: Northwestern Pennsylvania (Erie County).

G. H. Chadwick, 1925 (Geol. Soc. Am. Bull., vol. 36, pp. 457–464). Dr. [I. C.] White's "Venango group" consisted of five members, which, to avoid confusion with Venango oil sands, we propose to name as follows (descending): Upper ss. = *Woodcock ss.*; Upper sh. = Saegerstown sh.; Middle ss. = Millers ss.; Lower sh. = Amity sh.; and Lower or Le Boeuf ss. of White. The Woodcock ss. is highly fossiliferous and underlies Riceville sh., where present, and Cleveland sh. where Riceville is absent. [Outcrops mentioned.] Included in Bradfordian and also treated as next to top memb. of Chagrin fm. [which U. S. Geol. Survey classifies as Upper Dev.].

See under *Venango group* for Chadwick's correlations with I. C. White's units.

K. E. Caster, 1933 (Geol. Soc. Am. Bull., vol. 44, No. 1, p. 203). *Woodcock ss. memb.* (*Venango 1st oil,* (?) *Tuna cgl.*).—Top memb. of Cattaraugus fm. in NW. Pa. Overlies Saegerstown sh. memb. and underlies Riceville fm., restricted. [The U. S. Geol. Survey classifies Cattaraugus fm. as *Dev. or Carbf.*]

K. E. Caster, 1934 (Bulls. Am. Pal., vol. 21, No. 71, table opp. p. 61, pp. 92–94), assigned this ss. to Dev., stated that it was named for exposures along Woodcock Creek, Woodcock Twp, Crawford Co., and that it is probably younger than Tuna, Killbuck, and Hosmer Run cgls.

Wood Creek beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 90–95, 137, 141, 149, 154). *Wood Creek beds* (zone of *Cryptolithus bellulus* and *Bollia pulchra.* Fauna best exhibited along Wood Creek, btw. Lee's Center and Stokes, 7 mi. NW. of Rome, Oneida Co., and in Lorraine Gulf. Underlie Moose Creek beds and overlie Atwater Creek sh.; all of lower Lorraine age. Included in Whetstone Gulf fm.

Woodford chert.

Devonian (?): Central southern and southeastern Oklahoma (Ouachita Mountains).

J. A. Taff, 1902 (U. S. G. S. Atoka folio, No. 79). *Woodford chert.*—Thin-bedded chert and fissile black sh., 500 to 700 ft. thick. Underlies Caney sh. and overlies Hunton ls.

Named for exposures about 1/4 mi. N. of Woodford, Carter Co.

In 1911 C. A. Reeds introduced *Bois d'Arc ls.* for top div. of Hunton ls. of previous repts on southern Okla., the type loc. being in Pontotoc Co. The Bois d'Arc ls. is now classified as of Oriskany and Becraft (?) age. (Type loc. of Hunton fm. is in SW. part of Coal Co.)

In 1927 E. O. Ulrich introduced *Brushy Creek chert* for beds uncon. underlying Woodford chert and overlying Bois d'Arc ls. in Arbuckle Mtns. He stated these beds were included in top of Hunton fm. of Taff. (Type loc. of Brushy Creek is in Pittsburg Co.)

In 1934 H. D. Miser introduced *Pinetop chert* (of Onondaga age) to replace the preoccupied name "Brushy Creek chert," in Ti Valley-Choctaw belt of Ouachita Mtns, Okla. Type loc. of Pinetop chert is in Pittsburg Co. Miser stated that in his opinion Woodford chert is=middle and upper members of Arkansas novaculite of Ark. and northern McCurtain Co., Okla., and that he regards it as of Dev. age, but that E. O. Ulrich, C. L. Cooper, and others regard it as Miss. The U. S. Geol. Survey at present classifies the Woodford as Dev. (?).

†Woodford gneiss.

Pre-Cambrian: Southwestern Vermont (Bennington County).

F. A. Burt, 1929 (16th Rept. Vt. State Geol., pp. 68–69). The pre-Camb. gneisses of Bennington area, commonly called *Stamford gneiss*, lie uncon. below Vermont fm. and form core of Green Mtn Range. Six of these pre-Camb. gneisses have been found by writer in kaolin area. One of these is Stamford gneiss of literature of region. Another is probably the white gneiss of parts of adjoining Berkshire Co., Mass. Identity of the two has not been proved, but structure and lithology suggest their oneness. This probable white gneiss, together with the 4 as yet undescribed and little-studied gneisses, will, for brevity, be called collectively *Woodford gneisses*. Uncon. underlie Vermont fm. (Lower Camb.).

F. A. Burt, 1931 (17th Rept. Vt. State Geol., pp. 115–135). *Woodford gneisses* is a group term for several pre-Camb. gneisses underlying Vermont fm. which have not yet been differentiated or worked out as to their relations.

L. M. Prindle and E. B. Knopf, 1932 (Am. Jour. Sci., 5th, vol. 24, pp. 264–269), adopted *Mount Holly gneiss* for Taconic quad., within which lies type loc. of Woodford gneiss (preoccupied), and *Woodford gneiss* was accordingly abandoned by U. S. Geol. Survey.

Apparently named for Woodford village or Woodford Twp, Bennington quad.

Woodhouse clay. (In Ogallala formation.)

Miocene or Pliocene: Western Kansas (Wallace County).

M. K. Elias, 1931 (Univ. Kans. Bull., vol. 32, No. 7, Kans. Geol. Surv. Bull. 18, pp. 155+). *Woodhouse clays*.—Bentonitic clays, highly plastic, of bright colors. Are a local lateral change in lithology of lower half of Ogallala fm. in Wallace Co. The prel. examination by H. T. Martin of vertebrates from these clays showed decisively they are not Olig. but may belong to either Mio. or Lower Plio., or to age of Ogallala fm. of Wallace Co. It appears probable the Woodhouse clays correspond, at least in their upper part, to the Ogallala of Wallace Co., which in turn appears to correspond to type Ogallala (about 200 ft. thick) in Nebr. The lower portion of Woodhouse clays, in which the bones of type loc., 1 mi. W. of Woodhouse ranch, were collected, may be somewhat older than the strictly Ogallala beds and may possibly belong to Upper Mio. It is possible the Tert. clays in the counties E. and NE. of Wallace also belong in part to slightly earlier time than typical Ogallala beds of Wallace Co., which are undoubtedly Lower Plio. The clays are exposed 1 mi. W., also SW., of Guy Woodhouse ranch, in right tributary canyon on Goose Creek.

Woodhurst limestone member (of Madison limestone).

Mississippian (lower): Central northern Montana (Fort Benton quadrangle and to west) and central southern Montana (Little Belt Mountains quadrangle).

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Woodhurst ls.*—Well-bedded light-colored lss. separated by very thin argill. layers, the lss. often carrying much dark chert. The Woodhurst ls. is well jointed and often forms masonry-like exposures of cliffs with balcony ledges and retreating benches. On weathering breaks into small angular fragments. Underlies Castle ls. memb. and overlies Paine sh., which consists of thin-bedded shaly lss., commonly of gray color. [Derivation of name not stated, but Madison ls. is mapped over broad area at and surrounding Woodhurst Mtn. NE. corner of this quad.]

Woodland trachyte.

Age (?): Northeastern Maine (Aroostook County).

H. E. Gregory, 1900 (U. S. G. S. Bull. 165, pp. 109, 110, 164). *Woodland trachyte* forms low hills along a branch of Caribou Stream, in Woodland Twp, Aroostook Co.

On 1933 geol. map of Maine, by A. Keith, the trachytes of NE. Maine are assigned to Dev.

Woodman formation.

Mississippian (upper): Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Woodman fm.*—Lower part is dominantly calc. ss. and upper part sandy ls. The ss. is 200± ft. thick, generally purplish or reddish brown, fine-grained, and contains small amount of calcite as cement. Thin lenses of ls. and sh. are interbedded with the ss. Greater part of upper div. is dark-gray to almost black sandy ls. that weathers to light brown to pinkish. Nodules of dark-gray to black chert are abundant, many of them a ft. in diam. Interbedded with the lss. are calc. sss. A few beds of relatively pure ls. are also present. Thickness 1,500± ft. Contains upper Miss. fossils. Overlies Madison ls. and underlies Ochre Mtn ls. Named for fact it underlies Woodman Peak, on S. end of Dutch Mtn, Gold Hill region.

See also U. S. G. S. P. P. 177, 1934.

Woodmansie phase (of Bridgeton formation).

Pleistocene: New Jersey.

See 1917 entry under *Bridgeton fm.*

Probably named for occurrence at or near Woodmansie, Burlington Co.

Woodmont shale member (of Jennings formation).

Upper Devonian: Northern West Virginia, western Maryland, and southern Pennsylvania.

C. K. Swartz et al., 1913 (Md. Geol. Surv. Lower Dev. vol., p. 26, and Middle and Upper Dev. vol., pp. 411, 412). *Woodmont sh. memb.*—Middle memb. of Jennings fm. Consists of greenish argill. and aren. shales alternating with thin sss. of similar color, all of which weather yellowish green. Upper 1,000 to 1,100 ft. contain Ithaca fauna. Lower 500 to 1,300 ft. contain Naples fauna. Underlies Parkhead ss. memb. and overlies Genesee black sh. memb.

Named for exposures at Woodmont station on B. & O. R. R., Morgan Co., W. Va.

Wood Mountain gravels.

Miocene (middle or upper): Saskatchewan, Canada.

C. M. Sternberg, 1930 (Roy. Soc. Canada Trans., vol. 24, sec. 4, p. 29). Vertebrates considered by G. G. Simpson to be middle or upper Mio.

Woodpecker limestone.

Devonian: Eureka district, Nevada.

C. [R.] Keyes, 1923 (Pan-Am. Geol., vol. 40, p. 52) and 1924 (Pan-Am. Geol., vol. 41, p. 79). *Woodpecker lss.*, 1,200 ft. thick, underlie Combs ls. and overlie Atrypa ls. Included in Nevadan series [Nevada ls.]. Especially characterized by remains of sponges and chaetetid corals. Name derived from Woodpecker Peak, Eureka dist.

Wood River formation.

Pennsylvanian: Southern central Idaho.

W. Lindgren, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, pl. 8, pp. 89–90, 193–195). *Wood River fm.*—A series of qtzites, fine cgls., large masses of black slates and calc. shales, and a small amount of heavy-bedded gray lss. Unusually barren of fossils, but those that have been found are of Carbf. age, probably upper Carbf.

The fm. is usually thrown into sharp folds, so that the stratigraphy is difficult to decipher, and rocks older or more recent than Carbf. may have been included in this div. The Carbf. is certainly very largely represented and seems to have attained a thickness rarely found in other parts of the West. In places overlain by masses of the great post-Carbf. granite intrusive mass of Idaho. In places is overlain by Neocene Columbia River lava. Thickness several thousand ft.

L. G. Westgate and C. P. Ross, 1930 (U. S. G. S. Bull. 814, pp. 10, 29+). *Wood River fm.* restricted to rocks of Penn. age, which consist chiefly of calc. and qtzitic beds, but also contain cgl., sh., and dol. Nearly everywhere the basal memb. is a massive brownish qtzitic cgl. 300 to 800 ft. thick. Thickness of fm. 8,000± ft. The lower part of Wood River fm. of Lindgren is here named *Milligen fm.* It is of Miss. and possibly Dev. age.

Woods Bluff marl. (In Bashi formation.)

Eocene (lower): Southwestern Alabama.

A. Heilprin, 1882 (Phila. Acad. Nat. Sci. Proc. 1881, p. 157). [Refers to 25 ft. of highly fossiliferous marl comprising No. 2 of Tuomey's section on Bashi Creek, Clarke Co., as *Wood's Bluff marl bed.*]

E. A. Smith, 1883 (Ala. Geol. Surv. Prog. Rept. 1881–82, pp. 257, 321). *Wood's Bluff marl.*—Greensand shell marl with an indurated bed, usually near top, but sometimes near middle. Thickness 10–15 ft. Exposed at Wood's Bluff, on Tombigbee River, and at Johnson's Landing, below Bell's Landing, on Alabama River. Overlain by 25–30 ft. of laminated clays and clayey marls, and separated from the older Bell's Landing marl by 50–80 ft. of lignitic clays and sands. Included in Lagrange or Lignitic (pp. 236–237).

E. A. Smith, 1887 (U. S. G. S. Bull. 43, pp. 39, 43–46, 69). *Wood's Bluff or Bashi marl.*—Marl, with marine fossils and much greensand, 15–30 ft. thick, forming top memb. of Wood's Bluff or Bashi series. Overlain by purplish-brown sandy clays forming basal part of Hatchetigbee series.

As defined is top memb. of Bashi (†Woods Bluff) fm.

Named for exposures at Woods Bluff, on Tombigbee River, in NW. part of Clarke Co.

†Woods Bluff group.

†Woods Bluff series.

Eocene (lower): Southern Alabama and southeastern Mississippi.

A. Heilprin, 1882 (Phila. Acad. Nat. Sci. Proc. 1881, pp. 158–159). [See quotation under *†Eo-lignitic.*]

E. A. Smith and L. C. Johnson, 1887 (U. S. G. S. Bull. 43, pp. 43–47). *Wood's Bluff or Bashi series.*—Consists of (descending): (1) Wood's Bluff or Bashi marl, 15 to 30 ft. thick; (2) 25 ft. of gray sandy clays containing toward base 4 or 5 thin seams of lignite; (3) 35 to 40 ft. of yellowish cross-bedded sands; and (4) lignite bed 2 ft. thick. Underlies Hatchetigbee series and overlies Bell's Landing series.

Abandoned for *Bashi fm.*, the monomial alternative name.

Named for exposures at Woods Bluff, on Tombigbee River, in NW. part of Clarke Co., Ala.

Woods Hollow shale.

Middle Ordovician (Trenton): Southwestern Texas (Brewster County).

P. B. King, 1931 (A. A. P. G. Bull., vol. 15, No. 9, pp. 1066, 1071–1072). *Woods Hollow sh.*—Lower part consists of flaggy, thinly laminated gray or yellowish sandy ls. or limy ss., with some sh. partings. It grades up into greenish clay sh. with a few interbedded flaggy ls. layers. Some sandy beds are rill-marked on bedding surfaces, and some of lower flaggy layers contain graptolites. There are 5 or 6 nodular beds of coarsely granular and conglomeratic ls., weathering yellowish, crowded with comminuted remains of bryozoans, trilobites, brachiopods, and crinoids. Thickness at type loc. 470 ft. Named for exposures in Woods Hollow Mtns, btw. Woods Hollow and Little Woods Hollow, in an anticlinal valley on former Louis Granger ranch. Contains fossils of Trenton age. Underlies (uncon.?) Maravillas chert and overlies Fort Peña fm.

Woodside shale.

Lower Triassic: Northeastern Utah, southwestern Wyoming, and southeastern Idaho.

J. M. Boutwell, 1907 (Jour. Geol., vol. 15, pp. 439–458). *Woodside sh.*—A lithologic unit composed, from bottom to top, without significant exception, of fine-grained thinly bedded dark-red sh. Bears ripple marks, mud cracks, and raindrop imprints. Thickness, 1,180 ft. in Park City dist., Utah, where it underlies Thaynes ls. and overlies Park City fm. Named for Woodside Gulch, Park City dist., the best exposure being at head of this gulch, on slope that overlooks the Silver King plant from W.

Woods Run limestone. (In Conemaugh formation.)

Pennsylvanian: Western Pennsylvania and western Maryland.

P. E. Raymond, 1910 (Carnegie Mus. Annals, vol. 7, p. 147). *Woods Run ls.*—Marine ls., fossiliferous, lying lower in section than Ames ls. and higher in section than Pine Creek [Cambridge] ls.

