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MINERAL INDUSTRY OF ALASKA IN 1931

AND

ADMINISTRATIVE REPORT

BY

PHILIP S. SMITH

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NOTE.—Bulletin 844 will not be issued as a complete volume, but the last chapter will contain a volume title page and index for the use of those who may wish to bind together the separate chapters.

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By PHILIP S. SMITH [1]

INTRODUCTION

The mineral industry of Alaska was for many years the dominant incentive for the development of the Territory. Later, as the other possibilities of the Territory became better known, other industries sprang up and partly reduced the preeminence of mining, though they have by no means displaced the hold that mining has on the welfare of the people. It is probably safe to say that to-day, although the annual value of the minerals produced in Alaska is second to that of the fish products, mining developments still hold first place in the general interest of most of the residents. Assistance to the mining industry of Alaska has therefore long been recognized as a Federal obligation, and through the Geological Survey efforts have been made to determine the distribution and extent of these resources and to disseminate all pertinent information about them to the miner, prospector, or business man who might undertake their development. As a result several hundreds of reports have been issued by the Geological Survey describing the different mineral commodities or mining camps and setting forth, both in text and by illustrations and maps, the facts that have been determined and the inferences that may be drawn from them. Among these studies relating to the mineral industry is the collection of current information regarding the kinds and quantities of minerals produced and the places from which they came. To obtain this information the Geological Survey conducts an annual canvass of the mineral production of Alaska and makes the results available through reports published shortly after the end of the year to which

[1] The canvass of producers, the tabulation of their replies, and the general compilation of the statistics set forth in this report have been conducted principally by L. N. Eaton, of the Alaskan branch of the U. S. Geological Survey.

the records relate. The present report, which is of this type, is the twenty-eighth of the series.[2]

The collection of the facts requisite for the preparation of these annual statements involves difficulties, because the great size of the Territory, the diversity of its mineral products, and the large number but small size of many of the enterprises make it impracticable to gather all the desired information at first hand. The information used is therefore derived from many sources, which necessarily vary in reliability and completeness. Efforts are made, however, to reduce all the statements to a comparable basis and to give only those that appear to be well substantiated. Among the most reliable sources of information are the geologists and engineers who are sent out each year by the Geological Survey to conduct surveys in different parts of Alaska and who acquire not only much accurate information regarding the mineral production of the regions in which they work but also general information by contact with miners and operators in the course of their travels to and from the field. Members of other Government organizations—for instance, the Bureau of Mines, the Bureau of the Mint, the Alaska Railroad, the Bureau of Foreign and Domestic Commerce, and the Customs Service—in the course of their regular duties collect many data which are extremely valuable in these studies and the use of which avoids unnecessary duplication in collecting records. Most of the banks, express companies, and other business organizations in Alaska collect for their own use data regarding mineral commodities of their particular districts. Some of these data are extremely pertinent to the general inquiry conducted by the Geological Survey, and through the cordial cooperation of many of these companies important facts have been made available to the Geological Survey, though some of this information is confidential and is not released for publication. Most of the larger Alaska newspapers and certain papers published in the States that feature Alaska matters are courteously sent by their publishers to the Geological Survey, and from these and the technical and scientific periodicals are gleaned many items regarding new developments.

In addition to all these sources the Geological Survey each year sends out hundreds of schedules—one to every person or company known to be engaged in mining—on which are a number of questions regarding the mining developments and production of each individual property during the year. These schedules when filled out by the operators of course constitute a most authoritative record. Unfortunately, however, not all of them are returned by the operators, and

[2] The other volumes of this series, commencing with that for 1904, are Bulletins 259, 284, 314, 345, 379, 442, 480, 520, 542, 592, 622, 642, 662, 692, 712, 714, 722, 739, 755, 773, 783, 792, 797, 810, 813, 824, and 836.

even some of the operators who return them have not all the specific data desired, misunderstand the inquiries, or reply in such a manner that the answers may not be correctly interpreted when the schedules are edited. It is a gratifying evidence of the general appreciation of these annual summaries that so many of the operators cooperate fully and cordially with the Geological Survey by furnishing the information called for on the schedules as well as volunteering much other pertinent information.

It is apparent, however, that facts collected from one source, although of themselves strictly accurate, are likely to be computed or stated on a different basis from equally reliable reports received from another source, so that considerable editing and revision must be done in trying to bring all to one standard. It is not possible to know exactly all the corrections that should be applied in order to reduce the reports of production to a strictly uniform standard. However, though some uncertainties necessarily remain, it is believed that they do not have significant effect on the results expressed and that the reports are consistent within themselves and with the other reports of this series. The reader should realize that while the statistics given in these reports are comparable among themselves, they necessarily differ from those published by some of the other Government bureaus, because these are primarily records of production, whereas those issued by the Bureau of the Mint, for instance, relate to receipts at the offices of that bureau, those issued by the Customs Service relate to shipments, and those issued by other organizations may be computed on still other bases.

Another reason why the totals used in this volume for certain mineral commodities may differ from the reports received from other sources is that all values here stated are computed on the average selling price for each of the individual mineral commodities for the year, as determined by the Bureau of Mines, and not on the prices actually received by the individual producers. It is obvious that this method of computation disregards the amount received by individual mines, but it is believed to afford a better representation of the industry as a whole. Furthermore, it probably does not introduce any significant error in the totals, inasmuch as higher prices received by the more shrewd and efficient mine operators should be about balanced by lower prices received by the less fortunate ones.

It is the constant aim of the compilers to make these annual summaries of mineral production as accurate and adequate as possible. The Geological Survey therefore bespeaks the continued cooperation of all persons concerned in the Alaska mineral industry and urges them to communicate any information that may lead to this desired end. It should be emphasized that all information regarding indi-

vidual properties is regarded as strictly confidential. The Geological Survey does not use any facts that are furnished in a way that will disclose the production of individual plants nor allow access to its records in any way that will be disadvantageous to either the individuals who furnish the information or those to whom it relates. So scrupulously is this policy followed that in this volume it has been necessary to combine or group together certain districts or products so that the production of an individual may not be disclosed.

Special acknowledgment is due to O. E. Kiessling and other officers of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce of the Department of Commerce; the collectors and other officers of the Alaska Customs Service and of the Bureau of the Mint of the Department of the Treasury; Col. O. F. Ohlson and other officers of the Alaska Railroad; F. H. Moffit, S. R. Capps, J. B. Mertie, jr., B. D. Stewart, R. H. Sargent, J. M. Hill, J. C. Reed, F. G. Wells, G. A. Waring, C. P. Ross, J. C. Ray, C. F. Park, Ralph Tuck, R. W. Richards, P. A. Davison, J. J. Corey, C. F. Fuechsel, and Gerald FitzGerald, of the Geological Survey; the agents of the American Railway Express Co. in Alaska; Maj. Malcolm Elliott and other members of the Alaska Road Commission; the Alaska Weekly and Volney Richmond, of the Northern Commercial Co., of Seattle, Wash.; Ralph and Carl Lomen, of Seattle and New York; the Ketchikan Alaska Chronicle, of Ketchikan; the Hyder Weekly Herald, of Hyder; the Alaska Juneau Gold Mining Co., the Daily Alaska Empire, and J. C. McBride, of Juneau; the Cordova Daily Times and J. B. O'Neill, of Cordova; the Kennecott Copper Corporation, of Kennecott and New York; C. T. O'Neill, of McCarthy; M. J. Knowles, of Chitina; the Seward Daily Gateway, of Seward; H. N. Evans, of Kanatak; J. L. Waller, of Kodiak; the Anchorage Weekly Times, of Anchorage; W. E. Dunkle, Q. A. Pyle, and H. W. Wilmoth, of Wasilla; Ross Heckey, of Chickaloon; H. W. Nagley, of Talkeetna; Charles Zielke, of Nenana; Joe Quigley and C. A. Trundy, of Kantishna; C. W. Alexander, of Circle; the First National Bank, the Fairbanks Exploration Co., the Fairbanks Daily News-Miner, G. E. Jennings, Lynn Smith, J. A. Gustafson, and Joe Henderson, of Fairbanks; C. B. Haraden and J. J. Hillard, of Eagle; C. E. M. Cole, of Jack Wade; A. W. Amero, of Beaver; Chris Thyman, of Rampart; Jessie M. Howard, of Tanana; T. J. De Vane, George Jesse, and William Growden, of Ruby; Frank Speljack and Alfred Johnson, of Ophir; the Miners and Merchants Bank, of Iditarod; D. E. Browne, of Flat; H. S. Wanamaker, of Wiseman; J. W. Wick, of Russian Mission; John Haroldson and J. L. Jean, of Quinhagak; C. M. Link and George W. Hoffman, of Bethel; Charles Mespelt, of Medfra; Oliver Anderson, of McGrath; S. M. Gaylord, of Casadepaga; the

Nome Nugget, Hammon Consolidated Gold Fields, the Miners and Merchants Bank, Col. E. R. Stivers, and C. W. Thornton, of Nome; T. P. Roust, of Candle; Arthur W. Johnson, of Haycock; Ethel M. Marx, of Teller; Art M. Hansen, of Kiana; Lewis Lloyd and James C. Cross, of Shungnak.

MINERAL PRODUCTION

GENERAL FEATURES

The total value of the mineral production of Alaska in 1931 was $12,278,000. This was furnished by several mineral products, but gold and copper account for more than 92 per cent of the total. The value was only about 89 per cent of that of 1930, showing a decrease of about $1,534,000. At first sight this decrease might be interpreted as indicating a permanent decline in the mining industry. Such an interpretation, however, would be unwarranted and not in accord with the actual conditions. In fact, the world-wide stagnation of business and the accompanying depression that characterized 1931 seem to have been less acutely felt in Alaska than in most other countries. In such commodities as gold, whose price has remained constant, there was a gratifying increase of output. It was mainly at those mines which produced the commoner metals that the low prices paid for their output resulted in a serious decline. The sharpness of the decline in the prices paid for metals in the world market may be appreciated by the following comparison: Copper brought 8.3 cents a pound in 1931, or 64 per cent of the price in 1930; silver, 29 cents an ounce, or 75 per cent of the price in 1930; and lead, 3.8 cents a pound, or 76 per cent of the price in 1930. It may be of interest to note that had the prices for these three metals that prevailed in 1930 held good in 1931 the value of the output of 1931 would have been nearly $1,136,000 greater and the decrease from 1930 would have been only about $400,000. In this connection it should be realized that not only did the low price of metals have a direct effect on the actual value of the output but it had an even greater indirect and less obvious effect in deterring operators from opening up new properties or maintaining a high rate of output from the mines already producing. In many places development work was considerably curtailed and retrenchments instituted in order to effect economies required by the depression of business that affected every line of industrial enterprise in the States and throughout the rest of the world.

In the face of the severe curtailment in all lines of business the fact that the returns from mining in Alaska showed a decrease of only a little more than 12 per cent is of itself rather encouraging. There

are many other indications that with the return to normalcy mining in Alaska may be expected to participate in the general development. Already many inquiries have been set under way by persons and companies able to carry through such undertakings as they enter into, that indicate a revival of interest in Alaska mining ventures and a willingness—even a desire—to take part in worth-while projects. However, most of the inquiries of this type relate to more or less proved projects or to projects that if unproved promise to repay handsomely the large amount of money that will have to be laid out on testing them. Many Alaskans holding property on which some mineral showings have been found still fail to differentiate, in the price they ask for their properties, between a prospect and a proved ore deposit, and thus legitimate enterprises are discouraged. The constant tendency of mining companies in their efforts to reduce cost is to handle lower grade material and thus increase the size of their operating units. For this reason the searcher for mineral deposits no longer need confine his principal efforts to hunting for small stringers of rich ore but rather should scrutinize closely and sample accurately all deposits that appear to hold promise of yielding large quantities of moderately good ore. That places still remain which will repay such investigations is confidently believed, but their discovery and development will call for serious and intelligent effort and probably will not follow on haphazard or blind chance.

Each year brings more and more development thoughout the Territory as a whole, and these improvements in general conditions are stimulating prospectors and others to search for new mineral deposits or undertake the development of deposits that were too difficult to exploit under less favorable conditions. Such improvements are bound to exert a continuing and growing force, so that each year Alaska is becoming less and less an unknown frontier, and the hazards of mining under pioneer conditions are being reduced. Furthermore, the mere accumulation of experience produced by successful mining ventures builds up confidence and interest that induce the undertaking of other new enterprises and thus create an ever-widening circle of stimulation.

TOTAL MINERAL PRODUCTION

From the time of the earliest records of mining in Alaska to the end of 1931 minerals to the value of more than $641,000,000 have been produced in the Territory. The distribution of this large total among the individual years is set forth in the following table and is graphically represented by the curves in Figure 1. From this table and diagram it will be evident that prior to 1898 the annual pro-

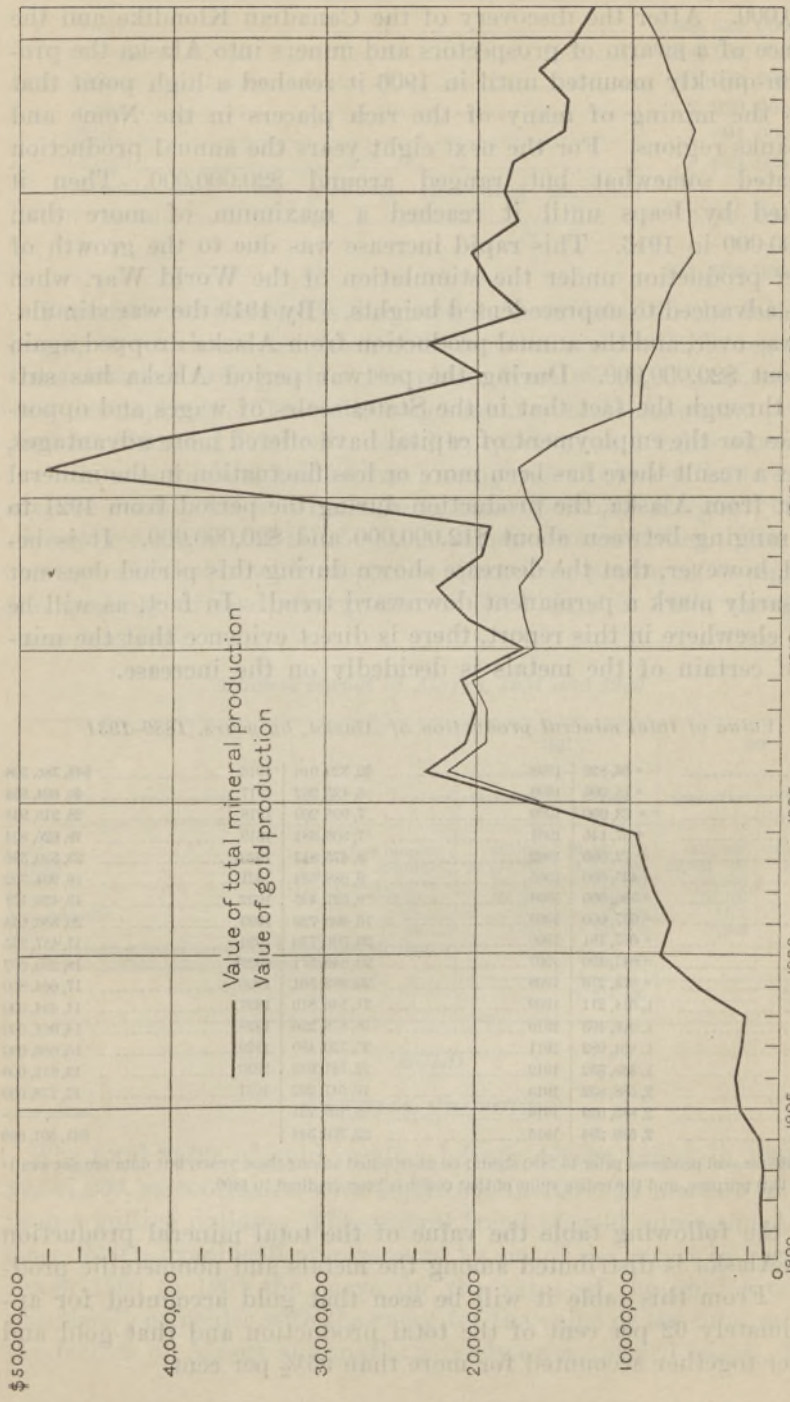

FIGURE 1.—Trends of mineral production of Alaska, 1890–1931

duction ranged from negligible amounts to a maximum of less than $3,000,000. After the discovery of the Canadian Klondike and the entrance of a swarm of prospectors and miners into Alaska the production quickly mounted until in 1906 it reached a high point that marks the mining of many of the rich placers in the Nome and Fairbanks regions. For the next eight years the annual production fluctuated somewhat but ranged around $20,000,000. Then it mounted by leaps until it reached a maximum of more than $48,000,000 in 1916. This rapid increase was due to the growth of copper production under the stimulation of the World War, when prices advanced to unprecedented heights. By 1919 the war stimulation was over, and the annual production from Alaska dropped again to about $20,000,000. During the postwar period Alaska has suffered through the fact that in the States scales of wages and opportunities for the employment of capital have offered more advantages, and as a result there has been more or less fluctuation in the mineral output from Alaska, the production during the period from 1921 to date ranging between about $12,000,000 and $20,000,000. It is believed, however, that the decrease shown during this period does not necessarily mark a permanent downward trend. In fact, as will be noted elsewhere in this report, there is direct evidence that the mining of certain of the metals is decidedly on the increase.

Value of total mineral production of Alaska, by years, 1880–1931

1880	[a] $6,826	1898	$2,329,016	1916	$48,386,508
1881	[a] 15,000	1899	5,425,262	1917	40,694,804
1882	[a] 23,000	1900	7,995,209	1918	28,218,935
1883	[a] 67,146	1901	7,306,381	1919	19,626,824
1884	[a] 72,000	1902	8,475,813	1920	23,330,586
1885	[a] 425,000	1903	9,088,564	1921	16,994,302
1886	[a] 540,000	1904	9,627,495	1922	19,420,121
1887	[a] 657,000	1905	16,490,720	1923	20,330,643
1888	[a] 667,181	1906	23,501,770	1924	17,457,333
1889	[a] 847,490	1907	20,840,571	1925	18,220,692
1890	[a] 873,276	1908	20,092,501	1926	17,664,860
1891	1,014,211	1909	21,140,810	1927	14,404,000
1892	1,019,493	1910	16,875,226	1928	14,061,000
1893	1,104,982	1911	20,720,480	1929	16,066,000
1894	1,339,332	1912	22,581,943	1930	13,812,000
1895	2,588,832	1913	19,547,292	1931	12,278,000
1896	2,885,029	1914	19,109,731		
1897	2,539,294	1915	32,790,344		641,591,000

[a] $37,205 for coal produced prior to 1890 should be distributed among these years, but data are not available for this purpose, and the entire value of that coal has been credited to 1890.

In the following table the value of the total mineral production from Alaska is distributed among the metals and nonmetallic products. From this table it will be seen that gold accounted for approximately 62 per cent of the total production and that gold and copper together accounted for more than 95½ per cent.

Total value of mineral production of Alaska, by substances, 1880–1931

Gold	$398,824,000
Copper	214,129,000
Silver	11,997,000
Coal	7,929,000
Tin	1,094,000
Lead	1,869,000
Marble and other products (including platinum metals)	5,749,000
	641,591,000

Each mineral product is discussed in more detail in the following pages, in which are set down such facts as are available regarding the amount of each product, the places from which it came, and any new developments. The following summary table shows the production for 1931 and 1930, distributed by quantity and value among the main kinds of substances, so that a comparison between the two years may be readily made. Increase in value is shown for gold, but decreases are shown for all the other mineral commodities. The same relation also holds with respect to quantities produced, except that the quantity of lead was greater in 1931 than in 1930, though its value was less.

Mineral output of Alaska, 1931 and 1930

	1931		1930	
	Quantity	Value	Quantity	Value
Gold—fine ounces	459,900	$9,507,000	410,020	$8,476,000
Copper—pounds	22,614,000	1,877,000	32,651,000	4,244,600
Silver—fine ounces	352,000	102,000	408,570	157,300
Coal—short tons	105,900	556,000	120,100	631,000
Tin, metallic—do	4.07	2,000	14.7	9,300
Lead—do	1,660	126,000	1,365	136,500
Miscellaneous mineral products, including petroleum, platinum metals, marble, gypsum, etc		108,000		157,300
		12,278,000		13,812,000

GOLD

GENERAL FEATURES

The total value of gold produced from Alaska mines in 1931 was $9,507,000, as contrasted with $8,476,000 in 1930, an increase of more than a million dollars. The general trend of gold mining in Alaska since 1890 is graphically represented by one of the curves in Figure 1. From 1890 to 1904 the curve for the value of the gold produced practically coincides with the curve for the value of the total mineral production of Alaska and marks a fairly even upward trend. From

1904 to 1906 there was an abrupt increase in gold production, marking the boom periods of many of the placer camps. From the peak of 1906 there was a gradual decline for the next 10 years, and during the period of the World War there followed a rather rapid decrease to less than $10,000,000 a year. From 1920 to 1927 the annual gold production was fairly uniform and ranged between about $6,000,000 and $8,000,000. In each year since 1927 there has been a marked increase in the amount of gold, and in 1931 the output was greater than in any other year since 1917.

There are two principal types of deposits from which the gold is recovered—lodes and placers. The lodes are the mineralized veins or masses of ore in the country rock that were in general formed through deep-seated geologic processes and represent material in place. The placers are deposits of sand and gravel which have been worn from the hard rocks in their general vicinity and in which the loose grains of gold or other valuable minerals have been more or less concentrated by surficial geologic processes that were effective because of some distinctive physical or chemical property of the material thus concentrated.

The following table shows the amount and value of the gold produced annually for the last 16 years, the total amount that has been produced since gold mining began in the Territory in 1880, and the value of the gold that has been derived from each of the two principal types of gold mines. The same information, except that the annual production for each year from 1880 is also included, is graphically represented by Figure 2. Of the $398,824,000 in gold that has been produced from Alaska mines $263,804,000, or about 66 per cent, has come from placers, and $135,020,000, or about 34 per cent, from lodes. The relation between the outputs from these two sources has varied widely. Thus up to 1898 the lode production was greater than that from the placers. Then ensued a period of more than 20 years when the annual placer production far exceeded that from the lodes. Since 1919 the production from each source has been approximately the same. There is reason to believe that the production from lodes is more likely to show an increase than that from placers. In fact the record seems to indicate clearly that the peak of lode-gold production has not yet been reached.

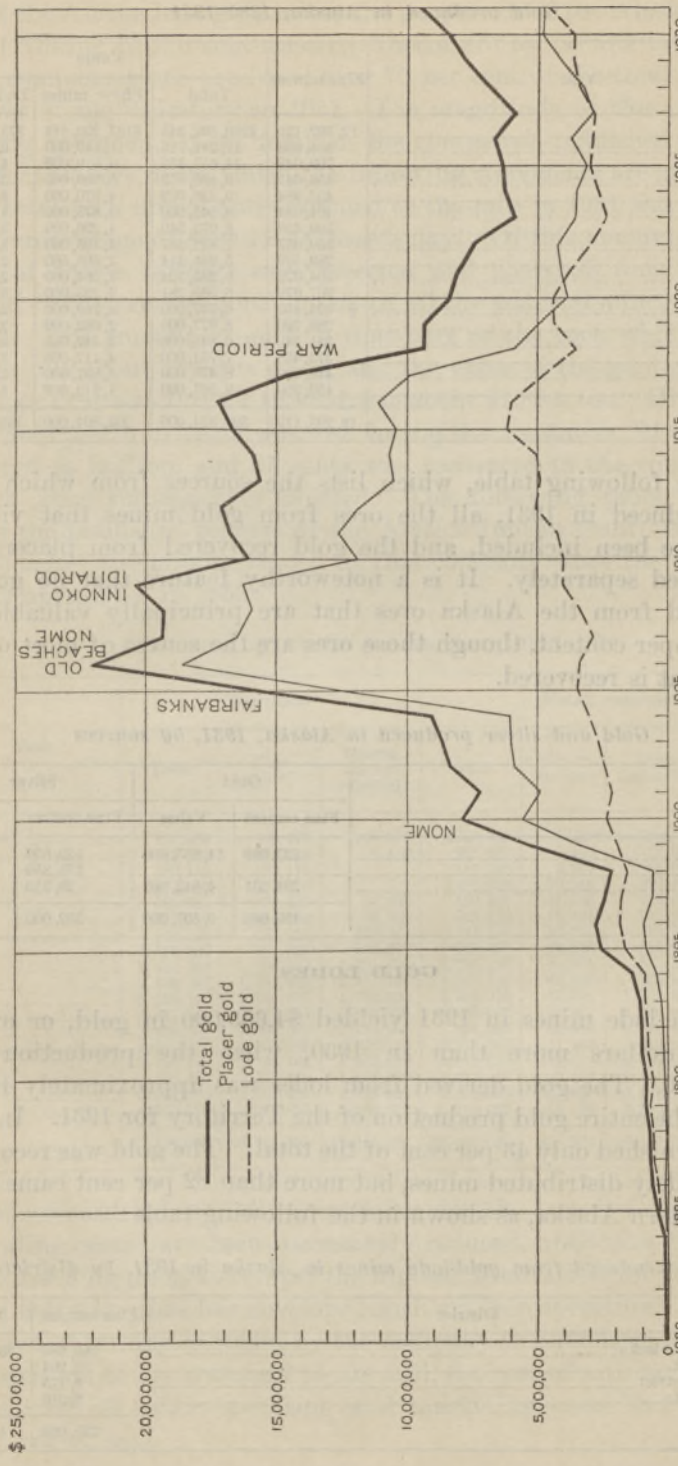

FIGURE 2.—Trend of value of gold production of Alaska, 1880–1931

Gold produced in Alaska, 1880–1931

Year	Fine ounces	Value		
		Total	Placer mines	Lode mines
1880–1915	12,592,121	$260,302,243	$185,200,444	$75,101,799
1916	834,068	17,241,713	11,140,000	6,101,713
1917	709,049	14,657,353	9,810,000	4,847,353
1918	458,641	9,480,952	5,900,000	3,580,952
1919	455,984	9,426,032	4,970,000	4,456,032
1920	404,683	8,365,560	3,873,000	4,492,560
1921	390,558	8,073,540	4,226,000	3,847,540
1922	359,057	7,422,367	4,395,000	3,027,367
1923	289,539	5,985,314	3,608,500	2,376,814
1924	304,072	6,285,724	3,564,000	2,721,724
1925	307,679	6,360,281	3,223,000	3,137,281
1926	324,450	6,707,000	3,769,000	2,938,000
1927	286,720	5,927,000	2,982,000	2,945,000
1928	331,140	6,845,000	3,347,000	3,498,000
1929	375,438	7,761,000	4,117,000	3,644,000
1930	410,020	8,476,000	4,837,000	3,639,000
1931	459,900	9,507,000	4,842,000	4,665,000
	19,293,119	398,824,000	263,804,000	135,020,000

In the following table, which lists the sources from which gold was produced in 1931, all the ores from gold mines that yielded gold have been included, and the gold recovered from placers has been listed separately. It is a noteworthy feature that no gold is recovered from the Alaska ores that are principally valuable for their copper content, though those ores are the source of most of the silver that is recovered.

Gold and silver produced in Alaska, 1931, by sources

	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Gold ores	225,669	$4,665,000	129,800	$37,600
Copper ores			193,850	56,200
Placers	234,231	4,842,000	28,350	8,200
	459,900	9,507,000	352,000	102,000

GOLD LODES

Alaska lode mines in 1931 yielded $4,665,000 in gold, or over a million dollars more than in 1930, when the production was $3,639,000. The gold derived from lodes was approximately 49 per cent of the entire gold production of the Territory for 1931. In 1930 lodes furnished only 43 per cent of the total. The gold was recovered from widely distributed mines, but more than 82 per cent came from southeastern Alaska, as shown in the following table:

Gold produced from gold-lode mines in Alaska in 1931, by districts

District	Fine ounces	Value
Southeastern Alaska	186,680	$3,859,000
Willow Creek	22,204	459,000
Fairbanks district	8,175	169,000
Other districts	8,610	178,000
	225,669	4,665,000

Of the Alaska lode-gold mines the properties of the Alaska Juneau Gold Mining Co. in southeastern Alaska are by far the largest, and that company alone produced over 79 per cent of the total lode-gold output of the Territory in 1931. The magnitude of this company's mining operations is set forth in the company's published report to its stockholders, from which the following statements are abstracted: The total rock mined and trammed to the mill in 1931 was 4,162,350 tons, an average of over 11,400 tons a day. Of this amount 1,863,352 tons of coarse tailings were rejected and 2,298,998 tons were fine milled. The average gold content of all the material mined was $1.12 a ton. The amount of gold in that part of the rock which was rejected was about 18 cents a ton, and the value of the gold content of the rock that was further treated was about $1.89 a ton. Of this content gold worth 27 cents was lost during the treatment, $1.25 was recovered as bullion, and 37 cents was recovered in the concentrates, which were subsequently smelted. The following table, compiled from the published reports of the Alaska Juneau Gold Mining Co., summarizes the mining record of this company since the beginning of its operations in 1893:

Production of Alaska Juneau mine, 1893–1931

Year	Ore (tons)			Metals recovered			
	Total	Fine milled	Coarse tailings rejected	Gold	Silver (ounces)	Lead (pounds)	Total value
1893–1913	507,254	330,278	176,976	$707,730	Lost in tailing.		$707,730
1914–15	242,328	239,918	2,410	251,655	6,192	117,031	261,326
1916	180,113	180,113	----------	115,022	2,844	61,068	121,378
1917	677,410	677,410	----------	429,262	12,248	296,179	460,666
1918	592,218	574,285	17,933	430,124	11,828	273,297	459,445
1919	692,895	616,302	76,593	499,002	16,431	359,762	542,714
1920	942,870	637,321	305,549	732,870	23,348	487,574	791,389
1921	1,613,600	904,323	709,277	969,703	40,619	550,913	1,035,251
1922	2,310,550	1,108,559	1,201,991	1,296,157	49,405	687,315	1,388,679
1923	2,476,240	1,134,759	1,341,481	1,427,199	41,876	755,423	1,514,774
1924	3,068,190	1,367,528	1,700,662	1,907,374	63,191	1,256,857	2,055,782
1925	3,481,780	1,537,884	1,943,896	2,030,067	55,971	1,288,974	2,184,384
1926	3,829,700	1,649,678	2,180,002	1,931,052	52,333	1,300,915	2,067,836
1927	4,267,810	1,839,695	2,428,115	2,328,540	61,232	1,513,306	2,463,262
1928	3,718,140	1,795,191	1,922,949	3,142,808	77,591	2,058,655	3,316,019
1929	3,836,440	2,020,470	1,815,970	3,410,408	90,635	2,501,832	3,627,247
1930	3,924,460	2,066,239	1,858,221	3,375,659	97,607	2,640,771	3,551,950
1931	4,162,350	2,298,998	1,863,352	3,710,927	118,508	3,309,176	3,879,839
	40,524,348	20,978,951	19,545,397	28,695,559	821,859	19,439,048	30,429,671

This record is especially impressive for the last few years, when operating costs have been successively reduced, until now they stand at so low a figure as to compel the highest admiration for the mining administration that has developed such efficient operation. For 1931 the cost of mining is stated by the company to have been 28.08 cents for each ton of ore trammed to the mill, the cost of milling was 21.60 cents, and all other operating and marketing costs and expenses,

including interest, amount to 11.14 cents, making the entire operating cost for each ton of ore trammed only 60.82 cents. Not only have the mining and milling costs been kept at a low figure, but the tenor of the ore handled has been rather higher than the average. So successfully have the company's affairs been handled that the officials report a net operating profit of 32.39 cents a ton of ore trammed and were thus able to begin payment of dividends early in 1931.

During the year the Alaska Juneau Gold Mining Co. has done considerable prospecting on its so called "north ore body." According to the company's annual report for 1931, "The deep development work on the north side of the Silver Bow fault * * * has * * * found better and more persistent values than have hitherto been disclosed by any similar lengths of development work elsewhere on the property." This condition is interpreted as due to finding the faulted end of the company's main ore shoot rather than to an increase in the richness of the ore in depth. Extensive diamond drilling and other methods of underground exploration and development will be continued, and the operators expect that by the end of 1932 the output of ore from this source will reach 1,000 tons a day. Stoping by shrinkage methods will be adopted for mining the better grades of ore first, and later the lower-grade portion will be mined by caving.

In addition to the work on its main property, the Alaska Juneau Gold Mining Co. did extensive trenching and sampling on the Hallum and Dora claims, which it held under option. These claims lie west of the Ebner group and contain nearly 1½ miles of the outcrop of the rocks of the Juneau gold belt. On the approach of winter the surface work was succeeded by underground drifting and crosscutting to test some of the areas that the surface work had indicated to be the most promising. The company also continued its interest in the Taku region, east of Juneau. At West Hill it added several new claims to its former holdings, and the entire group was surveyed for patent during 1931. An option was taken on a group of 20 claims west of the Tulsequah River, and surface prospecting was done late in the fall and will be resumed in the summer of 1932.