P. E. Raymond, 1911 (Pa. Topog. and Geol. Surv. Comm. Rept. 1908–10, pp. 88–89). *Woods Run ls.*—A previously unnoticed marine ls. to which writer called attention [but did not name] in Sci., n. s., vol. 29, p. 941, 1909. Named for Woods Run, within city of Allegheny, Pa. [The description of this (unnamed) ls. in Sci., vol. 29, states that it lies about 50 ft. below Ames ls. on Brighton Run, just W. of Woods Run, Allegheny, Pa.; that it is about 3 in. thick; and that it consists of hard clayey ls. with most of lime leached out at outcrop.]

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6, pl. 7), showed Woods Run ls. and fauna resting on Bakerstown coal at Pittsburgh, Pa., and as occurring in interval btw. Buffalo and Saltsburg sss. at Latrobe, Pa.

M. E. Johnson, 1929 (Topog. and Geol. Atlas Pa., No. 27, Pittsburgh quad.). [On p. 31 *Woods Run ls.* is shown as underlying Bakerstown coal and as same as Cambridge ls., while Pine Creek ls. is placed at a lower (p. 70 says 45 to 55 ft.) horizon. On p. 53 *Woods Run ls.* is placed about 15 ft. *above* Saltsburg ss. On pp. 66–67 is statement that *Woods Run ls.* occurs in 1 or 2 thin beds, from 80 to 119 ft. below Ames ls. and 35 to 55 ft. above Pine Creek ls., and that it includes Woods Run coal just below the upper ls. bed; also that it is 0 to 10 ft. thick in Pittsburgh quad.]

Woods Run shale. (In Conemaugh formation.)

Pennsylvanian: Western Maryland.

C. K. Swartz, 1922 (Md. Geol. Surv. vol. 11, pl. 6). *Woods Run sh.*—Rests on Lower Bakerstown (Thomas) coal in Lower Youghiogheny Valley, Md., also at Somerset, Pa., and in Castleman Basin and Georges Creek Basin, Md. Thickness 25 to 30 ft.

Woodstock conglomerate.

Carboniferous: New Brunswick.

H. Y. Hind, 1865 (Geol. of New Brunswick, p. 67).

Woodstock granite.

Carboniferous(?): Northern Maryland.

G. H. Williams and N. H. Darton, 1892 (U. S. G. S. map of Baltimore and vicinity, to accompany "Guide to Baltimore," prepared for Baltimore meeting Am. Inst. Min. Engrs., Feb. 1892). *Woodstock granite*, including eruptive granite and gneiss. Quarried at Woodstock and other places.

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799). *Woodstock granite* is possibly Paleozoic.

E. B. Knopf and A. I. Jonas, 1929 (Md. Geol. Surv. Baltimore Co. Rept., pp. 104, 131). *Woodstock granite* assigned to epi-Paleozoic(?).

In 1932 A. I. Jonas expressed opinion that this granite is Carbf., and U. S. Geol. Surv. adopted *Carbf.* (?) for its age. (See 16th Int. Geol. Cong. Guidebook 30, sheet 1.)

Woodstock greensand marl member (of Nanjemoy formation).

Eocene: Eastern Maryland and Virginia.

W. B. Clark, 1895 (Johns Hopkins Univ. Circ., vol. 15, No. 121, p. 3). The upper beds of Eocene of middle Atlantic slope may be designated *Woodstock stage*, and lower beds may be designated *Aquia Creek stage*. Fossils of Woodstock stage are closely related to "Claiborne" types, and those of Aquia Creek stage are decidedly "Lignitic."

W. B. Clark, 1896 (U. S. G. S. Bull. 141, pp. 54, 57; Am. Jour. Sci., 4th, vol. 1, pp. 369–370). *Woodstock stage or fauna*.—Fossiliferous greensand, 40 ft. thick, forming top div. of Pamunkey fm. Separated from underlying Aquia Creek stage or fauna of Pamunkey fm. by 117 ft. of greensands and argill. sands

W. B. Clark and G. C. Martin, 1901 (Md. Geol. Surv. Eocene vol., p. 58). *Woodstock memb. or substage*.—Characterized by fine homogeneous greensands and greensand marls, less argill. than Potapaco memb. Upper part consists of 80 ft. of greensand with *Ostrea sellaeformis* and other fossils; lower part consists of 40 ft. of greensand with few fossils, chiefly *Venericardia potapacoensis*. Is top memb. of Nanjemoy fm. Overlies Potapaco or lower memb. of Nanjemoy fm. Named for Woodstock, an old estate a short distance above Mathias Point of Va. bank of the Potomac [in King George Co., Va.].

W. B. Clark and B. L. Miller, 1912 (Va. Geol. Surv. Bull. 4, p. 104). *Woodstock greensand marl memb.*—Top memb. of Nanjemoy fm. Overlies Potapaco clay memb.

Woodstock stage.

See under *Woodstock greensand marl memb.*

Woodstock quartz schist.

Carboniferous: Northeastern Connecticut.

H. E. Gregory, 1906 (Conn. Geol. and Nat. Hist. Surv. Bull. 6, pp. 114, 128, and map). *Woodstock quartz schist*.—Varies from almost pure qtzite to mica schist with abundant quartz grains. Extends through E. part of Woodstock Twp and S. through Pomfret. Few outcrops. Of sed. origin.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the continuation of Woodstock in Mass. as *Paxton quartz schist*, of Carbf. age. *Paxton* has priority.

Woodstock schist.

Ordovician: Southeastern Vermont (Windsor County).

C. H. Richardson, 1927 (15th Rept. Vt. State Geol., pp. 127–158), in rept on Barnard, Pomfret, and Woodstock Twps, Vt., which lie short distance to SW. of Vershire Twp, stated: *Woodstock schist* may be considered by some geologists to be Vershire schist of earlier repts, but Vershire schist overlies Waits River ls., and Woodstock schist apparently underlies Waits River ls. If this interpretation is true, then Vershire schist and Woodstock schist represent two different fms., and a new name is needed, hence *Woodstock schist* is here introduced, from outcrops in Woodstock. It is represented by 2 beds intercalated in Waits River ls., which are very quartzose, micaceous, and grade into a micaceous qtzite.

Woodville sandstone.

Pennsylvanian (of Conemaugh age): Southern Michigan.

A. Winchell, 1861 (Mich. Geol. Surv. 1st Ann. Rept. Prog., pp. 126, 138, 153, 158). *Woodville ss.*—Pale-buff to nearly white friable, rather coarse quartzose ss., stained to variable extent with oxyd of iron. Varies greatly in hardness. Thickness 0 to 92 ft. Overlies dark bituminous shales of Coal Measures [Saginaw fm.] and is uncon. overlain by Quat. drift. Exposed at Woodville, Jackson Co., where it is 30 to 45 ft. thick. Near Lyons, Ionia Co., it is striped and mottled with red or even uniformly brick-red color. Is not easily distinguished from Parma ss.

A. C. Lane, 1895 (Mich. Geol. Surv. vol. 5, pt. 2). *Woodville ss.* is 304+ ft. thick. Overlies Jackson coal group [Saginaw fm.].

A. C. Lane, 1899 (U. S. G. S. W. S. P. 30). Top fm. of Carbf. in Mich. is a red ss. which Winchell called *Woodville ss.*, which appears to be uncon. on Jackson coal measures.

A. C. Lane, 1909 (Mich. Geol. Surv. Rept. 1908). *Woodville ss.* consists of 0 to 110 ft. of light-reddish ss. and sandy sh. Uncon. overlies Saginaw fm.

R. A. Smith, 1914 (Mich. Geol. and Biol. Surv. Pub. 14, pp. 22–32). *Woodville ss.* consists of 0 to 79 ft. of buff-colored ss., largely removed by erosion. Wells at Maple Rapids, St. Johns, Ionia, and Gladwin indicate presence of a reddish ss. that may be same as buff-colored Woodville ss.

R. C. Allen, R. A. Smith, and L. P. Barrett, 1916 (Mich. Geol. Surv. Geol. map of Mich.). *Woodville ss.* consists of 0 to 100 ft. of light-reddish ss. and sandy sh.; erosion remnants at top of Coal Measures.

W. A. Kelly and E. L. Beutner, 1930 (Mich. Acad. Sci., Arts, and Lett., vol. 14, pp. 471–474). *Ionia ss.*, youngest fm. of Penn. in Mich. Undoubted examples of this ss. are found in abandoned quarries near Grand River btw. Lyons and Ionia. Overlies Saginaw fm.

R. B. Newcombe, 1931 (letter dated Mar. 21). The name "Woodville," which was originally applied by Prof. Winchell to a ss. memb. at old Woodville mine, Jackson Co., Mich., was defined as uppermost ss. in Penn. of Mich. We have later learned that the locality near Ionia where a pink russet-color ss. occurs, is possibly the uppermost ss. memb. of Penn. However, a typical red-bed facies containing plastic shales and gyp. occurs above this ss. in central part of State farther to N. It is still a matter of conjecture whether these "red beds" are equiv. in age to the Woodville or are younger, and in my new strat. column it is proposed that the whole series be given the name "Red Beds," because of lack of any faunal evidence for exact strat. position of the beds. Prof. Wm. Kelly, of Mich. State College, who has been conducting the detailed studies of the paleontologic work for Miss. and Penn. rocks in Mich., maintains that *Ionia* is much more appropriate for this upper pink ss. memb. than the old Woodville, which actually refers to an entirely different bed. For this reason *Ionia* may be adopted for our new time scale.

R. B. Newcombe, 1933 (Mich. Geol. Surv. Pub. 38), in his classification of rocks of Mich. Basin, used *Woodville (Ionia)*, but on p. 61 he stated: The name of Woodville applying to a ss. which at its type loc. is only a lenticular restricted bed, probably should be dropped. A better name for the apparently persistent basal pink or russet-colored ss. of "Red Beds" section would be *Ionia ss.*, suggested by Lane in 1909. [On p. 22 he shows *Woodville (Ionia)* as overlain by sh., sandy sh., gyp., red, pink, gray, the thickness of which is given in fig. 6 as 50 to 120± ft.]

Woodward group.

Permian: Southwestern Oklahoma and Panhandle of Texas (?).

C. N. Gould, 1902 (Okla. Geol. Surv. 2d Bien. Rept., pp. 42, 49). *Woodward div.*—Chiefly shales, sss., and dolomites, 300 [500] ft. thick, distinguished from divisions above and below by prominence of dolomites and absence of gypsums. Includes all rocks btw. the two conspicuous gyp. horizons, the Blaine and Greer divisions. In general divided into three members [now fms.] (descending), Day Creek dol., Red Bluff [Whitehorse] sss., and Dog Creek shales.

The "Greer fm." as originally defined applied to Cloud Chief gyp. of present nomenclature, but as mapped it included Blaine and Cloud Chief (†Cyril) gypsums. The present definition of Woodward group is for rocks overlying Blaine gyp., underlying Cloud Chief gyp., and divided into (descending) Day Creek dol., Whitehorse ss., and Dog Creek sh. The name has been used in Tex., but E. H. Sellards, 1933 (Univ. Tex. Bull. 3232), omits it from the Tex. classification.

Named for Woodward Co., Okla.

Wooley's Bluff clays.

Eocene (Jackson): Eastern Texas and western Louisiana (Sabine Parish).

A. C. Ellisor, 1933 (A. A. P. G. Bull., vol. 17, No. 11, p. 1303, etc.). The bluff on Caney Creek back of old Wooley home in Sabine Parish, La., sec. 4, T. 3 N., R. 12 W., is here designated Wooley's Bluff. In this bluff is exposed 5± ft. of highly fossiliferous sandy glauconitic marly blue clays that weather yellowish brown, and 10 or more ft. of light chocolate-brown clays. These are the *Wooley's Bluff clays*. Total thickness 250 to 300 ft. Not well exposed but seen in San Augustine, Angelina, and Sabine Counties. Basal zone of McElroy fm. To W. of Angelina Co. these clays disappear on surface, and the overlying Wellborn sss. rest uncon. on Caddell fm. As weathered surface is identical with that of Caddell fm. it is difficult to differentiate the two units in field. Fossils listed.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, p. 24). In writer's opinion the Wooley's Bluff beds of Ellisor represent a marine facies within Wellborn fm., and the name Wellborn is applicable to them. The Wooley's Bluff fauna was not found W. of Neches River, but there is no field evidence to support the uncon. reported by Miss Ellisor btw. the Wellborn and the Caddell fm.

†Woonsocket conglomerate.

Carboniferous: Northeastern Rhode Island.

G. R. Mansfield, 1906 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 49, geol. ser. vol. 8, p. 100). *Woonsocket cgl.* occupies a rather limited area [around Woonsocket, R. I.] and is characterized by such a high degree of metamorphism that its composition is often not clearly distinguishable.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the cgl. of Woonsocket region as *Bellingham cgl.*, and "Woonsocket cgl." has been discarded.

†Woonsocket Basin series.

Carboniferous: Northeastern Rhode Island.

A. C. Hawkins, 1918 (Am. Jour. Sci., 4th, vol. 46, pp. 437–472, and map). *Woonsocket Basin series.*—Sh., ss., and cgl. of Carbf. age. The "Bellingham series" of Warren and Powers.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), mapped the deposits of Woonsocket Basin as *Bellingham cgl.*

Wooton coal group.

Local name for a group of coal beds in Raton fm. in Elmoro-Spanish Peaks region, Colo. Exposed a short distance above Wooton's station, on old Santa Fe Trail, and on line of Atchison, Topeka & Santa Fe Railway. See U. S. G. S. Elmoro folio, No. 58, 1899.

Worcester phyllite.

Pennsylvanian: Eastern central Massachusetts, central southern New Hampshire, and northern Connecticut.

B. K. Emerson, 1889 (Geol. Soc. Am. Bull., vol. 1, p. 560), mentioned, but did not define, *Worcester argillite.*

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 17). *Worcester argillite (phyllite)* overlies Harvard cgl. in Worcester Co., Mass.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597, pp. 60–72, 77, 225). In its least-changed or typical phase the *Worcester phyllite* ranges from soft black sl. or phyllite, partly carbonaceous and partly graphitic, to light greasy sericite schist. The prevailing rock is thinly fissile, lead gray, with corrugated satiny surface, generally splitting on original lamination. Laterally the typical Worcester phyllite grades into different types of schist. To W. it becomes the Brimfield schist. [See under *Brimfield schist.*] Includes Harvard cgl. lentil.

Is exposed at Worcester, Mass., and over broad area in N. part of Worcester Co., Mass.

†Worcester quartzite.

Carboniferous: Eastern central Massachusetts, central southern New Hampshire, and northern Connecticut.

B. K. Emerson, 1898 (U. S. G. S. Mon. 29, p. 17). *Worcester qtzite* underlies Harvard cgl. in Worcester Co., Mass.

B. K. Emerson, 1917 (U. S. G. S. Bull. 597), replaced "Worcester qtzite" with *Oakdale qtzite*, and retained Worcester for the phyllite.

Exposed at Worcester, Mass., and over a large area in N. part of Worcester Co., Mass.

†Worcester County gneiss.

E. Hitchcock, 1833 (Rept. geol., min., bot., and zool. of Mass., pp. 387–388). *Worcester County gneiss.*—The broad ranges of gneiss in central part of Mass. Porphyritic gneiss prevails extensively along W. margin of Worcester Co. gneiss range, in Northfield, Mass., and Winchester, N. H. Granitic gneiss abounds in various parts of deposit, but more in southern than in northern part of State. The range of Worcester County gneiss which extends northeasterly into Middlesex Co. possesses some peculiar characteristics and belongs to a different system of stratification from the gneiss W. of Worcester Valley. It contains numerous beds of ls., which are wanting in western ranges.

Includes 7 or 8 of the fms. differentiated by B. K. Emerson in U. S. G. S. Bull. 597, 1917.