The next most productive lode gold mine in southeastern Alaska is that of the Hirst Chichagof Mining Co., at the head of Mine Bay, on the west coast of Chichagof Island, some 60 miles northwest of Sitka. The development work which had been in progress during the past two years was satisfactorily completed, so that the mine and mill were in continuous operation throughout 1931 and yielded satisfactory returns. About 30 men were employed on the property, and in addition to keeping a sufficient flow of ore coming out to supply the mill they did considerable additional development work and driving ahead of the long tunnel from the main level. It is

also reported that a flotation plant was built and put into operation during the year. This plant was designed to treat the large quantity of tailings that had been made and impounded when the property had been in operation some years ago, as it was known that they contained considerable gold.

Not far from the Hirst Chichagof mine is the property of the Chichagof Mining Co., at the head of Klag Bay. Although this property contributed little to the output of the Alaska lode gold in 1931, it was the site of considerable activity. Before the end of the year the preliminary and developmental work had been sufficiently advanced so that some ore was being supplied to the mill, and it was expected that mining and milling would thenceforth be continuous. In the past this property has produced many million dollars in gold, and its return to the list of producers is regarded as of special significance. According to local reports, the developments in the deeper levels of the mine, especially the 1,300, 1,400, and 1,500 foot levels, have disclosed especially good ore. For a while only 10 stamps are being used, but present plans contemplate that the output will be increased as rapidly as practicable, though it will probably be some months before the mill is being run at its full capacity. About 40 men were employed on the property in different capacities.

The developments at the two larger properties on Chichagof Island have revived interest in prospecting in the entire region, and as a result several new finds of ore have been made, and development work has been resumed at several of the properties that lately have been inactive. Among these properties is that of the Alaska Chichagoff Mining Co., more generally known as the Bez property, where four to eight men were employed during the season in development work. A test shipment of ore from this property was made during the year, and plans are under way to enlarge the scope of operations in 1932 as conditions warrant. The report of the discovery of a promising lead by Joe Jackson in a mineralized shear zone not far from the Hirst Chichagof property led to the formation of a local company in Juneau to undertake its development. At least a dozen other prospectors are in the district trying to establish the value of such mineral indications as they have found on their claims.

Elsewhere in the northern part of southeastern Alaska the only property from which gold was produced in 1931 appears to have been that of the Admiralty Alaska Gold Mining Co., at Funter Bay, on Admiralty Island. At this place, however, the main work was of a prospecting or developmental character and consisted of further core drilling and opening up of some of the more promising leads heretofore discovered. Until the samples have been assayed and the results of this prospecting work have been interpreted, the owners

will not attempt to lay out definite plans for future work, but apparently they feel encouraged by the results so far accomplished and seem to expect that it may not be long before the mine may be in operation on a rather large scale.

The nonproductiveness of other mines in this part of southeastern Alaska does not mean that work has been suspended at the other properties. In fact, there seems to be a decided increase in the number of prospectors in the field and a revival in the search for lode deposits, some of which will doubtless disclose mineralized ground that had escaped detection. Not only is there revival of interest in prospecting for new deposits, but there have been many rumors of the reopening of known deposits that formerly were productive but have lain idle during the last few years. These rumors relate to many of the old properties in the mineralized zone southward from the Eagle River to and beyond the Taku River.

In the Wrangell-Petersburg district, which lies about midway in southeastern Alaska, the only production from lodes is reported to have come from the Maid of Mexico property, on Woewodski Island. At this place about 5 men were engaged principally in development work, but during part of the time they operated a small stamp mill on the property. Elsewhere in this district there was some prospecting for lodes but, so far as could be learned, the work amounted to little more than that required by law to retain possession of the claims.

In the Ketchikan district there was considerable prospecting for lodes but only a little production. During the year a new company was formed to undertake the development of some of the old properties at Helm Bay, in Cleveland Peninsula, north of Ketchikan, and some work looking toward that end was accomplished. On Prince of Wales Island, west of Ketchikan, some development work was reported to have been done near Dolomi, at Hollis, and near Nutkwa Inlet. The work near Dolomi was on claims embracing part of the old Valparaiso property. About six persons were employed during part of the year in this work, during which a test run of the ore is said to have given encouraging results. Near Hollis the work was done on the property that was under development a few years ago by the Kassan Gold Mining Co. That company was reorganized as the Alaska-Kassan Gold Mining Co. and according to local reports proposes to resume the development of this property as rapidly as conditions permit. At Nutkwa Inlet, which is on the west coast of Prince of Wales Island, about 40 miles in an air line southwest of Ketchikan, the developments are being undertaken by the Nutqua Gold Mining Co. No details regarding the developments at this place have been obtained by the Geological Survey. On Revillagi-

gedo Island some prospecting was in progress, but at several of the properties that showed special activity in 1930 the work had been more or less discontinued because, while their ores carried some gold, their principal value lay in the base metals, for which the low prevailing prices afforded little inducement to development.

In the Hyder district, at the head of Portland Canal, developments were restricted to those deposits whose principal metallic mineral was gold, so that many of the properties that hitherto were producers remained idle throughout the year and prospecting at several of the others was considerably curtailed. The greatest amount of work is reported to have been done on the claims of Metcalf & Findley, on Banded Mountain, near the head of the Chickamin River. Work at this place consisted principally in the continuation of driving the main drift. Some development work was also in progress on the Marietta group of six claims east of the head of the West Fork of Texas Creek. Considerable prospecting and search for ore is reported to have been done at the property of the Hyder Lead Mines (Inc.), whose claims are situated on Texas Creek. Production from the extension of this district that lies east of the international boundary in British Columbia continued on about the same scale as formerly and came largely from the Premier mine.

The Willow Creek district, at the head of Cook Inlet, has long been the second most productive gold-lode district of the Territory, having produced gold worth about $4,000,000 since lode mining started there, in 1909. Lately, however, its output has fallen off markedly, because of destruction by fire of the principal mill in the district. Although this loss was regarded at the time as a severe setback to the district, it has proved to mark a forward movement, in that it led to the installation of a completely new milling practice and the building of essentially a new camp to develop the property in accordance with best modern practice under the management of an especially skilled mining engineer. Most of these improvements were finished during 1930, so that the plant was operating at capacity during most of 1931. As a result the production from this district as a whole made a very large increase in 1931 and compared favorably with that of any year during the boom period of the camp. The principal producing company in the Willow Creek district is the Willow Creek Mines (Inc.), which holds considerable property on Craigie Creek and gets its ore mainly from the Lucky Shot mine, on the northern slopes of the creek valley. Between 80 and 100 men were employed on the property in construction work, as well as in the mine and at the mill.

Other properties in the Willow Creek district from which some ore was mined in 1931 include the Gold Cord mine, near the head of Fish-

hook Creek; the Fern mine, on the western slopes of Archangel Creek; the Mabel mine, high on the northwestern slope of Reed Creek; and the Marion Twin mine, on the southern slopes of the Little Susitna Valley, near Lone Pine Creek. Prospecting was also done at a number of other places in the district on mineralized leads that appear comparable in some of their features to those on which the producing mines have been developed. The type of mineralization in the Willow Creek district and the proved occurrence of valuable lode deposits has long made the district appear to have important ore reserves. In order to test this conclusion when the Alaska Railroad undertook, through the Geological Survey, an intensive search for mineral deposits that might yield tonnage to the railroad, the Willow Creek district was selected as one of those in which special examinations should be made. J. C. Ray, geologist, was assigned to make those examinations and spent the larger part of the open season in the district investigating the ore deposits. A summary of the results of Mr. Ray's studies, showing that the district is believed to have potential resources at least several times greater than those already developed, is given by Mr. Capps in another chapter of this volume, and his complete report will be published later.

The third most productive lode gold district in the Territory is in the vicinity of Fairbanks. Its lode gold output in 1931 was more than a quarter greater than in 1930, and the indications are that an even greater increase may be looked for in the future. The total output of lode gold from the Fairbanks district during the period since 1910, when that type of mining began, has been over $2,100,000. There are two principal producing lode-gold areas more or less close to Fairbanks and one which is rather remote but which, for convenience and because there is only one mine in it, has been considered as in the Fairbanks district. The two areas near Fairbanks are near Ester Dome and Pedro Dome, which lie respectively west and northeast of Fairbanks. The remote area is on Eva Creek, a tributary of the Nenana River about 60 miles southwest of Fairbanks, in what is usually known as the Bonnifield placer district. In the area near Ester Dome the principal mines that furnished some gold in 1931 were those of the Mohawk Mining Co., near St. Patrick Creek on the northeastern flanks of Ester Dome, and the Ready Bullion mine on the southwestern flanks. A crew of a dozen men or less were active during most of the open season at the Mohawk mine, and some custom ore was also treated at the company's mill. During the year engineers made a thorough investigation and sampled the old Ryan lode, a short distance south of the Mohawk mine, but no public announcement has been made as to the results nor as to future plans. The past work on the Ryan lode has indicated that it was wide and of

low grade, so that its development would entail mining a large amount of material cheaply. Whether the tenor of the ore is high enough to leave a satisfactory balance after deducting the charges for mining and milling is obviously a technical question that can be answered in advance only by the most rigorous analysis of the engineering data involved.

In the area adjacent to Pedro Dome the most gold was produced from mines in the valleys of Cleary and Fairbanks Creeks, but prospecting was reported from several other places. In the Cleary Creek Valley the greatest amount of mining was done at the property of the Cleary Hill Mines, near the mouth of Bedrock Creek. Some ore was also mined at the old Tolovana property, near the junction of Willow and Cleary Creeks, and at the Newsboy property, on the divide between Cleary Creek and Last Chance Creek, a tributary of Little Eldorado Creek. In the Fairbanks Creek Valley the greatest production came from the Henry Ford mine, at the head of the valley, operated by L. J. McCarty and associates. At the Hi Yu group of claims on Moose Creek, a tributary of Fairbanks Creek, which has long been one of the largest producers of the district, practically only development work was in progress. Northwest of Pedro Dome, on the northern slopes of the Dome Creek Valley, C. M. Hawkins and associates produced some lode gold at the Soo mine and carried on further development work.

In the area near Eva Creek the only lode mining in progress was that on the property of the Eva Mining Co. Here development work had progressed far enough to convince the owners that they were justified in building a mill. The mill and equipment were received from the States late in the summer, and the task of construction was rushed so that before the end of the year it was in operation. Much of the gold in the ore is associated with large amounts of arsenical pyrite, so that the ore must be concentrated and then shipped to a smelter for treatment. Up to the end of the year the results are reported to have been even better than had been anticipated, and it is hoped that another year, with a full season's work, this mine will add a considerable amount to the lode-gold output of the district.

The Fairbanks district has long been regarded as a promising field for the development of lode-gold deposits and well worth more intensive search for deposits of moderate tenor that could be mined on a large scale. Opportunity to test these conclusions was afforded in 1931 by the Alaska Railroad, which undertook, through cooperation with the Geological Survey, examinations in search of deposits that might yield tonnage to the railroad. J. M. Hill, geologist, was assigned to make these examinations in the Fairbanks district, and he spent the larger part of the season investigating all the known lode

occurrences. A summary of the conclusions reached by Mr. Hill, showing a belief that with adequate financial support and skilled technical and administrative assistance such deposits are likely to be developed, is given by Mr. Capps elsewhere in this volume, and the complete report is now in preparation for publication by the Geological Survey.

Among the districts producing lode gold grouped together in the table on page 12 under the heading "Other districts" the most productive are Kenai Peninsula, including the Nuka Bay area, the area south of Hope, and the hills north of Girdwood; the Nabesna district, which lies north of the Wrangell Mountains of the Copper River region; the Nixon Fork district, in the Kuskokwim region; and the mines in the vicinity of Valdez, in the Prince William Sound region. In most of these districts the production came from a single mine, so that to avoid disclosing the individual output it has been necessary to combine the statistics, though it is realized that by so doing they lose some of their significance.

In the Nuka Bay district the greatest amount of gold was recovered from the Sonny Fox mine, operated by Babcock & Downey, but there are more than a dozen other properties in the district on which development work was in progress, and of these at least three shipped some ore or concentrates to smelters in the States for treatment. The properties at which work was in progress are widely distributed through the district, indicating that the mineralization is not localized at a few points. The success that already attended the operations of the Sonny Fox mine and the samples that have been assayed from many of the other properties give assurance that the mineralization in many places has produced ores that, if skillfully mined and milled, are of commercial grade. The new installation of machinery and equipment and the development work that has been accomplished furnish good reason for believing that an increasing production of gold from this district is to be looked for. During the field season all of the mines and prospects of the district were examined by Earl Pilgrim, an associate Territorial mining engineer, under the auspices of the Territorial Government, which doubtless later will publish the report of his work.

Farther north on Kenai Peninsula, in the vicinity of Hope, the principal producing property was the Lucky Strike mine, on Palmer Creek, under the management of John Hirshey. The mill at this property was in operation throughout most of the open season and not only recovered much of the gold in the battery and on the plates but also produced several tons of concentrates on the table. The principal new development at this mine was the construction and operation of a plant to cyanide the tailings that had accumulated

during the earlier years and to effect a higher recovery from the ore that is currently milled.

In addition to the Lucky Strike mine, there are several other prospects widely scattered through the district at which some work was done during the year, though at most of them it amounted to little more than the assessment work required by law. During the year all the lode prospects were examined critically by Ralph Tuck, geologist, under a cooperative arrangement with the Alaska Railroad. A summary of Mr. Tuck's work is given by Mr. Capps in a later section of this volume, and his full report will be published later in a bulletin of the Geological Survey. Mr. Tuck's general conclusion is that, while deposits of sufficient size to warrant large-scale operations have not been found in the district, there are some veins which can probably be mined profitably on a small scale if skillfully and carefully managed.

North of Turnagain Arm, in the so-called Girdwood district, some prospecting and development work was in progress on gold lodes near the head of Crow Creek. The production from the area was small, but the district is one of the areas that was examined with special care by a Geological Survey party in 1931 as it has long been known to contain veins, some of which yield high assay returns in gold. A summary of the report of this investigation is given by Mr. Capps in another part of this volume, and the complete report of the geologist, Charles F. Park, accompanied by a new topographic map prepared by Walter G. Carson, topographer, will be published later by the Geological Survey. The property on which the greatest amount of activity was in progress in 1931 was the Monarch mine, which was being developed by Harry Staser, Bruno Agostino, and associates.

A new name appeared among the list of lode-gold producers in 1931, when the mine of the Nabesna Mining Corporation began actual operations. This property, which is sometimes known by the name of its principal owner and manager as the Carl Whitham mine, is situated on White Mountain west of the Nabesna River between its tributaries Jack and Jacksina Creeks. Although construction work at this property was not completed until midseasón and the mill was running for only a few months, it turned out considerable gold and concentrates. Part of the concentrates were transported from the rather remote site of the mine to the main highway by an airplane, which brought in supplies of gasoline for running the mill. The concentrates are shipped to a smelter in the States for treatment. A more complete description of the geology and mineral resources of this mine, as well as of the country adjacent thereto, is given in a report by Mr. Moffit, which is published in another chapter of this volume.

In the Kuskokwim Valley the only lode-gold production reported came from the old Pearson & Strand mine, on Ruby Creek, in the Nixon Fork district, which was operated by Charles Mespelt and associates. No details regarding the recent developments at this mine are available, but apparently from the output of gold the work must have been carried on much more intensively than during 1930. The mine was in operation about 10 months and the mill about 2 months, and on the average 6 men were employed. Although no other mine in this district reported having produced any lode gold in 1931, some prospecting was said to be in progress at the old Whelan mine. This work consisted mainly in the digging of several surface trenches in search of veins worthy of more intensive examination. It is reported that this work disclosed some ore that appeared of sufficiently high grade to justify the owner in continuing the search.

Lode-gold production from the Valdez district in 1931 was small, but at several properties development work was in progress, and there were reports that negotiations were in progress for the reopening of several of the old properties that have long been inactive, though in the past they produced considerable gold. The region is easily accessible to deep-water transportation, and the known occurrence of mineralization in it gives adequate incentive to reexamine some of the known deposits in the light of present conditions, because costs have decreased very much from those that prevailed at the time the mines were being worked. This statement, of course, applies only to the gold mines, inasmuch as their product has a fixed value. The lodes in which the principal metallic minerals are ores of the base metals can hardly be expected to be attractive to capital at this time of excessively low prices for base metals.

Prospecting for gold lodes was continued at many other places throughout the Territory, though at none of them, so far as reported to the Geological Survey, was there any real production of ore, and at none of them was any gold produced except the little that may have been recovered in the course of testing the ore during development work. In the Copper River region considerable prospecting for gold lodes is reported to have been done in the Bremner district. According to local reports, more than a dozen men were engaged in the search there during 1931, and as a result several leads that are regarded as promising have been found and partly opened up. The property on which most work is said to have been done is that of the Ramer Bros., on Golconda Creek. Elsewhere in the Copper River region little new prospecting for gold lodes has been done, though gold-lode claims are still held in the Kotsina district and the McKinley Lakes district.

In the Cook Inlet-Susitna region, in addition to the production from the districts already noted, some gold-lode development work

and prospecting was done during the year in the Chulitna Valley and the Valdez Creek district.

In the Chulitna Valley there are two areas in which gold lodes have attracted attention—one in the northern part of the valley, especially in the vicinity of the West Fork, and the other between Ruth and Eldridge Glaciers, in the west-central part of the valley. The prospects in the northern area were examined rather fully during the field season of 1931 by C. P. Ross, and a summary of his conclusions is published in a separate section of this volume by Mr. Capps. The complete report by Mr. Ross will be published later. He regards the outlook for the future expansion of mining in the district as favorable, provided economic conditions warrant the handling of ore whose gold content is rather low and whose arsenic content is rather high.

In the more southern area in the Chulitna Valley the only work accomplished has been the clearing of trails and such surface scouting as was practicable. The region is extremely difficult of access because of its thick forest, raging streams, and precipitous mountains. In spite of these physical difficulties, the few prospectors have found many indications of mineralization, and some of the specimens of quartz that they have brought out are of such high tenor that if the veins from which they were taken prove to have any considerable linear extent they will probably well repay the expense that will be required to open them up.

Prospecting in the Valdez Creek region for gold lodes in 1931 amounted to little more than the annual assessment work required by law to hold the claims. However, a Geological Survey party, working under a cooperative agreement with the Alaska Railroad, carried on rather extensive examinations in this district during the field season of 1931 with the aim of learning as much as possible regarding its probable resources. A summary of the results of this work, which was conducted by C. P. Ross, is published in another part of this volume, and his complete report on the district is to be issued later.

In the Yukon Basin, in addition to the production from the districts near Fairbanks and the Nabesna gold lodes, prospecting has been done in the Kantishna and Mount Eielson districts, on the northern slopes of the Alaska Range, and in the Chandalar district, north of the Yukon. No new developments of special significance were reported in any of these districts in 1931, but in a part of the Kantishna district and in the Mount Eielson or Copper Mountain district the Geological Survey, in cooperation with the Alaska Railroad, made special examinations of the lode resources. Summary statements as to the conclusions reached regarding each of these two

districts are published in another part of this volume, and the complete reports on each are in preparation for publication by the Geological Survey.

In southwestern Alaska, according to Frank Dufresne, of the Alaska Game Commission, two men were doing development work at the old Apollo mine, on Unga Island, and were milling a little ore. Between 1891 and 1904 this mine was one of the larger Alaska mines and produced gold worth about $2,000,000. It was extensively developed, and one of the tunnels has a length of about 6,000 feet. No details are available as to the character of the ore that is now being mined, so that it is not known whether it is some that was overlooked or was of too low grade to be mined at the prices that then prevailed, or whether the present operators have been able to uncover some new zones that may warrant the reopening of the property on a really productive scale. Further developments will therefore be watched with especial interest.

In Seward Peninsula development work was continued at the Head & Strand mine, north of Nome, but no reports have been received as to the work accomplished. A little search for gold lodes was made at a few other points in Seward Peninsula but appears not yet to have disclosed workable deposits. Rumors were afloat that steps might be taken shortly to reopen the old Big Hurrah mine, in the Solomon district, but so far as learned nothing was done on the ground in 1931 to carry that purpose into effect.

GOLD PLACERS

GENERAL CONDITIONS

Placer mining in Alaska in 1931 returned gold worth $4,842,000. This was practically the same as the value of the output in 1930, which was itself a year of high output, as it had not been exceeded by any year since 1919. On the whole, therefore, the year 1931 may be regarded as having been a good one for the placer industry, though by no means were its physical conditions abnormally favorable. In other words, there is reason to believe that the present rate of production will be maintained for some time yet, even without the discovery of extensive new placer areas or without the installation of much new equipment to handle in larger operating units the tracts of placer ground already more or less marked out.

The annual production of placer gold and certain other data relating to Alaska's gold production are represented graphically in Figure 2. From this diagram may be traced the changes that have taken place in the industry. Thus in no year from the beginning of the industry in 1880 to 1898 did the production of placer gold amount to as much as $1,000,000, and the average during that period was

less than $280,000. In 1899 there was a sudden increase, marking the discoveries of Nome and some of the camps in the upper Yukon Valley, which were soon followed by the discovery of Fairbanks and many of the other camps of the interior. The resulting golden period lasted through 1916, during which the annual yield of placer gold averaged more than $10,000,000 and in 1906 reached the peak of nearly $19,000,000. In 1918, after the entry of the United States into the World War, placer production dropped to about $5,000,000, and in the 13 years since that time it has fluctuated between that amount and $3,000,000.

There appears to be some revival of interest in prospecting, though there are still only a few prospectors of the old-fashioned type in the hills. Many of the former prospectors who were the builders of the mining business in Alaska have grown too old to accomplish much, and many of the younger generation who might follow in their footsteps prefer the higher immediate returns, lighter physical labors, and social attractions of the town to the lure of the hills. However, the lack of employment and the lowering of wages in the towns and throughout the States has made many a man pause and consider whether he would not be better off in the hills leading a simple life, working more or less as his own boss, when, where, and how he pleased, with the stimulating expectation of finding a real prize as a reward of his efforts. Such a career obviously should be undertaken only by the physically fit and those reasonably skilled in understanding nature's secrets and the ways of acquiring what she has to offer. The life of the prospector is hard, and success comes to few in any line of endeavor; but it is believed that Alaska still holds out opportunities for the capable placer prospector to find tracts that, while not bonanzas, will well repay his best endeavors. There also seems to be an increasing interest among capitalists and others in the mining development of the Territory, and doubtless, as they hold out incentives for finding workable properties, they will discover men ready and willing to undertake the quest. Anyone who remembers the difficulties of the early days and sees the present enormously better facilities and lower costs, however, has little sympathy with the laments that are often heard as to the difficulties of carrying on prospecting work. It sometimes seems as if we had become so tied to automobiles, railroads, and wagon roads that we forget that the bulk of the placer gold of Alaska was produced practically without dependence on these facilities. It is believed that there are still large tracts of Alaska that have not yet been thoroughly prospected or adequately examined for large-scale placer operations. Most of these areas do not appear to give promise of holding bonanza deposits that can be won cheaply. There are, however, extensive areas

in which, it is confidently believed, large, well-organized, and well-managed companies will find placers that can be mined profitably for many years.

PRODUCTION BY DISTRICTS

The description already given as to the methods used in collecting and interpreting the information that forms the basis of this report indicates that it is more difficult to obtain accurate facts regarding the production of placer gold than regarding any of the other items. This is due to the great number of small producers, who are widely scattered and many of whom are in the most remote parts of the Territory. The gold they produce frequently passes through many hands before it finally reaches a mint or assay office, so that a single lot is difficult to trace. It may appear in the reports of the individual and then lose its identity by being lumped with other gold by the storekeeper who took it in exchange for supplies, and still further consolidated by the bank, perhaps in some distant district, to which it was sent by the merchant, and its course perhaps still further obscured by being shipped to another bank before being turned in to the mint. Every reasonable effort has been made to check the information from different sources and to adjust discrepancies so far as possible. As a result it is believed that the figures given for the total placer production are in accord with the actual facts. The distribution of this total among the different districts, however, is open to more serious errors, as gold produced in one district, unless reported to the Geological Survey by the original producer, may be credited to some other district through which it passed in the course of trade. In spite of the possibility of some error in the distribution of placer gold among the different districts, the following table has been prepared to show the comparative standing of the different districts as accurately as possible. The largest amount came from the Yukon Basin, and the next largest from Seward Peninsula. Placer mining in each of the main regions will be discussed in some detail in the following pages, and the more notable events of the year will be recorded for each region.

Value of placer gold produced in Alaska in 1931 and 1930

Region	1931	1930	Decrease or increase, 1931
Southeastern Alaska	$3,000	$7,000	−$4,000
Copper River region	88,000	98,500	−10,500
Cook Inlet and Susitna region	105,000	75,500	+29,500
Yukon Basin	3,269,000	3,416,800	−147,800
Kuskokwim region	158,000	44,800	+113,200
Seward Peninsula	1,215,000	1,191,200	+23,800
Northwestern Alaska	4,000	3,200	+800
	4,842,000	4,837,000	+5,000

SOUTHEASTERN ALASKA

Although southeastern Alaska is rich in gold lodes, its placers are of relatively small extent and yield only a little gold, because throughout most of the region the topography is mountainous, with precipitous slopes leading down from the crests of the ridges to the ocean waters or to the valley floors and affording little or no lodgment for detrital material. Furthermore, so much of the region was occupied in the recent past by glaciers that there is an almost complete lack of deposits produced through the long-continued sorting action that is so essential for the formation of rich placers. Even along the coast there are almost no beaches where concentration has long been effective. In the lowlands of the larger streams, in some of which great amounts of detrital material have been dumped by past geologic processes, sorting action such as is conducive to the formation of rich placers has been relatively slight, and much of the material handled by the streams has not been subjected to weathering and similar processes, which unlock the mineral grains of different kinds and thus promote separation through physical differences. There is therefore small likelihood that southeastern Alaska as a whole holds much promise as a placer region, though in a few places where special geologic conditions prevail there is a chance of finding placers of value.

As shown in the table on page 26, the entire placer production from southeastern Alaska in 1931 is estimated to have been worth only $3,000, so that even the largest operations were small camps of two or three men each who took out only enough gold to make a very modest grubstake. There are three areas in southeastern Alaska in which, in the past, placer mining has been active; namely, near Juneau, in the valley of the Porcupine River, and in the beaches between Lituya and Yakataga Bays. No placer mining is reported to have been in progress in the Juneau district in 1931, and only a little gold was recovered from the placers in the Porcupine district, though there were a number of prospectors in it, and construction work was continued on the large group of claims that belonged to one company which has been doing preparatory work there for several years. In addition, a new company is said to have taken up nearly a hundred claims on the Klehini River, in the Porcupine district, and proposes to drill the tract thoroughly, with a view to installing a dredge there later if the returns from the drilling warrant that action. In the Lituya-Yakataga region placer mining was continued on about the same scale as it has been for several years. The placers there are all of the beach type, exposed to the waves of the Pacific Ocean. This position in a measure is favorable for concentration of the beach material, but it is also

disadvantageous, because except under suitable weather conditions the placers can not be mined, and even then the use of extensive fixed mechanical appliances is precluded by the necessity of removing them during times of storm.

COPPER RIVER REGION

In the Copper River Valley there are two principal areas and one minor area that yield placer gold, though there are a few small camps widely scattered throughout the river basin. The principal areas, named in order of their production, are the Nizina and Chistochina districts, and the minor area is the Nelchina district. As will be noted from the table on page 26, the value of the placer gold produced from the Copper River districts in 1931 was $88,000, or about $10,000 less than in 1930. In the Nizina district the bulk of the placer gold came from the properties of the Chititu Mines, on Chititu and Rex Creeks, and the Nicolai Placer Mines, on Dan Creek. About 55 men were employed at these two properties, and a few others were engaged in prospecting on their own account elsewhere in the district. At the Chititu and Rex Creek properties the work was conducted along the same general lines as heretofore, and no noteworthy new conditions were met. The principal new area near the Chitina Valley that is attracting prospectors is in the Bremner River region, to the south, especially in the vicinity of Golconda and Monahan Creeks. Work there has been confined mainly to simple prospecting methods of testing the deposits and has yielded only such gold as is recovered in the process. Apparently the results so far obtained indicate that the tenor of much of the ground that has been tested is too low to repay mining on a small scale by hand methods.

In the Chistochina district the Slate Creek Mining Co., on Slate Creek, was the only operator that reported any noteworthy production and was the only one in this district that did more than prospecting work. The production from this camp was somewhat less in 1931 than in 1930. It is reported that the decrease was in large measure attributable to the fact that the operators spent much of the season in dead work preparatory to undertaking more extensive work in the future. It is understood that the carrying out of these plans will probably require two seasons' work, so that there is no outlook for any notable increase in placer production for at least another year. In the Nelchina district all the mining was done by a few small camps consisting of only two or three men each, and the total production amounted to only a few thousand dollars.

COOK INLET-SUSITNA REGION

In the Cook Inlet-Susitna region, as the term is used in this report, are included the placer camps in Kenai Peninsula and adjacent

country, the Yentna-Cache Creek district, and the Valdez Creek district, near the head of the Susitna River. In the past many of these camps have been highly productive, though lately their output of gold has decreased, and only a few score miners are now at work where formerly there were hundreds. The output of placer gold from this region in 1931 showed an increase of about $30,000 over that reported in 1930 and is estimated to have been $105,000.

In the Yentna-Cache Creek district there were somewhat more than a dozen camps employing altogether about 50 men at which productive mining was in progress during 1931, and many other places where some prospecting work was done, though it amounted to little more than the annual required assessment work. By far the largest and most productive single operation in the district was that carried on by Murray & Harper on a lease from J. C. Murray. Six men were engaged in mining at this property, which includes a large part of Cache Creek and the bench ground adjacent to it. Mining is done by hydraulicking. Attempts to utilize the old dredge that took out much of the gold formerly mined on Cache Creek but has been idle for several years have evidently been given up, and the dredge has been advertised for sale. Four smaller placer plants were operated on Cache Creek, and others were reported on several of its tributaries—Nugget, Dollar, Falls, and Thunder Creeks—and on Chechako Gulch. A new mining development during the season was the installation of a hydraulic plant and steam shovel on Peters Creek. According to local reports, the steam shovel did not prove as efficient as had been hoped, and probably the placer will be mined by hydraulic methods. North of Peters Creek in the valley of the Tokichitna some prospecting was probably done during the season, but no direct information has been received by the Geological Survey as to the work accomplished or the specific places at which it was done. Southwest of Cache Creek, in the valley of the Kahiltna and in the Fairview district, there were no new developments of note. One operator was mining on Notobac Creek, and two men were doing development work on Pass Creek. No one was mining on Mills Creek.

In the Valdez Creek region, which lies some 125 miles north of Anchorage, near the head of the Susitna River and about 40 miles in an air line east of the main line of the Alaska Railroad, prospecting for both lodes and placers has been going on for many years. Although no new finds were reported to have been made during 1931, the returns to the few placer operators who were in the district appear to have been especially satisfactory, as they were larger than in 1930 or in any other recent year. The largest amount of gold came from properties mined by John E. Carlson and associates, com-

prising both bench and creek claims. Eight to ten men were employed in mining on these claims, and the ground was worked principally by hydraulicking. Some placer gold was also recovered from placers on White Creek. The Valdez Creek district was one of the districts whose mineral resources were examined in considerable detail in 1931 by a Geological Survey party in cooperation with the Alaska Railroad. A summary statement of the results of that work, which was done by C. P. Ross, is published in another chapter of this volume, and his complete report is in preparation for publication. Mr. Ross expresses the opinion that the future of the district appears to depend largely on the development of its placers, and he believes that there are large areas of potential placer ground in the district that have not yet been adequately tested.

The producing placer camps on the Kenai Peninsula are situated mainly in the vicinity of Hope, Sunrise, and Girdwood. All these camps are small, the largest of them yielding only a few thousand dollars and some of them only a few hundred dollars or a meager grubstake to the operators. In the vicinity of Hope and Sunrise placer mining was carried on at practically the same places as in the last few years, the largest operations being on Canyon and Lynx Creeks, south of Sunrise, and at the Resurrection River and Bear Creek, south of Hope. Late in the summer it was reported that options had been secured by an outside company on many of the claims on the Sixmile River, south of Sunrise, and that they were to be tested with a view to mining them with the hydraulic equipment that had been brought in to develop claims on California Creek, in the Girdwood district, if the tests indicated that such mining was practicable.

In the Girdwood district, which lies north of Turnagain Arm and includes the valleys of Glacier Creek and its tributary Crow Creek, the only placer property that reported any notable production of gold was that of Holmgren & Erickson, about 4 miles north of Girdwood. The placer that is being mined is bench ground on the north side of Crow Creek, where a face of gravel 25 to 30 feet high stands about 15 feet above the present stream. The deposit presents many puzzling geologic features, as well as obstacles to easy mining, because much of it is frozen and does not break down readily under the attack of the hydraulic giants, and the lower part is full of boulders that must be drilled and blasted before they can be got rid of through the sluice boxes. Neither at the old Girdwood property, upstream, nor at the property on California Creek, downstream from the Holmgren ground, was any placer mining in progress, and at the California Creek property steps were taken to remove the mining equipment that had been brought in some two years before. During

the field season of 1931 a Geological Survey party, working in cooperation with the Alaska Railroad, made special examinations in the Girdwood district. Although the principal object of this work was to determine the possibilities of productive lodes in the district, some attention was also given to the placers. A summary of the conclusions reached by C. F. Park, the geologist in charge of this work, is given by Mr. Capps in a later section of this volume, and the complete report is to be published later by the Geological Survey.

YUKON REGION

The Yukon Valley embraces a tremendous extent of territory, and scattered through it from one end to the other are many placer-gold camps. In the past, gold has been reported from almost every stream in the entire basin, though the quantities in some have been so small as to be of little commercial significance. For convenience of description in this report all the producing placer camps in this vast area have been grouped into 17 more or less distinct tracts that are here called districts. It should be noted that the boundaries of these districts are by no means well defined and do not necessarily correspond with any of the legal subdivisions, such as the precincts or recording districts. In the main, the names here given to these districts have been chosen from some of the more prominent features occurring in them. The main purpose of this grouping is to combine areas having in general similar interests and similar conditions and to separate those that are dissimilar. This results in throwing some large tracts together and in splitting up some other parts of the Yukon Valley into several small districts. In some places the boundaries of the different districts almost overlap; in others the boundaries of one district lie far from those of its nearest neighbor.

The gross output of placer gold from all the camps in the Yukon Valley in 1931 was worth $3,269,000, which is somewhat below the corresponding figure for 1930, but the decrease is regarded as practically nothing more than the normal fluctuation that may be expected. In fact, there was considerable variation in the production from the different camps during the two years, some showing an increase in 1931 and others a decrease.

In the following table the districts are arranged in order of their placer production in 1931, and for comparison the production from the same districts in 1930 is given. The total is believed to be correct as stated, but the distribution of this total among the districts is open to some uncertainty, owing to the great number of small producers, their wide distribution, and the failure of some of them to supply the essential information. However, every reasonable precaution has been taken to guard against serious errors and to keep

the estimates in accord with all the available facts, so that the figures stated are regarded for all practical purposes as accurate and comparable with similar figures for earlier years.

Value of placer gold produced in Yukon Basin, 1931 and 1930, by districts

District	1931	1930	District	1931	1930
Fairbanks and Richardson	$2,486,000	$2,785,500	Koyukuk and Chandalar	$32,000	$17,800
Iditarod	237,000	184,000	Eagle	16,000	16,000
Tolovana	138,000	82,000	Marshall	10,000	4,000
Innoko	96,000	86,000	Rampart	9,000	3,500
Fortymile	66,000	37,600	Kantishna and Bonnifield	8,000	8,600
Hot Springs	59,000	78,500	Chisana	3,000	5,800
Circle	55,000	69,000			
Ruby	54,000	38,500	Total	3,269,000	3,416,800

In the foregoing table two small districts, the Richardson and Chandalar, have been grouped with the near-by larger districts, Fairbanks and Koyukuk, respectively, and two other small districts, the Kantishna and Bonnifield, have been combined. These combinations have been made to conform with earlier reports and to avoid disclosing confidential information regarding individual production from some of the small districts, where the bulk of the placer gold has come from only one or two mines. None of these small districts produced as much as $10,000, and some of them only a few thousand dollars.

The region adjacent to Fairbanks, here called the Fairbanks district, has long been and still is the main placer district in interior Alaska. The greatest amount of gold from this district was produced by dredges of the Fairbanks Exploration Co. on the Chatanika River, Cleary and Pedro Creeks, and Goldstream; the Fairbanks Gold Dredging Co. on Fairbanks Creek; and the Chatham Gold Dredging Co. on Chatham Creek, a tributary of Cleary Creek. Considerable placer gold was also recovered by hydraulic or open-cut methods, and a little by drift mining. Placer gold recovered by other methods than dredging came principally from Ester, Pedro, Vault, and Little Eldorado Creeks and the Big Chena and upper Chatanika Rivers and their tributaries. Several thousand dollars' worth of placer gold, in addition to that produced by the dredges, came from placers on Fairbanks Creek. There were also smaller camps in the valleys of several of the other streams, whose production, though individually only a few hundred or a few thousand dollars, in the aggregate swelled the total production for the district considerably.

Two principal reasons may be advanced in explanation of the falling off of the production from the Fairbanks region in 1931. The first and by far the most influential was the earlier cessation of mining in the fall than in 1930. For instance, at several of the

dredges of the Fairbanks Exploration Co., work was stopped more than a month earlier than in 1930. The second cause of some of the decrease was due to the fact that certain properties—for example, the dredge of the Tanana Valley Gold Dredging Co., on Fish Creek—on which mining was in progress in 1930, were idle in 1931.

The extensive mining project being carried on by the Fairbanks Exploration Co., embracing large tracts on Goldstream, Cleary Creek, and the Chatanika River, continued to be the outstanding placer-mining enterprise not only in the Fairbanks district but throughout the Territory. Although new problems are constantly arising and being solved in connection with the work on this project, the underlying plan and methods have been outlined so adequately and skilfully that the work is proceeding in systematic fashion and, except for details, on about the same scale and in the same manner as heretofore. Among the many details that might be singled out for special mention as to the new operations of this company during the year is the acquisition of an extensive tract of placer ground on Engineer Creek, a tributary of Goldstream, which can probably be mined in conjunction with the company's other properties on that stream. Further details regarding the company's operation of its five dredges are given in the section of this report on dredging (pp. 52–56).

The experiment of sluicing placer gravel underground, which has been in progress in the valley of Engineer Creek for several years, was finally given up as unsuccessful under the conditions that were encountered. Briefly, the process consisted in sinking a shaft to the pay streak, in the test case at a depth of more than 100 feet below the surface. From the bottom of the shaft a low drift was driven on the pay streak, and lengths of sluice were laid on a slight grade in the floor of the drift. The gold-bearing gravel was then washed by small hydraulic giants from the face or walls of the drift and carried off through the sluice boxes, the excess material being hoisted to the surface and discharged on a waste dump. The principal trouble experienced was due to the heaving of the floor of the drift and the consequent closing of the drift and the unsettling of the foundation of the shaft structure.

East of the main mining area adjacent to Fairbanks are a number of small camps at intervals all the way to Richardson and south of that old settlement, including parts of Jarvis Creek and other tributaries of the Big Delta, south of the Tanana River. In years gone by, the Richardson or Tenderfoot camp had a rather large placer production, but at present there are not a dozen men mining in that district. Therefore the use of its name in combination with Fairbanks in this report is not so much to designate two separate camps

as to indicate a single ill-defined area between Fairbanks on the west and Richardson on the east. Thus between what may be called the real Fairbanks district and the Richardson district considerable gold was taken out by fairly large camps on Big Chena, and three small camps were at work at least part of the open season on the Salcha River and its tributaries. In the vicinity of Richardson at least three small camps were engaged in placer mining on Tenderfoot and Banner Creeks. No information has been furnished to the Geological Survey as to the placer mining south of Richardson in the valley of Big Delta and its tributaries. However, from current reports it appears probable that only a few prospectors were in that region and that such work as they did was mainly prospecting or preliminary development work.

In the early part of the season of 1931 placer mining in the Iditarod district was much hampered by a shortage of water for sluicing, and this condition continued until early in August. The dry weather then gave way to heavy rains, and these continued nearly until the freeze-up and enabled the miners to make up for the lost time in the early part of the season. About 13 separate outfits employing a total of about 90 men are reported to have done some productive mining during 1931, and there were, in addition, doubtless a few scattered prospectors who apparently accomplished little more than prospecting and development work. The bulk of the gold recovered was mined by the dredges of the J. E. Riley Investment Co. on Otter Creek about 2 miles from Flat and the North American Dredge Co. near the site of the old town of Flat. On the whole, the returns from the two dredges were slightly larger than in 1930, and this accounts for part of the increase in production from the district. Next to the dredges the greatest output of placer gold was recovered by a drag-line scraper recently installed on Happy Creek, a tributary of Willow Creek. About 10 men were employed at this property and the results accomplished indicate that a large production may be expected from it for several years. Two other scrapers were maintained in the valley of Willow Creek, the larger of which was that of Manley & Loranger. On Flat Creek, in addition to the dredge near the mouth of the stream, two other outfits were mining. The largest of these was the hydraulic plant of Strandberg & Son, near the head of the creek. The largest hydraulic and open-cut placer mining in the district was that done by the Chicken Creek Mining Co., under the management of William Duffy, who employed about 12 men. Four placer camps were hydraulicking on Otter Creek. There were 2 or 3 camps on other creeks in this same general district, including 1 each on Granite Creek and Malamute Gulch.

In the Tolovana district, which in this report, as in the preceding volumes of this series, has been extended to include Nome Creek, a tributary of Beaver Creek, there was a considerable increase in the value of the placer gold produced in 1931 over that of 1930. This increase is in part to be explained as due to the fact that the preceding year's production was abnormally low, and in part to the considerable increase from the dredge and from the discovery of new tracts of especially rich placer ground. A large share of the placer gold produced in the district was mined by the dredge on Nome Creek, under the management of Sam Godfrey. The company owning the dredge was formerly known as the Nome Creek Dredging Co., but during the year it was reorganized under the name Beaver Dredging Co. The past success of this dredge had given promise that it would continue for many years to contribute materially to the production of the district. Unfortunately, however, it has been reported by the Alaska papers that the dredge caught fire in the spring of 1932 and was destroyed. Exclusive of the gold mined by the dredge, ordinarily about half of the placer gold comes from drift mines, which are worked mainly during the winter, and the other half comes from hydraulic or open-cut mines. Lately, however, the production has come more largely from placers operated only during the open season. In 1931 there was a revival of prospecting some of the deep ground that would be mined by drifting, and according to local reports several finds that appear promising were made. Among the placers of this sort may be mentioned the benches adjacent to Wilbur Creek, where the pay streak has been found under more than 100 feet of overburden. Most of the larger producing mines are on its tributaries Lillian, Ruth, Amy, and Gertrude Creeks and Glen Gulch. Some placer gold was also recovered from the Tolovana River and its tributaries east of Livengood Creek. Among these tributary streams the most productive were Olive Creek and Lucky Gulch, which join the Tolovana from the north, and Wilbur Creek, which enters it from the south.

Information regarding the mining operations in the Innoko district is not so complete as might be desired. The available reports indicate that while the output of placer gold in 1931 was more than in 1930 it was considerably less than heretofore. The principal increase is to be attributed to increased production from the dredges on Ganes and Little Creeks, which are operated by Felder, Gale & Higgins. Altogether, about 60 men appear to have been engaged in productive mining in the district, and, as in the near-by Iditarod district, they were hampered during the early part of the season by a shortage of water for mining. In addition to the dredges the most

productive camps in the district were those of Collins & Hard, on Ophir Creek; Greenberg & Jones and Paulson, on Cripple Creek; and Vibe and associates, on Little Creek. At the camps of Collins & Hard and Greenberg & Jones mining is carried on by scrapers and hydraulic methods; at the other two, mainly by hydraulic methods. In addition to these larger camps, there were a few smaller ones whose production appears to have amounted to only a few hundred dollars each, or at most to a few thousand dollars.

Placer-gold production from the Fortymile district showed a great increase over the production in 1930. Without intending to discount the importance of that increase it should be pointed out that the output in 1930 was considerably below normal, because during that year much development work was in progress, which decreased the amount of productive work. That the development work had been satisfactorily done was reflected in the greatly increased production of 1931, and it should continue to bring results for several years to come. But not all the plans for expanding mining in the district have been completed, for, according to current reports, one of the largest companies in the district has under consideration the project of installing a dredge on its properties to be used in conjunction with its other mining methods. If this is done the dredge will probably be built in 1933. During the season of 1931 some 24 separate camps, employing a total of about 50 men, were mining in the Fortymile district. The largest mine in the district is that of the Walker Fork Gold Corporation, which is on Walker Fork and operates a drag-line scraper. The other most productive streams in the district were Chicken Creek and its tributaries and Jack Wade Creek. Smaller amounts of placer gold were recovered from Ingle, Canyon, and Napoleon Creeks, Franklin Gulch, and the bars of the Fortymile River. The consolidation of properties in the vicinity of Dome and Chicken Creeks that has been under way for some time by the Alaska Consolidated Gold Corporation, so that mining of the tract as a unit could be undertaken, has not yet been effected.

The Hot Springs district, as the term is here used, consists of two rather widely separated tracts—one including the western part of the district near Woodchopper and Tofty and even extending as far west as American Creek, and the other including the eastern part, which centers around Eureka Creek and may be spoken of as the Eureka Creek section. The value of the placer gold produced in the entire district was somewhat less in 1931 than in 1930. About two-thirds of the gold from this district is recovered from hydraulic and open-cut mines that are operated only during the summer, and the other third from underground or drift mines. About 60 men were engaged in the open-cut mines, and 15 of the same men were

engaged in the drift mines during the winter. In the Woodchopper-Tofty area the largest camp was that of Hansen & Allbright, on Innesvale Gulch. At this place a shaft was sunk to the northwest of the gulch, and drifting was carried on all summer by a crew of 11 men. The hydraulic plants of Tilleson & L'Heureux on a bench east of Sullivan Creek and of a company on Boulder Creek were among the next largest producers in the district. The dredge of the American Creek Dredging Co. was in operation only a few hours during the summer, though surface preparatory work necessary for the next season was in progress throughout much of the open season. In the Eureka Creek area the largest camp was that of J. R. Frank & Co., which was mining by hydraulic methods on Doric and Seattle Junior Gulches, tributaries of Pioneer Creek. The crew employed at this camp consisted of 9 persons. The other principal camps in the area were those of Farmer & Jones, on McCaskey Bar, employing a crew of 5; of M. S. Gill, on Last Bench, between Seattle Junior Gulch and Skookum Gulch, and also on the headwaters of Eureka Creek; and of Johnson & Tuftaker, on the lower end of Shirley Bar, just west of Glen Gulch. Smaller camps were doing some mining on Discovery claim, Eureka Creek; Rhode Island Creek; and Omega Creek; and some prospecting was done on the north fork of Pioneer Creek; on Poker Creek, a tributary of McKinley Creek; on Thanksgiving Creek; and on tributaries of Hutlinana Creek. A more detailed description of the mineral deposits and progress of mining in the Hot Springs district is presented in a report by J. B. Mertie, jr., which is published in another chapter of this volume.

Placer gold production in the Circle district was somewhat less in 1931 than in 1930. This is to be accounted for in part by the dry and cold season throughout most of the district, whereby there was not an adequate supply of water for hydraulicking and sluicing, and thawing did not proceed as rapidly as usual. Moreover, the freeze-up came rather early in the fall, and therefore the season was short. Altogether there appear to have been about 12 camps at which some 45 men were employed in 1931 in the district. The largest mining operations in the district were those of the Berry Holding Co., on Eagle Creek; the C. J. Berry Dredging Co., J. A. Anderson, and August Erickson, on Mastodon Creek; and the Independence Mining Co., on Independence Creek. Besides these larger operations there was one camp on each of the three creeks named above and also one camp each on Switch, Deadwood, Miller, and Harrison Creeks. Several one or two man camps were engaged principally in prospecting, and their output of gold was worth at most only a few hundred dollars. There are several tracts in the Circle district where considerable development work is in progress but has not been completed,

and there are numerous reports of plans of development that are in process of formulation and have not yet taken tangible shape. Among the projects that are in progress the principal one appears to involve the development of properties in the vicinity of Deadwood Creek.

The Ruby district is a rather ill-defined area extending from the settlement of Ruby, on the Yukon, southward for 60 to 75 miles, to and beyond the small settlement of Poorman. In the winter of 1930–31 considerable interest in the district was aroused by the finding of rich prospects in the southern part of the district, and a rush of newcomers followed. Some rich placer ground was found, but its extent was not as great as at first thought. Nevertheless, this find made the production of the district in 1931 increase nearly 50 per cent over the production for 1930 and has encouraged renewal of efforts in prospecting to find other rich tracts. Nearly two-thirds of the production from the Ruby district comes from mines that are developed by drifting methods, and practically all the mines in the southern area are of this type. The most productive streams in the Poorman area were Poorman Creek itself and its tributaries Moose and Beaver Creeks. About 20 men are engaged in productive mining in this area. The two largest plants on Moose Creek are those of Shropshire & Pedretti and their associates. On Poorman Creek the larger camps are those of Coyle & Jensen and their associates. A short time before the end of the season good prospects were found on Timber Creek, a tributary of Poorman Creek, and Monaghan, Stevens & Lohr are planning to carry on development work as rapidly as conditions permit. Nearer Ruby and in some of the longer-known creeks some placer gold continues to be mined each year. Of these creeks the most productive in 1931 were Flat, Greenstone, and Meketchum Creeks and Bear Gulch. Mining on Long Creek was temporarily discontinued owing to certain problems arising through internal questions of management. Apparently the trend of local opinion regarding conditions in the district is that the output of placer gold will probably not soon fall below that of 1931 and is likely to exceed it.

The Koyukuk district, as the term is here used, embraces a very large tract of country and consists of at least three rather widely separated areas in which placer gold has been mined. These subordinate areas are the Indian Creek-Hughes area, in the central part of the Koyukuk Valley; the Hogatza River area, somewhat north of Hughes and embracing country north of the Koyukuk River; and the upper Koyukuk area, which includes that part of the Koyukuk Valley lying north and northeast of Bettles and the country near Wiseman. Mining in the two more southern placer

areas was practically negligible, and the Geological Survey has received no specific information regarding work there. The production of gold from the northern area shows a marked increase in 1931 over the amount produced in 1930. It should be pointed out, however, that the recorded production in 1930 was abnormally low, and in fact the report for that year suggests that possibly it did not indicate the real output owing to the inadequacy of the returns that were received from the district. Whether or not part of the apparent low production in 1930 was due to error, it is certain that at least part was due to the fact that the season of 1930 was unusually dry and short. In 1931, however, the climatic conditions were essentially normal, so that mining was not unduly hampered. In the northern part of the Koyukuk Valley about 57 men were engaged in mining in 1931. The greatest output of gold came from properties on Nolan Creek, the Hammond River, and the Wild River. Some prospecting and development work was in progress on Gold Creek, a tributary of the Dietrich River, and on three or four of the other tributaries of the Middle Fork other than the Hammond River and Nolan Creek. Two prospectors are also reported to have done some work on tributaries to the John River in the central part of its basin, and two prospectors were in the valley of the Pingaluk, a tributary of the Alatna River. About 4 miles west of Bettles Lake four prospectors were engaged in developing a tract on Jim Gulch, on which some promising finds of placer ground had been made. Apparently, however, the results of that work did not turn out as well as had been anticipated, and the latest reports indicate that the work there was discontinued. Much of the Koyukuk region north of the Arctic Circle is little known, and many of the reports as to placer finds in the district can not be accurately located with respect to other features. The Geological Survey is therefore fortunate in having obtained from Robert Marshall a description and map of some of this district based on his own observations and determinations. These records are published elsewhere in this volume and should be of much service to anyone interested in the district. Much of the Koyukuk district lies in one of the more remote and inaccessible parts of Alaska, so that its development presents many obstacles, but the demonstrated extent and richness of its mineralization will inevitably lead to its further development. However, success in bringing this about will call for the skill, persistence, and courage of the best miners and prospectors.

In the table on page 32 the placer-gold production of the Chandalar district has been combined with that from the Koyukuk. The amount of gold that comes from the Chandalar is much less than that from the camps in the Koyukuk Valley. So far as reported,

practically all the placer gold recovered from the Chandalar district in 1931 came from the properties of A. L. Newton, on Big Creek. A small amount of gold was also taken from a claim on Little Squaw Creek, but most of the work at this claim was of a prospecting character, consisting in crosscutting the valley to determine the position and extent of the old channel. A little prospecting was also done at claims on Tobin Creek, where the prospects found are said to have been distinctly encouraging, though the output is not yet significant, and further crosscutting will be done. Much of the Chandalar district is so remote that, except for indirect reports, little first-hand information is available as to mining activities in it. It is probable, however, that there are not more than half a dozen active prospectors in the thousands of square miles embraced in the drainage basin of the Chandalar River.

In the Eagle district the production of placer gold in 1931 appears to have been the same as in 1930. There were eight camps, employing about 18 men, engaged in mining. The largest amounts of gold appear to have been produced from placers on Fourth of July Creek, by Froelich, Kummer, Ott & Scheele on Crooked Creek, by Olson & Johnson on Discovery Fork, and by Bryant and associates on Alder Creek. Smaller amounts of gold were recovered by other prospectors and miners on the Discovery Fork, American Creek, and the Seventymile River, and some prospecting that probably did not yield any gold that entered trade may have been in progress elsewhere in the district. On the whole, most of the miners in the Eagle district report that the season was dry and cold and that as a result water for mining was scanty and the season short.

The Marshall district, as the name is used in this report, includes practically all of the western part of the Yukon Valley below Holy Cross and is somewhat more inclusive than the so-called Wade Hampton recording precinct. In this large area there is but very little placer mining or prospecting, and what there is is more or less localized at two points—one near Marshall and the other in the Stuyahok or Bonasila Valley. A few miles upstream from Marshall (Fortuna Ledge post office), Willow Creek, the source of most of the placer gold that in earlier years was mined in the Marshall district, joins the Yukon. This stream heads in hills composed principally of Upper Cretaceous sediments and Paleozoic greenstones and related rocks. Within the hills the creek flows in a narrow-floored valley whose deposits contain many large boulders that interfere seriously with mining. In 1931 it is reported that only one prospector was working in the area. On Montezuma Creek a few men were mining the creek gravel and reported a fair return for their season's work. About 50 miles northeast of Marshall, in the valley of the

Stuyahok River, a tributary of the Bonasila River, a party of four men were mining with a hydraulic lift and plant. Although they report having experienced an unusually dry season and one which closed early because of the cold, so that their work was much hampered and curtailed, their output of gold bears witness to the general success of the enterprise and indicates that, with more favorable conditions, an even larger return may be expected.

Records received by the Geological Survey regarding placer mining in the Rampart district indicate that 8 or 10 camps were active during 1931. Most of these were small 1-man operations that recovered only a few hundred dollars' worth of gold. The greatest amount of gold seems to have come from the properties of John Cunningham and associates on Little Minook Creek and of J. A. Farrell and associates between Little Minook and Hunter Creeks. Some gold was produced at smaller camps in the valleys of Little Minook and Hunter Creeks and on Slate and Hoosier Creeks. Some prospecting was also done on the high gravel deposits of Idaho Bar. A more detailed description of the mineral deposits and the progress of mining in the Rampart district is presented in a report by J. B. Mertie, jr., which is published in another chapter of this volume. In the Gold Hill district, which lies west of the town of Tanana and in this report has for convenience been grouped with the Rampart district, a little prospecting was done in 1931 on Grant, Mason, and Moran Creeks. Only a little gold was recovered in this work, but it is significant as indicating a renewal of mining interest in this district, and on at least one of the properties the showings already found are said to be sufficiently good to convince the owner that they warrant the installation of a hydraulic plant.

Placer mining in the Bonnifield district was carried on by a total of about 20 men working in 8 or 10 small camps, the largest of which employed not more than 4 or 5 men, and none of them yielded gold worth much more than a few thousand dollars. Among those reporting some production of gold during 1931 may be mentioned those on Gold Run and Marguerite, Moose, and Platte Creeks. The production from this district has been combined in the table on page 32 with that from the Kantishna district, but it may be stated that the placer gold from this district was somewhat more than half of the combined total. In the Kantishna district there were altogether only about a dozen men engaged in placer mining or prospecting, and they were distributed through small camps on several of the creeks, notably Eureka, Little Moose, Glen, and Yellow Creeks. None of these camps, however, recovered gold worth more than a few hundred dollars. All the ground is shallow and is mined by simple methods.

A special investigation of the mineral resources of the Kantishna district was made in 1931 by the Geological Survey in cooperation with the Alaska Railroad. This work was done by F. G. Wells. A summary of his conclusions is published elsewhere in this volume, and the complete report will be published later.

The Geological Survey has received almost no first-hand information regarding mining developments in the Chisana (locally called Shushanna) district, and from the lack of rumors regarding developments there it has been concluded that very little mining was in progress in that district in 1931. Apparently work was done on only a very few properties and that consisted only in the small amount required by law for holding the claims. It is probable that not more than a dozen men were working in the district, and they made no new discoveries and apparently obtained their gold from small tracts of ground that were overlooked or passed by in the boom days of the camp. The largest amount of gold recovered from the district in 1931 appears to have come from placers on Little Eldorado Creek, the property of C. F. Whitham and mined under lease by B. J. Davis. One other man was employed at this property, and much of the mining involved the rehandling of old tailings.

KUSKOKWIM REGION

Included in the Kuskokwim region are four principal districts where gold placers were mined in 1931. For convenience of description they may be called the Mount McKinley, Georgetown, Tuluksak-Aniak, and Goodnews Bay districts. The Mount McKinley district embraces all the eastern part of the Kuskokwim Valley, but the placer mining in it is more or less localized around McGrath, Takotna, and Medfra. The Georgetown district is in the central part of the Kuskokwim Valley, and work there centers more or less closely around the settlement of Georgetown, on the Kuskokwim, about 45 miles in an air line south of Iditarod. The Tuluksak-Aniak district is named from two rivers that traverse parts of it; the Tuluksak enters the Kuskokwim from the south some distance east of the settlement of Bethel, and the Aniak enters the Kuskokwim about 50 miles still farther upstream, to the east. Goodnews Bay is a small indentation of the coast on the east side of Kuskokwim Bay, about 125 miles in an air line south of Bethel.

The production of placer gold in the Kuskokwim region in 1931 showed a great increase, being estimated at $158,000, against $44,800 in 1930. This increase is largely attributable to the resumption of dredging in the Tuluksak-Aniak district, which was discontinued in 1930. A fairer comparison might be found by comparing the production of 1931 with that of 1929, when the dredge was in operation.

The production from the Kuskokwim region in 1929 was $165,000, indicating that the yield of placers in the two years was practically identical. So far as known, no other dredges were in operation elsewhere in the Kuskokwim region in 1931, though there appear to be places that would warrant careful inspection to determine their suitability for mining of this sort. The dredge that for many years was so productive in the Candle Creek Valley, near McGrath, was again idle, as it has been since 1928, and apparently no plans are now under consideration for its early reconditioning. In fact, it is reported that most of the machinery from this dredge has been removed to be used in one of the dredges in the Innoko district. The vast, slightly explored or even totally unexplored area that is embraced in the Mount McKinley district is regarded as country that well deserves more thorough examination and intelligent prospecting, not only for workable gold placers but also for other mineral deposits.

Reports regarding placer mining in the Mount McKinley district are extremely meager, and so far as could be learned most of the work was done by several one or two man camps at widely separated points, most of which, however, are adjacent to McGrath or in the hills north of the Kuskokwim farther upstream, near Medfra. Among the streams near Medfra from which some placer gold was produced in 1931 may be mentioned Ruby, Hidden, and Eagle Creeks and Holmes and Riddle Gulches. Less than a dozen men were employed in this work, and no notable new finds appear to have been made. The greatest amount of gold was recovered from the properties of F. E. Matthews, on Hidden Creek, and of Pearson & Strand, on Ruby Creek. Mining is carried on only during the summer, and most of it is done by ordinary open-cut or simple hydraulic methods. The principal streams on which placer mining was in progress in the vicinity of McGrath were Moore Creek and Alder Gulch. The operations on Moore Creek carried on by Waino Kaskinen with five men appear to have yielded more gold than those at any other camp in the Mount McKinley district. Some productive mining was also reported to have been done on Alder Gulch.

Mining in the Georgetown district appears to have been restricted to the placers of Donlin and Julian Creeks. On both of these streams the season was especially favorable and the returns, in relation to the number of workers and expense, were highly satisfactory to the operators, so that the work will be continued on an even larger scale next season. In addition to their direct effect on adding to the supply of gold, the success of these enterprises is having an indirect effect on the development of the region by stimulating prospectors to reexamine some of the tracts that heretofore have been passed by.

For instance, it is reported that a few prospectors are planning to make further search for placers in the valley of the George River, which joins the Kuskokwim at Georgetown, and others are trying to make the necessary arrangements for outfits to prospect in some of the streams near the Donlin Creek area.

In the Tuluksak-Aniak district the main item of interest was the resumption of operations by the Bear Creek dredge of the New York Alaska Dredging Co. During 1930 this dredge had lain idle while the company had been mining under lease certain ground on Seward Peninsula. The cessation of work on Bear Creek led some to the belief that the ground there had been worked out, but the resumption of work and the statements by the company that it estimates at least three years' work ahead of the dredge have revived interest in the whole region. Next to the dredge production the largest placer production in the Tuluksak-Aniak district and, in fact, the largest in the whole Kuskokwim region came from the property of Dahl & Wilson, on Marvel Creek. Marvel Creek is a tributary of the Salmon River, which in turn flows into the Aniak River. Six men were employed at this camp, and all reports indicate that it experienced an especially good season. On Canyon Creek, a tributary of the Kwethluk River, on the western slopes of the Kuskokwim Mountains, east of Bethel, considerable gold was mined by O. K. Anderson with a crew of six men on a lease from Kvamme & Co. Several other small camps of a few prospectors each are reported to have been carrying on a search for placers on some of the streams that head in the general vicinity of Marvel Dome, and there is said to be a revival of interest in prospecting throughout the area, but returns from this work have not yet indicated any notable increase in the output of placer gold.

In the Goodnews Bay region the prospectors lately have been so much more interested in the search for platinum placers and their efforts have been so much better repaid that the search for gold placers and their development have been more or less abandoned. However, during 1931 there was some evidence of a return of interest in prospecting for gold, and three small camps are reported to have recovered a total of a few thousand dollars from placers in the district. The largest amount is said to have been obtained from placers in the valley of the Arolic River, north of Goodnews Bay. A small amount of gold was also mined from placers on Bear and Olympic Creeks. Recent reports indicate that negotiations have been perfected by the holders of claims on Wattamuse, Slate, and Cascade Creeks with an outside company to drill their claims with the view of undertaking an extensive development program if the returns prove favorable. The drilling will not be begun until the spring of 1932, and as there is a very large tract to be tested, it will be some

time before a decision can be reached as to further work. In the meantime the progress of the work will be watched with much interest, as the successful development of a profitable mining venture would doubtless do much to build up the mining industry in the whole western part of the Kuskokwim Valley. Practically no gold is associated with the platinum placers that are found south of Goodnews Bay, especially in the valleys of Clara, Squirrel, Platinum, and Fox Creeks. Further notes on this district are given in the section of this report that treats of platinum.

SEWARD PENINSULA

The production of gold from Seward Peninsula in 1931 was slightly more than in 1930, amounting to $1,215,000. General conditions throughout the region were somewhat less favorable for mining than normal. The season was rather late in opening, and owing to the small snowfall of the preceding winter the surface had frozen deeper than usual and when the snow melted it furnished a poorly sustained run-off. Furthermore, throughout most of the early part of the open season there was little rain, and this led to a more acute shortage of water for mining. In contrast to these drawbacks, however, there were encouraging features. For instance, several new enterprises were undertaken, and plans for several more have reached such advanced stages of consideration that they will probably be put into effect in the season of 1932. Current reports indicate that there were many more men engaged in prospecting than in recent years. In fact, it is said that the urge of necessity has caused many to work stretches of the present beach with rockers, so that that area took on some resemblance to the early boom days, though the amount of gold recovered, of course, was very much less.

Approximately $1,011,000, or over 83 per cent of the total gold recovered from Seward Peninsula placers, was mined by 14 dredges, one or more of which were active in practically every one of the larger districts of the peninsula. Additional data regarding dredge mining on Seward Peninsula, as well as in other parts of Alaska, are given in a later section of this report. In the relative order of their output of placer gold in 1931 the mining districts of Seward Peninsula stood as follows: Nome, Fairhaven (including the Candle and Inmachuk districts), Solomon (including the Casadepaga River region), Kougarok, Council, the Koyuk River region, Bluff, and Port Clarence. So much of the placer gold from some of these districts came from only one or two mines that it has not seemed advisable to publish the production of the separate districts, as it might disclose the output of the individual mines.

The outstanding mining enterprise in the Nome region, as well as in the whole of Seward Peninsula, continues to be that of the Hammon Consolidated Gold Fields, with its three dredges between Little and Dry Creeks, its scores of claims, and its extensive ditches and other equipment for properly conducting its work. Work at this property was conducted on the same general lines as heretofore, but from one cause or another during most of the season only two of its dredges were in operation at a time. The No. 2 dredge of this company, which was moved from its location on Little Creek, was successfully installed on its new site on Center Creek. An interesting technical description of the method of moving this dredge more than 8,000 feet overland is given in one of the current journals.[3] On Newton Gulch, near Nome, the Dry Creek Dredging Co. was mining throughout the summer and apparently had a successful season. On the old second beach, a short distance east of Nome, a small dredge known locally as the McCarthy & Panos dredge worked part of the season. The ground mined was frozen, and cold-water thawing was resorted to. Apparently the enterprise experienced many difficulties.

The dredge of the Osborn Mining Co., which was moved a few years ago from the Solomon River to a site on Osborn Creek, was not in operation during the season. Instead the bench ground near the dredge was mined by hydraulic methods by Lee & Swanberg with a crew of five men. There were also a number of open-cut mines on many of the creeks in the vicinity of Nome. Most of these mines were small and employed only a few men; the largest appears to have been that of the Monument Creek Mining Co., on Monument Creek, a tributary of the Nome River, where seven to nine men were employed throughout most of the open season. An extensive tract in the neighborhood of Nome was acquired during the season, with the view, it is said, of undertaking a large-scale development if suitable financial arrangements could be made and the preliminary tests came up to expectations.