Word formation.

Permian: Western Texas (Marathon region, Brewster County).

J. A. Udden, C. L. Baker, and E. Böse, 1916 (Univ. Tex. Bur. Econ. Geol. and Tech. Bull. 44, p. 52). *Word fm.*—Consists of (descending): (1) Thin- and thick-bedded gray and yellow to reddish ls., in part dolomitic, containing chert concretions and some interbedded ss., 380 ft.; (2) yellow ss., in part laminated, 120 ft.; (3) heavy-bedded gray ls. with chert concretions, 120 ft. Underlies Vidrio fm. and overlies Leonard fm.

J. A. Udden, 1927 (Geol. Soc. Am. Bull., vol. 38, p. 159). *Word fm.* is same [?] as Delaware Mtn fm., and name should be abandoned.

E. H. Sellards, 1933 (Tex. Univ. Bull. 3232, p. 151). *Word fm.* of Glass Mtns is Delaware Mtn fm. in part. [This is interpretation of P. B. King also. See Geol. Soc. Am. Bull., vol. 45, 1934.]

Named for Word's ranch, Glass Mtns, Hess Canyon quad.

Worland limestone.

Pennsylvanian: West-central Missouri.

F. C. Greene, 1933 (Mo. Bur. Geol. and Mines 57th Bien. Rept., pp. 14, 18, 37, App. 2, pl. 2). *Worland ls.*—In central Bates Co., at Worland, a zone of lss. and calc. shales appears in Bandera sh. memb. of Pleasanton fm. and persists to N., usually as two thin lss., here termed *upper and lower Worland ls.*, and an intervening sh. The upper ls. has been mistaken for Pawnee ls.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 58). The ls. beds in western Mo. that Greene has called lower and upper Worland may prove to be=already named beds in Kans., including Altamont ls., but Greene believes his *Worland ls.* is definitely below horizon of Altamont ls., and reconn. study by N. D. Newell indicates the so-called Worland ls. belongs to Pawnee ls.

World Beater porphyry.

Pre-Cambrian (?): Southeastern California (Inyo County).

F. M. Murphy, 1933 (Calif. State Div. Mines, Rept. 28 of State Min., July–Oct. 1932, p. 339 and map). *World Beater porphyry (porphyritic granite)*, of pre-Camb. (?) age. Forms quadrangular area of about 6 sq. mi., stretching from Pleasant Canyon to Happy Canyon, in S. part of Panamint Range. [Derivation of name not stated and not apparent from his map.]

Worm Creek quartzite member (of St. Charles limestone).

Upper Cambrian: Northeastern Utah and southeastern Idaho.

G. B. Richardson, 1913 (Am. Jour. Sci., 4th, vol. 36, pp. 407, 408). *Worm Creek qtzite.*—Massive gray qtzite, 300 ft. thick, forming basal memb. of St. Charles ls. in northern Utah and SE. Idaho.

Named for exposures on Worm Creek, Bear Lake Co., SE. Idaho.

Wormstones.

Upper Cambrian: Southwestern Wisconsin (Sparta and Tomah quadrangles).

W. H. Twenhofel and F. T. Thwaites, 1919 (Jour. Geol., vol. 27, p. 616). "*Wormstones.*"—Topmost beds of Dresbach ss. in Tomah-Sparta quads., SW. Wis., consisting of 1 to 10 ft. of ss., coarse- to medium-grained gray to brown beds, composed of firm ss., in which are large vertical worm holes ("wormstones") alternating with thinner beds of soft white ss. with limonite and siliceous concretions (nodular layers).

According to E. O. Ulrich, 1924 (Wis. Acad. Sci., Arts, and Lett. Trans., vol. 21, p. 93, footnote) this ss. "may be a part of Ironton ss. memb. of Franconia ss."

†Wortham aragonite lentil (in Wills Point formation).

Eocene (lower): Northeastern Texas (Brazos River region and northeastward).

F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 530, 535, 537, 538, 559). *Wortham aragonite lentil.*—Impure concretionary persistent stratum of ls., 6 to 10 in. thick; crystalline structure, in which many of the crystals are aragonite arranged in form of rosettes. Lies on top of Mexia memb. (lower memb. of Wills Point fm.). Been traced along outcrop from Brazos River NE. through Limestone, Freestone, Navarro, Henderson, Kaufman, Van Zandt, Hunt, and Hopkins Counties. Typical exposure is in town of Eureka, Navarro Co. It also occurs in R. R. cut just W. of station at Wills Point, Van Zandt Co., and in a stream valley 1 mi. E. of Wortham, Freestone Co.

The U. S. Geol. Survey includes this bed in Kerens memb. of Wills Point fm. but does not consider that a geographic name for it is necessary.

Worthington sandstone member (of Allegheny formation).

Pennsylvanian: Western Pennsylvania.

J. P. Lesley, 1880 (2d Pa. Geol. Surv. Rept. H_5, pp. xxi, 319). [See under *Kittanning ss. memb.* Lesley proposed *Pine Creek ss.*, also *Worthington ss.*, for a ss. lying in interval below Middle Kittanning coal and above Lower Kittanning coal, but sometimes occupying interval btw. Upper and Lower Kittanning coals.]

The U. S. Geol. Surv. uses *Worthington ss. memb.* for the ss. btw. Upper and Lower Kittanning coals, and has abandoned "Pine Creek ss." because of conflict with the name of a younger ls. in same region.

Worthville beds.

Upper Ordovician: Northern New York (Black River Valley).

R. Ruedemann, 1925 (N. Y. State Mus. Bull. 258, pp. 137, 141, 149, 154). *Worthville beds* (zone of *Pholidops subtruncata* and *Lyrodesma cincinnatiense*. Exposed along Sandy Creek about Worthville [Jefferson Co.]. Overlie Tremaines Bridge beds and underlie Sandy Creek beds; all included in Pulaski fm.

Wrangell lava.

Late Tertiary to Recent: Southeastern Alaska (Wrangell Mountains region).

W. C. Mendenhall, 1905 (U. S. G. S. P. P. 41, p. 54, map). *Wrangell lavas.*—A succession of lava flows and tuffs, 6,300 to 8,400± ft. thick, forming entire W. part of Wrangell group of mtns. Range in age from Tert. (nearly as old as Eo.) to present time.

Wreck Bay formation.

Pleistocene: British Columbia.

V. Dolmage, 1920 (Canada Geol. Surv. Summ. Rept. 1919, pt. B, p. 16).

Wreford limestone. (In Chase group.)

Permian: Eastern Kansas, central northern Oklahoma, and southeastern Nebraska.

R. Hay, 1893 (Kans. State Bd. Agr. 8th Bien. Rept., p. 104). *Wreford ls.*—Lss., 25 ft. thick, containing numerous flint nodules and separated by definite layers of flints. Form lower flint beds of Kans. section. Worked for lime at Wreford. Underlain and overlain by shales.

C. S. Prosser, 1902 (Jour. Geol., vol. 10, p. 713). *Wreford ls.*—Buff ls. and chert or flint. Thickness 35 to 50 ft. Cherty ls. at top, heavy ls. in middle, and cherty ls. at base. Is Strong flint of Prosser, 1895, and Wreford ls. of Hay. Basal fm. of Chase stage. Underlies Matfield shales and overlies Garrison fm.

Named for occurrence at Wreford, Geary Co., Kans., where it has been quarried and burned for lime.

Wright moraine.

Pleistocene (Wisconsin stage): Northeastern Minnesota.

F. Leverett, 1928 (U. S. G. S. P. P. 154). Named for Wright station, Carlton Co.

Wrightsville conglomerate.

Devonian or Carboniferous: Northwestern Pennsylvania (Warren County).

J. F. Carll, 1883 (2d Pa. Geol. Surv. Rept. I_4, pp. 180, 203–208, 230). *Wrightsville cgl.*—Massive flat-pebble cgl., yellowish, iron-seamed; sometimes contains numerous fossils. Thickness 15–25 ft. Lies 220–240 ft. below sub-Olean cgl. Forms several fine escarpments near Wrightsville, Warren Co. Is probably SW. continuation of Pope's Hollow cgl. of N. Y.

G. D. Harris, 1891 (Am. Geol., vol. 7, pp. 168, 172–178). *Wrightsville cgl.* is probably=Pope Hollow cgl.

L. C. Glenn, 1903 (N. Y. State Mus. Bull. 69, pp. 967–989). Name *Wrightsville cgl.* has been applied to Salamanca cgl. lentil of Cattaraugus beds in this region (Olean and Salamanca quads., N. Y.). [This is correlation accepted by N. Y. State Survey. (See W. Goldring, N. Y. State Mus. Hdb. 10, p. 425, 1931.)]

Wulff River formation.

Cambrian: Northwest Greenland.

C. Poulsen, 1927 (Meddelelser om Grønland, Bd. 70, pp. 239, 328). [Assigned to Camb. L. Koch, 1933, Bd. 73, Afd. 1, No. 2, p. 23, assigned it to Lower Camb.]

Wurtemburg limestone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania (Lawrence County).

J. P. Lesley, 1875 (2d Pa. Geol. Surv. Rept. J, pp. 93–100). *Wirtemburg lower ls.* (also *lower Wirtemburg ls.*).—Is 1 ft. thick at Wirtemburg (Lawrence Co.), and never exceeds 1½ ft. for 5 mi. above Wirtemburg along the creek. Always contains *Caulerpites marginatus.* Is separated from overlying Wirtemburg ss. by 15 ft. of soft sh. and is underlain by a thin coal, which rests on the Subcarbf., the "great cgl." (No. XII) being wholly absent. [His section at Wirtemburg describes 3 ft. of ls. above his Wirtemburg ss., which is evidently the reason he called this ls. *lower* Wirtemburg ls. His Wirtemburg ss. appears to be Homewood ss. memb. of later repts.]

I. C. White, 1878 (2d Pa. Geol. Surv. Rept. Q) and 1879 (2d Pa. Geol. Surv. Rept. Q_2). [See under *Mercer ls.*]

B. L. Miller, 1925 (Pa. Geol. Surv., 4th ser., Bull. M_7, pp. 280, 281, 332). Upper Mercer ls.=Mahoning ls.=*Upper Wurtemburg* ls.; Mercer ls.= Lower Mercer ls=*Lower Wurtemburg* ls. [Page 332.] "Another good exposure of Mercer ls. is to be seen just E. of Wurtemburg along Slippery Rock Creek, where it measures 12 to 14 inches." [Page 281.]

Wurtemburg sandstone. (In Pottsville formation.)

Pennsylvanian: Western Pennsylvania (Lawrence County).

J. P. Lesley, 1875 (2d Pa. Geol. Surv. Rept. J, pp. 93–94). *Wirtemburg ss.* thickens to 12 ft. ½ mi. above Smalley's Run and 23 ft. at mouth of Smalley's Run, where upper 17 ft. of it is gravel and lower 6 ft. sand. Near mouth of Conoquenessing, on Beaver River, it is from 60 to 75 ft. thick, and well developed into two gravel-sand fms. with a streak of coal between. It has always been recognized here as the genuine cgl. No. XII. At Wirtemburg [Lawrence Co.] the bottom of the ss. is 30 ft. above the water on both sides of the stream. Lies 180 ft. below Freeport ss. Is underlain by 15 ft. of soft grayish sh., which rests on *lower Wirtemburg ls.* [As defined appears to be Homewood ss. memb.]

Wyandot amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group and is probably=Winona amygdaloid. The mineralized part is the Wyandot lode. Named for occurrence in Wyandot mine, Houghton Co.

Wyandot flow.

Includes Wyandot amygdaloid and underlying trap.

Wyandot No. 8 amygdaloid.

Pre-Cambrian (Keweenawan): Northern Michigan.

Name locally in use many years. Used by B. S. Butler in U. S. G. S. P. P. 144, 1929. Belongs in Central Mine group. Occurs in interval btw. cgl. No. 6 above and Superior West amygdaloid below, and is eight amygdaloids back from Wyandot shaft, Houghton Co. The mineralized part is Wyandot No. 8 lode.

Wyandot No. 8 flow.

Includes Wyandot No. 8 amygdaloid and underlying trap.

Wyandotte group.

Pennsylvanian: Eastern Kansas.

R. C. Moore, 1931 (Kans. Geol. Soc. 5th Ann. Field Conf. Guidebook, correlation chart). *Wyandotte group*, new name, includes (descending) Lane sh., Iola ls., Chanute sh., Drum ls., Quivira sh., Dekalb ls., and Cherryvale sh.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, Aug. 28 to Sept. 3), discarded his Wyandotte group and applied *Kansas City group* to the fms. he previously had included in it. And, at same time and place, he used *Wyandotte ls.* for younger strata. (See *Wyandotte ls.*)

Wyandotte limestone.

Pennsylvanian: Eastern Kansas and northwestern Missouri.

R. C. Moore, 1932 (Kans. Geol. Soc. 6th Ann. Field Conf. Guidebook, pp. 85, 91, 92, 97). *Wyandotte ls.*—Basal fm. of Lansing group. Includes "Iola" ls. of Kansas City area (which is now named *Argentine*), a few ft. of overlying sh. (here called *Island Creek sh.*), and, at top, Farley ls. At base of the Argentine at some exposures are a very dark or black fissile sh. (*Quindaro*) and blue dense ls. (*Frisbie*). The Wyandotte includes a complete cycle except for the "lower" ls. and sh. It is very prominent in Wyandotte Co. and along Kansas River, but becomes thinner southward and disappears in Miami Co., Kans. Overlies Lane sh. and underlies Bonner Springs sh. [On p. 47 is a detailed section of Wyandotte ls. aggregating 59 ft.]

N. D. Newell, 1935 (Kans. Geol. Surv. Bull. 21, p. 59). Because no other name has been suggested for the ls. in interval btw. Iola and Plattsburg lss., I propose to apply to it the name *Wyandotte*, from county of that name in NE. Kans. The 5 subdivisions (Farley ls., Island Creek sh., Argentine ls., Quindaro sh., and Frisbie ls.) are recognizable throughout NE. Kans. N. of Miami Co. and far into NW. Mo.

R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22), stated that Newell is author of this name.

†Wyckoff limestone.

Pennsylvanian: Eastern Kansas.

E. Haworth and M. Z. Kirk, 1894 (Kans. Univ. Quart., vol. 2, p. 111). *Wyckoff ls.*—Ls. No. 9, 20 ft. thick, of section along Neosho River from Indian Territory to White City, Kans. Overlain and underlain by shales.

Preoccupied. Replaced by *Burlingame ls.*, according to R. C. Moore, 1936 (Kans. Geol. Surv. Bull. 22, p. 215).

Named for Wyckoff, Lyon Co.

Wycliffe glacial epoch (and drift).

Pleistocene: British Columbia.

S. J. Schofield, 1915 (Canada Geol. Surv. Mem. 76, p. 85).

Wykoff beds.

Upper Ordovician (Richmond): Southeastern Minnesota and northeastern Iowa.

C. W. Hall and F. W. Sardeson, 1892 (Geol. Soc. Am. Bull., vol. 3, pp. 349, 359, 366). *Wykoff beds.*—Rather heavy-bedded, very fossiliferous shaly lss., 20 to 70 ft. thick, overlying Maquoketa sh. and forming top div. of Cincinnati "group" in southern Minn. and northern Iowa. [In many subsequent repts this name was applied to beds overlying Maquoketa sh.]

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, pl. 28), showed that *Wykoff ls.* of Iowa and Minn. underlies Maquoketa sh. in places and is=Clermont sh. and older beds down to Dubuque dol.; in other places it underlies Clermont sh., and its upper part is=lower part of Maquoketa sh. of Mo.

C. L. Dake, 1921 (Mo. Univ. School of Mines and Met. Bull., Tech. ser., vol. 6, No. 1, p. 109). *Wykoff fm.* overlies Maquoketa sh. in Minn.

C. L. Dake, 1922 (Pan-Am. Geol., vol. 37, No. 4). Maquoketan shales are more limy to N., as represented by *Wykoff beds*, and more sandy to S., as indicated by Thebes ss.

Late reports of Minn. Geol. Surv. do not recognize any fm. in Minn. btw. Maquoketa sh. and the Dev. ls. They therefore include Wykoff beds of

Hall and Sardeson in Maquoketa sh. According to E. O. Ulrich (unpublished statement) they are a part of Maquoketa, and are so treated by U. S. Geol. Survey.

Named for exposures at Wykoff, Fillmore Co., Minn.

Wylie.

See under *Limpia*.

†Wyman sandstone.

Mississippian: Northern Arkansas and eastern Oklahoma.

F. W. Simonds, 1891 (Ark. Geol. Surv. Ann. Rept. 1888, vol. 4, pp. 26, 38–41). *Wyman ss.*—Rather soft ss., yellowish brown on weathered surface but much lighter-colored when freshly broken. Thickness 2 to 9 ft. At many localities in Washington Co., Ark., separates Boone chert and its accompanying ls. from Fayetteville sh. Frequently forms a layer, 2 to 3 ft. thick, interpolated just beneath uppermost layer of the ls. [evidently mistaken for the thin younger ls. of Chester age, which in places constitutes basal part of Fayetteville sh.] or btw. uppermost layer [of the Boone] and the black sh. above.

Same as Batesville ss. See explanation under *Fayetteville sh.*

Named for Wyman, Washington Co., Ark.

Wyman.

Name applied by C. [R.] Keyes to 300 ft. of shales in basal part of Kootenai fm. of Mont. Derivation of name unknown. (See Pan-Am. Geol., vol. 46, pp. 195–232, Oct. 1926.)

Wyman formation.

Pre-Cambrian: Central eastern California (Inyo Range).

J. H. Maxson, 1934 (Pan-Am. Geol., vol. 61, No. 4, p. 311). [See this entry under *Roberts fm.*]

J. H. Maxson, 1935 (Geol. Soc. Am. Proc. 1934, p. 314). *Wyman fm.*—Spotted schists and phyllites with a few interbedded dolomites. Thickness 3,700± ft. in Wyman Canyon, Inyo Range, Bishop quad. Uncon. underlies Reed fm. and overlies (uncon.?) Roberts fm. All of pre-Camb. age.

Wymer beds.

Tertiary: Northwestern California.

See *Wimer beds*.

Wymore shale. (In Chase group.)

Permian: Eastern Kansas and southeastern Nebraska.

G. E. Condra and J. E. Upp, 1931 (Nebr. Geol. Surv. Bull. 6, 2d ser., p. 37). *Wymore sh.*—Basal memb. of Matfield fm. Consists of olive to gray sh., some mudstone, and a zone of red sh. near middle. Thickness about 20 ft. or more in Nebr. and northern Kans., but only about 9 ft. in vicinity of Burden, Kans. Type loc. ravines W. side of creek 2½ mi. E. of S. side of Wymore, Gage Co., Nebr., in E½ sec. 27, T. 2 N., R. 4 E., about ¼ mi. N. of where highway crosses Burlington and Union Pacific Railroads. Underlies Kinney ls. and overlies Wreford ls.

See Kans.-Nebr. chart compiled by M. G. Wilmarth, 1936.

Wynona sandstone member (of Nelagoney formation).

Pennsylvanian: Central northern Oklahoma (Osage County).

C. F. Bowen, 1918 (U. S. G. S. Bull. 686D, pp. 17, 18). At top of section in T. 24 N., R. 10 E., Osage Reservation, Okla., is a ss., 15 to 20 ft. thick, named by K. C. Heald (Rept. on T. 24 N., R. 9 E., in preparation, to form part of Bull. 686) *Wynona ss.*, from exposures at and near town of Wynona, T. 24 N., R. 9 E. It lies 25 ft. above Fourmile ss.

K. C. Heald, 1918 (U. S. G. S. Bull. 686E, p. 28), showed (but did not define) *Wynona ss.*, 10 to 15 ft. thick in section of S. part of T. 25 N., R. 9 E., as lying 7 ft. below Oread ls. and separated from underlying Fourmile ss. by 30 to 40 ft. of shales containing 2 sss.

Wynona sandstone group or series.

Pennsylvanian: Central northern Oklahoma.

H. T. Beckwith, 1928 (Okla. Geol. Surv. Bull. 40T, pp. 22–24). *Wynona ss. (group) memb.* (also *Wynona ss. group or series*).—This name is given to a series of lenticular sss. in upper part of Nelagoney fm. The group as a whole extends from Arkansas River to Kans. line, but it cannot be traced continuously except by adjacent distinctive beds. The ss. beds have few distinguishing characteristics, and individual beds cannot be traced more than a few miles. They thin very rapidly, and as one lens pinches out another usually comes in a short distance below or above. The Bowman [Bowhan] and Jonesburg ss. is considered a part of this group. Thickness of entire group variable. In N. part of county, from base of Bowman [Bowhan] ss. up to base of Middle Oread ls. the thickness is 120± ft., of which over half is sh. In T. 26 N., R. 10 E., a thickness of 150 ft. has been measured, the greater part of which is sh. In vicinity of Wynona the Wynona ss., *including Fourmile ss. memb.*, has a thickness of 100 ft., most of which is ss. South in T. 22 N., R. 10 E., the ss. is split up into several lenses separated by sh. beds of variable thickness. In this locality the ss., from top of Wildhorse ls. to top of ss. lying under the gray to dark blue-gray shales below Elgin ss., has total thickness of 160 ft. or more. The Cochahee ss. memb. is = middle (?) bed of Fourmile ss.

Wyo division.

Upper Cambrian or Lower Ordovician: Central Texas.

T. B. Comstock and E. T. Dumble, 1890 (Tex. Geol. Surv. 1st Ann. Rept., pl. 3, pp. 295–306). *Wyo div.*—Chiefly brown-weathering dolomites or semicrystalline lss., of dark-reddish or purplish color, becoming sandy or granular above; beds rather thinly laminated. Thickness 60 to 80 ft. No fossils. Middle div. of Leon series. Overlies Beaver div. and underlies, apparently uncon., Hoover div.

Is a part of Ellenburger ls.

Named for "well-known cattle brand (YO) used in Blue Mtn region along course of James River in adjoining parts of Mason and Kimble Counties."

†Wyoming conglomerate.

Tertiary (Miocene ?): Southern Wyoming, northwestern Colorado, and northeastern Utah.

C. King, 1876 (U. S. Geol. Expl. 40th Par. Atlas, maps 1 and 2; separate sheets were issued in 1875, but atlas bears 1876 imprint). *Wyoming cgl. (Plio.)* mapped over scattered areas.

C. King, 1878 (U. S. Geol. Expl. 40th Par. vol. 1). *Wyoming cgl.*—Coarse semistratified gravels and cgls., 0 to 300 ft. thick. Distinctly overlies Niobrara Plio. Absolutely certain it antedates Glacial period. Is the cgl. of Bishop Mtn.

A. Hague, 1877 (U. S. Expl. 40th Par. vol. 2, btw. pp. 58 and 65). Isolated patches of coarse gravel and smooth boulders held together by ferruginous sands, in region of Big Thompson, eastern Colo., reach thickness of 200 ft. From close resemblance to beds E. of Laramie Hills and to others westward on *Wyoming Plains* they have been referred provisionally to Wyoming cgl., the latest Plio. beds of Rocky Mtns.

Now replaced by *Bishop cgl.*, the type loc. of which (Bishop Mtn) is more definite, and also because *Wyoming* has been applied to deposits of different ages, widely separated geographically and stratigraphically.

†Wyoming formation.

†Wyoming group.

Pennsylvanian, Permian, and Triassic (?): Eastern Colorado.

G. H. Eldridge, 1896 (U. S. G. S. Mon. 27, on Denver Basin). *Wyoming fm.*—Prominent series of brilliant red cgls., sss., and shales, with thin lss. and gypsums in upper part. Constitutes well-known Red Beds of Rocky Mtns region. Commonly referred to Trias. In Denver field they rest directly and uncon. on ancient crystalline rocks, although in many other localities there intervene thousands of Paleozoic measures—Perm. (?), Carbf., Sil., and Camb. Thickness 500 to 3,000 ft. In Denver Basin consists of an upper div. and a lower div. The upper div. consists of (descending): (1) Fine-grained ss., often massive, pink and brown, persistent, 15 to 25 ft.; (2) gray, yellow, green, pink, and lilac clays, gypsiferous and calc., especially 40 ft. below top, 125 to 175 ft.; (3) clays more aren. than those above, transitional in color from grays above to prevailingly brick reds below, 150 to 200 ft.; (4) sss. and shales alternating, brick red to pink, white dots, 50 ft.; (5) sss. and shales, 60 ft.; and (6) sandy and argill. shales, brick red, with narrow bands of white crystalline ls., 75 ft. The lower div. is divided into *"Creamy" ss.* at top and Red Beds below. The *"Creamy" ss.*, named for its color, is 200 to 400 ft. thick, and consists of quartzose ss., conglomeratic at base, with two sandy ls. bands in lower part and round ferruginous concretions near top. The Red Beds consist of 270 to 2,000 ft. of cgls., sss., and shales (chiefly cgls. and sss.), of red color, the basal 5 to 20 ft. nearly everywhere composed of coarse subangular fragments of adjacent granite, gneiss, or schists, usually loosely agglomerated, with small admixture of sand which in places shades to red aren. mud.

Is now divided into (descending) Lykins fm. ("Upper Wyoming" of Eldridge); Lyons ss. restricted; Ingleside fm.; and Fountain fm.; the latter 3 representing "Lower Wyoming" of Eldridge. The Lykins fm. is now considered to be of Triassic (?) and probably Perm. age; the Lyons ss. restricted of Perm. age; and the Ingleside and Fountain of Penn. age.

Named for widespread development in Wyo., but the application of the name in the literature has been restricted to eastern Colo.

Wyoming Valley limestone beds.

A name applied by C. A. Ashburner (2d Pa. Geol. Surv. Rept. 1885, pp. 437–450, map, 1886) to the lss. occurring in the post-Pottsville rocks of Wyoming Valley, Luzerne Co., NE. Pa. His table (p. 449) lists (descending): (1) *Mill Creek ls.*, 1 ft. thick, lying 138 ft. below top of Penn. section; (2) *Canal ls.*, 2 ft. thick, lying 25 ft. lower; (3) unnamed ls., 2 ft. thick, lying 134 ft. lower; and (4) *Hillman ls.*, 3 ft. thick, lying 156 ft. lower.

Yaak quartzite.

Pre-Cambrian: British Columbia (Idaho-Montana bdy) and northwestern Montana (Purcell Range).

R. A. Daly, 1905 (Canada Geol. Surv. Summ. Rept. 1904, pp. 96–100). *Yahk qtzite.*—White to gray indurated sss. bedded in thin to medium courses. Thickness 500+ ft.; top not seen. Conformably overlies Moyie argillite, in section along Int. Bdy from Port Hill, Idaho, to Gateway, Mont.

R. A. Daly, 1913 (Canada Dept. Int. Rept. Chief Ast. 1910, vol. 2, pp. 119–139). Moyie fm. includes at summit the *Yahk qtzite*, which it appears advisable to withdraw from list of Boundary fms. It crops out at only one place in whole belt. The upper 400 ft. of *Moyie fm. as redefined* are chiefly composed of whitish and gray qtzites with meta-argillitic intercalations.

Probably named for *Yaak* River (NW. Mont.-B. C.), the spelling adopted by U. S. Geog. Bd.

Yabucoa granite.

Age (?): Puerto Rico.

C. R. Fettke, 1924 (N. Y. Acad. Sci. Scientific survey of Porto Rico and Virgin Islands, vol. 2, pt. 2, p. 159).

Yahk quartzite.

See *Yaak qtzite.*

Yakataga formation.

Oligocene: Southeastern Alaska (Yakataga district, Controller Bay region).

N. L. Taliaferro, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 756+). *Yakataga fm.*—Series of sss., dark shales, and cgls., 5,000± ft. thick, conformably overlying Poul Creek fm. in Yakataga dist. The shales resemble those of Poul Creek fm. but are usually softer and less platy. The cgls. are often thick and heavy and, like those in underlying beds and many cgls. of Katalla dist., are in part of glacial origin. Although sss. and cgls. are much more abundant than in Poul Creek fm., sh. and sandy sh. form almost half of exposed section. Many sss. contain scattered grains of glauconite, and there are occasional beds, up to 40 ft. thick, largely made up of closely packed glauconite grains. First thick ss. above the shales of Poul Creek fm. is taken as base of the Yakataga. This ss. is well exposed on Two Mile Creek and eastward on ridge btw. White River Valley and the coast. The fm. is well exposed at Yakataga Reef and on N. and S. flanks of Yakataga anticline. The entire area of Yakataga dist. is underlain by Tert. sediments that appear to be wholly of upper Olig. age. A fairly large fauna was obtained from various parts of both Yakataga and Poul Creek fms. According to B. L. Clark both are of upper Olig. age, and=Blakely horizon of Wash. and San Ramon horizon of Calif.

B. L. Clark, 1932 (Geol. Soc. Am. Bull., vol. 43, No. 3, pp. 797–846). [See summary under *Poul Creek fm.*]

Yakima basalt.

Miocene: Central and southern Washington, northern Washington, and eastern Washington.

G. O. Smith, 1901 (U. S. G. S. W. S. P. 55). *Yakima basalt.*—Includes the great series of lavas poured out in Mio. time over the vast area btw. what is now the crest of Cascade Mtns on W. and mtns of Idaho on E., and btw. mtns of NE. Wash. on N. and Blue Mtns of Oreg. on S. In Snake River Canyon 3,000 ft. of lava is exposed and Russell counted 8 distinct lava sheets. Max. thickness there is estimated at 5,000+ ft. Ten or more separate flows can be counted in the 2,500+ ft. vertical section in canyon of Yakima River, and individual flows can be traced great distances. The names *Columbia lava* and *Columbia River lava* have been used by Prof. I. C. Russell in describing the extensive lava series of Columbia River Basin. Under those terms are included basalts of both Eo. and Mio. age, also hypersthene andesite of post-Tert. age. In detailed mapping of Yakima area, which is a part of Columbia River Basin, it has been found inadvisable to use this general fm. name, because the lavas of different ages must be separated. *Yakima basalt* is therefore used for that of Mio. period. In Yakima Co. the basalt is a black rock, compact and heavy, often brownish on weathered surface.

G. O. Smith, 1903 (U. S. G. S. P. P. 19). *Yakima basalt* is early or middle Mio. Rests uncon. on Manastash fm. in Wash.

See also under *Columbia River basalt.*

Yakima group.

Pliocene: Central northern Oregon.

T. Condon, 1902 (The two islands). *Yakima group*, Plio. [Not defined. Lake deposits?]

Yakinikak limestone.

Mississippian (upper): Northwestern Montana (Glacier National Park).

B. Willis, 1902 (Geol. Soc. Am. Bull., vol. 13, pp. 316, 324). *Yakinikak ls.*—Light-gray to dark gray-blue crystalline ls. speckled with black cleavage faces, or amorphous; sometimes oolitic; weathers rough. Thickness 0–100+ ft. Is without upper strat. limit but rests conformably on an unnamed Carbf. [?] qtzite, 25 ft. thick, which is uncon. on Algonkian strata. Contains numerous fossils, identified by Weller as of St. Louis horizon. Absence of earlier Miss. strata indicates unusual overlap. Type loc. on Yakinikak Creek, 4 mi. W. of North Fork of Flathead River. Is apparently down-faulted.