The greatest amount of placer gold mined in the Fairhaven district came from three main tracts—Candle Creek, the Inmachuk River, and Bear Creek. Altogether about 110 men were employed on different mining properties in this district in 1931. Candle Creek is a large tributary of the Kiwalik River from the west, close to the town of Candle. On Candle Creek and its tributaries, Patterson and Jump Creeks, the greatest amount of placer gold was recovered by the dredge of the Keewalik Mining Co. This is the dredge that was operated in 1930 under lease by the New York Alaska Gold Dredging Co., but the lease was terminated, and it was operated

[3] Moving a gold dredge overland: Eng. and Min. Jour., July 13, 1931, p. 11.

under the company's own management in 1931. Production continued at essentially the same rate as heretofore, and no new developments of significance were reported. Altogether about six camps, employing a total of about 50 men, were mining on this creek and its tributaries. Farther up the Kiwalik River, on Quartz Creek, which enters from the east, a little productive placer mining was done, and on Gold Run, which enters the Kiwalik River from the west a few miles below Quartz Creek, some prospecting was in progress.

In the Inmachuk Valley the principal producer was the hydraulic mine of A. V. Cordovado, on the Pinnell River a short distance upstream from its junction with the Inmachuk. Work at this place has been in progress for several years, but much ground still remains to be mined, and according to the records of production the tenor seems to show no marked change. Several small hydraulic-mining camps were established on near-by creeks. The largest of these was on Humboldt Creek, where four men had a fairly successful season. On the Inmachuk River a small dredge that was formerly known as the Fries dredge was reconditioned by the Forsgren & Vollmer Dredging Co. and was in operation at intervals throughout the season. Altogether between 35 and 40 men were engaged in mining in the Inmachuk area in 1931. Rumors were current that negotiations were in progress for obtaining a considerable tract of ground in the Inmachuk Valley with a view to dredging it if the preliminary field examinations proved encouraging. The enterprise has not yet taken definite form, and the determination of the many technical problems involved requires extensive testing in the field, so that even if the project should be undertaken it would be a couple of years before it would reach the stage of yielding much gold. No progress in the search for ancient channels buried under the recent lavas of the large tract adjacent to Imuruk Lake has been reported.

The third tract in which placers were mined in the Fairhaven district lies on Bear Creek east of the hills that form the divide between the Buckland and Kiwalik Rivers. No specific reports have been received as to the individual mining operations in that tract, and the absence of news indicates that there have not been any notable developments during the year. However, the production was considerably larger in 1931 than it has been during the last few years, and apparently 14 men were engaged in mining there.

In the Solomon district by far the larger part of the placer gold recovered in 1931 was obtained by dredges of the Spruce Creek Dredging Co. and the Goldsmith Dredging Co. The dredge of the Spruce Creek Dredging Co. is situated on Spruce Creek, about 6 miles east of Solomon. Work at this property was started late, as a thick sheet of ice lay on the ground, and the seasonal frost was

excessively deep. At intervals during the season patches of permanently frozen grounds were struck that had to be thawed before they could be dredged. The ground was about 11 feet deep, and the thawing was done by cold water, the points being spaced 7 feet apart and allowed to stand three to four days. The dredge of the Goldsmith Dredging Co. is situated in the northern part of the Solomon River Valley. Here, too, mining was hampered by the late spring and the unusual amount of seasonal frost. The placer mined by the dredge is rather shallow, the average depth being only about 7 to 8 feet. In addition to the gold produced by the dredges, several thousand dollars was recovered from small open cuts at a number of widely separated points in the valley of the Solomon River and its tributaries, but at none of them did the output exceed one or two thousand dollars, and at most of them it was only a few hundred dollars.

North of the Solomon River is the valley of the Casadepaga River, which for the purpose of this report is included in the Solomon district. At one time considerable placer gold was won from the gravel deposits of the tributaries of the Casadepaga, but lately the amount recovered has been insignificant. A small dredge was in operation part of the season on placers near the mouth of Ruby Creek. It experienced considerable difficulty through the lateness of the reason and from mechanical and other causes, so that it was running only a short time and its output was small. Elsewhere in the Casadepaga area there is practically no prospecting in progress.

Mining in the Kougarok district was much more actively carried on than it has been of late years. The old dredge that formerly belonged to the Behring Dredge Corporation and was reconditioned in 1930, was in operation almost continuously in 1931 and, considering the conditions, had a highly successful season. This dredge is the property of the Henry Creek Gold Dredging Co., and it was mining on the Kougarok River between Arizona and Henry Creeks. Elsewhere in the Kougarok district the mining was carried on by small camps consisting usually of only one or two men each. In the vicinity of Coffee Dome, in the southern part of the district, the Coffee Creek Mining Co. continued its explorations and is reported to have found encouraging prospects. Small hydraulic plants were in operation on Eagle and Wonder Gulches, tributary to Coffee Creek. Dahl Creek yielded the most gold of all the creeks in the southern part of the district, and more than 10 men were mining at different points along its course. A nugget worth $200 is reported to have been found during the summer on one of the Dahl Creek properties. Near the head of the Kougarok several claims were being developed, especially in Macklin and near-by creeks. All these claims are being developed by open-cut methods and shoveling in,

few of them being equipped with mechanical labor-saving devices. Some mining is also reported to have been done at small camps in the valleys of some of the streams that head against the northern divide of the Kougarok River.

South of the Kougarok district, in the vicinity of Iron Creek, four men are reported to have done some hydraulic mining during the year. On American Creek, about 8 miles east of Iron Creek, one camp employing several men was said to have been engaged in constructing a ditch to lead water for use in hydraulicking placer ground on that stream. The entire production of gold from the Iron Creek area, however, was so small that it amounted to little more than wages for the men concerned.

In the Council district, as in the other larger producing districts of Seward Peninsula, most of the placer gold produced in 1931 came from dredges. Two dredges were operated on Ophir Creek—one belonging to the Ophir Gold Dredging Co. and the other to the Northern Star Dredging Co. The first named was in the lower part of the valley, where the stream traverses the lowland of the Niukluk. Some 10 men were employed on the dredges. Although they recovered considerable gold, the charges for wages and expenses did not leave a very large margin of profit. One small hydraulic mine was also working on Albion Gulch, a tributary of Crooked Creek, and one small camp was reported to have been mining on Benson Gulch, a tributary of Melsing Creek. Although there were a few other small camps scattered through the district, no direct reports have been received from them, and nothing is known about the progress of their work, though to judge from the total amount of gold received from this district by the banks most of them made at best only a modest grubstake.

The Koyuk district, as the term is used in this report, includes most of southeastern Seward Peninsula and is so named from the principal stream that traverses it. Most of the placer deposits that are mined are on Dime Creek and a few of the other streams in the vicinity of Haycock. Although there is one small dredge in the district, a considerable amount of its placer gold came from bench and creek placers mined by hydraulic or open-cut methods. One camp, employing 3 men, was mining during the winter, and 6 camps, employing a total of about 12 men, during the summer. All these camps were on Dime Creek except two on Sweepstake Creek.

In the Bluff district, which lies east of Solomon, the principal producing property was that of the Topkok Chief Mines Co., which operated a scraper on Daniels Creek during most of the open season. The ground where the scraper was installed is in places as much as 40 feet deep and was therefore difficult to mine economically by this method. For this reason it is probable that some other method of

mining will be used another season. About 12 men were employed on this property. Some placer gold was also produced from one other property on Daniels Creek and from claims on Swede and Eldorado Creeks.

The Port Clarence district, in western Seward Peninsula, is the only one of the large sections of the peninsula in which no dredge is in operation. The production from the district in 1931 was valued at only a few thousand dollars, and probably there are not more than 15 to 20 men in it that are doing any mining. So far as learned from local reports, the greatest amount of gold was recovered by camps of four men each on Windy, Ilene, and Coyote Creeks and smaller amounts from 1-man camps on Gold Run and Offield Creek. No reports have been received as to mining north of Teller in the Agiapuk Valley. Probably some prospecting was in progress there, but if so the amount of gold recovered was probably small and has been credited in the tabulations to the adjacent Kougarok district.

Lying east of Seward Peninsula but more or less closely related to it is the Bonanza district, so named from a small stream which has long been known to carry some placer gold. Prospecting has been carried on at several places in this general area in the past and for the last two or three years has been localized in the narrow coastal plain that lies between the waters of Norton Bay and the hills to the east. The bedrock in this part of the area consists mostly of dark slate and sandstone and thus differs markedly from the schist bedrock that occurs in most of the other placer camps in Seward Peninsula. The history of the coastal plain at this place in the main seems to have been comparable to that of the coastal plain at Nome and elsewhere in Seward Peninsula, so that prospecting for ancient beaches in this district is well justified. Whether the ancient beaches will prove to be gold bearing, however, depends on the occurrence of mineralization in the material that formed this coastal plain and, if it occurred, on the effectiveness of any subsequent concentration. The present production from this entire tract amounts at most to only a few hundred dollars a year.

NORTHWESTERN ALASKA

The Kobuk River Valley is the only one in northwestern Alaska that is reported to have been the scene of any placer mining in 1931. In this valley there are two principal areas where placer mining is being done. The western area is near Kiana, and the principal placer tract is in the valley of the Squirrel River and especially in the valley of its tributary Klery Creek. The eastern area is in the vicinity of Shungnak, a small settlement about midway between the

head and mouth of the Kobuk River. Kiana is about 50 miles in an air line above the mouth of the Kobuk, and Shungnak is about 90 to 100 miles in an air line east of Kiana. Both of these tracts are so remote and so poorly served by any means of regular transportation or communication that their development is much retarded and hampered by high costs, unavoidable delays, and short working season.

In the area near Kiana six men were reported to have done a little prospecting and recovered a small amount of gold from three separate patches of placer ground on Klery Creek and its tributaries. The proved occurrence of gold in this area is an incentive for further search for workable deposits, but the field of search is so large and the number of prospectors to do that work is so small that progress in really testing out its worth is extremely slow. The present total production of gold from this tract amounts to little more than a meager grubstake for the workers. According to current reports, 24 prospect holes were drilled during the winter of 1930–31 on Central Creek, with a view to determining whether a tract suitable for mining with a dredge could be blocked out. Still further drilling will be required to determine this question. It is also reported that another drill was to be taken into the area near Kiana and used during the winter of 1931–32 in testing the gravel in the valley of Klery Creek and on the adjacent benches.

In the tract near Shungnak the placer deposits occur in the lowland adjacent to the Kobuk, close to the places where the small streams that come down from the hills to the north traverse that lowland, or in the valleys of the streams within this belt of hills. The source of the placer gold found in these deposits appears to be local, as in general it is rough and shows little evidence of having been transported far. This conclusion is further supported by the finding of many quartz veins carrying free gold in the metamorphic rocks that form the hills in which these streams rise or which they traverse. In 1931 four small camps, employing a total of 11 men, were established on streams in the vicinity of Shungnak, one each on Dahl Creek, Lynx Creek, California Creek, and the Shungnak River. Lynx and California Creeks are tributaries of the Kogoluktuk River, which joins the Kobuk some 3 or 4 miles east of Shungnak, and the Shungnak River enters the Kobuk about 15 miles west of Shungnak. The largest of these camps were those of the Kobuk Alaska Mines, on the Shungnak River, and of Ferguson & Son, on California Creek. At each of these camps six men were employed during the open season. Mining at the camp on the Shungnak River was done by hydraulic methods, but it is said that the company plans to use a power scraper in 1932, its

installation having been delayed, owing to difficulties of transportation. The work is being done under the direct field management of C. W. Alexander. The property on California Creek was mined by hydraulic methods and on approximately the same scale as during the preceding year. The company's other plant on Dahl Creek was not in operation in 1931. The remoteness of the district makes mining there expensive, as transportation facilities for moving heavy supplies and equipment are meager. For the transportation of persons or small or light commodities airplanes make the district relatively accessible, and already some of the prospectors are using this means of travel.

One man is reported to have done some winter work on Agnes Creek, a tributary of the Ambler River, some distance north and west of Shungnak. No information has been received regarding the results of that work, but the very absence of news about it suggests that no finds of much economic importance were made.

DREDGING

More than 77 per cent of all the placer gold produced in Alaska in 1931 was mined by dredges. The total gold thus recovered was $3,749,000, of which the greater part came from 13 dredges in the Yukon region and the rest from 14 dredges in Seward Peninsula and 1 in the Kuskokwim region. This total is somewhat less than the amount recovered by dredges in 1930, and the decrease is largely due to the shorter season that several of the larger dredges were in operation, notably those in the Fairbanks district, and to the fact that in Seward Peninsula the seasonal frost was unusually deep so that it hampered operations in the early months. The accompanying table gives the output of gold by Alaska dredges, beginning in 1903, the earliest year for which records are available.

Gold produced by dredge mining in Alaska, 1903–1931

Year	Number of dredges operated	Value of gold output	Gravel handled (cubic yards)	Value of gold recovered per cubic yard
1903–1915		$12,431,000		
1916	34	2,679,000	3,900,000	$0.69
1917	36	2,500,000	3,700,000	.68
1918	28	1,425,000	2,490,000	.57
1919	28	1,360,000	1,760,000	.77
1920	22	1,129,932	1,633,861	.69
1921	24	1,582,520	2,799,519	.57
1922	23	1,767,753	3,186,343	.55
1923	25	1,848,596	4,645,053	.40
1924	27	1,563,361	4,342,667	.36
1925	27	1,572,312	3,144,624	.50
1926	32	2,291,000	5,730,000	.40
1927	28	1,740,000	6,084,000	.29
1928	27	2,185,000	6,371,000	.34
1929	30	2,932,000	8,709,600	.336
1930	27	3,912,600	9,906,000	.395
1931	28	3,749,000	10,214,000	.367
Total value		46,669,000		

The total value of the gold produced by dredges since 1903 is nearly 17.7 per cent of the total value of gold produced from all kinds of placer mining since 1880, and lately there has been a general tendency each year for a greater and greater percentage of the placer output to be mined by dredges. During 1931 the ratio of dredge production to the output from all other kinds of placer mining was nearly 77 to 23, and there are no signs of a diminution in dredge mining in the near future—in fact, an even higher ratio seems not unlikely.

In the foregoing table the figures given for yardage mined and value of the gold recovered per cubic yard are subject to some inaccuracy because several of the dredge operators have not furnished specific information on those subjects for their individual properties, and the figures for these properties have therefore had to be estimated. In making these estimates the following procedure has been adopted to determine the unknown factors: Operators of dredges that produced approximately $3,496,600 in gold, or a little more than 93¼ per cent of the total mined by dredges, report that that amount came from 9,526,088 yards of gravel. The average yield thus shown is about 36.7 cents in gold to the cubic yard. Applying this average to determine the unreported yardage gives a total of 10,214,000 cubic yards, and this is the figure that has been used in the table. This procedure is obviously open to criticism, because the companies that reported fully the amount of gravel mined were the larger ones, and doubtless they worked ground of a lower tenor than that mined by some of the smaller companies. As a result, the average value adopted may be too low and consequently may indicate a larger volume of gravel than was actually handled. This method, however, has been followed for the last seven years, so that the quantities and values given for 1931 are comparable with those reported for the preceding seven years. If this value as stated is correct, it will be evident from the table that the average tenor of the ground dredged in 1931 was somewhat higher than the average for 1927 to 1929, though considerably lower than the average for most of the preceding years. The average value of the gold recovered per cubic yard in the period from 1916 to 1931 was somewhat more than 43½ cents.

The length of time that the different dredges were operated varied widely. The longest season reported was 242 days for one of the dredges of the Fairbanks Exploration Co., which was operating in the Fairbanks district of the Yukon-Tanana region. The longest season reported for any of the Seward Peninsula dredges was for one of the dredges of the Hammon Consolidated Gold Fields, at Nome, which mined for 182 days. The earliest date for beginning work in the spring and the latest date for ending work in the fall were reported by the Fairbanks Exploration Co., which began min-

ing April 7 and did not stop its last dredge until December 6. The earliest and latest dates on Seward Peninsula were May 21 and November 19, both reported by the Hammon Consolidated Gold Fields. The average length of working season in 1931 of the 11 companies for which information is available, as determined from the beginning and ending dates reported by each company, irrespective of how many dredges it operated, was 135 days. Obviously, the shortness of the average season as compared with the record of 242 days for the longest working season was due not to climatic conditions, but to breakage or some other purely local cause at the different dredges. The lesson that is demonstrated by this dredging record is that throughout most of interior Alaska a moderate-sized dredge reasonably well handled may be expected to have at least an average working season of 4½ months, and that with skill and special provisions against unfavorable climatic conditions the dredging season may be extended for an additional period of two to three months in practically any of the placer camps south of the Arctic Circle. The longest dredging season yet recorded is that of one of the dredges of the Fairbanks Exploration Co. in 1930, which was in operation for 269 days. This unusually long season, however, was found to be undesirable, as the difficulties experienced outweighed the advantages gained.

The following is a list of the dredges that did some productive mining during 1931:

Yukon Basin:	
Fairbanks district—	
Chatham Gold Dredging Co	Chatham Creek.
Fairbanks Exploration Co. (5)	Goldstream and Cleary Creek.
Fairbanks Gold Dredging Co. (Ltd.) (2)	Fairbanks Creek.
Iditarod district—	
North American Dredge Co	Otter Creek.
J. E. Riley Investment Co	Do.
Innoko district—	
Felder-Gale & Higgins	Yankee Creek.
Felder-Gale & Higgins	Ganes Creek.
Tolovana district—Beaver Dredging Co	Nome Creek.
Kuskokwim region:	
Tuluksak-Aniak district—New York Alaska Gold Dredging Corporation	Bear Creek.
Seward Peninsula:	
Council district—	
Northern Star Dredging Co	Ophir Creek.
Ophir Gold Dredging Co	Do.
Fairhaven district—	
Keewalik Mining Co	Candle Creek.
Forsgren & Vollmer Dredging Co	Inmachuk River.
Kougarok district—Henry Creek Gold Dredging Co	Kougarok River.

Seward Peninsula—Continued.	
Koyuk district—Dime Creek Dredging Co	Dime Creek.
Nome district—	
Dry Creek Dredging Co	Newton Gulch.
Hammon Consolidated Gold Fields (3)	Old beach line.
McCarthy & Panos	Second beach line.
Solomon district—	
Ruby Dredging Co	Ruby Creek.
Goldsmith Dredging Co	Solomon River.
Spruce Creek Dredging Co	Spruce Creek.

During 1931 four dredges that had been active in 1930 were idle, but some mining was done by five dredges that had not been in operation in 1930. The net result of these changes was that the total number of active dredges in 1931 was 28. The dredges that were active in 1930 but idle in 1931 were the dredge of the Tanana Valley Gold Dredging Co., on Fish Creek, in the Fairbanks district; one of the small dredges on Little Creek, in the Innoko district; and the Hastings Creek and Osborn Creek dredges, in the Nome district. The dredges that were in operation in 1931 and not in 1930 were those of the Forsgren & Vollmer Dredging Co., in the valley of the Inmachuk River; McCarthy & Panos, near Nome; the Ruby Dredging Co., in the valley of the Casadepaga River; the Henry Creek Gold Dredging Co., on the Kougarok River; and the New York Alaska Gold Dredging Corporation, on Bear Creek, in the Kuskokwim region. All these dredges have been in operation before, and all except the two named last are of small capacity and of more or less homemade construction from material not specially designed for the use to which it was put. The dredge of the American Creek Dredging Co., on American Creek, in the Hot Springs district of the Yukon region, was in operation for only a few hours and reported no production, and therefore it has been omitted from the list. Surface work at this property was in progress throughout the season, and the dredge will probably be in active operation in the season of 1932.

Much of the placer ground at practically all the places where dredges are now working in Alaska is frozen, so that extensive plants for thawing it must be available. This adds heavily to the cost of the work, and unless the thawing has been done adequately it slows up or actually checks mining. Most of the dredge camps are now using cold water for thawing, though in the past steam or hot water was thought to be necessary. At any large dredging operation, such as at Nome or Fairbanks, miles of pipe are used for the thawing process, and a larger force of workmen is required in the various tasks connected with the thawing than in actual mining. In addition to the labor costs for thawing operations, there is need for large quantities of water, both for thawing and for sluicing.

Adequate supplies of water for most of the dredging camps in interior Alaska and Seward Peninsula are difficult to find and costly to develop. In places it has been necessary to go scores of miles to get water under sufficient head and then lead it by means of long ditches and siphons to the mining ground. The regulation of this water and the maintenance of the ditches require the constant attention of a considerable force of men throughout the working season, especially if the construction is new and the ground has not settled.

The success of most of the good dredges already built has induced many individuals and companies to reexamine formerly known extensive deposits that were too low in tenor to be worked by any of the methods that require less capital. As a result rumors are heard regarding dredging projects to be undertaken on placer ground from one end of interior Alaska to the other. Unquestionably these projects deserve most careful consideration, and some of them will doubtless be successfully carried through, but there is a tendency to regard the dredge as a magic method by which even worthless deposits may be mined at a profit, so that a word of caution may not be amiss to those who are considering investment in some of the projects. The amount of money needed to finance the building of a dredge and furnish the necessary equipment is so great that the cost of a report by a competent engineer is relatively insignificant, and such a report should be obtained as almost the first step in any well-advised project. Furthermore, adequate prospecting in advance, although apparently costly, well repays the outlay, as it prevents unwise commitments and enables the competent manager to effect savings through constructive planning.

Rumors are so numerous of places where prospecting is said to be contemplated or in progress, with a view to determining their suitability for dredging operations, that it is difficult to distinguish those that are merely forlorn hopes from those that are being seriously considered by persons or companies who would be able to carry through any enterprise they might undertake. It has therefore seemed inexpedient to attempt to list here all the places that have been mentioned as being under consideration. However, in earlier parts of this report describing the different placer districts mention has been made of some of the enterprises that have been most extensively discussed. It should be realized, however, that although some of them may be regarded as approaching a real prospective stage others will inevitably be dropped, and that in all probability there are many others that, though they have not yet advanced so far as to be extensively discussed, may be even more meritorious and may be developed first.

COPPER

Deposits containing some copper minerals are found throughout most of the length and breadth of Alaska. During 1931, however, nearly all of the Alaska copper came from two mines in the Copper River region that are operated practically as a unit, though owned by different companies. Besides the copper recovered from these mines, a few pounds of copper was reported to have been recovered in 1931 at a smelter in the States from ores and concentrates shipped from southeastern Alaska. Also some placer copper was recovered in the course of mining the gold placers in the Nizina district. The total amount of copper recovered from Alaska ores in 1931 has been computed as 22,614,000 pounds, valued at $1,877,000. The bare statement of the quantity of copper produced is more or less meaningless, however, unless the basis on which it is computed is stated, because in all the processes that the ore undergoes, from the time it is broken out of the vein in the mines until all of the metallic copper that can be recovered from it is finally placed on sale, there are inevitable losses, so that at no two stages is the amount of copper exactly the same. Even though the losses incurred in these different stages are small compared with the amount recovered, the quantities involved are so large that even a small percentage of loss is equivalent to many thousands of pounds. For instance, with a production in the neighborhood of 23,000,000 pounds, a loss of only 1 per cent is equivalent to 230,000 pounds.

Furthermore, owing to various causes, the amount of ore mined may bear only a remote relation to the amount of ore shipped from the same property, so that the content of copper in the ore mined may be greater or less than the amount in the ore shipped, either because more or less ore was shipped or because of the inevitable losses in the various steps through which the material passed. As illustrating this condition it may be stated that according to the mine reports approximately 88,000 tons of ore was mined which had an estimated copper content of about 21,877,000 pounds. However, according to the reports of these same companies ore containing over 700,000 pounds more copper was shipped. Either some additional ore was included in the shipments, or the estimated copper content of the ore as mined was later found to be too low. In other years an opposite condition has been noted, and the explanation is to be found in the fact that some of the ore that was mined was stored and not treated at once or shipped. Under any circumstances there is always a considerable lag between the time when the ore starts on its progress from the mine and the time when it reaches the market. It is therefore apparent why authoritative statements as to mineral output taken from different sources may

appear to differ widely and why it is essential in comparing statistics that the basis on which they are computed be clearly stated, so that it may be evident whether or not they are in terms that permit direct comparison. For the purpose of the present report the quantity of copper in the ore and concentrates that were shipped is adopted as the amount of copper yielded by Alaska mines during 1931. The total copper-bearing ore mined in Alaska in 1931 is estimated to have been 88,000 tons. The ore as concentrated or otherwise prepared and ready for shipment to the smelter amounted to approximately 17,050 tons, which had a copper content of 22,614,000 pounds.

In attempting to set a value for this copper many methods may be employed, and the results will vary widely. Obviously it would be inaccurate to value all the copper in the ore as it comes from the mine at the current market price for the metal as it comes from the smelter, because not all of it is recovered, and most of it is not in the form of metal and so is not worth the full price of metallic copper. Although the same conditions are also in a measure true of the ore and concentrates that are shipped to the smelter, the losses that they undergo in the smelting process are generally much less. As a consequence it has been the practice of the Geological Survey to compute the value of the Alaska output on the assumption that the copper in the ore and concentrates, as shipped to the smelter, is worth the average price at which metallic copper sold during the year. The average price of all copper sold in the United States in 1931, according to computations by the Bureau of Mines, was 8.3 cents a pound. The total value of the copper in the ore and concentrates shipped from Alaska mines during the year is therefore regarded as $1,877,000. It is recognized that this method of calculating the value does not take into account the fact that an efficient and fortunate selling agent would take advantage of fluctuations in the price of copper and thus dispose of as much as possible during periods of high prices and hold as much as possible during periods of low prices. The figures given for the value of the Alaska output of copper can not, therefore, be regarded as representing the amounts received by the different companies for their copper. They do, however, serve to indicate within close limits the magnitude of the industry and are comparable with the figures for earlier years as stated in these reports.

In the following table are shown the amount and value of the copper produced in Alaska since the earliest recorded mining of copper took place. For the last five years there has been a gradual decrease in the output. Between the production of 1930 and that of 1931 there was a decrease of about 10,000,000 pounds in quantity and of nearly $2,367,000 in value.

Copper and silver produced at Alaska copper mines, 1880, 1900–1931

Year	Ore mined (tons)	Copper		Silver	
		Pounds	Value	Fine ounces	Value
1880		3,933	$826		
1900–1915	1,232,396	220,773,969	35,031,225	2,351,726	$1,297,756
1916	617,264	119,654,839	29,484,291	1,207,121	794,286
1917	659,957	88,793,400	24,240,598	1,041,153	857,911
1918	722,047	69,224,951	17,098,563	719,391	719,391
1919	492,644	47,220,771	8,783,063	488,034	546,598
1920	766,095	70,435,363	12,960,106	682,033	743,416
1921	477,121	57,011,597	7,354,496	544,311	544,311
1922	581,384	77,967,819	10,525,655	623,518	623,518
1923	731,168	85,920,645	12,630,335	715,040	586,333
1924	761,779	74,074,207	9,703,721	572,078	383,292
1925	860,023	73,855,298	10,361,336	596,607	412,131
1926	670,000	67,778,000	9,489,000	605,190	377,600
1927	645,000	55,343,000	7,250,000	525,100	297,800
1928	579,500	41,421,000	5,965,000	350,430	205,000
1929	590,400	40,510,000	7,130,000	351,730	187,400
1930	531,000	32,651,000	4,244,600	279,990	107,800
1931	88,000	22,614,000	1,877,000	193,850	56,200
	11,006,000	1,245,254,000	214,130,000	11,847,000	8,741,000

The general trend of the copper-mining industry in Alaska is graphically shown by the curve in Figure 3, which shows the output of copper in pounds for each year from 1900 to 1931. On the same diagram has also been plotted the average price of copper for each year. It is significant to note the very close relation that has been maintained between the price of copper and the Alaska output. In other words, when the price of copper was high there was a corresponding stimulation in output, and when prices were lower the output fell off. The foregoing statement applies only to trends and does not at all mean that a certain price for copper will bring out a certain tonnage. For instance, in 1907, when the price of copper was 20 cents a pound, only 6,308,000 pounds was produced, whereas in 1927, with a price of about 13 cents a pound, the output was 55,343,000 pounds, or nearly nine times as much. Interpretation of the conditions, however, shows that in 1907 an increase in price over the preceding year was accompanied by an increase in output, and in 1927 a decrease in price was accompanied by a decrease in output.

No new developments of note were reported at the productive mines of the Kennecott Copper Corporation at Kennecott, in the Copper River region, during 1931. The ore from this property, as in the past, was largely high-grade copper sulphide and carbonate containing considerable silver but no gold. The highest-grade ore is sacked and shipped directly to the smelters, but the lower-grade ores are concentrated before shipment. According to the published statements of this company,[4] 55,530 tons of ore was mined during the year, which was estimated to have an average content of 12.01 per

[4] Kennecott Copper Corporation Sixteenth Ann. Rept., for 1931, p. 7, 1932.

cent of copper and 2.27 ounces of silver to the ton. At the mine of the Mother Lode Coalition Mines Co., which is contiguous to the properties of the Kennecott Copper Corporation and is operated by that corporation, although the accounting and bookkeeping are conducted separately, the ore is essentially the same, being a high-grade copper sulphide and carbonate containing considerable silver. The report of this company [5] shows that during the year 32,456 tons of ore was mined which had an estimated content of 13 per cent of copper and 2.06 ounces of silver to the ton.

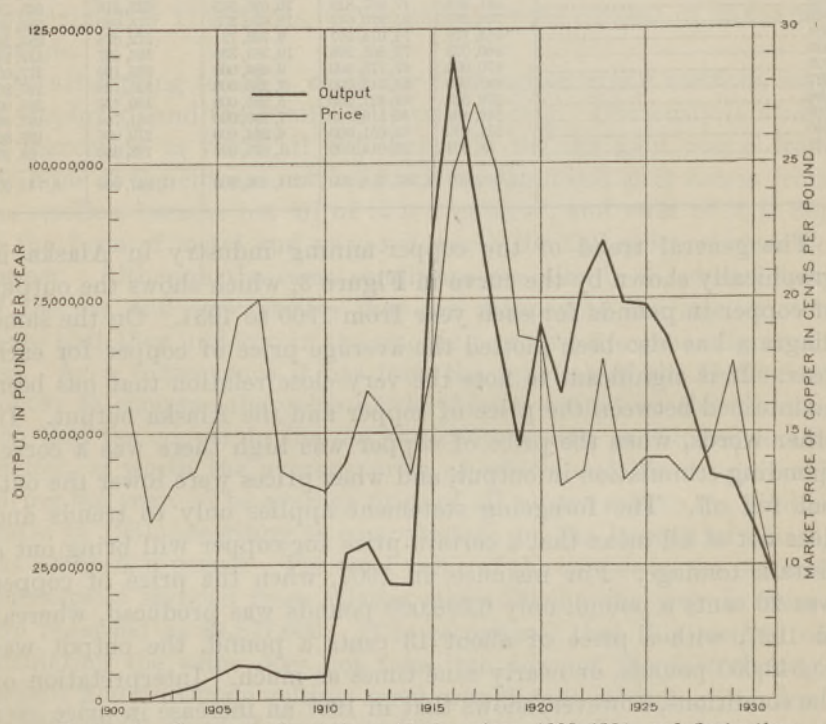

FIGURE 3.—Copper produced from Alaska mines, 1900–1931, and fluctuations in the price of copper during that period

The famous Beatson mine of the Kennecott Copper Corporation, on Latouche Island, which was closed down late in 1930, was idle throughout the year, and the only work done consisted in dismantling some of the buildings and removing some of the equipment. The exhaustion of the ore that can be economically mined marks an inevitable stage in the history of all mining properties, but when it actually takes place it is a shock to which one is never quite reconciled. During its life the mine added several millions of dollars' worth of copper to the mineral output of Alaska, and part of the

[5] Mother Lode Coalition Mines Co. Twelfth Ann. Rept., for 1931, p. 3, 1932.

great falling off in the output of 1931 was due to the cessation of operations at this property.

That there are other places in Alaska where copper minerals occur is well known. That some of these deposits contained enough copper to enable them to be worked at a profit under past conditions is a matter of history. It is extremely doubtful whether any of the known copper deposits that are not now being mined can be worked at a profit under present conditions. As a consequence, practically all field investigation of these properties has been discontinued and doubtless will not be resumed until the price of copper has materially advanced. That there may be deposits, as yet unknown, which might repay development is possible, but the incentive to search for them is so small and the probability of failure so great that prospectors are not willing to take the gamble. At present, therefore, search for new copper deposits or development of those already known has practically ceased. Even at the operating mines retrenchment of activities has been the guiding policy, and all of them are operating far under their capacity and curtailing output or unnecessary outlays.