Yakoun volcanics.

Jurassic: British Columbia.

J. D. MacKenzie, 1914 (Canada Geol. Surv. Summ. Rept. 1913, p. 41).

Yakutat group.

Mesozoic(?): Southeastern Alaska (Yakutat Bay region).

I. C. Russell, 1891 (Nat. Geog. Mag., vol. 3, pp. 167–175). *Yakutat system.*—The gray and brown heavily bedded sss. and nearly black shales about Yakutat Bay and westward along foot of St. Elias Mtn to Icy Bay. Forms bold shore of Yakutat and Disenchantment Bays. Faulted and upheaved. Dips beneath St. Elias schist. Relations to Pinnacle system undet.

G. C. Martin, 1926 (U. S. G. S. Bull. 776, pp. 485–486). *Yakutat group* is of unknown thickness; its relation to adjoining rocks has not been satisfactorily determined, and it has yielded no fossils except the supposed worm tube *Terebellina palachei* Ulrich and a supposed irregular echinoid which Stanton believes to be post-Triassic.

Yale member (of Ironwood formation).

Pre-Cambrian (upper Huronian): Northwestern Michigan and northwestern Wisconsin (Gogebic district).

W. O. Hotchkiss, 1919 (Eng. and Min. Jour. vol. 108, pp. 501, 503). *Yale memb.*—Interbedded ferruginous cherts and even-bedded ferruginous slates, with slates predominating. At base a "flatwise" cgl., which may belong to underlying Plymouth ferruginous chert memb. Thickness of Yale memb. 65 to 370 ft. Conformably underlies Norrie ferruginous chert memb. and overlies (uncon.?) Plymouth ferruginous chert memb.; all members of Ironwood fm. Named for Yale mine, near Bessemer, Mich.

Yale moraine.

Pleistocene (Wisconsin stage): Southeastern Michigan. Shown on moraine map (pl. 32) in U. S. G. S. Mon. 53. Named for Yale, St. Clair Co.

Yallahs formation.

Cretaceous: Jamaica.

R. T. Hill, 1899 (Harvard Coll. Mus. Comp. Zool. Bull., vol. 34, p. 42).

†Yampa sandstone.

Pennsylvanian: Northeastern Utah (Uinta Mountains).

J. W. Powell, 1876 (Geology of eastern portion of Uinta Mtns, pp. 41, 55). The Upper Aubrey group consists of sss. and lss., the latter cherty. To N. there are 2 members of this group; the upper is cherty ls., 100 to 200 ft. thick, which we have called *Bellerophon ls.* The lower, the *Yampa ss.*, is very massive, rarely showing evidences of stratification; in some places obliquely laminated. [On p. 55 he says:] In Uinta Mtns we have a homogeneous gray ss. which we call *Yampa ss.*, from 1,000 to 1,200 ft. thick, capped by a bed which is believed to be equiv. to the one at top of Upper Aubrey at junction of Grand and Green and varies in thickness from 150 to 200 ft. [According to Powell's map the canyon of Yampa River, in NW. Colo. and NE. Utah, is cut in his "Upper Aubrey group," which also forms most of Yampa Plateau.]

A. R. Schultz, 1920 (U. S. G. S. Bull. 702, table opp. p. 24), showed Yampa ss. of Powell's Uinta Mtns section as exact equiv. of Weber qtzite, the more widely used name.

Yampa limestone lentil (of Bingham quartzite).

Pennsylvanian: Central northern Utah (Bingham district).

A. Keith, 1905 (U. S. G. S. P. P. 38, p. 43, map, sections). *Yampa ls. lentil of Bingham qtzite.*—White siliceous cherty marble; nodules and irregular masses of chert are frequently found in it. Thickness 0 to 400 ft. Possibly is same as Commercial ls. [In sections is shown as much younger than Highland Boy ls. Named for Yampa mine.]

Yampai sandstone.

Permian: Northwestern Arizona (Grand Wash Cliffs).

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, pp. 251, 339). *Yampai sss.* is proposed for the red friable sss. particularly distinguishing the middle section of Supaian series and outcropping in Yampai Cliffs, or southern extension of Grand Wash Cliffs, in western Ariz. Thickness 300 ft.

Yankee Fork rhyolite member (of Challis volcanics).

Tertiary (late Oligocene or early Miocene): Southern central Idaho (Casto region).

C. P. Ross, 1932 (Idaho correlation chart compiled by M. G. Wilmarth). *Yankee Fork rhyolite memb. of Challis volcanics.*—Varicolored flows and light-colored tuffs, 0 to 1,600± ft. thick. In places comprises top memb. of Challis volcanics, and in places is overlain by tuffaceous beds belonging to the Challis. Rests on Germer tuffaceous memb. of Challis. Type loc. head of Yankee Fork Creek, SE. corner of Casto quad.

C. P. Ross, 1934 (U. S. G. S. Bull. 854, on Casto quad.). *Yankee Fork rhyolite memb.*—Flows, in general brownish with more or less distinct violet tinge; some, especially where weathered, are light-colored; a few are almost black. Many of lower flows contain small subangular fragments of the light-colored rocks of Germer memb. In most places light-colored tuff such as characterizes the Germer is interbedded in the rhyolite, but in minor amount. Top is greatly eroded. Thickness 500 to 1,600± ft. Encircles head of Yankee Fork, Casto quad. No fossils found. Assigned to Tert. (Mio.?).

C. P. Ross, 1937 (U. S. G. S. Bull. 877, on Bayhorse region). In Casto quad. most of rhyolitic flows were grouped in *Yankee Fork rhyolite memb.* at top of Challis volcanics. In Bayhorse region the corresponding flows interbed with Germer tuffaceous memb. to greater extent than they do farther N. Is late Olig. or early Mio.

Yankeetown chert. (Of Chester group.)

Mississippian: Southwestern Illinois and eastern Missouri.

S. Weller, 1913 (Ill. Acad. Sci. Trans., vol. 6, pp. 120, 124). *Yankeetown fm.*—Light-buff or nearly white siliceous ls., 20 ft. thick, some beds slightly sandy, and locally the fm. is partly qtzitic. Rests, with probable uncon., on Renault fm. and is overlain by Paint Creek fm.

Named for Yankeetown School, SE. corner of Monroe Co., Ill. Typically developed in region adjacent to the school.

Yaque group.

Miocene: Dominican Republic.

C. W. Cooke, 1920 (Geol. Soc. Am. Bull., vol. 31, p. 219).

Yaquina formation.

Oligocene: Northwestern Oregon (Lincoln County).

Harrison & Eaton (firm), 1920 (Min. Res. Oreg., Oreg. Bur. Min. and Geol., vol. 3, No. 1). *Yaquina ss.* (also *Yaquina div.*).—Upper 1,300 ft. consists of micaceous blue-gray ss., heavy-bedded, very fine-grained and very fossiliferous. Lower 1,000 to 1,300 ft. consists of coarse-grained buff-colored ss. interbedded with carbonaceous sh.; some thin seams of soft coal in lower part. Underlies *Acila* sh. and overlies Toledo div.

H. G. Schenck, 1927 (Calif. Univ. Pub., Dept. Geol. Sci. Bull., vol. 16, No. 12). *Yaquina fm.* is middle Olig. Underlies, apparently uncon., Nye sh. It is believed no angular uncon. separates Yaquina and Toledo fms.

H. G. Schenck, 1928 (Univ. Calif. Pub., Dept. Geol. Sci. Bull., vol. 18, pp. 22–31). Thickness of *Yaquina fm.* is 4,000± ft., according to writer's interpretation. Type loc. is town of Yaquina. Fossils correlate with Eugene fm., Tunnel Point ss., Pittsburg Bluff ss.

Yarmouth stage of deglaciation (Pleistocene).

Yarmouth stage is name applied to the interglacial stage following the second or Kansan stage of glaciation and preceding the third or Illinoian stage of glaciation. The deposits include soil, gumbotil, vegetal, and other interglacial deposits. The name was proposed by F. Leverett (Jour. Geol., vol. 6, pp. 176, 238–243, 1898), deposits of this interglacial stage having been discovered in material thrown out of a well at Yarmouth, Des Moines Co., Iowa. The locality name is therefore objectionable, but there are many exposures of the deposits in SE. Iowa.

Yates sand.

A subsurface sand, of Perm. age and 50 to 60+ ft. thick, lying 400± ft. below eroded top of Perm. in Yates oil pool, Pecos Co., western Tex. Also known locally as *Smith sand*. Oil-bearing lss. lying at approx. horizon of this sand have been called *Yates lime* and *Yates ls.*

Yavapai schist.

Pre-Cambrian: Central Arizona (Bradshaw Mountains).

T. A. Jaggar, Jr., and C. Palache, 1905 (U. S. G. S. Bradshaw Mtns folio, No. 126). *Yavapai schist.*—Most abundant rock is an argill. phyllite varying to sl., mica schist, and chlorite schist, but the fm. as mapped locally includes gneisses, granulites, hornfels, and epidote and hornblende schists, also cgl. and ss. bands and lenses and zones of intense metamorphism. The variations of the normal schist are mapped separately. Greater part of fm. is clearly sedimentary. Is oldest fm. in area. Assigned to Algonkian, but Archean rocks may be present in area. Thickness 5,000 to 7,000 ft. Is=Vishnu schist of Grand Canyon and is same as "Arizonian" of Blake. Named for extensive development in Yavapai Co.

Yazoo clay member (of Jackson formation).

Eocene (upper): Mississippi and southwestern Alabama.

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 79). *Yazoo clay marl.*—Drab or yellowish calc. clays showing heavy bedding and distinct jointing. Thickness 300 ft. Of marine origin. Most notable fossil *Zeuglodon*. Included in Jackson group. Underlies Moody's Branch green marls.

C. W. Cooke, 1918 (Wash. Acad. Sci. Jour., vol. 8, No. 7, pp. 186–198). *Yazoo clay memb. of Jackson fm.* overlies Moodys marl memb., which includes, at top, the bed called "Zeuglodon bed" in Ala.

Later work led Cooke to modify the definitions so as to include the *Zeuglodon*-bearing bed in Yazoo clay memb. (See A. A. P. G. Bull., vol. 17, No. 11, pp. 1387–1388, 1933.) These modified definitions are those now followed by U. S. Geol. Survey, which treats the Yazoo and Moodys as *members* of Jackson fm., instead of as fms. of Jackson group. The Yazoo clay is overlain by Vicksburg group. Cooke (1918) described the Yazoo as almost entirely calc., very plastic clay of various colors, but in most places blue or green when wet and gray when dry. He gave its thickness at Vicksburg as 600 ft., at Jackson as 200 ft., at Shubata as 70 ft. In western Ala. the lower part of Yazoo clay of Miss. is represented by Cocoa sand memb. of Jackson fm., and the name *Yazoo* is there restricted to the overlying clay beds. The Yazoo and Moodys have not been mapped separately.

Named for exposures in bluff of Yazoo River at Yazoo City, Miss.

†Yeager clay.

Tertiary (Oligocene?): Southern Texas.

Julia Gardner and A. C. Trowbridge, 1931 (A. A. P. G. Bull., vol. 15, No. 4, p. 470). *Yeager clay.*—Massive or obscurely bedded clays in pastel shades of green, gray, yellow, or pink, carrying little or no sand and ash, which because of rarity of outcrops and absence of organic remains have not received the attention they deserve. Deussen (1924) included them in Frio clay. Dumble (1924) probably included them in upper part of his "Whitsett beds," the lower part of which form upper part of Fayette ss. of present writers. Bailey (1926) in most sections assigned them to his Frio, which was not Frio of Dumble, 1894. Unfortunately, both Dumble's original description and the text map that accompanies it include only outcrops of the volcanic series, and for that reason the name Frio must, by accepted laws of nomenclature, be retained for that series. For the lithologic unit of dominantly nonvolcanic clays, persisting from northern Live Oak Co. to the border, and several hundred ft. in max. thickness, the name Yeager is proposed, from Yeager ranch, on Cotulla-San Diego road in NE. Webb Co. The clays are interruptedly exposed from about ¼ to ½ mi. E. of to 3½ mi. SE. of the ranch house, where they are succeeded by the dominantly volcanic Frio fm. Fossil wood is commonly associated with the Yeager, but no other organic remains, either macro- or microscopic, have been recovered from surface exposures or well cores. Age not established. Absence of any evidence of uncon. btw. Fayette and Yeager is suggestive of Jackson age, but this appearance of conformity may be due to nonresistant lithologic character of the two fms., rather than to continuous deposition, and the field and possibly organic evidence may later prove the Yeager to be of Olig. age.

Owing to delay in publication of repts in which this fm. was defined by its proposers, the name first appeared in U. S. G. S. Press Mem. 50678 (pp. 10, 13, Feb. 16, 1931), entitled "Survey of the underground waters of Tex.," wherein it is described as consisting of gray to grayish-violet clay; (?) to 125 ft. thick; overlying Fayette ss. and underlying Reynosa fm. Later (Sept. 1931) it was decided to drop the new name "Yeager" and to adopt instead the definition of *Frio clay* which restricts that name to the beds beneath Catahoula tuff (=†Corrigan fm.) and above Fayette ss.

Yegua formation. (In Claiborne group.)

Eocene (middle): Eastern and southern Texas, northwestern Louisiana, and western and southern Mississippi.

E. T. Dumble, 1892 (Brown coal and lignite of Tex., pp. 124, 148–154). *Yegua div.*—Chiefly sands, sandy clays, clays, and brown coal, overlying Cook's Mtn beds (marine) and underlying Fayette div. [restricted]. Is lower part of deposits heretofore classed as Fayette beds.

The rept cited above gives sections in E. part of Burleson Co., along Brazos River above mouth of Yegua Creek, which show thicknesses ranging from 32½ to 37 ft., while sections given along Colorado River show 90 to 116 ft. of Yegua strata. The fm. was also identified along Rio Grande, but no mention was made of Lee Co. Until 1918, therefore, the type loc. of Yegua fm. was supposed to be in E. part of Burleson Co. In 1918, however (Tex. Univ. Bull. 1869, pp. 102–106), Dumble stated that type loc. is near mouth of Elm Creek, on [West] Yegua River [Creek], in Lee Co., and that in type section the line btw. Cook Mtn and Yegua fms. is drawn at base of the massive selenite-bearing clays. The fact that the thick nonmarine deposit mapped and described in eastern Tex. as Yegua fm. is same as †Cockfield fm. (top fm. of Claiborne group of La.) has been known for many years, but the more recent intensive work of Julia Gardner showed that the deposit at Yegua type loc. is a thin marine bed belonging to the underlying Cook Mtn fm. In view of these facts it was believed that a single name should be applied to the deposits in both States, and *Cockfield* was thought to be the better name. *Yegua* was therefore for a time discarded in favor of *Cockfield*. But in 1933 it was decided by Tex. geologists and U. S. Geol. Survey to revive *Yegua fm.* for the dominantly nonmarine unit forming top fm. of Claiborne group, and to abandon Cockfield fm. The Yegua fm. as now defined underlies Fayette ss. (of Jackson age) and overlies Cook Mtn fm.

See F. B. Plummer, 1933 (Univ. Tex. Bull. 3232, pp. 666–677).

Yegua River conglomerate. (In Yegua formation.)

Eocene: Eastern Texas (central Brazos County).

L. C. Reed and O. M. Longnecker, Jr., 1929 (Univ. Tex. Bull. 2901, pp. 163–174). *Yegua River cgl.*—Composed of clay balls, some angular, up to ft. or so in diam., which have been derived from material similar to that in underlying Turkey Creek bed. Considerable sand, in lenses and masses, is present in the cgl. No flint, pebbles, or petrified wood observed. Thickness at least 40 ft. It has shape and trend of a river channel. It gouges both the Turkey and Upper Turkey Creek beds, and its contact with the former is quite clear at one outcrop. Is a lithologic div. of Yegua fm., but name is used for convenience only and is not intended as a fm. or memb. name. [Is mapped. Derivation of name not stated, and appears to be applied to a *river* cgl. in Yegua fm., without reference to its proximity to Yegua River.]