Obviously, no forecast can be made as to when these conditions are likely to change. Various remedial or palliative measures have been proposed which might encourage the copper-mining industry, but it seems doubtful whether much change can be looked for in the near future. Probably, the thing that may bring about any notable increase in the production of copper from Alaska ores will be the mining of ores in which the copper is a by-product and gold or some other metal more sought after is the principal object. In the past ore of this type has not attracted favorable attention in Alaska, and it is by no means certain that there are any such bodies that can be mined on a larger scale profitably, but with the revival of interest in lode-gold mining the possibility of defraying some of the costs of development by means of by-products should not be overlooked.

SILVER

None of the ores that are mined in Alaska are valuable solely for the silver they contain, and by far the greater part of the silver that is produced occurs as a relatively minor constituent in ores whose principal value lies in some other metal. Thus, as shown by the table below, silver to the value of $56,200 was received in 1931 from ores that are valuable principally for copper. This source alone accounts for about 55 per cent of all the silver that was produced in Alaska in 1931. The amount of silver in the copper ore, however, is actually very small, as is shown by the fact that the average silver content of all the copper ore that was reported

amounted to only little more than 2 ounces to the ton, and the ore from the mine that reported the highest average silver content contained only 2.27 ounces to the ton.

All the gold-lode mines yield some silver in addition to their gold. Thus the mine of the Alaska-Juneau Gold Mining Co., though worked principally for gold, yielded 118,508 ounces of silver in 1931, according to the company's published report.[6] The silver from all the gold-lode mines amounted to 129,800 ounces, and it was worth $37,600. Some silver is also contained in all the gold that is recovered from Alaska placer mines. This silver is not recognizable, as it is intimately alloyed with the gold and is recovered only after the gold is treated chemically or refined. The total silver from this source was 28,350 ounces, worth $8,200.

Data regarding the production of silver have been referred to in several places in the preceding pages and included in some of the tables that cover the production of other metals. For convenience the sources and quantity and value of the production from each source in 1931 and 1930 are set forth in the following table:

Silver produced in Alaska in 1931 and 1930

Source	1931		1930	
	Ounces	Value	Ounces	Value
Gold lodes	129,800	$37,600	102,080	$39,300
Gold placers	28,350	8,200	26,500	10,200
Copper lodes	193,850	56,200	279,990	107,800
Total	352,000	102,000	408,570	157,300

Perhaps the most striking fact that is brought out by the foregoing table is the decrease in both quantity and value of the silver produced in 1931. However, although the decrease in quantity was about 14 per cent, the decrease in value was about 35 per cent. The explanation of this difference lies in the selling price of silver in the two years. According to the computations of the Bureau of Mines, the average market price of silver in 1931 was 29 cents an ounce, as against 38.5 cents in 1930. If the price of 38.5 cents had prevailed in 1931, the value of the silver production of Alaska in that year would have been over $33,000 more than the value stated. It should be remembered that the bulk of the silver produced is merely an accessory to other metals, notably copper and gold, so that its output fluctuates more or less widely, being dependent on the production of the other metals. This does not always hold true in detail, for obviously the proportion of the different metals, even in the same ores, is not constant.

[6] Alaska-Juneau Gold Mining Co., Seventeenth Ann. Rept. for 1931, p. 13, 1932.

The development in Alaska of ores that are valuable principally for their silver content is necessarily attended by many more difficulties and expenses than are likely to be met in developing gold mines. Among the most obvious reasons for this difference are the much lower value per unit of weight of the silver and the fact that more elaborate and expensive processes are usually required to recover silver in a readily salable metallic state than to recover gold. As a result, it is more or less unwarranted at this time to attempt to develop or even to search for silver lodes in remote parts of Alaska unless the ore has an especially high tenor. Therefore, although silver-lead lodes have been reported at many places in interior Alaska, none of them have been very thoroughly examined or seriously considered by capitalists. It is true that some shipments of silver-lead ores have been made from interior Alaska, especially from the Kantishna district, north of the Alaska Range, but although the ore was of high grade and the price of silver more than three times as much as at present, the expense of transporting it to smelters in the States and having it smelted consumed practically all the profits. In southeastern Alaska, however, where the region is much more accessible to deep-water transportation and all operating costs are lower, there have been many attempts to find and develop silver-lead deposits. The greatest amount of work of this kind has been done in the region at the head of Portland Canal, near the international boundary. The richest deposits that have been found lie on the Canadian side of the boundary, and it is there that the famous Premier silver and gold mine is situated. The geologic conditions on the Alaska side of the boundary, in the Hyder district, as it is locally called, in places seem to be comparable to those on the Canadian side and this similarity has sustained interest in the search for profitable silver and gold deposits there. Several claims have been taken up and more or less prospecting and development work done. The much greater unit price of gold and its more ready recovery have focused the search on gold lodes rather than on silver lodes, so that some of the claims that in the early days of the camp showed indications of prospective value mainly in silver and lead have been neglected. This does not mean, of course, that rich showings would necessarily be overlooked, but simply that work has not been pressed on deposits that appeared only moderately promising. In the past mines in the Hyder district have made shipments of silver ore or concentrates to smelters in the States, but in 1931, so far as has been reported to the Geological Survey no such shipments were made. Undoubtedly some ore carrying more or less silver was excavated in the course of the prospecting and development work,

but this does not appear in the estimates of 1931, as its quantity and value are not known.

A little development and prospecting work on silver-lead ores is reported to have been done during the year on claims lying a short distance north of the settlement of Wrangell. North of Skagway the Inspiration Point Mining Co. is reported to have continued work on its property, where indications of silver-lead lodes that are said to appear promising have been found. The cost of development, however, has proved to be greater than the present owners care to incur under existing conditions, so that further development will be slow or will await suitable arrangements with a larger mining company. In the Susitna Valley of west-central Alaska, about 9 miles east of Chulitna station on the Alaska Railroad, where a unique deposit containing ruby silver was found some three or four years ago, no active work was in progress, and the property lay practically idle throughout the season of 1931.

The remarkably efficient development of the Mayo deposits, in Yukon Territory east of Dawson, and the successful handling of the ore from that remote camp encourage the belief that methods are being made available whereby even deposits in the remote regions of Alaska, if they afford a considerable tonnage of rich ore, may be mined in spite of adverse physical conditions. With the improved transportation facilities that are already available in Alaska many regions that were formerly almost inaccessible are less difficult to reach, and these facilities are being constantly improved and will doubtless be still further extended as the opening up and development of the Territory as a whole inevitably takes place. The current low price of silver and the whole business situation in this country and indeed throughout the world act as strong deterrents against attempting to mine silver deposits at this time. Silver mines even more advantageously situated than those now known in Alaska are closing down or materially curtailing their output.

LEAD

The lead produced from Alaska ores in 1931 amounted to 3,321,000 pounds, an increase of 591,000 pounds over the production of 1930. This is the greatest quantity of lead that Alaska has ever produced in a single year. The value of the output at 3.8 cents a pound, the average market price of the lead sold in the States in 1931, according to the Bureau of Mines, was $126,000. This marks a considerable falling off in value, owing to the fact that lead brought 1.2 cents a pound more in 1930. Had the lead that was produced in 1931 brought the same price as that produced in 1930, it would have shown an increase of more than $40,000 instead of a decrease of about $10,000.

Lead produced in Alaska, 1892–1931.

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1892	30	$2,400	1906	30	$3,420	1920	875	$140,000
1893	40	3,040	1907	30	3,180	1921	759	68,279
1894	35	2,310	1908	40	3,360	1922	377	41,477
1895	20	1,320	1909	69	5,934	1923	410	57,400
1896	30	1,800	1910	75	6,600	1924	631	100,899
1897	30	2,160	1911	51	4,590	1925	789	140,571
1898	30	2,240	1912	45	4,050	1926	778	124,400
1899	35	3,150	1913	6	528	1927	1,008	127,000
1900	40	3,440	1914	28	1,344	1928	1,019	118,000
1901	40	3,440	1915	437	41,118	1929	1,315	166,000
1902	30	2,460	1916	820	113,160	1930	1,365	136,500
1903	30	2,520	1917	852	146,584	1931	1,660	126,000
1904	30	2,580	1918	564	80,088			
1905	30	2,620	1919	687	72,822		15,170	1,869,000

In Alaska no ores are mined solely for their lead content. Practically all the lead produced is recovered as a by-product in the course of gold or silver mining, the concentrates containing lead being shipped to smelters in the States for treatment to recover the different metals they contain. Practically all of the lead that is reported in the foregoing table as produced in 1931 was recovered in the course of treatment of the gold ores of the Alaska Juneau Co.'s mines, in southeastern Alaska. According to the published reports of this company, it recovered a little less than three-fifths of a pound of lead from each ton of ore that is mined and trammed to the mill, or less than 1½ pounds of lead from each ton of ore that is fine milled.

Information regarding the recent developments on Alaska ores that contain lead as well as other metals is given in other parts of this report, especially in those that describe the gold and silver lodes. Lead ores are widely known throughout the Territory, and in the past shipments valuable at least in part for their lead content have been made from many areas in southeastern Alaska, especially the Hyder district; from the Yukon-Tanana region, especially the Kantishna district; and even from far-away Seward Peninsula, at the Omalik mine; and from the Kobuk district in the vicinity of Shungnak. Lead is, however, a heavy, low-priced commodity which requires rather elaborate treatment to produce in readily salable metallic form, and these drawbacks coupled with the extremely low current price for the metal act as deterrents to the development of lead deposits in remote regions. The outlook for any notable increase in the production of this metal, therefore, seems to depend on the stimulation of the mining of other metals and the consequent increase in their production. That this increase in mining lodes of mixed metallic content is likely to take place is regarded as a certainty, and that some of the silver-lead deposits, which are now lying idle, will be opened up again seems almost equally certain. An increase in the output of lead is therefore looked for with considerable assurance.

but that this increase will take place in the near future seems extremely doubtful.

PLATINUM METALS

Platinum is one of the group of several metals which, because they are closely related in physical and chemical character, are often not differentiated by name or are not even identified specifically in the usual forms of assay or analysis but are spoken of as the platinum metals, or, even more loosely, as platinum. Platinum, palladium, osmium, and iridium are some of the individual members of this group. Some of these metals have been found in lodes and in placers in Alaska. The total quantity of platinum metals produced in Alaska in 1931 is estimated to have been approximately 506 crude ounces or 393 fine ounces, which at $35.66, the average market price for platinum as computed by the Engineering and Mining Journal, was worth about $14,000.

By far the greater part of the platinum metals produced in Alaska in 1931 was recovered from placers in the Goodnews Bay district, south of the mouth of the Kuskokwim River. Approximately 13 men were engaged in mining in this district in 1931. The occurrence of platinum in the Goodnews Bay region has been known for several years, but interest has recently been revived in the district because of its greatly increased production, though with the tremendous drop in the price of platinum metals in the last year or so that interest has waned. In spite of exaggerated statements regarding the richness of these deposits that have been made from time to time in the press, it is true that placer deposits containing platinum, worth continued careful prospecting, occur in this district, and that the search for places where concentration has been great enough to form deposits that can be worked at a profit is well justified. The most extensive work is reported to have been done on streams tributary to Salmon Creek south of Goodnews Bay, especially those that head in the general vicinity of Red Mountain. The greatest amount of platinum recovered in 1931 came from Clara Creek, where six men were employed part of the season. Smaller quantities were recovered from Squirrel, Platinum, and Dry Creeks and Fox Gulch. A considerably greater output was expected by the operators, but the unusually dry season hampered mining greatly and prevented several of the camps from starting work until early in August. During the season of 1931 Irving Reed, an associate territorial mining engineer, spent about eight days in the region, and much information regarding operations in the district has come from his manuscript report, which has been made available for consultation by the Geological Survey through the courtesy of the Alaska officials, as well as from reports that have been received direct from the miners.

What little is known about the geology of the district appears to encourage the belief that conditions favorable for the presence of platinum minerals may exist there. Probably, altogether, nearly 2,000 ounces of platinum metals have been recovered from the district since 1926. Nothing has yet been found, however, that justifies any rush of prospectors into the region in the hope of finding easily won riches. The recovery of so much platinum by so small a force of men as is now mining in the region certainly warrants a complete survey and examination to determine its mineral possibilities. Some difficulty has been experienced by the platinum miners in disposing of their product at satisfactory prices. This condition was especially marked during the period from 1929 to 1930, when the prices paid for platinum fluctuated widely but on the whole showed a marked decline. As may not be generally known, none of the Government mints or assay offices pay for platinum sent to them, so that the producer must sell to private purchasers, and the transaction becomes one of bargaining, which at the distance that separates the Alaska producer from the purchaser in the eastern United States is time consuming to conduct and rather difficult for either party to manage satisfactorily.

A few ounces of platinum metals were recovered in the course of placer gold mining on Dime Creek, in the Koyuk district of Seward Peninsula. This locality has been a small though consistent producer for many years.

Although no other places in Alaska are known to have produced platinum metals that were sold in 1931, it is not at all unlikely that small amounts may have been produced elsewhere and held by their producers. Places where platinum has been recognized are widespread through other parts of Alaska, and some of them in other years have produced platinum that has been sold. Among these places may be mentioned the Chistochina district of the Copper River region; Metal Creek, in the Kenai district; some of the beach placers of Kodiak Island, in southwestern Alaska; the Kahiltna River and near-by streams, in the Yentna district of the Susitna region; Boob Creek, in the Tolstoi area of the Innoko district; Granite Creek, in the Ruby district of the Yukon region; and some streams in the Marshall district, in the western part of the Yukon region. In the past a considerable production of platinum metals came from lodes in southeastern Alaska operated by the Alaska Palladium Co., on Kasaan Peninsula, Prince of Wales Island, about 30 miles west of Ketchikan. This mine has not been in operation since 1926, but during the time it was running it produced several hundred thousand dollars' worth of platinum metals, mainly palladium, as well as a good deal of gold and some copper. The platinum metals formed only a small part of the total metallic content

of the ore—so small a part that they could not be identified in ore by the unaided eye.

TIN

Alaska's tin production in 1931 showed a marked falling off in both quantity and value from 1930 and compared with the annual production for the period from 1912 to 1917, when the industry was at its height, was almost negligible. As with so many of the other metals, the drop in price—from 31.7 cents a pound in 1930 to 24.46 cents in 1931—acted as a strong deterrent against active development. The output of tin was all derived from placers, and consequently the ore reported represents really concentrates running almost 73 per cent of metallic tin. The output of tin ore was about 5.6 tons, containing a metallic tin content of 8,150 pounds, or 4.1 tons. These statistics relate to the production only and should not be confused with shipments or sales, because it is understood that none of the tin ore produced in 1931 was sold, though most of it was shipped out of Alaska. None of the tin is treated in Alaska to recover its tin content in the form of metal, so that ultimately all of it is shipped to outside smelters. Practically all the ore is shipped to Singapore for reduction.

On the whole, the year 1931 was marked by very slight activity in the search for tin throughout the Territory, and little revival of interest is to be expected until the price offered for the metal is considerably higher than at present. That there are deposits of tin-bearing minerals that could be developed at a suitable price can not be doubted, though it is impossible to predict what that price would have to be in order to call out a specified tonnage. Although all the tin produced in 1931 came from placer deposits, lode deposits carrying tin are known and have been developed to a greater or less extent in the past. The tin lodes that have been mined are all limited to the area in western Seward Pensinsula near York and Tin City.

Tin produced in Alaska, 1902–1931

Year	Ore (tons)	Metal (tons)	Value	Year	Ore (tons)	Metal (tons)	Value
1902	25	15	$8,000	1918	104.5	68	$118,000
1903	42	25	14,000	1919	86	56	73,400
1904	23	14	8,000	1920	26	16	16,112
1905	10	6	4,000	1921	7	4	2,400
1906	57	34	38,640	1922	2.3	1.4	912
1907	37.5	22	16,752	1923	3	1.9	1,623
1908	42.5	25	15,180	1924	11	7	7,028
1909	19	11	7,638	1925	22.2	13.8	15,980
1910	16.5	10	8,335	1926	12.85	8	10,400
1911	92.5	61	52,798	1927	37.5	26.7	34,000
1912	194	130	119,600	1928	58.6	41	41,000
1913	98	50	44,103	1929	51.6	38.6	35,000
1914	157.5	104	66,560	1930	21	14.7	9,300
1915	167	102	78,846	1931	5.6	4.1	2,000
1916	232	139	121,000				
1917	171	100	123,300		1,834	1,149	1,094,000

The larger part of the tin produced in Alaska in 1931 came from Goodwin Gulch, near Tin City, in western Seward Peninsula. The placer that was worked here carried about 28 pounds of tin ore to the cubic yard of gravel and was mined by hydraulic methods similar to those used in gold placers. It is a noteworthy fact, however, that practically no gold is found in the tin-bearing gravel. According to local reports the operator of this property moved part of the hydraulic equipment and buildings to Cape Creek and proposes to carry on mining from both camps as soon as the price of tin has gone up enough to make such a course profitable. Some tin ore was also recovered during the year in the course of gold placer mining operations in the Hot Springs district, of the Yukon region. This ore came principally from Deep and Miller Creeks, in the vicinity of Tofty. So far as known this ore was retained at the places where it was separated from the gold and will be allowed to accumulate until enough is on hand to warrant its shipment to a smelter. A description of the occurrence of the tin-bearing placers of this district is contained in a report by J. B. Mertie, jr., that forms a separate section of this volume.

COAL

The coal produced from Alaska fields in 1931 is estimated to have been 105,900 tons. This marks a decrease of about 14,000 tons from the high production of 120,100 tons reached in 1930, but it has been exceeded in only three years in the entire period that coal mining has been in progress in the Territory, so that it is to be regarded as a temporary fluctuation rather than as a permanent trend. In fact, all the indications point to the stimulation of the Alaska coal industry rather than to a retrogression. On the other hand, it should be realized that at present Alaska coal mining has been a relatively small business, even during the year of highest production, when about 126,000 tons was produced. This quantity is less than many of the moderate-sized mines in the States produce individually and is not enough to supply even all of the Alaska market. In 1931 about 49,000 tons of coal was imported from fields outside of Alaska and no Alaska coal was exported. A comparison of the records of coal production and consumption in Alaska for the entire period for which records are available is afforded by the following table:

Coal produced and consumed in Alaska, 1880–1931

Year	Produced in Alaska, chiefly subbituminous and lignite		Imported from States, chiefly bituminous coal from Washington [a] (short tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia [a] (short tons)	Total coal consumed (short tons)
	Short tons	Value			
1880–1915	71,633	$456,993	679,844	1,079,735	1,831,212
1916	12,676	57,412	44,934	53,672	111,282
1917	54,275	268,438	58,116	56,589	168,980
1918	75,816	413,870	51,520	37,986	165,322
1919	60,894	345,617	57,166	48,708	166,768
1920	61,111	355,668	38,128	45,264	144,503
1921	76,817	496,394	24,278	33,776	134,871
1922	79,275	430,639	28,457	34,251	141,983
1923	119,826	755,469	34,082	43,205	197,113
1924	99,663	559,980	40,161	41,980	181,804
1925	82,868	404,617	37,324	57,230	177,422
1926	87,300	459,000	35,620	34,254	157,174
1927	104,300	548,000	35,212	27,225	166,737
1928	126,100	662,000	39,184	32,521	197,805
1929	100,600	528,000	32,762	24,172	157,534
1930	120,100	631,000	37,128	23,892	181,120
1931	105,900	556,000	30,772	17,796	154,468
	1,439,154	7,929,000	1,304,688	1,692,256	4,436,098

[a] Compiled from reports from Bureau of Foreign and Domestic Commerce. No figures on imports before 1899 are available.

In the table the total value of the coal produced in Alaska in 1931 is stated to have been $556,000. This value can be regarded only as a fair approximation, because the records are not available for precise determination of the actual selling price of the coal. Much of the coal is purchased by the Alaska Railroad on contract for large quantities, so that the price paid by the railroad is not an accurate basis on which to compute the price paid for the lots sold to the smaller consumers, who in the aggregate buy a large part of the output and pay much higher prices. From all the available information, and by weighting the resulting estimate as closely as practicable, it appears that the average price of all the coal mined in Alaska in 1931 was approximately $5.25 a ton, which is the same as in 1930 and is about 50 cents a ton less than the average for the entire period shown in the table.

The Alaska coal came principally from 3 mines—2 in the Matanuska field and 1 in the Nenana or Healy River field. The two mines in the Matanuska field were those of the Evan Jones Coal Co., at Jonesville, and of the Alaska-Matanuska Coal Co., in the valley of Moose Creek. Mining at the Evan Jones mine was maintained at an average rate of more than 100 tons a day throughout the year, and in addition to supplying such coal as the railroad required, the company filled many domestic orders and was active in trying to build up an even more extensive market for its coal, furnishing some to canneries in the Alaska Peninsula and

some to residents near Cordova. An average of about 30 men were employed by this company throughout the year. At the Alaska-Matanuska property, after the contract for supplying coal to the railroad had been awarded to another company, the force of miners which had been producing at the rate of more than 100 tons a day was gradually cut down to the few necessary to maintain the property. Before long the expense of maintaining even this reduced operation led to an arrangement with the Alaska Railroad whereby the railroad agreed to keep the mine pumped and in return was permitted to mine enough coal to defray the expenses incurred. The danger of destroying much of the adjacent coal lands if the mine was allowed to fill with water made action of this sort by the Government practically unavoidable if the owner was no longer able or willing to expend the necessary funds with no market in sight for his product. This arrangement was therefore put into effect in June and throughout the rest of the year was continued by the railroad, with J. J. Corey, of the Geological Survey, directing the work and acting in an advisory capacity. A little productive work was also in progress at the Pioneer mine, in the southern part of the Moose Creek Valley, and small quantities of coal were produced at the Ross Heckey property, on Coal Creek, in the eastern part of the Matanuska Valley near Chickaloon. The coal from the Heckey property is especially good for blacksmithing, and for several years the Alaska Railroad has operated a home-made coke oven, using this coal to make such coke as it requires for local use. The coke is strong and of good quality, and it seems possible that there will be a more extended use of this coal for that purpose, not only by the railroad but by others. The old Government-owned mine at Eska was idle throughout the year, but it was maintained in a more or less stand-by condition so that if anything should happen which might endanger the supply of coal needed to run the railroad it could be reopened quickly and mining resumed.

In the Nenana coal field the only producing property was the Suntrana mine of the Healy River Coal Corporation, on the Healy River, about 4 miles east of the junction of that stream and the Nenana River. The plant of this mine has been well laid out and is now equipped with the necessary modern machinery to handle at least 200 tons of coal a day. The largest single user of coal from this property is the Fairbanks Exploration Co. for furnishing power to its dredges and in its large placer-mining operations in the vicinity of Fairbanks. The coal has a somewhat lower heating value than that from the Matanuska and near-by fields and, as a consequence, is not used in the railroad locomotives. This mine was in

continuous operation throughout 1931 and yielded considerably more than half of all the coal mined in Alaska during that year.

Small amounts of coal are reported to have been mined during the year at the old Chicago Creek mine, in the valley of the Kugruk River, in northern Seward Peninsula; at a recently opened deposit near Unalakleet, east of Norton Sound; at one point near the settlement of Kiana, on the Kobuk River; and at several points along Kuk Lagoon, south of Wainwright, in northern Alaska. The coal from these different properties was used only locally and had no significant effect on the general Alaska coal situation, except to confirm the statement, often made before, that throughout the Territory there are many areas containing coal adequate for local use. At several other places in the Territory some development work was in progress on coal deposits but had not reached the stage of furnishing a reliable supply of coal. One of the most advanced of these projects was the work in progress on Admiralty Island, west of Juneau, in southeastern Alaska. This area has long been known to be coal bearing, and in the past several attempts have been made to market the coal that was produced by mines at which considerable underground development work had been done. The causes that have led to cessation of work have more often been inadequate funds or difficulties in the management rather than lack of coal. A new organization has been formed, and plans are under way to prospect the entire area more thoroughly, in part by diamond drill, and, if worth while, to attempt to develop the property so as to supply much of the Juneau market as well as that of other coast towns in southeastern Alaska.

In the Bering River field, where extensive deposits ranging in composition from bituminous coal to anthracite have long been known, prospecting or other development work relating to the coal resources was apparently at a standstill in 1931. Rumors of renewed activity in this field were heard from time to time, and requests for extensions of some of the Government permits for coal prospecting there were received. It is evident that this field has much potential value, but it is also evident that the present coal consumption of Alaska is not such as to stimulate large companies to undertake extensive projects and that until there is a greater demand for their product or until they are prepared to invade a more distant market, where competition will be more severe, they will not enter this field. Furthermore, the development work already done in this field indicates that some complex geologic conditions will be encountered, so that desultory prospecting by small, poorly financed, or technically unskilled operators holds little promise of success, and full development must await a company that is able to go into the matter in a

large way and to bear the necessary expense of exploring a new field.

In addition to these private enterprises which are developing or attempting to develop certain of the Alaska coal fields, one of the most significant enterprises of the year has been the Government's efforts to determine the character and content of certain of the coal lands in its own possession. The initiation of the present efforts may be traced directly to the investigations made by a special committee of the Senate as to what could be done to reduce the operating deficit of the Alaska Railroad. One of the conclusions reached was that mineral tonnage must be sought for supplying much of the business to the road, and to make it possible to search for that tonnage the committee recommended and Congress granted funds for the work. Among the projects undertaken as a result of this grant was the reexamination of the Anthracite Ridge coal field, about 10 to 15 miles east of Chickaloon, in the Matanuska district. A summary statement of the results of this field examination is given in a later section of this report. The general conclusion reached was that further tests of the region should be made by putting down diamond-drill holes, so as to recover samples of the formations penetrated, for examination in detail and tests of any coals found. This advice was adopted, and plans were formulated for carrying through the tests. Contracts were entered into, and early in the spring of 1932 the task of assembling the outfit on the ground and following it with drilling commenced. It will take many months to do the field work, and after it is completed the thousands of feet of core will be studied critically, so that it will probably be 1933 before definite conclusions can be reached as to the quantity and quality of the coal. Even after these facts are known there will still be need for much additional knowledge as to mining, preparation, and marketing of the product before a decision can be reached as to the practicability of attempting to develop the coal area. Already a start on assembling some of this information has been made, especially as relates to possible consumers and their requirements. The problem is not simple, however, for many consumers are reluctant to enter into any specific agreements until they see with certainty that the coal they want is available, and the mining operator, of course, can offer little definite assurance as to costs and availability of his product until he has some certainty as to his market. As a specific example of the way in which this waiting for someone else to make the first move is retarding development may be cited the controversy that has raged regarding the construction of coal bunkers at Seward. Considerable coal is used in the various canneries in Prince William Sound and Seward. Much of this coal is transported from the States to Alaska

by vessels supplying the canneries. Attempts to have the owners use Alaska coal have resulted only in partial success, because they feel that the higher cost of outside coal is offset by the uncertainty as to the availability of Alaska coal at the time wanted, the delay incident to loading it at Seward, unless bunkers are provided, and the absence of suitable transportation lines to remote points. On the other hand, the construction of bunkers in advance of a more or less guaranteed use would entail the outlay of $60,000 or $70,000—a charge that the small operator can not face and that the responsible railroad officials who might finance the construction from Government funds appear to regard as not advisable as a business venture because the returns are too uncertain. Certainly many of the steps that must be taken if any extensive use of Alaska coal is to be made require that the enterprise must be undertaken on such a scale as will justify the outlay for the essential facilities. This means that a considerable tonnage must be marketed, but the attempt to dispose of a large tonnage of Alaska coal will bring it into competition with coals from other areas and in places where the competitive conditions appear to be almost insuperable for the Alaska product. Many of the competitive conditions are changing, however, so that the situation must be subjected to constant review. For instance, the present low rate of exchange in Canada has materially altered the situation that prevailed a few years ago, and import and export taxes are matters that are constantly being brought up for action by the legislative bodies of both this country and Canada. Of course as Alaska develops and becomes more settled its people and industries will call for more and more coal, and in meeting this demand Alaska coals will have great competitive advantage over those from outside sources. That growth, however, probably will be relatively slow, but none the less sure.

PETROLEUM

The only petroleum produced in Alaska comes from the wells of the Chilkat Oil Co., in the Katalla field, near the coast of south-central Alaska. This company obtains oil from several relatively shallow wells, few of which are more than 1,000 feet deep and none more than 2,000 feet. The wells penetrate beds that are identified as of Tertiary age. A small refinery is operated at Katalla by the company, and the products—gasoline and distillate, which are of especially high quality—find a ready market near at hand, especially for use by the fishing fleet near Cordova. According to the annual report of this company, no new developments worthy of special mention were made during the year, and the production of oil was maintained at a somewhat smaller rate than in the preceding year. During 1931 the drilling of well 25 was advanced to a depth of 300

feet, but bad weather made it desirable to defer further work on it until 1932.

The small domestic production of petroleum from the Katalla field is not adequate to supply even local needs, and the demand for large quantities of petroleum products throughout the Territory is met principally by imports from the States. The most notable feature shown by the subjoined table is that except for 1930 and 1931 there has been a constant increase since the war in the amount of gasoline and related lighter products of distillation imported. This increase was called for by the growing use of power in fishing boats and other water craft, in the canneries, in many mining developments, and in the operation of means of transportation, such as automobiles and gas cars or engines on practically all the railroads, and the decrease in the last two years is interpreted as only a temporary drop in the consumption brought about by the general decline in all business activities.

Petroleum products shipped to Alaska from other parts of the United States, 1905–1931, in gallons [a]

Year	Heavy oils, including crude oil, gas oil, residuum, etc.	Gasoline, including all lighter products of distillation	Illuminating oil	Lubricating oil
1905	2,715,974	713,496	627,391	83,319
1906	2,688,940	580,978	568,033	83,992
1907	9,104,300	636,881	510,145	100,145
1908	11,891,375	939,424	566,598	94,542
1909	14,119,102	746,930	531,727	85,687
1910	19,143,091	788,154	620,972	104,512
1911	20,878,843	1,238,865	423,750	100,141
1912	15,523,555	2,736,739	672,176	154,565
1913	15,682,412	1,735,658	661,656	150,918
1914	18,601,384	2,878,723	731,146	191,876
1915	16,910,012	2,413,962	513,075	271,981
1916	23,555,811	2,844,801	732,369	373,046
1917	23,971,114	3,256,870	750,238	465,693
1918	24,379,566	1,086,852	382,186	362,413
1919	18,784,013	1,007,073	3,515,746	977,703
1920	21,981,569	1,764,302	887,942	412,107
1921	9,209,102	1,403,683	2,021,033	232,784
1922	15,441,542	1,436,050	2,095,675	345,400
1923	12,285,808	4,882,015	473,826	454,090
1924	14,412,120	5,554,859	566,431	506,364
1925	16,270,746	6,993,560	562,844	580,321
1926	14,000,664	5,069,584	328,615	730,924
1927	17,628,744	8,141,574	516,306	620,450
1928	13,000,176	8,025,402	463,134	715,082
1929	17,347,344	6,847,050	589,340	878,094
1930	13,801,746	6,317,934	401,646	701,946
1931	12,282,480	5,532,912	338,310	450,870
Total	415,611,533	85,574,331	21,052,310	10,228,965

[a] Compiled from reports from Bureau of Foreign and Domestic Commerce.

Search for new oil fields in Alaska has practically been discontinued during the last few years, and in 1931 drilling was done at only one place, in addition to the property of the producing company already mentioned. Hundreds of permits for prospecting for oil that have been issued by the Government and cover tracts in all

parts of Alaska are outstanding in the hands of individuals or companies, but most of them were evidently taken up solely for speculative purposes and will lapse if no active work is done under them. As prospecting permits for oil are issued on application, without regard to the merits of the land involved as a favorable place in which to search for oil, the investing public should be warned that a permit from the Government is only what it purports to be—permission to search for oil—and it in no way implies that the search has even a remote chance of being successful. Furthermore, the public should realize that prospecting permits if within the law are readily granted by the Government at a nominal charge and so should be warned against unscrupulous companies that offer their services in obtaining permits for their clients at a charge far in excess of any reasonable fee for the services they render and for any payments they make to the Government.

Drilling for oil was in progress in 1931 in the Matanuska Valley, a few miles west of Chickaloon, on the property of the Peterson Oil Association. Drilling at this place started in 1926, and when work was suspended for the winter of 1930 the hole had reached a depth of about 1,465 feet. The well was drilled to a depth of about 1,300 feet with a Star rig, but that was subsequently replaced by a Standard rig. During 1931 the work was more or less at a standstill, and though a small crew was maintained on the property practically all the summer the hole was deepened only slightly. It appeared probable that disappointment at the slow rate of progress that had been made in the last five years might soon lead the backers of the enterprise to discontinue the test. The geologic conditions in the vicinity of the well, so far as known, are not those usually found in the areas in the States where the larger commercial pools of oil occur, and a geologist can not but entertain grave doubts as to the occurrence of oil in that locality. However, the finding of a commercial accumulation of oil would be of so much benefit to the region as a whole, as well as to the operators, and so much time and money have already been spent in the enterprise that if any doubt remains as to the probability of finding oil there it would be too bad to stop drilling before that question is definitely settled, either by striking oil or by demonstrating that further search would be fruitless. It is to be regretted that the same amount of time and money was not invested at places that seemed to show more promise of containing oil.

MISCELLANEOUS MINERAL PRODUCTS

The list of minerals of value that have been found in Alaska is long. In addition to those described in the preceding sections of this report others which have at one time or another been produced

in quantities large enough to have more than local significance and some of which have been and still are the basis of profitable mining industries include, among metallic products, antimony, arsenic, bismuth, chromium, iron, manganese, mercury or quicksilver, molybdenum, nickel, tungsten, and zinc; and among nonmetallic products, asbestos, barite, building stone, clay, garnet, graphite, gypsum, jade, limestone, marble, and sulphur. Without doubt small quantities of practically all these materials were "produced" in 1931 in the broadest sense of that word, but with the exception of stone none of them were reported to have been produced and sold in quantities that represent a value of more than a few thousand dollars at most, and for any single commodity rarely more than a few hundred dollars.

In the following table, as well as in certain of the other tables in this report, all these minerals that were produced in quantities so small that to list them separately would disclose the production of individual operators have been grouped together under the collective term "miscellaneous mineral products." Among the mineral products that have been described in this report, but are included in this table, are platinum metals and petroleum. The inclusion of petroleum in this list is due to the fact that at present there is only one producer in the Territory, and therefore it has not been permissible to disclose the quantity or value of the product. The inclusion of platinum metals is a relic of the period when practically the entire production of platinum metals in Alaska came from one mine and so could not be disclosed. Now that there are many producers it is appropriate to state their combined production, and this has been done, but in order that there may be a fair comparison of the production of the minerals grouped together as miscellaneous products in earlier years with those same products in 1931, it has been necessary to include the value of the platinum metals in this table.

Value of output of miscellaneous mineral products of Alaska, including platinum, petroleum, quicksilver, stone, antimony, gypsum, marble, and other products, 1901–1931 [a]

Year	Value	Year	Value	Year	Value
1901	$500	1912	$165,342	1923	$229,486
1902	255	1913	286,277	1924	348,728
1903	389	1914	199,767	1925	454,207
1904	2,710	1915	205,061	1926	444,500
1905	710	1916	326,737	1927	162,000
1906	19,965	1917	203,971	1928	164,000
1907	54,512	1918	171,452	1929	194,000
1908	81,305	1919	214,040	1930	157,300
1909	86,027	1920	372,599	1931	108,000
1910	96,408	1921	235,438		
1911	141,739	1922	266,296	Total	5,749,000

[a] $117,000 of placer platinum metals mined prior to 1926 and $238,000 of antimony mined prior to 1927 not distributed by years but carried in total.

The largest single enterprise that is included under this section is the quarrying of great quantities of high-grade limestone rock in southeastern Alaska that is transported to Seattle in the company's own vessels and used in the company's own plant for the manufacture of cement. This operation, which is rather new, as it was started in 1928, is carried on by the Pacific Coast Cement Co. It is reported that in the course of three years' operation the company has carried its plans through successfully and is well satisfied with the results. The quarry from which the rock is taken is on Dall Island, between Baldy Bay and Tlevak Strait, about 40 miles west of Ketchikan. The general practice at this place is to drill the limestone in the quarry, blast it down, and haul it to the crushing plant, where it is broken down to suitable size and stored near the wharf, ready for loading on the steamer for Seattle. The round trip, including loading and unloading, takes less than 10 days. Owing to the fact that the producer, transporter, and consumer are all one and the same, it is impossible to arrive at a true market price for the limestone produced by this company. In the table given above it has been necessary to adopt a more or less arbitrary price for the limestone, as a means of including this product with the other mineral resources. The price adopted, however, is believed to be extremely conservative, so that the total value of the output as given probably is not more than the actual cost of mining and transportation, without any charge for the basic raw material, the limestone.

For many years marble in considerable quantities was quarried and shipped from several points in southeastern Alaska. The industry later dwindled, so that recently only one company has produced any notable amounts of marble, and in 1931 even this company, the Vermont Marble Co., quarried no new stone at its Alaska properties. However, the demand for this stone, especially for part of the decorating of the new Federal building at Fairbanks, has led to reopening of the company's Alaska quarries, and early in 1932 a crew was sent in from the States for this purpose. The quarries owned by this company are near Tokeen and Calder, on the west coast of Prince of Wales Island, but the finishing plants to which the rough stone is sent are in Tacoma, Wash., and San Francisco, Calif. The stone has been in great demand throughout the west coast and has been used in many of the most imposing buildings, principally for interior trim and decoration. Limestone is widely distributed throughout southeastern Alaska, and, according to Burchard,[7] many different grades, some even approaching statuary

[7] Burchard, E. F., Marble resources of southeastern Alaska: U. S. Geol. Survey Bull. 682, pp. 29–39, 1920.

quality, are found in the region. It therefore seems strange that more of these limestone and marble deposits, many of which are favorably situated with respect to deep-water transportation, have not been profitably developed. It is currently reported that late in the fall an investigation of the possibilities of finding calcareous rocks in the vicinity of Petersburg was made by agents of an outside company. The quality of rock desired, whether limestone or marble, was not stated, and the results of the examination have not been made public.

Little detailed information has been received by the Geological Survey regarding the developments during the year at the quicksilver deposits in the Kuskokwim Valley. At the E. W. Parks property, a short distance west of Sleitmut, at the mouth of the Holitna River, about 60 tons of ore were mined, and a considerable part of it was treated in a small furnace and the quicksilver extracted. During the year an examination of the property was made by a mining engineer in the interest of private parties, and samples were taken for analysis. The results of that examination have not been announced publicly, so that it is not known whether the results were good enough to induce the principals to take hold of the property with the purpose of aiding in its development. None of the other quicksilver deposits in the Kuskokwim Valley are reported to have made any production during the year, and it is believed that no work other than the assessment work required by law was done at any of them. In the vicinity of Bluff, in the Seward Peninsula region, development work is reported to have been continued by the Alaska Mercury Corporation on lodes carrying quicksilver minerals on Swede Creek. Two men were employed at this place almost continuously throughout the year, driving an exploration tunnel. The results are said to be encouraging, and the owners propose to have the work continued. Quicksilver has been recognized in the placer concentrates from streams in many parts of the Territory, but the lodes from which it came were apparently small stringers and, except in the places already mentioned and the Hot Springs district of the Yukon region, none of them appear to be likely to afford ore that can be mined under present conditions.

Renewed interest was shown in the development of the chrome ores of southern Kenai Peninsula, which attracted considerable attention during the war but which subsequently have been more or less neglected. A shipment of some 10 tons of ore, estimated to carry about 54 per cent chromic oxide (Cr_2O_3), was made for experimental purposes by Whitney & Lass from their property near Red Mountain, south of Seldovia. Representatives of the Alaska Road Commission visited the area and made preliminary surveys as to possible trans-

portation routes by which the ore of these deposits, if developed, might best reach the coast. That there are large bodies of chrome ore in this region has been known for some time, but what average chrome content can be maintained under commercial conditions, what the cost of mining it and transporting it to market, and what profit will be left over after it is sold, are matters that still require investigation, and evidently some of them are now receiving attention.

Molybdenum, one of the elements used in making certain special steels, is found in a number of mineralized areas throughout Alaska. The principal source of this metal is the mineral molybdenite, in which it is combined with sulphur as a sulphide. During 1931 interest was revived in the deposits containing molybdenite that are found in veins near Wrangell, and a company was formed to promote their development. No details are known as to the actual work accomplished on this enterprise, but several of the local Alaska papers have carried notes that a crew of several men were on the properties during the summer cutting samples and doing extensive prospecting.

Antimony ores are widely distributed throughout Alaska, and in the past considerable quantities were produced and shipped from the Territory. In 1931, however, so far as reported to the Geological Survey, no antimony ores were sold and no prospecting is known to have been done on lodes solely valuable for the antimony they contain. However, according to newspaper reports a test shipment of about 1 ton of antimony ore was made to a smelter in California from the property near Point Caamano, about 20 miles north of Ketchikan, at which prospecting has been in progress for several years. Many of the lodes of the other minerals, notably gold, contain considerable stibnite, the sulphide of antimony, and in the course of mining them some antimony is necessarily taken out, though most of it is lost in the tailings. At a few places some of the larger masses of stibnite are laid aside until enough has accumulated to be worth shipping. The present low price of antimony of 6 to 7 cents a pound and the remoteness of most of these deposits in interior Alaska do not encourage their development at this time.

Prospecting is said to have been continued on the known nickeliferous sulphides of the Chichagof district, in southeastern Alaska, but no ore is reported to have been produced for sale during the year.

The ore from the Eva Quartz Mining Co.'s property near Ferry, in the Bonnifield district, which is mined principally for the gold it contains, also carries considerable bismuthinite, a sulphide of bismuth, from which bismuth might be obtained if the additional cost of recovering it warranted the expense. More than a carload of con-

centrates are being shipped from this mine each month to a smelter in the States.

During the year inquiry as to whether some of the Alaska lead ores might not contain considerable vanadium led to a test being made by the Vanadium Corporation of America on samples furnished by the Geological Survey from Seward Peninsula and the Kantishna, Hyder, and Fairbanks districts. None of these samples showed any vanadium.

Little new development took place during 1931 on the many kinds of nonmetallic mineral products that occur in Alaska. The deposits of asbestos near Bear Creek, on Admiralty Island, at which some development work was reported to have been in progress in 1929, were apparently not further exploited during 1931, and it is understood that the cessation of work was due to certain problems of management and finance which had not been worked out to the satisfaction of all the persons having an interest in the property. Some further search is reported to have been made for asbestos deposits in the vicinity of Shungnak, in the Kobuk district of northwestern Alaska, and according to Irving K. Reed, of the Territorial mining bureau, some promising-appearing samples were found. This region, however, is so remote and difficult of access that the deposits are not likely to be developed or mined in the near future. In this same region deposits of jade have long been known, and in 1929 some was shipped to persons in the States in the hope that a market for it might be found. Although it is reported that this shipment was successfully disposed of, no subsequent shipments, so far as the Geological Survey could learn, have been made.

During 1931 there has been a renewal of interest in the search for barite deposits in southeastern Alaska. This mineral, which is sometimes known as heavy spar, bears a slight resemblance to calcite, but is much heavier and is a sulphate of barium and not a carbonate of calcium. It is reported that a company was formed to mine one of the barite deposits on the west coast of Prince of Wales Island, in the Ketchikan district, and that drilling was to be undertaken to test one of the properties on Duncan Canal that had been patented some years ago. An occurrence of witherite, the carbonate of barium, which is used for many of the same purposes as barite, was discovered by George Comstock on Kuiu Island. The mineral was found as beach pebbles, and subsequent search for the bed from which they came has not been successful. According to B. D. Stewart, of the Geological Survey, who identified the mineral, Mr. Comstock stated that several tons of similar pebbles were strewn along the beach at a point near the northeastern extremity of Kuiu Island,

near the place where barite had previously been reported by Buddington.[8]

Reports have reached the Geological Survey that during the summer of 1931 Paul Buckley, who is interested with others in certain sulphur deposits on Akun Island, visited the property with a view to studying the local conditions and formulating plans for future development. No definite information regarding the outcome of this inspection has been made public, and, so far as could be learned, no active steps have been taken to do any actual construction work on this project.

A new Alaska enterprise that does not strictly relate to mineral deposits but is in a way so closely allied to them that mention of it here seems warranted is the attempt to utilize some of the enormous deposits of peat that occur in the Territory, and experiments have been under way to determine the value of the peat as an aid to agriculture. This investigation has been undertaken largely on the incentive of C. E. Bunnell, president of the Alaska Agricultural College and School of Mines, and the Alaska Peat Corporation, with George A. Lingo as president, has been formed to carry on the enterprise. A considerable tract of peat land has been leased, and the initial steps of putting the product on the market in the Pacific Coast States have been taken. Such tests as have been made indicate that the Alaska peat compares very favorably with the peat now being imported into the United States from European countries. That the importation of peat is a large industry is shown by the fact that annually about 100,000 tons is brought into the country. If the Alaska peats should prove to have the desirable qualities that the tentative tests seem to indicate, they may well form the basis for a considerable industry, as the volume of the peat deposits in parts of the Territory is enormous.

Although the various mineral commodities here grouped under the heading " miscellaneous mineral products " yield small monetary returns—approximately $108,000 in 1931—yet their diversity, their wide distribution, and the interest that is being displayed in the search for them indicate that they already play an important part in the mineral economics of the Territory and are destined to become even more significant as the development of Alaska proceeds.

[8] Buddington, A. F., Mineral investigations in southeastern Alaska in 1923: U. S. Geol. Survey Bull. 773, pp. 136–138, 1925.

ADMINISTRATIVE REPORT

By Philip S. Smith

INTRODUCTION

The interest of the Government in the lands under its dominion is diverse and coextensive with their far-flung limits. In part, this interest is that of owner or landlord, who in that capacity must first inventory what he possesses and then determine what proper use shall be made of it. On the other hand, part of this interest is that of counselor, who undertakes to guide his clients—all the citizens of the Nation—in the wise utilization of their possessions and to carry on in their behalf investigations that are too large or too difficult for them to undertake individually. These two different points of view are especially cogent reasons for the Government's interest in Alaska and particularly in its mineral resources, because about 99 per cent of the Territory belongs outright to the Government, which must determine what it has and what is to be done with it. It also has realized that this northern possession plays a very material part in the welfare of a great number of its citizens both in Alaska and in the States, so that their prosperity is in a measure linked up with the development of that region.

The Government early recognized this twofold responsibility and for more than 30 years has been carrying on investigations of the mineral resources of the Territory, not only to find out what it owned but also to advise its citizens as to the conditions that were considered favorable for their finding deposits of minerals that were of commercial value. This work on the mineral resources of Alaska has been largely carried on through a unit of the Geological Survey, now known as the Alaskan branch, and hundreds of reports and maps of the investigations of this unit have been published and made available to all who are interested in the development of the Territory. The work on which these reports is based has taken the geologists and engineers into all parts of the Territory and to all the known important mining camps. Their trails and maps have frequently been the only authoritative guides to many of the remote districts.

The object of the present report, however, is not to set forth the technical results of these various investigations nor to review the history of the work that has been done in the remote years, but rather to sum up the current work by stating where it has been done, what it has cost, and what projects are in progress. In this review the two rather distinct phases of the Survey's Alaska work will be described separately—the one of a general investigational type and the other of a semiadministrative type in connection with the technical supervision of the leases granted by the Government covering coal, oil, or other mineral lands. This separation follows a more or less natural line of cleavage due not only to difference in character of the work but also to the fact that each is supported by funds supplied from different appropriation items. For convenience of description the work of the first type will be referred to briefly as work on mineral resources and that of the second type as leasing work. A third class of work practically identical with the work on mineral resources but paid for from a separate appropriation item is conducted by the Geological Survey in cooperation with the Alaska Railroad. This work will also be described separately under the brief title "Railroad Project," though the products of that work in the form of maps and reports are included with those that were the outcome of the regular work on mineral resources.

All the Survey's Alaska work may be regarded as essentially a continuing enterprise with no clearly marked breaks to serve as distinct stages from which to measure progress, or it may be regarded as made up of a number of small projects, each of which may start at any time, and its finish, instead of marking a goal, may really mark only the beginning of a larger project that awaited the bit of information that the finished job supplied. In other words, the work as a whole or its component parts bear very little relation to any fixed period such as the calendar year. In fact, the projects have been started in all months of the year and may last a few days, months, or even several years. Obviously the fiscal year, which forms the basis for defining so much of the Government's financial business, does not fit and is of little significance in describing the Geological Survey's technical work in Alaska. Indeed, it is especially unsuitable as a basis for measuring this Alaska work because practically all the appropriations for that work are made immediately available on the passage of the act through which the money is appropriated. The date of availability is therefore a most uncertain one, in some years falling in February and in others perhaps not until late in the summer. For example, the appropriations for the Alaska work in the act providing funds for the Interior Department covering the fiscal year 1932 became effective February 14, 1931, and the funds were available for expenditure at any time

after that date until June 30, 1932. During part of that period, from April 22 to June 30, 1932, the similar appropriation contained in the act of 1933 was available; and part of the work continued in the fiscal year 1932 was started and paid for from funds carried in the appropriation act for 1931, which was available after May 14, 1930. Under these conditions it is evident that except for the obvious limitations the determination as to which of these appropriations should be charged with a certain project was based more on administrative convenience than on any real difference in the character or object of the work.

To describe as two separate jobs what is really a single project, simply because parts of it were paid for from different appropriations, would obviously fail to give a correct perspective of the work in its entirety to a person who was more interested in that aspect than in accounting procedure. For this reason, the projects have been described principally on the basis of what for the want of a better term have been called seasons. It should be realized that the term is intended to denote an indefinite period and that not all the time devoted to a project is spent in the field. Thus, the season of 1931 for many projects began early in the spring of that year, when the field men began to assemble their supplies and equipment or otherwise to prepare themselves for the tasks to which they were assigned. The period of actual field operations was followed in the fall and winter of 1931 and the spring of 1932 by the office and laboratory studies required in working up the field notes and preparing the reports on the results accomplished. The last stages of this work may have gone on more or less coincidentally with the beginning of preparations for the season of 1932 and may have ceased only when the geologists or engineers left headquarters to undertake the new projects—in fact, the final revision of the reports, the reading of the proof, and the countless other details incident to publication in finished form may not have been completed even in the succeeding season.

Work on even those other projects that relate to a specific period is necessarily done at some time subsequent to that period, so that the question arises whether the work should be described as falling within the period to which it relates or to the period in which it was done. For example, the statistical studies of mineral production relate to the calendar year, though the most intensive part of the work falls in the early part of the succeeding year. Thus, though collection of data and sending out of questionnaires for the 1931 canvass went on throughout 1931, most of the replies were not received until the end of that year, and the final compilations could not be made until all replies that were likely to be sent in were in

hand, which was late in the spring of 1932. Although the project of collecting these data might logically be counted as belonging to either or both years, the work is assigned to 1931, the season to which the statistics relate.

MANUSCRIPTS AND PUBLICATIONS

The principal products of the Alaska work of the Geological Survey are the reports and maps made by the members of the Alaskan branch, based on original surveys or investigations. These are considered an integral part of every project, and they stand as the tangible expression of the outcome of the investigations they describe. They are the authoritative means by which the results achieved are brought to the attention of the public, in whose interest the projects have been undertaken and who may profit by the information thus disseminated. It does not matter how much the investigator may have learned personally in the course of his studies or how significant his interpretations may be, they are of little public service until they are set down in definite form, published, and disseminated, so that they may be known and put to work. For this reason special attention is called to the following list of the manuscripts that are in various stages of preparation or publication.

During the year 11 such official reports have been issued:

The occurrence of gypsum at Iyoukeen Cove, Chichagof Island, by B. D. Stewart. (Bulletin 824–E.)

The Slana district, upper Copper River region, by F. H. Moffit. (Bulletin 824–B.)

Mining in the Circle district, by J. B. Mertie, jr. (Bulletin 824–D.)

The Lake Clark-Mulchatna region, by S. R. Capps. (Bulletin 824–C.)

Mineral resources of Alaska—Report on progress of investigations in 1929, by Philip S. Smith and others. (Bulletin 824.)

A geologic reconnaissance of the Dennison Fork district, Alaska, by J. B. Mertie, jr. (Bulletin 827.)

Mineral industry of Alaska in 1930, by Philip S. Smith. (Bulletin 836–A.)

Administrative report, 1930–31, by Philip S. Smith. (Bulletin 836–A.)

Notes on the geography and geology of Lituya Bay, Alaska, by J. B. Mertie, jr. (Bulletin 836–B.)

Surface water supply of southeastern Alaska, by F. F. Henshaw. (Bulletin 836–C.)

Glaciation in Alaska, by S. R. Capps. (Professional Paper 170–A.)

The following reports are in course of editing or printing:

The Tertiary flora of Alaska, by Arthur Hollick, with a chapter on the geology of the Tertiary deposits, by Philip S. Smith.

The eastern portion of Mount McKinley Park, by S. R. Capps. (Bulletin 836–D.)

The Kantishna district, by F. H. Moffit. (Bulletin 836–D.)

Mining developments in the Tatlanika and Totatlanika basins, by F. H. Moffit. (Bulletin 836–D.)

The Tatonduk-Nation district, by J. B. Mertie, jr. (Bulletin 836–E.) (Published in October, 1932.)

Mineral industry of Alaska in 1931, by Philip S. Smith. (Bulletin 844–A.)

Administrative report, 1931–32, by Philip S. Smith. (Bulletin 844–A.)

Mineral investigations in the Alaska Railroad belt in 1931, by S. R. Capps. (Bulletin 844–B.)

The Suslota Pass district, upper Copper River region, by F. H. Moffit. (Bulletin 844–C.)

Mineral deposits of Rampart and Hot Springs district, by J. B. Mertie, jr. (Bulletin 844–D.)

Reconnaissance of northern Koyukuk Valley, by Robert Marshall. (Bulletin 844–E.)

Progress of surveys in the Anthracite Ridge coal basin, by R. W. Richards and G. A. Waring. (Bulletin 849–A.)

Lode deposits of the Fairbanks district, by J. M. Hill. (Bulletin 849–B.)

The Willow Creek gold lode district, by J. C. Ray. (Bulletin 849–C.)

The Mount Eielson district, by J. C. Reed. (Bulletin 849–D.)

Mineral deposits near the West Fork of the Chulitna River, by C. P. Ross. (Bulletin 849–E.)

Lode deposits of Eureka and vicinity, by F. G. Wells. (Bulletin 849–F.)

The Girdwood district, by C. F. Park, jr. (Bulletin 849–G.)

The Valdez Creek district, by C. P. Ross. (Bulletin 849–H.)

Geology and mineral resources of the Moose Pass-Hope district, by Ralph Tuck. (Bulletin 849–I.)

The reports listed below are in course of preparation by their authors but have not approached near enough to completion to warrant a definite statement as to when they are likely to be printed and available.

Geology of the Yukon-Tanana region, by J. B. Mertie, jr.

Glacier Bay and vicinity, by F. E. and C. W. Wright.

The Nushagak district, by P. A. Davison.

Nonmetalliferous deposits of the Alaska Railroad region, by G. A. Waring.

Mineral resources of the Taku River region, by B. D. Stewart.

The Alaska Railroad route, by S. R. Capps.

The geology and mineral resources of the Chitina Valley and adjacent areas, by F. H. Moffit.

The southern Alaska Range, by S. R. Capps.

Several other manuscripts have long been in course of preparation, but as they will require further field work or extensive research before they can be completed, they are no longer considered as in progress.

Fifteen short papers on the mineral production of Alaska and various phases of the work of the Alaskan branch were published as press bulletins.

Eight maps were issued during the year, as follows:

Topographic map of Tonsina district, 1932, by C. F. Fuechsel and J. W. Bagley; scale 1:250,000. Issued in a preliminary photolithographic edition.

Topographic map of Girdwood district, 1932, by W. G. Carson; scale 1:62,500. Issued in a preliminary photolithographic edition.

Topographic map of Mount Eielson district, 1932, by S. N. Stoner; scale 1:62,500. Issued in a preliminary photolithographic edition.

Topographic map of Revillagigedo Island, 1931, by R. H. Sargent; scale 1:250,000. Compiled principally from aerial photographs taken by the Alaska aerial expeditions of the Navy Department, 1926 and 1929. Issued in a preliminary photolithographic edition.

Topographic map of lower Matanuska Valley (reprint, revised), 1931, by R. H. Sargent; scale 1:62,500. Published for sale.

Topographic map of Dennison Fork district, 1932, by J. W. Bagley, D. C. Witherspoon; scale 1:250,000. In Bulletin 827, 1932.

Alaska Map E (reprint, extensively revised); scale 1:2,500,000. Published for sale.

Alaska Map A (reprint, revised); scale, 1:5,000,000. Published for sale.

The following maps have been transmitted for or are in process of publication, on the scales indicated:

Topographic map of Mount Spurr region, by R. H. Sargent and Gerald FitzGerald; scale 1:250,000. To be published for sale.

Topographic map of Lake Clark-Mulchatna region, by Gerald FitzGerald and R. H. Sargent; scale, 1:250,000. To be published for sale. This and the Mount Spurr map are compiled from surveys in recent years in the Skwentna, Mount Spurr, Chakachamna-Stony, and Lake Clark-Mulchatna districts. (Published in January, 1933.)

Topographic map of Fairbanks district (reprint, revised); scale 1:62,500. To be published for sale.

Topographic map of Anthracite Ridge, by L. O. Newsome; scale 1:12,000. To be issued in a preliminary photolithographic edition. (Published July 9, 1932.)

Topographic map of Eureka and vicinity, by S. C. Kain; scale 1:62,500. To be issued in a report on the same area.

Topographic map of Wrangell district, by R. H. Sargent and V. S. Seward; scale, 1:250,000. To be issued in a photolithographic edition. (Published September 16, 1932.)

In addition, practically all the published reports are accompanied by maps, the bases of which have been made principally from surveys conducted by the topographers of the Alaskan branch.

Progress was also made in the preparation of a map of the Nushagak region, scale 1:250,000, compiled from surveys conducted in 1930 and 1931, and a map of a portion of the Taku district, compiled principally from aerial photographs taken by the Alaska aerial survey expedition of the Navy Department. Several other maps are in early stages of preparation.

Besides the official reports, several articles were prepared by the scientific and technical members of the Alaskan branch for publication in outside journals, and 24 public lectures were given regarding the general work of the branch or some of its special features. Most of these were prepared unofficially but represent by-products of the regular work and serve to reach special audiences not readily reached by the official publications. Among these articles may be mentioned the following:

Work of the U. S. Geological Survey in 1931 in areas adjacent to the Alaska Railroad, by Philip S. Smith.

Some aspects of the Geological Survey's recent investigations along the Alaska Railroad, by G. A. Waring.

A proposed geometric classification of folds, by J. B. Mertie, jr.

WORK ON MINERAL RESOURCES

PROJECTS IN PROGRESS DURING THE SEASON OF 1931

The work done by the Geological Survey in connection with the study of the mineral resources of Alaska is so diverse that it can not be reduced to common terms capable of unified tabulation or coordinated description. Part of it embraces areal surveys that are readily definable in terms of square miles mapped, but other parts concern examinations in mining camps that cover only small tracts and yet may require an outlay of time and effort in laboratory researches or office studies that exceed the scope of the original field investigations. The most comprehensive idea of the work of the Alaskan branch in 1931 may therefore be gained best from a brief description of each of the projects undertaken during that season.

In addition to the routine duties of administration and of supplying information in answer to hundreds of inquiries received from the public and from other branches of the Government, 11 principal projects that were supported by funds allotted from the Alaskan branch were carried on during the season of 1931. Eight of these projects involved field work, and three required only work in the office. The eight projects involving field work are described below. The projects involving no direct field work were the annual canvass of mineral production, the continuation of the preparation of drainage maps, by compilation of the aerial photographs taken by the Navy Department expeditions of 1926 and 1929, and miscellaneous office duties carried on at the local offices of the Alaskan branch at Juneau and Anchorage, Alaska.

The topographic mapping project in southeastern Alaska is part of the general undertaking of preparing reconnaissance maps of the entire area and following up with mineral investigations as rapidly as the bases are available and funds and personnel permit. The start on the present program may be said to date from 1926, when a detachment from the Navy Department on the solicitation of the Geological Survey took aerial photographs of several thousand square miles of southeastern Alaska and turned the films over to the Geological Survey for cartographic purposes. Maps showing the shore lines, streams, and other water features were prepared from these pictures and taken to the field by the engineers on which to show the features of relief. In 1929 another expedition was sent by the Navy Department to the Territory to complete the photograph-

ing of southeastern Alaska, and thousands of additional views suitable for mapping purposes were obtained. The ground surveys were started, and it was work of that sort that was the purpose of sending a party into the vicinity of Wrangell in 1931. This party was in charge of R. H. Sargent, who was assisted by V. S. Seward. Transportation for the party in the field was supplied by a power boat, which also served as a camp, and the party, in addition to the topographers, consisted of a station assistant and two to three members of the boat's crew. The field work began May 15 and ended September 12, and during that period 1,057 square miles was mapped topographically on the reconnaissance scale of about 4 miles to the inch with a contour interval of 200 feet. The work was carried on by plane table and traverse methods and was much expedited by the fact that the drainage base, which had been compiled from aerial photographs, was available. This saving in time and the consequent greater accomplishment was especially evident, for the region mapped is one of very steep slopes covered by an almost impenetrable growth of trees and brush that would be impracticable and expensive to map by any direct method, though, because of the numerous deep fiords and excellent system of control executed by the Coast and Geodetic Survey, it could be readily mapped by the combination of methods adopted. Although, as stated above, the principal purpose of the Geological Survey in undertaking this project has been its utilization in investigations of mineral resources, these topographic maps have a much more extended use and many other Government organizations and individuals are finding them of service. The Forest Service, for example, has found the maps already issued so useful in its investigations of the forest conditions, pulpwood resources, and possible power developments that the officials have constantly urged greater expedition in the preparation of the maps from the aerial photographs and the field surveys.

The work in the Taku district of southeastern Alaska during 1931 was a continuation of the project started in the season of 1930 of studying the recently reported finds of sulphide ores that appeared to be worthy of commercial exploitation. Several of the early finds had been made east of the international boundary, in British Columbia, but as the geology of adjacent parts of Alaska appeared likely to be similar it was considered worth investigating to determine its real character. This work was assigned to B. D. Stewart, supervising mining engineer of the Juneau office, and he spent about a month in field work in the district. Unfortunately, other official calls for Mr. Stewart's services, among which was his required attendance as an expert witness at a trial in Seattle, interfered seriously with this work, so that not only will further field work be

required but office and laboratory studies will have to be made before the report can be completed. In the field work transportation was furnished mainly by small boats on the river, but away from the streams supplies and equipment had to be carried on the men's backs. For this packing, camp duties, and other related services a crew of five men were employed. To offset in part the lack of funds and available personnel to make a topographic map of the area a drainage map of approximately 400 square miles was prepared in the Washington office from the aerial photographs on file. This map supplemented by the early boundary surveys and the traverses of Mr. Stewart should afford a fairly serviceable map until the area is mapped with more precision.

Several years ago F. E. and C. W. Wright made extensive investigations in Glacier Bay, a deep indentation of the coast about 60 miles west of Juneau. Owing to various causes, among which was the fact that the Wrights resigned from the Geological Survey to undertake other work, the report on these investigations was not finished and could not be put forward for publication without further field work. It therefore was regarded as a distinct stroke of good fortune to learn that C. W. Wright, now chief engineer of the mining division of the Bureau of Mines, was willing to complete the work if suitable official arrangements could be made and funds to defray the field expenses could be provided by the Geological Survey. These arrangements were made, and Mr. Wright and Dr. Harry Fielding Reid, one of the foremost of the early observers of Alaskan glaciers and a recognized world authority on the physics of glaciers, spent nearly two months during the season of 1931 in making observations and measurements in Glacier Bay and its environs. The party was transported in the field by a power boat, which also served as camp, and its members reoccupied many stations that had been established in earlier years, so that they obtained a record as to the changes that had occurred in the interval. Through the generous cooperation of the Bureau of Mines no charges were made against the Geological Survey for the salaries of the technical members of the party, and Dr. F. E. Wright, of the Carnegie Geophysical Laboratory, has kindly offered to do much of the petrographic laboratory work required in the study of the rock specimens brought back by the party.

North of the Wrangell Mountains and forming the divide at the head of the Copper River is a vast stretch of country, extending from the main thoroughfare of the region, the Richardson Highway, eastward almost to the international boundary, that has not been adequately mapped or studied as to its mineral resources. In some of the earliest exploratory surveys made by the Geological Survey in Alaska part of this region was visited, but the conditions under

which the work was done necessitated only the scantiest sort of examination, and even such notes as were obtained were not published. For a long time this was one of the least accessible parts of Alaska, but recently the Alaska Road Commission has constructed a road from Gulkana, on the Richardson Highway, to the Slana River, which has rendered it rather easy of approach. That parts of the area are mineral bearing has been amply demonstrated. To determine more specifically the conditions under which the mineralization occurred and its character and extent a Geological Survey party was sent into this region in 1931. This party was in charge of F. H. Moffit, geologist, who was assisted by two camp helpers. Transportation was afforded by a small pack train. The major activities of the party were directed toward the study of an area in the vicinity of Suslota Pass. Active field work was started June 14 and stopped September 5. During the season the geology of 490 square miles was mapped on reconnaissance standards. The topographic map of the district, however, was found to be so inadequate that attempts to represent the geology with precision on it appeared futile, so that much of the time of the geologist was spent in gaining a general insight as to the principal geologic features and relations, leaving the mapping and closer studies to be done later after a suitable topographic map has been prepared. A comprehensive statement of the results of Mr. Moffit's work is given in a later section of this volume.

Reconnaissance topographic mapping in the Tonsina district, of the Copper River region, was done by a party in charge of C. F. Fuechsel, topographic engineer, assisted by four camp hands and helpers. As a result of their work, about 1,300 square miles was mapped for publication on the scale of 1:250,000, with a contour interval of 200 feet. Of the total area mapped by this party, about 500 square miles consisted of revision of earlier surveys that had been made under conditions which precluded as accurate work as is required by present standards. Field work on this project began June 4 and ended September 4, being somewhat curtailed by lack of funds. The area lies north and west of the main wagon road from Valdez to the interior of Alaska and consequently is relatively accessible to transportation, though at present, except near the road, it is practically uninhabited and undeveloped. Very little was known about the region, and this lack of information was the reason for undertaking the work. The topographic mapping will be followed up by studies of the geology and mineral resources, because the trend of certain of the formations that occur in the known mineralized areas to the east indicates that they should be found in the Tonsina district. A preliminary photolithographic edition of the topographic map of the district was issued during the year. (See p. 87.)