Yellian series.

A term proposed by C. [R.] Keyes (Pan-Am. Geol., vol. 49, p. 287, 1928, and vol. 57, p. 344, 1932) to replace his *Arkansan series* (Penn.), "which is preoccupied many years previously by Endlich for a Carbonic ss. in Colo." Named for Yell Co., Arkansas River Valley, western Ark. coal-field region.

Yellow Creek sandstone member (of Hance formation).

Pennsylvanian: Southeastern Kentucky and northeastern Tennessee.

G. H. Ashley and L. C. Glenn, 1906 (U. S. G. S. P. P. 49, pp. 31, 33, 38, 119). *Yellow Creek ss. memb.*—Massive cliff-making ss., 25 to 60 ft. thick, in Hance fm., lying 100 ft. above base of Hance.

Named for Yellow Creek, Bell Co., Ky.

†Yellow Creek beds.

Mississippian (early) and Devonian: Northeastern Mississippi (Tishomingo County).

E. N. Lowe, 1915 (Miss. Geol. Surv. Bull. 12, p. 51). *Yellow Creek beds.*—Dark-gray and blue shaly lss., shaly and cherty toward top. Thickness 450 ft. Contain fauna corresponding to that of New Scotland of N. Y. Named for exposures on Yellow Creek, a branch of Tenn. River in Tishomingo Co.

W. C. Morse, 1930 (Miss. Geol. Surv. Bull. 23, pp. 18, 71). Yellow Creek beds of Lowe included Carmack ls. (Miss.) and all underlying Dev. terranes, and was a most appropriate term had not this uppermost ls. later proved to be Miss. in age. [On pp. 30 and 31 he gives sections on Yellow Creek, which show (descending): Carmack ls., 53 ft.; Whetstone Branch fm. (Upper Dev.), 0–31½ ft.; Island Hill fm. (Lower Dev.), 3 ft.; and New Scotland ls. (Lower Dev.), 39 ft.]

Yellow Hill limestone.

Lower Ordovician (Beekmantown): Eastern Nevada (Pioche region).

L. G. Westgate and A. Knopf, 1932 (U. S. G. S. P. P. 171). *Yellow Hill ls.*—Medium-bedded gray lss., weathering light gray, in part conglomerate, passing up into fine-grained gray lss., in beds 2 or 3 inches to 1 ft. thick, which cap Yellow Hill (near center of Ely Springs Range) and are well exposed in its W. face. The lowest part of fm. is on E. slope of Yellow Hill. Cgl. layers are common in fm., which weathers to gray or yellowish slabs and debris. Thin-bedded layers alternate with thicker beds and give a fluted cliff face on weathering. Total calculated thickness 670 ft. Fossils [listed] are late Beekmantown, according to E. Kirk. Faults bound the fm., so that neither base nor summit is shown, and it is impossible to say whether this Ord. fm. is conformable on Upper Camb. Mendha ls.

Yellowjacket formation.

Pre-Cambrian (Belt series): Southern central Idaho (Casto region).

C. P. Ross, 1934 (U. S. G. S. Bull. 854). *Yellowjacket fm.*—Dark-gray to greenish argill. qtzite with some calc. beds and, rarely, lenses of ls. Thickness probably nearly 9,000 ft. Underlies Hoodoo qtzite. Named for exposures at town of Yellowjacket, Casto quad. Basal fm. of Belt series. A. L. Anderson suggests (Idaho Bur. Mines and Geol. Pam. 34, p. 10, June, 1930) the rocks here named *Yellowjacket fm.* and *Hoodoo qtzite* may correspond to lower and middle members of Prichard fm. as identified by him in Orofino region.

Yellow Leaf quartz schist.

Devonian (possibly post-Lower Devonian): Eastern Alabama.

C. Butts, 1926 (Ala. Geol. Surv. Spec. Rept. No. 14, map, pp. 57, 147–148). *Yellow Leaf quartz schist.*—An unknown thickness, but at least 500 ft., of thin-layered fine-grained siliceous rock, varying in composition and texture from argillite to fine-grained ss., the latter greatly predominating. As the rock has a well-developed schistose structure, resulting from deformative stresses to which region has been subjected, the lithologic designation quartz schist can appropriately be applied to it. Immediately overlies Jemison chert (Oriskany). No fossils, but believed to be of Oriskany or later Dev. age. Formerly included in Talladega sl., to a part of which it corresponds.

Named for exposures on headwaters of Yellow Leaf Creek, 1½ mi. E. of Jemison, Chilton Co.

Yellowpine limestone member (of Monte Cristo limestone).

Mississippian (middle): Southeastern Nevada (Goodsprings region).

D. F. Hewett, 1931 (U. S. G. S. P. P. 162, pp. 9, 18, etc.). *Yellowpine ls. memb.*—Several beds of dark-gray ls. that locally weather as a massive ledge; in places completely altered to dol. Thickness 60 to 120 ft. Top memb. of Monte Cristo ls. Overlies Arrowhead ls. Contains the productive ore bodies of Yellow Pine, Potosi, Ingomar, and other mines.

†Yellowstone formation.

Upper and Lower Cretaceous and Jurassic (?): Central southern Montana (Little Belt Mountains region).

G. D. Harris, 1845 (Phila. Acad. Nat. Sci. Proc., vol. 2, pp. 235–237). *No. 5 or Yellowstone series.*—Probably continues from mouth of Yellowstone River to Great Falls of Mo. Consists of sand, clay, ss., and coal alternating without regularity. Strata vary from few inches to few ft. and are of a variety of colors.

H. D. Rogers, S. G. Morton, W. R. Johnson, 1845 (Phila. Acad. Nat. Sci. Proc., vol. 2, pp. 239–240). In immediate vicinity of Fort Union, near junction of Yellowstone and Missouri Rivers, in the group of strata designated as *No. 5* in Mr. Harris' paper, occur incontestable proofs of a fresh-water fm.

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). Above the coal seam forming top bed of Cascade fm. (Lower Cret.) about E. flank of Little Belt Mtns, and resting upon the still older Ellis fm. (Juratrias) in SW. part of Little Belt quad., is a great series of clay shales and sss., 4,500 ft. thick, for convenience grouped under name of *Yellowstone fm.* Different parts of this fm. exhibit diverse characters, but the gradation from one to another makes it difficult to divide it into the distinct parts generally recognized. There is, however, an advantage in recognizing these different parts, so that one may know to what horizon the beds seen at any locality belong, even if the boundaries and precise thickness of the subdivisions cannot be given. It includes Dakota ss. at base (400 to 500 ft. thick), the Colorado sh. or Benton and Niobrara, the Pierre sh. and Fox Hills sss., and is overlain by Laramie fm.

†Yellowstone Lake group.

Pliocene: Northwestern Wyoming.

See under *South Pass group.*

†Yellville limestone.

Lower Ordovician: Northern Arkansas and southern Missouri.

G. I. Adams and E. O. Ulrich, 1904 (U. S. G. S. P. P. 24, pp. 18, 32 (fig. 1), 90, 93). *Yellville fm.*—Mag. lss. or dolomites of Ord. age, which constitute principal lead- and zinc-bearing rocks of northern Ark. Of wide occurrence in lead and zinc dist., especially in Marion and Baxter Counties. Oldest rocks exposed in northern Ark. Base not exposed, and total thickness can only be estimated from record of deep well at Cushman, near Batesville, which passed through 1,505 ft. of strata without reaching pre-Camb. crystallines. Lower rocks in this well may be Camb. Name *Yellville fm.* intended to include only Ord. rocks. Natural exposures of fm. along White River approx. 500 ft. The lss. vary from massive to thin-bedded, with intercalations of shaly material and well-defined sh. beds. Underlies Key ss.

H. F. Bain and E. O. Ulrich, 1905 (U. S. G. S. Bull. 267, p. 12), applied *Potosi or Yellville group* to all rocks btw. top of Elvins fm. of Mo. and base of St. Peter ss. (St. Peter ss. as then used by Ulrich included most of Everton ls.—see 1907 entry under *Everton ls.*). These rocks include Powell, Cotter, Jefferson City, Roubidoux, and Gasconade fms. The Roubidoux has long been classified as of Beekmantown age and the Gasconade also is now classified by U. S. Geol. Survey as of Beekmantown age.

E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22, p. 667 and pl. 27). *Yellville ls.*—Provisionally regarded as embracing all rocks in northern Ark. and southern Mo. btw. top of Jefferson City dol. and base of Everton ls. This is in fact a restriction, but I take it a permissible one, since Adams, author of the term (P. P. 24, p. 18) had a very inadequate and in certain respects an erroneous conception of the series of rocks to which he proposed to apply the name. As here limited the fm. is bounded both above and below by an important uncon. and comprises all Canadian [Beekmantown] deposits on flanks of Ozarkia.

R. S. Bassler, 1915 (U. S. Nat. Mus. Bull. 92, vol. 2, pl. 2). *Yellville* uncon. overlies Gasconade ls. and includes (descending) Powell ls., Cotter ls., Jefferson City ls., and Roubidoux ss.

A. H. Purdue and H. D. Miser, 1916 (U. S. G. S. Eureka Springs-Harrison folio, No. 202, p. 5). *Yellville* of E. O. Ulrich, 1911 (Geol. Soc. Am. Bull., vol. 22) included only Powell ls.

E. T. McKnight, 1935 (U. S. G. S. Bull. 853, on Yellville quad., Ark.). *Yellville fm.* of Adams included (descending): Everton fm. (400 ft. thick, and of Chazy or older age); Powell dol. (85 to 170 ft. thick, and of Beekmantown age); Cotter dol. (400+ ft. thick, and of Beekmantown age); and Jefferson City dol. (of Beekmantown age).

Named for exposures at Yellville, Marion Co., Ark.

†Yellville group.

See 1905 entry under †*Yellville ls.*

†Yentna beds.

Tertiary: Southern Alaska.

J. E. Spurr, 1900 (U. S. G. S. 20th Ann. Rept., pt. 7, pp. 172, 183). *Yentna beds* is name applied to rocks of which only a single outcrop was examined, and this opp. Sushitna trading post, on Sushitna River below mouth of the Yentna. Is coarse-grained cgl. containing quartz pebbles. Provisionally referred to Kenai series.

Further explorations showed this is not a useful name.

Yeso member (of Chupadera formation).

Permian: New Mexico (northern, central, and southern).

W. T. Lee, 1909 (U. S. G. S. Bull. 389). *Yeso fm.*—Consists of 1,000 to 2,000 ft. of ss., sh., earthy ls., and gyp. The ss. varies in color from gray to many shades of pink, yellow, red, and purple and in texture from soft coarse-grained friable masses to fine-grained layers, evenly bedded and flinty. The shales, frequently gypsiferous, are soft, pink to yellow in color, and beds of massive white gyp. 100 to 200 ft. thick occur in many places. Is middle fm. of Manzano group. Underlies San Andreas ls. and lies with apparent conformity on Abo ss. [See also under *San Andres ls.*] Until further information is available San Andreas ls. cannot be definitely separated from Yeso fm. except in type loc. in San Andreas Mtns. Typically exposed on Mesa del Yeso, a small table-land 12 mi. NE. of Socorro. [In several sections the top memb. of Yeso fm. is shown as consisting of 200 to 275 ft. of pink, yellow, and white ss.]

See under *Chupadera fm.*, N. H. Darton (1922), for reasons for making it a memb. of Chupadera fm.

W. B. Lang, 1937 (A. A. P. G. Bull., vol. 21, No. 7), abandoned *Picacho ls.* of Pecos Valley region for *San Andres ls. memb. of Chupadera fm.*, and replaced *Nogal fm.* of that area with *Hondo ss. memb. of Chupadera fm.* (above) and *Yeso memb. of Chupadera fm.* (below). The recognition of Hondo ss. involves a slight redefinition of both San Andres and Yeso as heretofore used.

Yoder formation.

Oligocene (early): Southeastern Wyoming (Goshen County).

E. M. Schlaikjer, 1935 (Harvard Coll. Mus. Comp. Zool., vol. 76, No. 3, pp. 71–75). *Yoder fm.*—A series of fluviatile deposits, lying uncon. on Lance fm. (upper Cret.) and grading upward into Chadron fm. (lower Olig.), occurring in certain parts of Goshen Hole area. The fauna is distinctly transitional btw. uppermost Eo., or Duchesne, and lowermost Olig., or lower Chadron. It seems too progressive to be assigned to Eo., and too primitive to be assigned to Chadron. The beds represent a strat. level quite apart from upper Eo. and easily distinguished from Chadron. The Eo. and Paleocene are absent in Goshen Hole area. Considering faunal relationships and strat. position the fm. should be regarded as Olig. rather than Eo. Named for town of Yoder, which is 1½ mi. SE. of type loc., which is SE¼ sec. 29, T. 23 N., R. 62 W., Goshen Co., where the fm. consists of (descending): (1) Reddish-green clays, with channels of wine-colored intricately cross-bedded coarse to fine ss., 20± ft.; (2) red to greenish sandy clays, mostly bedded, 18± ft.; (3) red sss. and dark to light-red rather finely bedded sandy clays, 15± ft.; base concealed.

Yogo limestone.

Upper Cambrian: Central northern Montana (Fort Benton quadrangle) and central southern Montana (Little Belt Mountains quadrangle to Helena region).

W. H. Weed, 1899 (U. S. G. S. Fort Benton folio, No. 55). The brick-red shales and lss. constituting Dry Creek sh. are overlain by 100 ft. of *Yogo ls.*

W. H. Weed, 1899 (U. S. G. S. Little Belt Mtns folio, No. 56). *Yogo ls.*—Gray or mottled ls. with a few layers of sh. Uppermost memb. of Barker fm. [a name applied to all Camb. rocks of area]. Overlies Dry Creek sh. and underlies Jefferson ls. [Derivation of name not stated, but Barker fm. is mapped at and around village of Yogo, also along Yogo Creek (both in N. part of this quad.), at both of which places it is overlain by Jefferson ls.]

W. H. Weed, 1900 (U. S. G. S. 20th Ann. Rept., pt. 3, p. 286). *Yogo ls.* of Little Belt Mtns generally consists of thin-bedded ls. flags alternating with crumbly gray or greenish sh. but grades into rather pure thick-bedded lss. Entire section is well shown at head of Sheep Creek and S. of Monarch. [On p. 328 Weed gave section exposed in Sheep Mtn, Yogo Creek Valley, N. of Yogo, which showed 10 ft. of Yogo ls. underlying Jefferson ls. and overlying Dry Creek sh. On p. 330 he gave a section at mouth of Bear Creek, Yogo Gulch, which listed 65 ft. of Yogo btw. the Jefferson ls. and Dry Creek sh. Type loc. of Dry Creek sh. is in NE. corner of Three Forks quad. See definition.]

A. Knopf, 1913 (U. S. G. S. Bull. 527, p. 91). *Yogo ls.* of Helena dist. consists of light-colored thin-bedded lss., with crinkly bands and films of jasper, in many places composed of ls. pebbles held in a glauconitic matrix. It corresponds to so-called "Pebbly" ls. of Three Forks folio [which rests on Dry Creek sh.].

C. F. Deiss, 1936 (Geol. Soc. Am. Bull., vol. 47, No. 8, pp. 1258–1342), proposed that Yogo ls. be discarded and defined Dry Creek as uncon. overlain by Dev. rocks. In upper part of his Dry Creek sh. he included a great thickness of lss.

Yogo Peak type (of granite porphyry).