During the more than 30 years that mineral investigations have been in progress in interior Alaska, many expeditions have been sent into different parts of the Yukon-Tanana region—the large tract west of the international boundary between the Yukon and Tanana Rivers. This work was done by different geologists at different times, under diverse conditions that prevented thorough examination of the tracts visited, but it has brought together a considerable array of valuable facts. However, to be of greatest use these data needed to be reviewed, coordinated, and brought up to date according to a unified method of treatment by one person familiar with the entire region, in order that a comprehensive report might be prepared in which differences of interpretation should be reconciled and the diverse features knit together in a well-organized sequential statement that would present the best current interpretation of the complex geologic history of this region. Progress on this principal project had been made during the last few years through the field work of J. B. Mertie, jr., who has personally revisited many of the critical areas and done a large amount of research on the problem, until practically the only area remaining to be reviewed was the Rampart-Hot Springs district, in the western part of the tract between the Yukon and Tanana Rivers. Into this area Mr. Mertie went during the season of 1931 and, as a result, revised the mapping of some 1,500 square miles that had been mapped earlier by other geologists. In the course of that work he examined practically all the camps where mining was in progress and obtained as much information as possible bearing on the distribution and character of the mineralization of the district. Field work on this project started June 8 and stopped September 1. For transportation in the field Mr. Mertie traveled with a small pack train and was assisted by three men.

In southwestern Alaska north of Bristol Bay and including the basin of the Nushagak River was one of the largest unmapped areas of Alaska. Almost nothing was known about the geology and mineral resources of this area, though rumors were heard from time to time that prospectors had discovered deposits that would be valuable in a more accessible region. In order that the actual conditions might be determined the Geological Survey sent a topographic party into the region in 1930, and about 2,400 square miles was mapped on a reconnaissance scale. A second party, in charge of Gerald FitzGerald, topographic engineer, was sent into the region in 1931, to continue this work, and P. A. Davison, junior geologist, was attached to the party. Work started at Dillingham on June 8 and ended at that place September 13. During this interval, 2,850 square miles was surveyed topographically and about 3,500 square miles was

surveyed geologically. Of the area credited to topographic surveys in 1931 in this region about 250 square miles represented the revision of earlier, less precise surveys. The topographic work was carried on mainly by the usual plane table and traverse methods, but in the surveys along the larger watercourses some 125 miles of stadia traverse was made. The geologic surveys covered country that had not hitherto been mapped by the Geological Survey. During most of the early part of the season the geologist and topographer worked together, but later, when the topographic work lay mostly out in the broad alluvium-filled lowlands adjacent to the larger streams, it became evident that the time of the geologist could be employed elsewhere to better advantage. Accordingly, Mr. Davison left the main party and traversed parts of the area surveyed by Mr. Fitz-Gerald in the season of 1930. A report on the geology of the region that will be accompanied by the topographic map is in preparation and will be issued later by the Geological Survey. Transportation for the parties in the field was effected principally by boats equipped with outboard motors. In getting to and from Dillingham at the beginning and end of the season the movement of the party was much facilitated by the utilization of airplane service from Anchorage. This not only saved much valuable time but was of great service in giving a preliminary view of the whole region that was to be surveyed and thus allowed the subsequent work to be planned effectively.

The only other piece of field work that was done during the season of 1931 by a member of the staff having headquarters in Washington was the customary broad survey of recent developments in the mining industry as a whole, with special visits to some of the more active mining camps or those that have not been recently visited by members of the Geological Survey. This work was done by Philip S. Smith, chief Alaskan geologist. Leaving Washington late in June, Mr. Smith spent the larger part of the field season in the mining districts adjacent to the Alaska Railroad, in which the Geological Survey had parties that were making special investigations in cooperation with the railroad. In this work visits were made to the Moose Pass-Hope, Willow Creek, Anthracite Ridge, Matanuska, Mount Eielson, Kantishna, and Fairbanks districts. Much time was devoted to conferences with the members of the Geological Survey as to the technical phases of the work, but every opportunity was also taken to get in touch with the miners and others interested in the development of the mineral resources of the Territory to learn not only about the work they had in progress but also about their needs. The general familiarity with the mining industry of the Territory as a whole that may be gained on an

inspection trip of that sort is regarded as essential in keeping track of recent developments and laying out plans for future work of the Geological Survey, so that they will fit the requirements of the mining industry. In the course of the summer W. C. Mendenhall, Director of the Geological Survey, who had been a member of several of the pioneer parties in remote parts of Alaska about 30 years before and had gone to Alaska in 1931 with a congressional party that was studying various problems connected with the Federal relations to the Territory, joined Mr. Smith. Together they spent some time going over the work in progress in the Willow Creek, Anthracite Ridge, Matanuska, and Fairbanks districts. Mr. Mendenhall then returned to the States by way of the Copper River region and southeastern Alaska, stopping at Juneau to inspect the Geological Survey office and to discuss Geological Survey matters with the governor and other officials. Mr. Smith returned to Washington in October, after all the field parties had discontinued work.

Some of the results of the season's work on the field projects described in the foregoing paragraphs, as well as that done in earlier years, may be expressed in terms of the area covered. In the following table the areas reported are based on the field season and not on the fiscal year, and therefore no account is taken of the work that was started during the field season of 1932 but remained uncompleted at the end of the fiscal year 1932. This procedure has been adopted in part because at the end of the fiscal year most of the field parties are out of communication and so can not report how much they have accomplished, but in part because, as already explained, the field season is regarded as a more practicable unit of measurement. The areas credited in the table to 1931 include those surveyed in cooperation with the Alaska Railroad (see pp. 108–110) as well as those covered in the course of the Geological Survey's regular work on investigation of mineral resources.

Areas surveyed by Geological Survey in Alaska, 1898–1931, in square miles

Season	Geologic surveys			Topographic surveys		
	Exploratory (scale 1:500,000 or smaller)	Reconnaissance (scale 1:250,000)	Detailed (scale 1:62,500 or larger)	Exploratory (scale 1:500,000 or smaller)	Reconnaissance (scale 1:250,000)	Detailed (scale 1:62,500 or larger)
1898–1930	75,650	176,630	4,277	55,630	213,249	4,066
1931 revision	----------	1,935	51	----------	1,024	13
	75,650	174,695	4,226	55,630	212,225	4,053
1931	----------	5,656	320	----------	5,373	307
	75,650	180,351	4,546	55,630	217,598	4,360
Percentage surveyed of total area of Alaska		44.4			47.3	

In the table given above only the net areas surveyed are listed in the appropriate column, though, of course, most of the areas that have been surveyed geologically have also been surveyed topographically. It is by no means unusual that areas surveyed hastily at first are later resurveyed with more precision on the same or a larger scale, and if the areas thus revised were not excluded from the totals the same areas would be counted twice. Certain areas that were remapped in 1931 have, therefore, been deducted from the totals for the earlier years. The necessity for resurveying some areas in more detail is generally not due to faulty execution of the earlier surveys, but to the desirability of covering a large tract rapidly at first. Then, as development takes place in certain parts of that large tract, more accurate and detailed work may be required to furnish the needed information. To cover the entire tract with that same degree of care would have unduly delayed the work and cost far more than would be warranted. Therefore, the resurvey of certain areas here and there as required is really the most economical and logical procedure. Even in tracts where more detailed work is known to be needed it is usually best to make first a relatively rapid, inexpensive survey, so as to supply immediate needs, and then to follow this up with the necessarily slower, more expensive detailed surveys. This policy may be well illustrated by the procedure that was adopted in surveying the Seward Peninsula placer camps. During the same year in which the rich deposits of this region were discovered two Federal geologists made hurried studies of the known productive areas, and within two or three months after the return of these geologists from this camp, during the height of the first stampede to Nome, a rough exploratory map and report on the environs of Nome were published by the Geological Survey. During the next field season reconnaissance surveys were made of the entire region within 100 miles of Nome, and these in turn within a few years were succeeded by detailed mapping and reports on smaller tracts in the vicinity of the richest camps.

The scale most commonly adopted for Alaska surveys, either geologic or topographic, is the reconnaissance scale (1:250,000), in which about 4 miles (250,000 inches) on the ground is represented by 1 inch of paper on the map and the relief is shown by contour lines with an interval of 200 feet. This scale has been chosen because all the larger features of the country can be represented by it, so that it is adequate for most general purposes, and at the same time the map can be made expeditiously and cheaply. For work requiring less detailed mapping, as, for instance, in remote parts of northern Alaska, the exploratory scale of 8 to 10 miles to the inch has been adopted, as the field work can be done more quickly and cheaply. For detailed work the usual scale that has been adopted

is 1 mile to the inch, but even larger scales are used if required. The surveys of the region near the mines at Juneau were made on a scale of about one-third of a mile to the inch, and during the summer of 1931 a map of part of the Anthracite Ridge coal field, where intensive investigations were in progress, was made on the scale of one-fifth of a mile to the inch (1:12,000). The expense of detailed surveys is, of course, many times that of reconnaissance surveys, some costing more than $100 a square mile as against $5 to $10 for reconnaissance surveys.

As a result of the photographing expeditions of the Navy Department in 1926 and 1929 the Geological Survey has in its files tens of thousands of photographs taken specially for map-making purposes. Progress in taking off from these views such information as is required to prepare drainage maps has been much slowed down, owing to the lack of funds to pay for the necessary personnel and other expenses, so that now little more compilation is undertaken than is required to furnish the ground parties with bases on which to do their field work. Through necessity, therefore, the working up of the photographs into maps is now utilized mainly as a fill-in job and is laid aside during much of the time. This is regarded as a most undesirable condition, because until worked up this valuable material, which has already been paid for, can not be used for the purpose for which it was obtained and therefore does not appear to justify the expense that was incurred. Fortunately, however, the records are permanent, so that ultimately all of this material will be used. As a result of this curtailment only a little more than 1,000 square miles of new drainage base was compiled during 1931. This covered part of the region north and west of Wrangell, in southeastern Alaska, and was prepared for one of the topographic parties described under the projects for the season of 1932. The map compilation was in charge of R. H. Sargent, topographic engineer, who was assisted by V. S. Seward, assistant topographic engineer, and J. I. Davidson, draftsman. During the course of the work many problems as to the best means of recovering the topographic data from these photographs arise, which call for the exercise of considerable technical skill, good judgment, and ability to develop original methods for their solution. In a measure, the same qualities are required in working up the pictures as for making topographic surveys in the field, and the same general principles are involved.

The collection of statistics regarding the output of minerals from Alaska each year is carried on mainly from the Washington office, but the wide acquaintance of the field men and their surveys in different parts of the Territory make them a source of much definite information. In addition, many of the other Government organ-

izations, such as the Bureau of Mines, the Bureau of the Mint, and the Customs Service, collect data within their respective fields which contribute to the general subject. Most of the banks, express companies, and other organizations conducting business in Alaska collect for their own use data regarding mineral commodities in their particular districts, some of which are freely placed at the disposal of the Geological Survey. Most of the larger Alaska newspapers, as well as certain papers published in the States that feature Alaska matters, are courteously sent to the Geological Survey by their publishers, and from them many items regarding new developments are gleaned. In addition, the Geological Survey sends out hundreds of schedules—one to each person or company that is known to be engaged in mining in Alaska—which call for information regarding the developments and production at each property during the year. From all these sources a large volume of authoritative information is obtained. These annual production reports are conducted on the basis of the calendar year, but the work of canvassing the producers and assembling the data is practically continuous. In fact, during the period from January to June, 1932, data relating to two separate calendar years, 1931 and 1932, were being collected coincidentally. The general clerical work on the collection of the statistical data for 1931 was carried on by Mrs. L. N. Eaton, and the material was coordinated and the resulting report prepared by the chief Alaskan geologist. The report on the mineral industry in 1931 is given on pages 1–82.

The Geological Survey maintains in Alaska 2 district offices, 1 at Juneau and 1 at Anchorage. The main duties of the personnel attached to these offices relate to mineral leasing (see p. 115), but a part of their time is given to general investigations of mineral resources, though the services of one of the staff attached to the Anchorage office is confined primarily to studies of deposits that may afford tonnage to the Alaska Railroad. This cooperative work with the railroad was performed by Ralph Tuck, and his salary and expenses were paid from railroad funds. Mr. Tuck's work is more fully described on pages 112–113. In 1931 approximately two-fifths of the time of B. D. Stewart, supervising mining engineer, with headquarters in Juneau, was allotted to general investigations of mineral resources, including, besides office duties, visits to different parts of the Territory as conditions warranted. The field work assigned to Mr. Stewart in 1931 is described on pages 90–91. His long familiarity with mining matters throughout the Territory and his availability for consultation at Juneau have made his advice much sought by many of the Federal and Territorial agencies in Alaska, including the Alaska Railroad, the Forest Service, the governor, and members of the Territorial legislature, as well as by many of the

individual operators and prospectors. The Alaska offices also act as local distributing points for publications of the Geological Survey and assist the main office at Washington by furnishing information on many phases of the mineral industry of the Territory. The coordination of the investigative work done from the Alaska offices with that done from the Washington office is still being worked out in detail, but the aim is to make such an adjustment that the combination will be able to give better and greater service to the mining industry at less expense.

Each of the projects described above involves considerable office work in examining and testing the specimens collected, preparing the illustrations and maps, and writing the reports. In addition, some work of this sort was also done on projects that had been started in earlier years but not completed. Some of the work on these earlier projects represents only the normal routine of seeing a report through the press, such as proofreading the text and illustrations, but a part of it represents the advancement of studies that for some reason were not finished during the year in which the project was undertaken.

In all the office work on the technical reports the members of the Alaskan branch have received much assistance and valuable advice from their associates in other branches of the Geological Survey. T. W. Stanton, chief geologist; G. H. Girty, J. B. Reeside, jr., Edwin Kirk, and E. W. Berry, paleontologists, have examined and reported on the fossils collected in the field surveys. The text editors have been helpful in critically scrutinizing the Alaska reports that were in course of preparation to see that they should conform so far as practicable to the best Geological Survey standards.

All the clerical work of the branch in the Washington office has been performed under the direction of Lucy M. Graves, who has been assisted principally by Lillian N. Eaton and Kathleen P. Stead. The clerical work in the Anchorage office was performed by Harriet V. LaZelle. All the ordinary drafting work other than that performed by the topographers of the branch has been done by J. I. Davidson. Some drafting requiring ability in special lines was done by members of other Geological Survey units, especially those of the section of illustrations, who have also made all drawings used for reproduction in the official reports.

PROJECTS FOR THE SEASON OF 1932

Ten projects chargeable to funds appropriated directly to the Geological Survey have been approved for the season of 1932. These projects had been under way for only a short time at the end of the fiscal year, so that it is too soon to make any definite statement as to

the results accomplished, though an outline of the principal objects may be given. Seven of these projects involve field work and are described below. The three projects that do not directly involve field work are the annual canvass of the mineral production from Alaska in 1932, the completion of a report on the geologic features and resources of the area in central Alaska lying between the Yukon and Tanana Rivers, and the general work conducted by the local field offices at Juneau and Anchorage.

The reconnaissance topographic mapping project in the Wrangell district, southeastern Alaska, is a continuation of the surveys that have been in progress for the last several years, starting a little south of Ketchikan and swinging northward each season as conditions permit. These surveys are being made by R. H. Sargent, assisted by V. S. Seward and the necessary field helpers and crew of the power boat, which serves not only to transport the party but also furnishes their quarters while in the field. In the main the area which it is planned to cover during the season of 1932 includes much of the eastern part of Wrangell Island, Mitkof Island, and the southern part of Kupreanof Island. However, should time and other conditions permit the mapping will be extended over the western part of Kupreanof Island and Lindenberg Peninsula and possibly into the northern part of Prince of Wales Island and the eastern part of Kuiu Island. A drainage base of the area to be surveyed had already been prepared in the office from aerial photographs taken by the Navy Department. The field work was begun early in May and will be continued as late in the fall as it can be done effectively—to judge from past experience about the middle of September, as after that date storms and adverse weather conditions interfere so seriously that the time gained by prolonging the season is far more than offset by the time lost awaiting favorable mapping conditions. It had been hoped that the topographic mapping of southeastern Alaska might be expedited by having two separate parties in the field there in the season of 1932 inasmuch as, in addition to the need of these maps in the Geological Survey's own fields of investigation, the Secretary of Agriculture had urged that in the interest of the work of the bureaus of his department mapping should be done also in the northern part of southeastern Alaska, especially in the vicinity of Admiralty Island. The severe curtailment of funds, however, prevented undertaking that work this season, but it is one of the tasks that should be done at the earliest opportunity.

Mining studies in the Taku district near Juneau and elsewhere in southeastern Alaska form a continuation of investigations that were started some time ago and owing to various causes not yet completed. B. D. Stewart has been designated to have charge of

the work and will be assisted by such field helpers as are required, though, because of the retrenchment in expenses that has been necessary, only a small allotment for this work has been made. Mr. Stewart has also been authorized to make such investigations in other mining camps as time and other conditions permit, preference being given to starting a rather detailed examination of the mineral-bearing lodes on and near Chichagof Island.

Lying west of the Richardson Highway between Tonsina and Copper Center in the Copper River Valley and including Tonsina and Klutina Lakes, is a tract of country that had not been examined geologically. A reconnaissance topographic survey of this tract was completed in 1931 and a map of the Tonsina district issued as a preliminary edition. To trace the geologic formations into this district from the better-known Chitina district, to the east, where some of them are mineral bearing, is the principal object of the reconnaissance geologic party that was sent into the district in 1932. This party, in charge of F. H. Moffit, geologist, assisted by two camp men, started work early in June and will carry on the investigations as late as forage for the horses of the pack train can be obtained and other conditions permit. Not only should this work be of value in determining the geology of the specific tract studied but it will round out the information regarding a much larger area and permit a comprehensive statement regarding the general features of the whole southern part of the Copper River Basin, a project that has been in progress for several years and embraces practically the whole of the Chitina quadrangle.

The reconnaissance topographic survey of portions of the Alaska Range at the head of the Copper River and of isolated tracts adjacent to the Richardson Highway is the field assignment that has been given to C. F. Fuechsel for the season of 1932. This really marks the start on the main project of mapping the whole Alaska Range province east of the Richardson Highway to the international boundary, an area which had been in part surveyed topographically in the past, but under adverse conditions that precluded the work being done with the degree of precision required by present standards. However, owing to the small amount of money that could be allotted to the work in 1932 little more than a start can be made on this program. The party will be restricted in its movements to areas that can be reached rather easily from the roads, as an autotruck is being used as the means of transportation. Adequate control will be carried from the strong system established by the Coast and Geodetic Survey along the main highway, along the new road to the Slana River, and from points established near the road the party will determine the main features of much of the more remote country and thus clear away a good deal of the preliminary

work so that the work may be vigorously pushed forward by a pack-train expedition another season. As this work will probably take only the first two months or so of the season, it is expected that Mr. Fuechsel will spend the rest of the time in filling in the topography of some of the tracts near the Richardson Highway, south of Copper Center, that were not surveyed by earlier expeditions. In the main the work will be carried on by the usual plane-table and traverse methods, but the party is equipped with a photo-topographic panoramic camera, so as to be able to use photographic methods also where those methods are especially advantageous, as for mapping distant rugged mountains.

Lying off the coast of southwestern Alaska is Kodiak Island, a large island whose inland portions are unsurveyed and whose mineral resources are practically unknown, though at a few places near the coast signs of mineralization have been observed and gold recovered from some of the beaches, and other industrial developments have been started on the island. To obtain adequate knowledge of the physical conditions the Geological Survey has begun the topographic mapping of the island. This task has been assigned to Gerald FitzGerald, topographic engineer, who with one field assistant started field work early in June, working along the coast in a power dory. It is expected that in the main Mr. FitzGerald's surveys will be confined to the northern part of Kodiak and adjacent islands, including Afognak. Incidentally, however, he will gain as much information as possible about the island as a whole, so as to formulate plans for the continuation of the mapping another season either by a pack-train expedition working inland or by a boat expedition working along the coast. It is possible that late in the season Mr. FitzGerald will have an opportunity to establish contact with the detachment of the Navy Department that will spend most of the season in the Alaska Peninsula and Aleutian Island region, as that contact might prove advantageous to the work of both.

Early in the spring the Navy Department, on the invitation of the Coast and Geodetic Survey, decided to send a detachment to Alaska with the object of cooperating in certain of the surveys being carried on in the waters adjacent to the Alaska Peninsula and Aleutian Islands. As this appeared to offer a unique opportunity to examine many of the remote and little-visited portions of the Territory, the Geological Survey made known its desire to have a geologist assigned to the detachment. This request was granted by the Navy Department, and S. R. Capps, geologist, was assigned to the work. The main detachment left Seattle April 20 in the Navy's ship *Gannet*, the two airplanes that were to accompany the expedition being flown by their officers under their own power to Seward. At Seward the planes were partly dismantled and taken aboard

the *Gannet* for transport with the entire party to Dutch Harbor. At that place the planes were to be reassembled, and the rest of the season was to be spent in cruising among the islands and making observations. The detachment will return to the States when the bad weather of the fall prevents further effective work. The conditions under which the work is done will necessarily restrict geologic observations to those places touched in the course of the principal work of the expedition, and therefore no continuous areal work can be attempted. However, there should be abundant opportunity to determine some of the general features of the geology and geomorphology of this little-known region and obtain information on which to make plans for more intensive examination of those areas that appear likely to hold promise of having mineral deposits of value. Informal reports already received from Mr. Capps indicate that every effort is being made by the Navy personnel to make available to him facilities for gaining geologic information.

The general survey of Alaska mining conditions to be conducted by the chief Alaskan geologist during the season of 1932 will resemble similar work in the past, though the individual points visited will necessarily differ. Detailed plans can not be stated in advance, as they will necessarily depend very largely on the conditions that are found in the field and the availability of transportation. It is expected that a considerable part of the time in the field will be spent with the parties engaged in work in the vicinity of the Alaska Railroad; but it is hoped that time will also permit studies in some of the larger producing camps as well as in some of the more remote tracts that have not recently been visited by members of the Geological Survey. Owing to duties in Washington the actual field work will not be started until after the 1st of July.

The collection of statistics regarding the mineral output of Alaska in 1932 will in general be similar to the work done on the corresponding project in 1931. (See pp. 97–98.) It should be completed about the middle of 1933.

Another project that does not directly require field work for its completion, though it is based primarily on the field work that has been done in the past, is the preparation of the comprehensive report on the Yukon-Tanana region mentioned on page 93. The task was assigned to J. B. Mertie, jr., whose eight seasons' field work in different parts of this region, together with his many years' work in other parts of Alaska, have made him preeminently fitted to discuss authoritatively the early work and to know the latest developments and interpretations. It should not be inferred that all problems relating to this region have been solved or that no further investigations in the region will be needed. In fact, the fundamental idea back of the whole project is that by summarizing the existing

knowledge and bringing it up to date the way to future advancement in understanding the complex history of the region may become clearer, so that the summary, instead of being a climax, may really be a firm foundation from which to start further studies.

The projects for 1932 that do not require field work include such duties of the personnel attached to the Juneau and Anchorage offices as are not related to a definite field project or are regarded as distinctly administrative.

It is proposed to use any available time of the branch personnel and any free funds in preparing drainage maps of as much as possible of southeastern Alaska from the aerial photographs of that region already in the Geological Survey files. In fact, it is essential that drainage maps covering at least 1,000 square miles should be compiled before the field season of 1933 begins, as otherwise topographic mapping in that region will have to be delayed. It is hoped that sufficient personnel and funds may be available so that it will not be necessary to limit the amount compiled to the bare requirements for immediate topographic use, for it is desirable to press on the project of completing the compilation of all the photographs now in hand, because, even without topography, these maps are in much demand by the Forest Service and other Government organizations and private individuals who are active in development throughout southeastern Alaska.

EXPENDITURES

The funds directly appropriated for the work of the Geological Survey on Alaska's mineral resources during the field season of 1931 were made available through the Interior Department appropriation acts for 1931 and 1932. Each act contained a provision for making the funds appropriated available for expenditure immediately on the approval of the act. The act of 1931 was approved May 14, 1930, and the act of 1932 was approved February 14, 1931. The act of 1931 appropriated $75,000; the act of 1932, $84,500. The funds used during the field season of 1932 were made available through the Interior Department appropriation act for 1932, already noted, and the act for 1933, which appropriated $60,000, the funds from which were available after April 22, 1932.

Although there is no direct relation of the field season to the fiscal year, the amount of money spent during any field season closely approximates the amount of money appropriated for the corresponding fiscal year. Thus the expenditures for starting parties in the field season of 1931 in advance of July 1 that were paid from one appropriation are about balanced by the expenditures for parties that started in the season of 1932 in advance of July 1 and were

paid from the next appropriation. In other words, the sum of the expenditures during a season, though paid from different appropriations, is essentially identical with the total amount of the appropriation available for a single year, unless there has been a marked change in the amount of money appropriated for the different years. Such a change took place in 1932, whereby the appropriation for the fiscal year 1932–33 was reduced 29 per cent, necessitating a great curtailment in the scope of the work that could be undertaken during the season of 1932.

The following table shows the principal classes of expenditures for which the appropriation for the fiscal year 1931–32 was allotted. The table is not to be regarded as a precise bookkeeping statement but rather a generalized summary to bring out the larger aspects of the work.

Approximate expenditures from funds appropriated for investigation of mineral resources of Alaska for the fiscal year 1931–32

Projects for the season of 1931	$22,190
Projects for the season of 1932	11,100
Administrative salaries, July 1, 1931, to June 30, 1932	4,970
All other technical and professional salaries, July 1, 1931, to June 30, 1932	32,930
All other clerical and drafting salaries, July 1, 1931, to June 30, 1932	8,710
Office maintenance and expenses	3,900
Balance and contingent	700
	84,500

In the first two items in the foregoing statement no charges are included for the salaries of any of the permanent employees of the branch, as all of these are carried in the three following items. Proper proportional charges for these services, as well as for the expenditures listed as office maintenance and expenses, might well have been made in these first two items, for practically every expenditure made by the branch relates more or less directly to these projects. Thus, the administrative officers are concerned primarily with the successful accomplishment of these projects, the scientific and technical personnel is maintained solely to carry out these projects, the clerical and drafting force is required to help in preparing the reports and maps and in attending to the innumerable details connected with the task of properly conducting the projects, and all the office supplies and other equipment purchased are really incidental to the task of carrying through the projects.

The expenditures for the projects of 1931 from the appropriation for 1932 amounted to $22,190, which includes $11,652 for geologic and general investigations and $10,538 for topographic work. The

expenditures for the season of 1932 from the same appropriation amounted to $11,100, of which $3,300 was for geologic work and $7,800 for topographic work. Of the $33,290 allotted to field projects for both seasons from the appropriation for 1932, $14,952, or about 45 per cent, was allotted to geologic or related general work and $18,338, or 55 per cent, to topographic work.

The item for administrative salaries in the foregoing table includes only those salaries that are directly related to general administration and does not include charges for administration such as each party chief is called on to perform with regard to the party in his charge, though that work requires considerable time and much administrative skill to discharge properly. During the fiscal year 1932 the chief Alaskan geologist was engaged in field work until October and later spent the equivalent of one and a half months on the preparation of the statistical report, as well as one and a half months in the preparation of other reports. This item includes part of Mr. Stewart's salary, as the local administration of the Alaska offices is in his charge, and part of the salary of the chief clerk of the branch, who acted for the chief Alaskan geologist during the time he was in the field. The low cost of administration is due principally to the fact that the administrative officers are engaged also in technical projects, to which are therefore charged proportional parts of their salaries. This makes for low cost of administration, but lessens the amount of time spent in real directive handling of many of the affairs of the branch and would not be at all practicable, except with a personnel long familiar with the work to be done and well qualified to solve for itself many of the problems that arise.

The item for clerical and drafting salaries covers the salaries of the chief clerk (except such part as is considered administrative duty), two junior clerks, occasional intermittent or irregular clerical service, and a draftsman in the Washington office and part of the salary of a clerk in the Anchorage office. Approximately three-fourths of the time of one of the junior clerks in the Washington office is given to the canvass and compilation of data regarding the production of minerals in the Territory. The draftsman is engaged in all kinds of map preparation, involving the compilation of cartographic material and the preparation of fair copy therefrom for use in direct reproduction or for record. The present clerical and drafting personnel is entirely too small to handle the volume of business that passes through the office. As a result, many things conducive to the proper conduct of the work are unduly rushed or laid aside, thus crippling or retarding the work. This condition has resulted from curtailments in appropriations, which have been met by curtailments in

the office force, so as to make as much money as possible available for the field projects. This practice has adversely affected the work as a whole and is really uneconomical.

The item for office maintenance and expenses in the table includes all the miscellaneous expenses incident to the general conduct of the work that are not directly part of a definite project. It includes purchase and repair of the technical instruments used, the photographic and related work required in the course of the compilation and preparation of the maps, and the printing of field photographs. Other expenditures that fall under this item are telegrams, stationery, technical books, services rendered by other units of the Geological Survey, such as making thin sections of rocks and minerals needed in microscopic examinations, and shipment of material not to be used in designated projects. The largest single type of expenses charged to this item is the photolithographic reproduction of topographic maps that are issued as preliminary editions subject to correction. During the year six maps of this type were charged against this item. (See pp. 87–88.) The purchase of technical instruments was the second heaviest charge against this item and included among other things the cost of a new petrographic microscope and a transit.

In the following tables has been set down the cost of the projects, including field expenses and the salaries paid from different appropriations, by geographic regions or by classes of work. Only the salaries of the permanent technical force are included in the column of salaries. The wages paid to temporary assistants, camp hands, and other seasonal employees are included in the columns headed "Expenses." The figures for the portions of the salaries charged against each project are only approximately accurate, for the whole time of a geologist or topographer assigned to a project is charged against that project, whereas much of his time in the office is required for miscellaneous duties. The columns of salaries, except as specifically noted, do not include administrative salaries or clerical salaries, and the columns of expenses do not include items charged to office expense or maintenance. For these reasons, as well as because two different appropriation years are tabulated together, the total given in the last column does not equal, even approximately, the total given in the table on page 105, which represents a single fiscal year. Furthermore, the charges against the appropriation for 1933 are necessarily only estimates, as actual expenditures will not be known until the end of the field work in the winter or until the completion of the report next spring. The figures used therefore simply represent the advance allotments or estimates that have been made for the different projects.

Approximate cost and distribution of work by geographic divisions for the season of 1931

Region and work	Appropriation for 1931		Appropriation for 1932		Total
	Expenses	Salaries	Expenses	Salaries	
Southeastern Alaska, Wrangell and vicinity, reconnaissance topography	$3,500	$1,300	$4,582	$6,500	$15,882
Southeastern Alaska, Taku region and Alaska offices, mineral resources			2,000	2,410	4,410
Southeastern Alaska, Glacier Bay, geology and mineral resources	500		2,500		3,000
Copper River region, Suslota Pass district, geologic reconnaissance	1,360	650	2,948	4,550	9,508
Copper River region, Tonsina Lake district, topographic mapping	2,500	483	4,560	2,417	9,960
Central Yukon region, Rampart-Hot Springs district, geologic reconnaissance	3,800	800	2,121	4,000	10,721
Southwestern Alaska, Nushagak district, reconnaissance topography and geology	2,975	1,000	2,792	4,500	11,267
General mining developments, central Alaska			687	2,133	2,820
Mineral statistics				2,327	2,327
Total	14,635	4,233	22,190	28,837	69,895

Approximate cost and distribution of work by geographic divisions for the season of 1932

Region and work	Appropriation for 1932		Appropriation for 1933		Total
	Expenses	Salaries	Expenses	Salaries	
Southeastern Alaska, Wrangell and vicinity, reconnaissance topography	$3,000	$1,300	$2,400	$6,500	$13,200
Southeastern Alaska, Taku and Alaska offices, mineral resources			500	2,410	2,910
Copper River region, reconnaissance topography	2,950	483	1,070	2,417	6,920
Copper River region, Klutina Lake, geologic reconnaissance	2,650	650	985	4,550	8,835
Yukon-Tanana region, preparation of report		400		4,000	4,400
Southwestern Alaska, North Kodiak and vicinity, topographic mapping	1,850	667	650	3,333	6,500
Southwestern Alaska, Aleutian Islands, geologic reconnaissance	500	1,400	400	4,200	6,500
General mining developments	150		450	2,133	2,733
Mineral statistics				2,147	2,147
Total	11,100	4,900	6,455	31,690	54,145

COOPERATIVE WORK WITH THE ALASKA RAILROAD

OUTLINE OF PLAN

The development of mineral resources necessarily involves the problem of transportation to bring supplies in and the resulting product out. Consequently for many years the Geological Survey has been vitally interested in that problem, and it was with the aim of aiding the development of those resources that the Geological Survey urged the opening up of the country by railroads and wagon roads and made extensive examinations of the deposits that might be developed adjacent to the principal natural routes that could be utilized by these avenues of communication. With the building of

the Alaska Railroad the early emphasis shifted, or rather was amplified, because there was added to the older incentive to search for and aid in the development of mineral resources the Government's own interest in establishing business for the railroad. Although the second reason was recognized it was not at first stressed, because, according to its organic act, the construction of the railroad was not undertaken so much to enter the business of common carrier as to develop the Territory. However, the excess of expenses over income was large, and Col. O. F. Ohlson, the manager of the railroad, as early as 1929 requested aid from the Geological Survey to determine what could be done to stimulate mineral development that might contribute tonnage to the railroad. The obligation to give all assistance possible was keenly felt, not only as a friendly act but as a very real responsibility on the Geological Survey's own account toward the mineral industry, and through it to the development of the Territory. However, with the funds and personnel available only a little new work was actually accomplished. In 1930, however, when a senatorial committee visited Alaska with the prime purpose of seeing what could be done to decrease the deficit of the Alaska Railroad they concluded that active steps should be taken to stimulate mining in the region tributary to the railroad. The committee supported this conclusion by recommending an appropriation of $250,000 to carry it out. This fund was subsequently granted by Congress in 1931 " for the continuation of the investigation of mineral and other resources of Alaska to ascertain the potential resources available which will affect railroad tonnage." To avoid the expense and difficulty of setting up a new organization to conduct this work, the Geological Survey was asked to submit recommendations as to the areas that appeared desirable to examine under this grant. After numerous conferences and interchanges of views it was agreed to undertake at once investigation of 10 different areas adjacent to the railroad, and the Geological Survey was invited to direct the technical work through its trained personnel and in accordance with estimates of expenses that had been approved by the manager of the Alaska Railroad, who made the necessary funds available.