A term used by L. V. Pirsson (U. S. G. S. 20th Ann. Rept., pt. 3, p. 502, 1900) for a mass of granite porphyry on divide running E. from Yogo Peak, Little Belt Mtns, central southern Mont.

Yonkers granite.

Pre-Cambrian: Southeastern New York.

F. J. H. Merrill, 1890 (Am. Jour. Sci., 3d, vol. 39, p. 388). *Yonkers gneiss.*—Lowest stratum yet recognized in Westchester Co. is a reddish gneiss which forms central mass of some of hills in Yonkers, where it is well exposed, and consists of small grains of detrital quartz with fragments of reddish orthoclase and a few crystals of biotite which have developed during process of metamorphism. From macroscopical characters it would be called a gneiss; from microscopic characters it would be called a metamorphosed ss. or arkose. It is proposed to designate it an arkose gneiss. Thickness not determined. Base not seen, but believed it rests on the stratified granulites at top of the pre-Camb. Underlies Fordham gneiss. Included in Manhattan group.

W J McGee, 1894 (Geol. map of N. Y., prepared under direction of James Hall). [Among "ancient crystalline rocks" *Yonkers granite* is shown below Cortlandt series and above Laurentian granite.]

F. J. H. Merrill, 1898 (N. Y. State Mus. 15th Ann. Rept., vol. 1, pp. 21–31). *Yonkers gneiss* is technically a gneissoid granite, is plainly *intrusive* into Fordham gneiss, and is younger than Manhattan schist.

C. P. Berkey, 1907 (N. Y. State Mus. Bull. 107, pp. 361–378). *Yonkers gneiss* appears to have been a great granite sill that can now be traced along axis of southern ridges for distance of 15 mi. Is intrusive into Fordham gneiss.

C. P. Berkey and M. Rice, 1921 (N. Y. State Mus. Bull. 225, 226, p. 140). [*Yonkers gneissoid granite* is placed in column as much younger than injection gneiss part of Fordham gneiss, which is much younger than paragneiss parts of Fordham gneiss.]

E. B. Knopf and A. I. Jonas, 1929 (U. S. G. S. Bull. 799, table opp. p. 68), classified this fm. as post-Glenarm Algonkian.

Yonkers gneiss.

See under *Yonkers granite.*

†York limestone.

Ordovician and Cambrian: Southeastern Pennsylvania.

P. Frazer, Jr., 1876 (2d Pa. Geol. Surv. Rept. C, pp. 130 et seq). [Throughout his description of York Co. Frazer frequently used *York ls.* and stated that it is same as Auroral ls.]

P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_3, btw pp. 1 and 31). *York ls.* is a slender offshoot of Lancaster ls.

Same as ls. later named Shenandoah ls. and now divided into several fms., as shown on Pa. chart II.

†York schist.

Lower Cambrian: Southeastern Pennsylvania.

P. Frazer, Jr., 1876 (2d Pa. Geol. Surv. Rept. C, pp. 130–143), in describing the rocks of York Co., stated that hydromica slates and schists overlie the qtzite of Chiques rock and uncon. underlie York (Auroral) ls. On p. 135 he called the schists *York schists.*

P. Frazer, Jr., 1880 (2d Pa. Geol. Surv. Rept. C_3, pp. 3–6). *York schists.*—Hydromica schists. Named for locality where first studied in this [Lancaster Co.] dist. Overlie Chikis [Chickies] qtzite. Compose greater part of Chikis ridge and Chestnut Hill.

The schist overlying Chickies ("Chiques") qtzite in York Co. is now called *Harpers schist.*

†York shale.

Lower Cambrian: Southeastern Pennsylvania (York County).

C. D. Walcott, 1896 (U. S. G. S. Bull. 134, pp. 14–15, 26, 36–37). *York shales* is proposed for the band of shales resting upon the qtzites surrounding Hellam Hills. Well developed in York Co. Is subjacent to Lancaster ls. and underlain by Chickies qtzite.

Same as Harpers schist, mapped over large areas to SW. of York Co.

York zone.

Archean: Northern South Carolina.

See *Abbeville-York zone.*

Named for exposures in York Co.

†York County hydromica slates.

Lower Cambrian: Southeastern Pennsylvania.

J. P. Lesley, 1892 (2d Pa. Geol. Surv. Summ. Final Rept., vol. 1, p. 203). *York Co. hydromica schists* overlie Chiques ss. and underlie Great Valley ls.

Same as York schist of Frazer, which is now replaced by *Harpers schist.*

York Harbor biotite granite.

Devonian (?): Southwestern Maine.

A. Wandke, 1922 (Am. Jour. Sci., 5th, vol. 4, pp. 148, 149). *York Harbor biotite granite* (Dev. ?) is exposed along S. side of York Harbor, York Co.

Yorkian period.

Yorkic period.

Names introduced by C. [R.] Keyes (Pan-Am. Geol., vol. 37, pp. 234, 243–244, 1922) to include Dev. and Sil. of present commonly accepted nomenclature, "in commemoration of what is perhaps its most complete terranal representation in the world—the New York section of these rocks."

C. [R.] Keyes, 1931 (Pan-Am. Geol., vol. 56, pp. 88, 89), restricted his *Yorkic* to the time btw. Carbf. and Sil., or to Dev. period of current terminology.

C. [R.] Keyes, 1933 (Pan-Am. Geol., vol. 59, p. 57). *Yorkic* is of course a modern abbreviation of Ebenezer Emmons' early term of *New York system*, "a name which turns out to be as justly regarded as ranking with Murchison's Silurian system, and Sedgwick's Cambrian system, in date of birth, formal and precise stratigraphic characterization, exact faunal definition, just accreditation to the astute American pioneer in modern geological definition and nomenclature, useful terminal application, and in every way peer of any of our geological periodic time divisions." [†New York system of Emmons extended from top of Chemung (Upper Dev.) to base of Potsdam ss. (Upper Camb.).]

York-Petro limestone.

A name applied by R. N. Hunt, also by O. P. Peterson, 1924, Am. Inst. Min. and Met. Engrs. Trans., vol. 70, pp. 859–883 (Hunt) and pp. 908–926 (Peterson) to a ls., 1 to 10 ft. thick, in upper part of Bingham qtzite (Penn.) of Bingham dist., Utah. Lies 300 ft. above Parnell ls.

York River sandstone.

Devonian: Quebec (Gaspe Peninsula).

H. S. Williams, 1910 (Geol. Soc. Am. Bull., vol. 20, p. 690). *York River beds*, assigned to Dev.

C. H. Kindle, 1936 (Eastern geol., No. 1, April, 1936, pp. 3, 4, 6). Fossils found at various horizons in *York River ss.* of Williams, 7,000 ft. thick and lower memb. of Gaspe ss., are probably Middle Dev. This ss. underlies Malbaie cgl., upper memb. of Gaspe ss.

†Yorktown epoch.

Miocene: Atlantic coast.

J. D. Dana, 1863 (Man. geol., pp. 506, 510, 521, 522). *Yorktown epoch*, or that of the beds of Yorktown, Va., in which 15 to 30 percent of the species are living—usually called Miocene. *Yorktown beds* cover a large part of Atlantic Tert. border, occurring at Gay Head on Martha's Vineyard; in N. J.; in Md., on both sides of the Chesapeake for a great distance; and in Va., at Yorktown, Suffolk, Smithfield, and through larger part of Tert. region.

Corresponds to Chesapeake group, or all of Mio. of region described, of which Yorktown fm. of present nomenclature is upper part.

Yorktown formation. (In Chesapeake group.)

Miocene (upper): Eastern Virginia and North Carolina.

W. B. Clark and B. L. Miller, 1906 (Va. Geol. Surv. Bull. 2, pt. 1, p. 19). *Yorktown fm.*—Sands and clays crowded with remains of calc. shells, chiefly marine Mollusca. At Yorktown and on James River afford the most highly fossiliferous beds of Chesapeake Bay region. Fossils differ from those of underlying Mio. fms. and evidently represent a distinct faunal aggregate. Thickness 100+ ft. Rests conformably on St. Marys fm. Is top fm. of Chesapeake group.

W. C. Mansfield, 1935 (Fla. Geol. Surv. Bull. 12, p. 9). *Yorktown fm.* of Va. and N. C. is divisible into 2 major zones. Zone 2 (the upper) includes: (1) The uppermost Yorktown beds, which are exposed at Suffolk, Va., and which are correlated with upper part of *Cancellaria* zone of Fla.; (2) the beds at Yorktown, Va., which are correlated with lower part of *Cancellaria* zone of Fla.; and (3) the *Chama*-bearing bed, which is correlated with the aluminous clay of Fla. Zone 1 (at base) corresponds to the beds exposed at Raysor Bridge, S. C. [Raysor marl of C. W. Cooke], which are=*Ecphora* zone of Fla.

Yorkville granite.

Late Carboniferous (?): Northwestern South Carolina and southern North Carolina.

A. Keith, 1931 (U. S. G. S. Gaffney-Kings Mtn folio, No. 222). *Yorkville granite.*—Dark-gray coarse-grained granite. Intrusive into Roan gneiss. Believed to be younger than Whiteside granite.

Named for exposures at Yorkville (also called York), York Co., S. C.

Yosemite glacial epoch.

Name applied by E. Blackwelder (Geol. Soc. Am. Bull., vol. 41, pp. 91–92, 1930) to time during which the glacial deposits of Wisconsin age were laid down on slopes of Sierra Nevada, Calif. He later (G. S. A. Bull., vol. 42, pp. 865–922, 1931) replaced this name with *Tioga glacial stage*.

Young Peak dolomite.

Middle Cambrian: Western Utah (Gold Hill district).

T. B. Nolan, 1930 (Wash. Acad. Sci. Jour., vol. 20, No. 17, Oct. 19, pp. 421–432). *Young Peak dol.*—Massive dark-gray to black crystalline dol. spangled with short rods of dol. To N. the dol. interfingers with shaly lss. similar to those in underlying Abercrombie fm. Less than 5 mi. to N. only a few ft. of dol. can be found, and the strat. interval of the fm. is occupied by portions of Abercrombie fm. Top bed is a dark-gray dol. containing abundant nodules of dark-gray chert which may reach several ft. in diam. It is overlain by a cream-colored, finely laminated dol. which forms basal bed of Trippe ls. Thickness 600 ft. No fossils, but unquestionably is Middle Camb. Is well exposed on Young Peak, on S. side of Dry Canyon.

See also U. S. G. S. P. P. 177, 1934.

Young's Bluff bed.

Eocene (Jackson): Northwestern Louisiana (Grant County).

T. L. Casey, 1902 (Sci., n. s., vol. 15, p. 716). *Young's Bluff bed.*—Blackish and red clays characterized by profusion of a large *Pinna* and of *Venericardia planicosta*, *Volutilithes*, and *Pseudoliva*. Outcrops about 3 mi. below Kimbrel beds, and limits the estate of John Young. Is still higher than Kimbrel bed. Must be very nearly synchronous with Kimbrel bed but is a sufficiently distinct horizon to have developed another characteristic species of *Lucina*. Included in Jackson stage. Named for outcrops on estate of John Young, S. of Montgomery, Grant Co.

Youngstown sand.

A subsurface sand, of early Penn. (Cherokee) age, in eastern Okla., which has been said to be=Dutcher sand series, the upper or first Youngstown sand corresponding to upper Dutcher sand, and the lower or second Youngstown sand corresponding to lower Dutcher sand; but according to pp. 177–178 of Okla. Geol. Surv. Bull. 40Q, 1928, the Youngstown sand in its type area (Youngstown pool, Okmulgee Co.) lies at 2,250 ft. depth, the Dutcher sand at 2,400 ft. depth, and the Booch sand at 1,994 ft.

Younkin formation. (Buried.)

Devonian or Silurian (?): North-central Kansas.

J. S. Barwick, 1928 (A. A. P. G. Bull., vol. 12, No. 2, p. 184). *Younkin fm.*—Unit No. 3 encountered in wells in Salina Basin, Kans. Not exposed. Thickness 0 to 400 ft.; is 400 or more ft. thick in Clay and Riley Counties. Consists of white to gray dolomitic ls. locally interbedded with thick bodies of rounded quartz sand in lime matrix. Underlies Skelton sh. (unit No. 2) and overlies Engle sh. (unit No. 4). Lithology and position suggest fossiliferous Sil. and Dev. of SE. Nebr., SW. Iowa, and NW. Mo., which does not correspond to Hunton ls. of Okla. Named for Boggess et al. Younkin No. 1 well, sec. 21, T. 9 S., R. 4 E., Clay Co., Kans., where encountered at 2,194 to 2,520 ft. depth.

Ysidro shale.

Pre-Cambrian: Central northern New Mexico (Sandia and Manzano Mountains).

C. [R.] Keyes, 1915 (Iowa Acad. Sci. Proc., vol. 22, pp. 257–259; Conspectus of geol. fms. of N. Mex., pp. 4, 12). *Ysidro shales.*—The thick argill. memb. of Proterozoic sediments lying above the great qtzite, which is best exposed in sharp truncated arch in Tijeras Canyon btw. Sandia and Manzano Ranges. Thickness 1,500 ft. [Derivation of name not given.]

Yucca bed.

Lower Cretaceous (Comanche series): Western Texas (El Paso County).

J. A. Taff, 1891 (Tex. Geol. Surv. 2d Ann. Rept., pp. 725, 736). *Yucca bed.*—Consists of (descending): (1) *Caprotina* ls. (second horizon), 15 ft. of massive thick-bedded ls.; (2) alternating sands, grits, aren. ls., cgl., and flaggy marble;

(3) *Exogyra texana* horizon. Overlies Etholen bed and underlies Bluff bed; all included in Washita div.

C. L. Baker, 1927 (Univ. Tex. Bull. 2745, p. 21). Lower part of *Yucca bed* belongs to Cox ss. and upper part to Finlay ls.

Named for Yucca Mesa, El Paso Co.

†Yuha reefs.

Miocene (lower): Southern California (Imperial County).

G. D. Hanna, 1926 (Calif. Acad. Sci. Proc., 4th ser., vol. 14, p. 435). Above these [Coyote Mtn] clays, and interbedded with them near top to some extent, are extensive deposits of oyster shells for which the name "*Yuha Reefs*" has been selected. Type loc. has been chosen as prominent hill made up of the material, thoroughly cemented and partially metamorphosed, located on E. end of Coyote Mtn uplift. The same reefs are found on Yuha Buttes. Overlain by Coahuila silt. Assigned to Plio., probably middle or upper Plio. [Seems to form uppermost part of †Carrizo Creek beds. See under *Imperial fm.*]

See W. P. Woodring, 1931, under *Imperial fm.* Are interbedded at different horizons in upper part of Imperial fm.

Yukon silts.

Pleistocene: Northeastern Alaska (Yukon River region).

J. E. Spurr, 1898 (U. S. G. S. 18th Ann. Rept., pt. 3, pp. 200–220). *Yukon silts.*—The gravels or silts forming lower terraces of Yukon River. Contain remains of mammoth and other Pleist. mammals and land and fresh-water shells of living species. In most cases it seems certain the deposits were formed in fresh-water lakes.

A. G. Maddren, 1907. (See 1907 entry under *Kowak clay.*)

Yukon group.

Pre-Cambrian: Northeastern Alaska (Yukon River region) and Yukon Territory, Canada.

D. D. Cairnes, 1914 (Geol. Soc. Am. Bull., vol. 25, p. 184; Canada Geol. Surv. Summ. Rept. 1912, p. 11; Canada Geol. Surv. Mem. 67, p. 40).

J. B. Mertie, Jr., 1937 (U. S. G. S. Bull. 872). *Yukon group* is=Birch Creek schist (sedimentary) and associated meta-igneous schists, gneisses, and intrusives, and includes all older pre-Camb. crystalline rocks of Yukon Territory.

Yule marble.

Trade name for marble quarried from Leadville ls. (Miss.) in Gunnison Co., Colo. Also known to trade as *Colorado Yule marble* from 1908 to 1916. In 1928 the Yule Colorado Marble Co. was organized and the trade name for the product became *Yule Colorado marble*. The quarry is now (1937) owned by Vermont Marble Co. The Lincoln Memorial at Washington, D. C., is constructed of this marble.

†Yule limestone.

Ordovician: Western and central Colorado.

G. H. Eldridge, 1894 (U. S. G. S. Anthracite-Crested Butte folio, No. 9). *Yule ls.*—*Upper div.*, 60 to 90 ft. thick, consists mainly of green, yellow, red, and white shales, with more or less aren. or calc. layers which pass into thin lss. *Middle div.*, 250 to 280 ft. thick, consists of lss., often very thin-bedded, frequently siliceous, especially at base, and containing grayish-white cherts. Color generally gray with pink or purple cloudings, turning to brown on weathered surfaces. On Yule Creek the lss. are altered to marbles of white, green, yellow, and other colors, and they are fossiliferous. *Lower div.* consists of 75 to 100 ft. of qtzite, generally white, sometimes spotted by iron oxide, often calc., and containing indistinct fossils. The Yule overlies Sawatch qtzite and underlies Leadville ls. and has a total thickness of 350 to 450 ft. Named for fine development at head of Yule Creek.

In type area is now divided into Fremont ls. (Upper Ord.), Harding ss. (Middle Ord.), and Manitou ls. (Lower Ord.), and has been discarded.

Yule coal group.

A term applied to a group of strata in Ludlow lignitic memb. of Lance fm. in SW. N. Dak., including coals A to F, both inclusive. (See A. G. Leonard, 1908, N. Dak. Geol. Surv. 5th Bien. Rept.)

†Yulean series.

Cambrian to Upper Devonian: Western Colorado.

C. [R.] Keyes, 1924 (Pan-Am. Geol., vol. 41, pp. 281, 289) *Yulean series.*—Composes all of Late Ordovicic of Colo. Divided into (descending): Cement shales, 100 ft.; Fremont dolomites, 300 ft.; and Harding sss., 100 ft. "A modification of Eldridge's name" [Yule ls.].

According to E. Kirk, 1930 (Am. Jour. Sci., 5th, vol. 20, pp. 456–465), the Harding sss. of Keyes are Upper Camb. Sawatch qtzite; his Fremont includes equivalents of Manitou ls., Harding ss., and Fremont ls.; and his Cement is probably Upper Dev.

Yuma sandstone member.

Eocene (upper): Southeastern Texas.

B. C. Renick, 1936 (Univ. Tex. Bull. 3619, table opp. p. 17, and pp. 36–39). *Yuma ss. memb. of Manning fm.*—Massive and flaggy ss., locally containing fossiliferous marine beds; 3 to 25 ft. thick. Lies 25 to 40 ft. above Dilworth ss. memb. of Manning [expanded] and 0 to 25 ft. below top of Manning fm. [Above definition is from table. On p. 36 is statement:] Along Missouri Pacific R. R. track about 300 ft. N. of station at Yuma and about 6,000 ft. W. and 3,300 ft. S. of NE. corner of Walter Sutherland survey, there are strata consisting mostly of flags of medium-hard ss. interbedded with soft sand and sandy sh., and in basal part of this section there is an earthy ss. The entire section at Yuma is about 25 ft. thick and name *Yuma ss.* is here applied to this memb., though it is recognized that it is possible these strata may be equiv. of Dilworth ss. of Gonzales Co. [At bottom of p. 37 is statement that Yuma ss. is 25 to 40 ft. above Dilworth ss., and a long list of places where the Yuma is exposed.]

Yumuri limestone.

Miocene or Oligocene: Cuba.

E. L. DeGolyer, 1918 (A. A. P. G. Bull., vol. 2, p. 143). [Assigned to Olig., but C. Schuchert, 1935 (Hist. geol. Antillean-Caribbean region, p. 507), assigned it to middle Mio.]

Zaleski flint. (In Allegheny formation.)

Pennsylvanian: Southeastern Ohio (Vinton County).

W. Stout, 1927 (Ohio Geol. Surv., 4th ser., Bull. 31, p. 181). *Zaleski flint.*—A gray to black calc. bed, 1½ in. thick, underlying Winters clay in Vinton Co.

Zandia clay.

See *Sandia clay.*

Zanzibar limestone.

Ordovician(?): Central Nevada (Manhattan district).

H. G. Ferguson, 1924 (U. S. G. S. Bull. 723). *Zanzibar ls.*—Blue-gray ls. with black jasper; a little black sl. near top. Thickness 800 ft. Underlies Toquima fm. and overlies Mayflower schist. Prominently developed on Zanzibar claim, about 1½ mi. E. of Manhattan.

Zapata formation.

Pleistocene: Cuba.

J. W. W. Spencer, 1894 (Geol. Soc. Am. Bull., vol. 6, p. 129).

Zapotitlan formation.

Cretaceous: Mexico.

W. A. VerWiebe, 1924 (Am. Jour. Sci., 5th, vol. 8, p. 281).

Zebra limestone.

A descriptive term applied by the miners of Colo. to patches of dark-blue fine-grained ls. or dol. cut by closely parallel veinlets of coarser-grained white dol.

Zemorrian stage.

Tertiary: California.

R. M. Kleinpell, 1934 (A. A. P. G. Bull., vol. 18, No. 3, pp. 376–378), proposed the following 6 new stage names, for faunal subdivisions of Mio. series in Calif. (ascending order): (1) *Zemorrian stage* (type loc. Zemorra Creek, a branch of Chico Martinez Creek, Kern Co.); (2) *Saucesian stage* (type loc. Los Sauces Creek, Ventura Co.); (3) *Relizian stage* (type loc. Reliz Canyon, Monterey Co.); (4) *Luisian stage* (type loc. on Highland monocline about 4½ mi. W. of Indian Creek, San Luis Obispo Co.); (5) *Mohnian stage* [derivation of name not stated]; and (6) *Delmontian stage* (type loc. at head of Canyon Segundo, S. of Del Monte, Monterey Co.).

R. M. Kleinpell, 1935 (Geol. Soc. Am. Proc. 1934, p. 391), gave *Mohnian* type loc. as N. of Mohn Spring, Santa Monica Mtns.

H. G. Schenck and R. M. Kleinpell, 1936 (A. A. P. G. Bull., vol. 20, No. 2, p. 224, etc.). *Zemorrian stage* includes "*Turritella inezana* zone" of type Vaqueros, upper San Lorenzo fm., etc. Overlies Refugian stage and underlies Saucesian stage.

Zeuglodon beds.

A paleontologic name applied by W. H. Dall (U. S. G. S. 18th Ann. Rept., pt. 2, p. 342, 1898) to a bed in upper part of Jackson fm. (Eo.) that contains the remains of *Zeuglodon*.

Zia marl.

Eocene (?): Central northern New Mexico (Sandoval County).

A. B. Reagan, 1903 (Am. Geol., vol. 31, btw. pp. 67 and 111). *Zia marls*.—Bluish-yellow Eo. marls, 0 to 40 ft. thick, forming cap rock on one side of Rio Grande. Called Pleist. by Herrick. Rest on soft red and gray Eocene sss., and uncon. underlie Plio. calc. sss. and cgls. of white to deep-green color.

Probably named for village of Zia, near Jemez, Sandoval Co.

Zilhlejini formation.

Upper Cretaceous: Northeastern Arizona (Black Mesa).

A. B. Reagan, 1925 (Pan-Am. Geol., vol. 44, pp. 287, 291). *Zilhlejini shales* [on map].—Overlying, in apparent conformity, sss. in Black Mesa, Ariz., that appear to belong to Pictured Cliffs ss., is an important coal-bearing section, 200± ft. thick, which seems to have no very close affinities elsewhere unless it is=some part of Fruitland fm. of N. Mex. It is therefore designated *Zilhlejini coal fm.*

A. B. Reagan, 1926 (Pan-Am. Geol., vol. 46, pp. 193–194). *Zilhlejini fm.*—Several hundred ft. of fresh-water coal-bearing sss. and shales occurring on top of Black Mesa. Overlie 30 ft. of Masukian black shales, thought possibly to be southerly equiv. of typical Laramie fm. of Wyo., Colo., Utah, the Lower Laramie or Cretacic Laramie of some recent authors. Contains an impure limerock characterized by heaps of oyster shells (listed).

Apparently named for exposures on Ziltahjini Peak (as spelled on 1924 geol. map of Ariz.), in Black Mesa, where rocks of this description occur.

The 1921 ed. of decisions of U. S. Geographic Board states that *Black* is adopted as the name of the mesa in Hopi and Navajo Indian Reservations, Ariz., instead of Zilh-le-jini or Zilthe-le-Jini. On 1937 map of Indian Office of U. S. Dept. Int. this peak is spelled Zibi-dush-jhjni.

A. B. Reagan, 1932 (Kans. Acad. Sci. Trans., vol. 35, pp. 233–236), says Fruitland fm. [Bauer, 1916] is same as his Zilhlejini fm., and that latter name is "from Dzilijini (black streak) mountain (coal beds), the Navajo name for Black Mesa."

Zimmerman sand.

A subsurface sand of Chester (Miss.) age in Ind. that has been correlated with Cypress ss.

Zion Hill quartzite.

Lower Cambrian: Eastern New York (Rensselaer County) and southwestern Vermont (Rutland County).

R. Ruedemann, 1914 (N. Y. State Mus. Bull. 169, pp. 69-70). *Zion Hill qtzite.*—The Ferruginous qtzite of [T. N.] Dale. Named for Zion Hill, Hubbardtown, Vt., [in Castleton quad.], where, according to Dale, it is exposed to thickness of 70 ft. Overlies Schodack shales and lss. Is top fm. of Lower Camb.

Zoar limestone. (In Pottsville formation.)

Pennsylvanian: Eastern Ohio.

J. S. Newberry, 1874 (Ohio Geol. Surv. vol. 2, pp. 133, 134, and pl. opp. p. 81). *Zoar ls.*, 2 to 6 ft. thick, lies in Lower Coal Measures, overlying coal No. 3.

E. Orton, 1878 (Ohio Geol. Surv. vol. 3, pp. 891-892). *Zoar ls.*—Black or dark-blue highly fossiliferous shaly ls., 10 in. to 10 ft. thick, lying 90 to 135 ft. above Maxville ls. and 160 ft. below Hanging Rock ls. Often replaced by flint. To N. and E. of Hanging Rock dist. separated, by an interval of 15 to 22 ft., into two courses called *Upper Zoar ls.* and *Lower Zoar ls.*, each capped with iron ore and underlain by a coal seam, the ores continuing after the lss. fail, the lower ore becoming known as Dresden, Junction City, and Union Furnace Block, and the upper ore as Main Block or Hocking Furnace ore.

Later repts state this is Lower Mercer ls. memb. of Pottsville fm.

Named for Zoar, Tuscarawas Co.

Zuckerman limestone member (of Hoxbar formation).

Pennsylvanian: Central southern Oklahoma (Carter County).

C. W. Tomlinson, 1928 (Okla. Geol. Surv. Bull. 40Z, p. 16). [See 1928 entry under *Daube memb.*]

C. W. Tomlinson, 1929 (Okla. Geol. Surv. Bull. 46, p. 46). *Zuckerman memb.*—Chiefly white to buff coarsely crystalline calc. ss., with a finer-grained layer at top and a local development of intraformational (?) cgl. of gray ls. pebbles up to ¼ in. diam. in a calc. matrix. Thickness 30± ft. Lies 400 to 500 ft. above Daube ls. Overlain by 500± ft. of beds belonging to Hoxbar fm. Named for same coal mine that Daube memb. is named for.

†Zuni sandstone.

Upper Jurassic: Northwestern New Mexico and northeastern Arizona.

C. E. Dutton, 1885 (U. S. G. S. 6th Ann. Rept., pl. 16, p. 137). *Zuni sss.*—Sss. and sandy shales, with occasional masses of gyp.; wonderfully banded; variegated colors. Thickness 800 to 1,300 ft. Underlies Dakota ss. and overlies Wingate sss. in Zuni Plateau, N. Mex.

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr. (U. S. G. S. P. P. 183, 1936, p. 43 and chart opp. p. 43), the Zuni ss. of Dutton (1885) and N. H. Darton (U. S. G. S. Santa Fe Ry Guidebook, 1915) is same as Morrison fm., the intervening Summerville, Curtis, Entrada, Carmel, Navajo, and Kayenta fms. being absent in Zuni Plateau.

†Zuni shale.

Upper Jurassic: Western New Mexico.

C. R. Keyes, 1905 (Am. Jour. Sci., 4th, vol. 20, p. 424). *Zuni shales*, 1,200 ft. thick, underlie Dakota sss. in western N. Mex. and overlie Wingate sss. Are correlated with Pyramid shales of eastern N. Mex. [Derivation of name not given.]

The rocks btw. the ss. that has been called Dakota ss. in NW. N. Mex. and the Wingate ss. are now designated *Morrison fm.* In SE. Utah, NE. Ariz., and parts of SW. Colo. 6 fms. intervene btw. the Morrison and the underlying Wingate, named (descending) Summerville, Curtis, Entrada, Carmel, Navajo, and Kayenta. (See U. S. G. S. P. P. 183, 1936, by A. A. Baker, C. H. Dane, and J. B. Reeside, Jr.)

†Zunian series.

Jurassic and possibly Triassic: Northwestern New Mexico and northeastern Arizona.

C. R. Keyes, 1906 (Sci., n. s., vol. 23, p. 921, and Am. Jour. Sci., 4th, vol. 21, pp. 298–300). *Zunian series.*—Shales and sss., 0 to 1,200 ft. thick, underlying Morrisonian series and overlying Shinarumpian series in N. Mex.

C. [R.] Keyes, 1922 (Pan-Am. Geol., vol. 38, p. 250). *Zunian series* in Ariz. is divided into (descending) McElmo, LaPlata, Todilto, and Wingate.

Keyes also applied his name *Zunian series* in other Western States.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 65, No. 4, May 1936, pp. 303, 306). *Zunian series* of SW. Colo., NW. N. Mex., and NE. Ariz. divided into (descending) McElmo shales, Lohali ss., Montezuma shales, and Arido ss. The latter 3 fms. correspond to LaPlata ss. of Cross.

C. [R.] Keyes, 1936 (Pan-Am. Geol., vol. 66, No. 1, pp. 71–72). *Lohali* is preoccupied and is here replaced with *Tyende ss.*

According to A. A. Baker, C. H. Dane, and J. B. Reeside, Jr., 1936 (U. S. G. S. P. P. 183, table opp. p. 37), the Zunian series of Keyes in Ariz. included the following fms. of U. S. G. S. classification (descending): Morrison fm., Summerville fm., Entrada ss., and Carmel fm., all of Upper Jurassic age; and the Navajo ss., Kayenta fm., and Wingate ss., all of Jurassic (?) age; and the upper 4 fms. are included in Keyes' McElmo and the lower 3 in his LaPlata.

Zwolle marl.

Upper Cretaceous: Northwestern Louisiana (Sabine County).

H. R. Kamb, 1931 (A. A. P. G. Bull., vol. 15, No. 10, p. 1293). The oil in Zwolle field has been regarded as coming from the so-called "Zwolle marl," overlying the chalk series proper, which latter, according to E. B. Hutson (oral communication) is probably Marlbrook and Annona in age. The marl probably represents the time interval from the Midway to the Marlbrook.

Zypsie sand.

A subsurface sand, of Penn. age and 0 to 20 ft. thick, in Cotton Co., Okla. Lies 205 to 230 ft. below top of Priddy sand.

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