PROJECTS IN PROGRESS IN 1931

The 10 projects that were approved for the season of 1931 embraced examinations in 1 coal area (Anthracite Ridge), 5 gold districts (Fairbanks, Willow Creek, Moose Pass, Girdwood, and Valdez Creek), and 3 areas where the lodes consisted mainly of mixed sulphides (Eureka, Mount Eielson, and the West Fork of the Chulitna River), and a general investigation of the potential nonmetalliferous deposits throughout the railroad belt. As all these areas had

been already examined by Geological Survey geologists in a manner that was regarded as adequate for reconnaissance standards, the new work was to be of a much more detailed and intensive character and was directed toward quantitative determination of possible mineral tonnage rather than toward more general theoretical studies. The direct oversight of all the parties was in charge of S. R. Capps. During part of the season, through the courtesy of the geologic branch, the services of D. F. Hewett were made available as special consultant, and he visited in the field many of the parties working in metalliferous areas and gave advice and suggestions that were of great assistance. Through the courtesy of the Bureau of Mines the samples collected by the different parties were analyzed at the laboratories of the bureau in Alaska—the coal samples in the coal-testing laboratory at Anchorage and the metallic and nonmetallic minerals other than coal in the laboratory at Fairbanks, conducted in cooperation with the Alaska Agricultural College and School of Mines. Cooperation was also courteously afforded by the Alaska Road Commission, through its president, Maj. Malcolm Elliott, in placing its facilities at the disposal of the parties in areas where the commission was carrying on work.

It is unnecessary to set down here the technical results accomplished by each of the different parties, as they are summarized elsewhere in this volume. The complete reports of each except the nonmetalliferous investigations are now in preparation. The following table presents in condensed form information regarding the various projects:

Summary of Alaska Railroad projects

District or area	Principal kind of deposits examined	Types of work	Technical personnel
Anthracite Ridge	Coal field	Detailed mineral resources and topography (1:12,000).	R. W. Richards, geologist in charge; G. A. Waring, geologist; L. O. Newsome, assistant topographic engineer.
Fairbanks	Gold lodes	Detailed mineral resources	J. M. Hill, geologist.
Willow Creek	do	do	J. C. Ray, geologist.
Moose Pass-Hope	do	do	Ralph Tuck, assistant geologist.
Girdwood	do	Detailed mineral resources and topography (1:62,500).	W. G. Carson, assistant topographic engineer in charge; C. F. Park, geologist.
Valdez Creek	Gold lodes and placers.	Detailed mineral resources and reconnaissance topography.	C. P. Ross, geologist.
Eureka (Kantishna)	Gold and mixed sulphides.	Detailed mineral resources and topography (1:62,500).	F. G. Wells, assistant geologist in charge; S. C. Kain, assistant topographic engineer.
Mount Eielson	Copper, lead, and zinc.	Detailed mineral resources and topography (1:62,500 and 1:24,000).	S. N. Stoner, associate topographic engineer in charge; J. C. Reed, assistant geologist.
West Fork of the Chulitna.	Gold and mixed sulphides.	Detailed mineral resources and reconnaissance topography.	C. P. Ross, geologist.
General	Nonmetalliferous deposits.	Reconnaissance mineral resources.	G. A. Waring, geologist.

PROJECTS IN PROGRESS IN 1932

Of all the projects undertaken in the summer of 1931 probably the most general interest centered around the work in the vicinity of Anthracite Ridge. It was the occurrence in this field of a bed of anthracite nearly 40 feet thick that undoubtedly induced the senatorial committee to take such an optimistic view as to the probability of discovering mineral tonnage for the railroad, and the large amount of money recommended was based on the idea of core drilling this field extensively. However, although this field had already been gone over with some thoroughness by its geologists, the Geological Survey felt that the great expense of drilling should not be incurred until all the information that could be gleaned from surface examination had been utilized. When the reports of the Richards-Waring party were received and showed that the geologic information that could be obtained from surface indications was not adequate as a basis for conclusions but suggested that there was a good chance that a considerable area was underlain by coal, though its character and volume could not be foretold, it became evident that the best way to determine the real value of the field was by drilling. On the presentation of these facts, Colonel Ohlson authorized the Geological Survey to draw up specifications and proposals to be sent out to contractors to carry through the program. Bids were received and opened on January 15, 1932, and the contract was awarded to Lynch Bros., of Seattle, Wash., to drill four holes at specified points, an estimated depth of 2,000 feet each, and to recover the cores from them. The Geological Survey was to represent the Alaska Railroad in the field by assigning an engineer to see that the drilling was carried on in accordance with the specifications and to receive and take care of the cores as recovered. G. A. Waring, geologist, was designated as the Survey representative and P. A. Davison, junior geologist, was assigned to act as his assistant. Messrs. Waring and Davison left Washington early in February to carry out this assignment. According to the terms of the contract the driller has until December 31, 1932, to complete the work, but it seems probable that if no unusual difficulties arise the work may be finished considerably before that date. After the drilling is completed there will still remain much work to be done in examining the cores, testing the coals, and analyzing the geologic interpretations that are to be drawn from the information obtained. These are only the geologic aspects of the problem, and before a decision can be reached as to the commercial possibilities of developing the field it will be necessary to examine critically the mining problems, the cost of extracting and preparing the coal, and its availability for different uses, and the still larger problem of markets. Ob-

viously, unless a large quantity of a coal that can be marketed on its own merits in competition with other coals can be demonstrated without much shadow of a doubt, it will be difficult to get responsible operators to make the outlay of funds to start the necessary preliminary construction, which will include among other things the building of a suitable line of transportation to the field from the present end of the Chickaloon branch of the railroad, a distance of at least 15 miles.

Another drilling project to test a coal area adjacent to the railroad, undertaken by the Geological Survey in 1932, involves the testing of an area west of the present developed part of the Moose Creek field in the Matanuska Valley. In the past the coals in this field have not been entirely satisfactory, because they crumble and break badly when handled in the course of transit. Furthermore, the beds stand at rather high angles and are therefore rather expensive to mine. To the west of the developed area the dip of the beds seems to flatten, and this suggests that the coals may be less shattered and capable of being more cheaply mined. The region is heavily covered with glacial deposits, however, so that rock exposures are lacking and the most suitable method of determining the sequence and structure of beds is by drilling them and recovering cores of the formations penetrated. With the approval of Colonel Ohlson specifications for this work were prepared by the Geological Survey. The bids were opened April 30, 1932, and the contract was awarded to the Pennsylvania Drilling Co., of Pittsburgh, Pa. Under the terms of this contract four holes are to be drilled at designated points west of Moose Creek, the estimated depth of each being about 1,000 feet and the work to be completed by December 31, 1932. General oversight of the Government's interest in this work has been intrusted to G. A. Waring, but after it is under way the details will probably be looked after by P. A. Davison. As in the Anthracite Ridge project much will remain to be done after the drilling is finished before a final conclusion can be reached as to the commercial possibilities of this field. On the whole, however, the problem in the Moose Creek field appears to be much simpler than that in the Anthracite Ridge field, and Moose Creek has the added advantage for development that it lies within a few miles of existing transportation lines.

Another means of aiding the railroad in its endeavor to stimulate the production of minerals in the territory adjacent to its line has been the assignment of a geologist to the headquarters of the railroad at Anchorage, so that he may be readily available for consultation both by the officials and by others who wish technical information. This duty, with the approval of Colonel Ohlson, has been assigned to Ralph Tuck, who during the season of 1931 was engaged in field

examinations in the Moose Pass-Hope district, as noted on page 110. After the conclusion of the field work on that project Mr. Tuck went to Anchorage and made that town his headquarters. According to his instructions, Mr. Tuck's first duty is to render any assistance that he can to the manager of the Alaska Railroad and to undertake any special investigations that are assigned to him. In addition, he is expected to familiarize himself with the mineral resources throughout the railroad belt and to prepare reports on the investigations undertaken by him. In following out these instructions Mr. Tuck during the winter of 1931–32 made trips throughout the extent of the railroad, made several special examinations, completed a report on the Moose Pass-Hope district, and started a comprehensive file listing all the mineral properties adjacent to the railroad. So satisfactorily has the cooperation worked out that the manager of the railroad has requested that the arrangement be continued.

Part of the plan of assigning a geologist to cooperate with the railroad contemplated that each year the geologist should spend most of the open season in the examination of some prospective mineral-bearing area whose development might contribute tonnage to the railroad. In accordance with recommendations from the Geological Survey, Colonel Ohlson approved for the season of 1932 an examination of an extensive tract along the southern flanks of the Alaska Range between Ruth and Eldridge Glaciers, about west of Curry, a region which has been only slightly prospected but which has shown indications of containing mineral deposits that may be of commercial value. This work will be carried on by a combined geologic and topographic party consisting of Ralph Tuck, assistant geologist, C. P. McKinley, topographic engineer, and four camp hands and field helpers. The surveys will be of the usual reconnaissance type, the topographic mapping being done by plane table and traverse methods, supplemented by the use of the phototopographic panoramic camera. Field work was started about the middle of June and will be continued as long as forage for the pack animals can be obtained or as weather and other conditions permit. The report and maps resulting from these investigations will be worked up during the fall and winter as rapidly as other duties permit.

EXPENDITURES

It is impracticable to present here a detailed analysis of the expenditures that have been made by the Geological Survey in connection with the work it has done in cooperation with the Alaska Railroad, because such an analysis would give only a partial picture of the project as a whole. This situation arises through the fact that although all the money used is carried in the railroad appropria-

tion, only such amounts as are needed for direct expenditure by the Geological Survey are transferred to its credit. For example, only part of the expenses for the surface examinations in the Anthracite Ridge project were paid through a transfer of funds to the Geological Survey, and other expenses of the surface party, as well as the much larger amounts due to the driller under his contract, will be paid directly by the railroad. Obviously, all these financial transactions have been adequately accounted for in accordance with regular Government business procedure both by the Geological Survey and the Alaska Railroad. All the funds used in the railroad projects were provided in the items for the Alaska Railroad carried in the Interior Department appropriation acts of 1931, 1932, and 1933, already noted.

However, although the details are not regarded as significant in giving a general idea of the total expenses incurred and although the work is still in progress, so that the costs must be given as estimates and not as actual expenditures, it may be of interest to state in general terms the allotments so far made to the Geological Survey for disbursement. The field investigations carried on by the parties in the railroad belt during the season of 1931 were allotted approximately $72,000; the expenses of supervision of the drilling and other Geological Survey work in connection with the Anthracite Ridge and Moose Creek coal field projects until December 31, 1932, are estimated as $13,800; and the field expenses of the reconnaissance geologic and topographic survey, including all office charges for Mr. Tuck's services until December 31, 1932, are estimated at $7,000. In addition the contracts for drilling at Anthracite Ridge and Moose Creek have obligated the railroad to expenditures that may approximate $58,000 and $28,000, respectively. The cost of drilling is indeterminate in advance, as the price paid is dependent on the amount of core recovered. For instance, the contract for the work at Anthracite Ridge provides for a charge of $4.25 a foot for drilling and of an additional $3 for each foot of core recovered, and the contract for the Moose Creek project provides for $5.50 a foot for drilling and an additional $1.50 for each foot of core recovered. All the foregoing estimates provide only for expenses directly incurred in connection with the projects and do not include any charges for the general administration exercised by the officials of the Survey nor any indirect charges for overhead Washington office expenses, although the projects have thrown a heavy load on the small regular personnel. Furthermore, the Geological Survey has agreed to provide for the publication of the reports and maps resulting from the cooperation with the railroad from the funds appropriated for its regular work.

LEASING WORK

Part of the activities of the Alaskan branch are related to the proper conduct of mining work on the public mineral lands that have been or may be leased to private individuals or corporations under certain laws. Funds for this work throughout the United States are provided in a general item contained in the Interior Department appropriation act, under the following language: "For the enforcement of the provisions of the acts of October 30, 1914, October 2, 1917, February 25, 1920, and March 4, 1921, and other acts relating to the mining and recovery of minerals on Indian and public lands and naval petroleum reserves." Appropriations carried for this item are available only during the specified fiscal year. The amount that is allotted for the different districts, including Alaska, is determined by the relative needs of each district. For the fiscal year 1932 the allotment for Alaska leasing work was $8,000, or $2,000 less than in the preceding fiscal year.

In order that the policies and practices that have been developed by the leasing unit of the conservation branch of the Geological Survey for handling the much larger volume of similar work in the States should be maintained in Alaska and at the same time the specialized knowledge of Alaska affairs possessed by the Alaskan branch should be utilized, the general conduct of the leasing work in Alaska is in a measure shared between the two branches, the office work in Washington being done principally by the conservation branch and the field work by the Alaskan branch. The field work is done by the same engineers who conduct such work on mineral resources as is assigned to the Alaska local offices. B. D. Stewart, supervising engineer, who has headquarters at Juneau, is in immediate charge of the field work, assisted by J. J. Corey, coal-mining engineer, at Anchorage. The use of the same personnel and facilities for both the leasing work and the work on mineral resources makes it extremely difficult and at times uncertain to distinguish accurately between the two. Except from an accountant's point of view, however, the distinction is of little importance. The point of real importance is that by this close cooperation or consolidation of interests duplication of activities is avoided, costs are lowered, and the technical facilities are focused on the main problem, which is the development of the Territory's mineral resources. During the fiscal year 1932 about three-fifths of Mr. Stewart's time, four-fifths of Mr. Corey's time, and three-quarters of the time of a clerk in the Anchorage office are considered to have been devoted to the leasing work. The charges for the maintenance of the local office at Anchorage are shared between the leasing and mineral-resources work in the ratio of about 3 to 1. In the fiscal year 1932 the allotment for

field expenses was approximately $1,200, an amount that is inordinately low and that proved adequate only because the Alaska Railroad has extended to the limit its services in facilitating the movement of the engineers.

The primary purpose of the leasing work is to supervise the operations under the coal and oil leases or permits that have been granted by the Government and to advise and consult with the proper authorities, both Federal officers and private applicants, regarding lands that may be under consideration for a lease or permit. Practically all the coal mining and much of the oil prospecting in Alaska is done on public lands by private individuals or companies under leases or permits issued by the Secretary of the Interior. The interest of the Government in these lands requires not only that these grants shall be a source of revenue to the Nation but that proper methods of extracting the minerals shall be employed, thus preventing waste or damage to the property, and that the lives, health, and welfare of those engaged in the work shall be properly safeguarded. Practically all the producing coal mines that have been opened in the Territory are in the region adjacent to the Alaska Railroad. The Goverment has therefore an especially direct interest in their successful operation. For this reason the Federal engineers have given intensive study to the problems confronting these mines and have been especially active in supervising their operations, not only to see that the terms of the leases are observed but also to be of as much assistance as possible to the small operators who are opening them, by giving them competent technical advice and so aiding them in making their ventures successful. Among the points to which special attention has been given are the installation and maintenance of safe and efficient tramming and hoisting equipment, the adequate ventilation of the mines, the reduction of explosion and blasting hazards, and the providing of adequate pillars in advance of all mining operations. This service is appreciated by the operators, and the relations between them and the engineers are extremely cordial and friendly, with no hint of the antagonism that sometimes exists between inspector and inspected.

During 1931 the operator of one of the two coal mines in the Matanuska district that had furnished a considerable part of the coal used in the operation of the railroad found it financially impracticable to continue operation and decided to close the mine temporarily. This would result in flooding the mine, and the Government engineers felt that such a procedure would jeopardize the whole tract adjacent to the property. The Alaska Railroad on representation of these facts by the Geological Survey entered into

an arrangement with the operator whereby the railroad would keep the water pumped out and in return would be allowed to mine enough coal to defray the cost. This work was placed in charge of J. J. Corey, who maintained a small force at the mine throughout the year and mined several thousand tons under this arrangement.

At the present time almost no active drilling for oil is being done in Alaska under Government permit, and consequently little of the time of the engineers is spent in the supervision of oil developments. There are, however, many tracts of public land in Alaska that appear to hold promise of containing oil, and hundreds of prospecting permits for oil have been issued by the Government throughout the length and breadth of the Territory. It would ordinarily be the practice for the Federal engineers to check up on these permits occasionally by field visits, but the field force available is altogether too small to attempt to make even a casual examination of most of the tracts under permit. Under present conditions it is therefore necessary to rely mostly on local unofficial reports, especially as these indicate no active oil prospecting in progress in any but two of the fields. In this connection it should be pointed out that the number of engineers needed to look after the Government's mineral lands in Alaska can not fairly be measured by the relatively small revenues received by the Government at this time, nor by the number of leases or permits outstanding. In Alaska the Government lands are so much more extensive, the open season is so short, the distances so great, and the regular means of transportation so slow and infrequent that either a force proportionately much larger than is required in many of the States must be maintained, or supervision in the more remote parts must be reduced to a mere gesture.

SELECTED LIST OF GEOLOGICAL SURVEY PUBLICATIONS ON ALASKA

[Arranged geographically]

All these publications can be obtained or consulted in the following ways:

1. The reports are sold, at the prices indicated, by the Superintendent of Documents, Washington, D. C., to whom remittances should be sent by money order. No copies are available of those marked with an asterisk (*); they may be consulted at many public libraries.

2. The maps whose price is stated are sold by the Geological Survey and not by the Superintendent of Documents. On an order for maps amounting to $5 or more at the retail price a discount of 40 per cent is allowed.

3. Copies of all Government publications are furnished to the principal public libraries throughout the United States, where they can be consulted by those interested.

GENERAL

REPORTS

* The geography and geology of Alaska, by A. H. Brooks. Professional Paper 45, 1906, 327 pp.

The Alaskan mining industry in 1931, by Philip S. Smith. In Bulletin 844, 1933, — cents. The preceding volumes in this series and years covered are Bulletins 259, 1904, 15 cents; 284, 1905, 25 cents; 314, 1906, 30 cents; 345, 1907, 45 cents; 379, 1908, 50 cents; 442, 1909, 40 cents; 480, 1910, 40 cents; 520, 1911, 50 cents; 542, 1912, 25 cents; * 592, 1913 (592–A, 15 cents); 622, 1914, 30 cents; 642, 1915, 35 cents; 662, 1916, 75 cents; *692, 1917 (692–A, 5 cents); * 712, 1918; * 714, 1919 (714–A, 25 cents); 722, 1920, 25 cents; 739, 1921, 25 cents; 755, 1922, 40 cents; 773, 1923, 40 cents; 783, 1924, 40 cents; 792, 1925, 25 cents; 797, 1926, 80 cents; 810, 1927, 50 cents; 813, 1928, 40 cents; 824, 1929, 20 cents; 836–A, 1930, 20 cents.

Railway routes from the Pacific seaboard to Fairbanks, Alaska, by A. H. Brooks. In Bulletin 520, 1912, pp. 45–88, 50 cents.

Geologic features of Alaskan metalliferous lodes, by A. H. Brooks. In Bulletin 480, 1911, pp. 43–93. 40 cents.

Alaska coal and its utilization, by A. H. Brooks. Bulletin 442–J, reprinted 1914, pp. 47–100. 10 cents.

The preparation and use of peat as a fuel, by C. A. Davis. In Bulletin 442, 1910, pp. 101–132. 40 cents.

* Methods and costs of gravel and placer mining in Alaska, by C. W. Purington. Bulletin 263, 1905, 273 pp.

* Geographic dictionary of Alaska, by Marcus Baker (second edition, prepared by James McCormick), Bulletin 299, 1906, 690 pp.

Tin mining in Alaska, by H. M. Eakin. In Bulletin 622, 1915, pp. 81–94. 30 cents.

Antimony deposits of Alaska, by A. H. Brooks. Bulletin 649, 1916, 67 pp. 15 cents.

The use of the panoramic camera in topographic surveying, by J. W. Bagley. Bulletin 657, 1917, 88 pp. 25 cents.

Mineral springs of Alaska, by G. A. Waring. Water-Supply Paper 418, 1917, 114 pp. 25 cents.

The future of Alaska mining, by A. H. Brooks. Bulletin 714–A, 1921, pp. 5–57. 25 cents.

Preliminary report on petroleum in Alaska by G. C. Martin. Bulletin 719, 1921, 83 pp. 50 cents.

The Mesozoic stratigraphy of Alaska, by G. C. Martin. Bulletin 776, 1926, 493 pp. 75 cents.

The Upper Cretaceous flora of Alaska, by Arthur Hollick, with a description of the Upper Cretaceous plant-bearing beds, by G. C. Martin. Professional Paper 159, 1930, 123 pp., 87 pls. 80 cents.

Glaciation in Alaska, by S. R. Capps. In Professional Paper 170, 1932, pp. 1–8, 15 cents.

In preparation

The Tertiary flora of Alaska, by Arthur Hollick, with a chapter on the geology of the Tertiary deposits, by Philip S. Smith.

TOPOGRAPHIC MAPS

Map of Alaska (A); scale, 1:5,000,000; 1931. 10 cents retail or 6 cents wholesale.

Map of Alaska (C); scale, 1:12,000,000; 1929. 1 cent retail or five for 3 cents wholesale.

Index map of Alaska, including list of publications; scale, 1:5,000,000; 1929. Free on application.

Relief map of Alaska (D); scale, 1:2,500,000; 1923. 50 cents retail or 30 cents wholesale.

Map of Alaska (E); scale, 1:2,500,000; 1931. 25 cents retail or 15 cents wholesale.

SOUTHEASTERN ALASKA

REPORTS

The Juneau gold belt, by A. C. Spencer, pp. 1–137, and A reconnaissance of Admiralty Island, by C. W. Wright, pp. 138–154. Bulletin 287, 1906, 161 pp. 75 cents.

Reconnaissance on the Pacific Coast from Yakutat to Alsek River, by Eliot Blackwelder. In Bulletin 314, 1907, pp. 82–88. 30 cents.

The Ketchikan and Wrangell mining districts, by F. E. and C. W. Wright. Bulletin 347, 1908, 210 pp. 60 cents.

The Yakutat Bay region, Alaska, by R. S. Tarr and B. S. Butler. Professional Paper 64, 1909, 183 pp. 50 cents.

Occurrence of iron ore near Haines, by Adolph Knopf. In Bulletin 442, 1910, pp. 144–146. 40 cents.

Geology of the Berners Bay region, by Adolph Knopf. Bulletin 446, 1911, 58 pp. 20 cents.

The Eagle River region, southeastern Alaska, by Adolph Knopf. Bulletin 502, 1912, 61 pp. 25 cents.

The Sitka mining district, by Adolph Knopf. Bulletin 504, 1912, 32 pp. 5 cents.

The earthquakes at Yakutat Bay, in September, 1899, by R. S. Tarr and Lawrence Martin. Professional Paper 69, 1912, 135 pp. 60 cents.

*A barite deposit near Wrangell, by E. F. Burchard. In Bulletin 592, 1914, pp. 109–117.

Geology and ore deposits of Copper Mountain and Kasaan Peninsula, by C. W. Wright. Professional Paper 87, 1915, 110 pp. 40 cents.

*The structure and stratigraphy of Gravina and Revillagigedo Islands, by Theodore Chapin. In Professional Paper 120, 1918, pp. 83–100.

*Geology and mineral resources of the west coast of Chichagof Island, by R. M. Overbeck. In Bulletin 692, 1919, pp. 91–136.

The Porcupine district, by H. M. Eakin. Bulletin 699, 1919, 29 pp. 20 cents.

Notes on the Salmon-Unuk River region, by J. B. Mertie, jr. Bulletin 714–B, 1921, pp. 129–142. 10 cents.

Marble resources of southeastern Alaska, by E. F. Burchard. Bulletin 682, 1920, 118 pp. 30 cents.

Water-power investigations in southeastern Alaska, by G. H. Canfield. In Bulletin 722, 1922. 25 cents. Similar previous reports in Bulletins 642, 1916, 35 cents; 662, 1917, 75 cents; *692, 1919; *712, 1920; 714–B, 1921, 10 cents.

Ore deposits of the Salmon River district, Portland Canal region, by L. G. Westgate. In Bulletin 722, 1922, pp. 117–140. 25 cents.

Mineral deposits of the Wrangell district, by A. F. Buddington. In Bulletin 739, 1923, pp. 51–75. 25 cents.

Mineral investigations in southeastern Alaska in 1924, by A. F. Buddington. In Bulletin 783, 1927, pp. 41–62. 40 cents. Similar report for 1923 in Bulletin 773, 1925, pp. 71–139. 40 cents.

Aerial photographic surveys in southeastern Alaska, by F. H. Moffit and R. H. Sargent. In Bulletin 797, 1929, pp. 143–160. 80 cents.

Geology of Hyder and vicinity with a reconnaissance of Chickamin River, southeastern Alaska, by A. F. Buddington. Bulletin 807, 1929, 124 pp. 35 cents.

Geology and mineral deposits of southeastern Alaska, by A. F. Buddington and Theodore Chapin. Bulletin 800, 1929, 398 pp. 85 cents.

The occurrence of gypsum at Iyoukeen Cove, Chichagof Island, by B. D. Stewart. In Bulletin 824, 1931, pp. 173–177. 20 cents.

Notes on the geography and geology of Lituya Bay, by J. B. Mertie, jr. Bulletin 836–B, 1932, pp. 117–135. 5 cents.

Surface-water supply of southeastern Alaska, by F. F. Henshaw. Bulletin 836–C, 1933, pp. 137–218. 10 cents.

In preparation

Geology and ore deposits of the Juneau district, by H. M. Eakin.

Glacier Bay and vicinity, by F. E. and C. W. Wright.

Mineral resources of Taku River region, by B. D. Stewart.

TOPOGRAPHIC MAPS

Juneau gold belt, Alaska; scale, 1:250,000; compiled. In Bulletin 287, 1906. 75 cents. Not issued separately.

Juneau special (No. 581A); scale, 1:62,500; 1904, by W. J. Peters. 10 cents retail or 6 cents wholesale.

Berners Bay special (No. 581B); scale, 1:62,500; 1908, by R. B. Oliver. 10 cents retail or 6 cents wholesale. Also contained in Bulletin 446, 1911, 20 cents.

Kasaan Peninsula, Prince of Wales Island (No. 540A); scale 1:62,500; by D. C. Witherspoon, R. H. Sargent, and J. W. Bagley. 10 cents retail or 6 cents wholesale. Also contained in Professional Paper 87, 1915, 40 cents.

Copper Mountain and vicinity, Prince of Wales Island (No. 540B); scale, 1:62,500; by R. H. Sargent. 10 cents retail or 6 cents wholesale. Also contained in Professional Paper 87, 1915, 40 cents.

Eagle River region; scale, 1:62,500; by J. W. Bagley, C. E. Giffin, and R. E. Johnson. In Bulletin 502, 1912, 25 cents. Not issued separately.

Juneau and vicinity (No. 581D); scale 1:24,000; 1918, by D. C. Witherspoon. 20 cents retail or 12 cents wholesale.

Hyder and vicinity (No. 540C); scale, 1:62,500; 1927, by R. M. Wilson. 10 cents retail or 6 cents wholesale. Also published in Bulletin 807, 1929, 35 cents.

Revillagigedo Island; scale, 1:250,000; 1931, by R. H. Sargent (preliminary edition). Free on application.

Wrangell district; scale, 1:250,000; 1932, by R. H. Sargent and V. S. Seward (preliminary edition). Free on application.

In preparation

Taku district. Compiled principally from aerial photographs taken by the Alaska aerial survey expeditions of the Navy Department, 1926 and 1929.

CONTROLLER BAY, PRINCE WILLIAM SOUND, AND COPPER RIVER REGIONS

REPORTS

Geology of the central Copper River region, by W. C. Mendenhall. Professional Paper 41, 1905, 133 pp. 50 cents.

Geology and mineral resources of Controller Bay region, by G. C. Martin. Bulletin 335, 1908, 141 pp. 70 cents.

Mineral resources of the Kotsina-Chitina region, by F. H. Moffit and A. G. Maddren. Bulletin 374, 1909, 103 pp. 40 cents.

Mineral resources of the Nabesna-White River district, by F. H. Moffit and Adolph Knopf, with a section on the Quaternary, by S. R. Capps. Bulletin 417, 1910, 64 pp. 25 cents.

Reconnaissance of the geology and mineral resources of Prince William Sound, by U. S. Grant and D. F. Higgins. Bulletin 443, 1910, 89 pp. 45 cents.

Geology and mineral resources of the Nizina district, by F. H. Moffit and S. R. Capps. Bulletin 448, 1911, 111 pp. 40 cents.

Headwater regions of Gulkana and Susitna Rivers, with accounts of the Valdez Creek and Chistochina placer districts, by F. H. Moffit. Bulletin 498, 1912, 82 pp. 35 cents.

Coastal glaciers of Prince William Sound and Kenai Peninsula, by U. S. Grant and D. F. Higgins. Bulletin 526, 1913, 75 pp. 30 cents.

The McKinley Lake district, by Theodore Chapin. In Bulletin 542, 1913, pp. 78–80. 25 cents.

Geology of the Hanagita-Bremner region, Alaska, by F. H. Moffit. Bulletin 576, 1914, 56 pp. 30 cents.

* Mineral deposits of the Yakataga district by A. G. Maddren. In Bulletin 592, 1914, pp. 119–153.

* The Port Wells gold-lode district, by B. L. Johnson. In Bulletin 592, 1914, pp. 195–236.

* Geology and mineral resources of Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant. Bulletin 587, 1915, 243 pp.

The gold and copper deposits of the Port Valdez district, by B. L. Johnson. In Bulletin 622, 1915, pp. 140–188. 30 cents.

The Ellamar district, by S. R. Capps and B. L. Johnson. Bulletin 605, 1915, 125 pp. 25 cents.

* A water-power reconnaissance in south-central Alaska, by C. E. Ellsworth and R. W. Davenport. Water-Supply Paper 372, 1915, 173 pp.

Copper deposits of the Latouche and Knight Island districts, Prince William Sound, by B. L. Johnson. In Bulletin 662, 1917, pp. 193–220. 75 cents.

The Nelchina-Susitna region, by Theodore Chapin. Bulletin 668, 1918, 67 pp. 25 cents.

The upper Chitina Valley, by F. H. Moffit, with a description of the igneous rocks, by R. M. Overbeck. Bulletin 675, 1918, 82 pp. 25 cents.

* Platinum-bearing auriferous gravel of Chistochina River, by Theodore Chapin. In Bulletin 692, 1919, pp. 137–141.

* Mining on Prince William Sound, by B. L. Johnson. In Bulletin 692, 1919. Similar previous reports in Bulletins * 592, 1914; 622, 1915, 30 cents; 642, 1916, 35 cents; 662, 1918, 75 cents.

* Mineral resources of Jack Bay district and vicinity, by B. L. Johnson. In Bulletin 692, 1919, pp. 153–173.

* Nickel deposits in the lower Copper River Valley, by R. M. Overbeck. In Bulletin 712, 1919, pp. 91–98.

The Kotsina-Kuskulana district, by F. H. Moffit and J. B. Mertie, jr. Bulletin 745, 1923, 149 pp. 40 cents.

The metalliferous deposits of Chitina Valley, by F. H. Moffit. In Bulletin 755, 1924, pp. 57–72. 40 cents.

The occurrence of copper on Prince William Sound, by F. H. Moffit. In Bulletin 773, 1925, pp. 141–158. 40 cents.

Notes on the geology of the upper Nizina River, by F. H. Moffit. In Bulletin 813, 1930, pp. 143–163. 40 cents.

The Slana district, upper Copper River region, by F. H. Moffit. In Bulletin 824, 1931, pp. 111–124. 20 cents.

The Suslota Pass district, upper Copper River region, by F. H. Moffit. In Bulletin 844, 1933, pp. —. — cents.

In preparation

The geology and mineral resources of the Chitina Valley and some adjacent areas, by F. H. Moffit.

TOPOGRAPHIC MAPS

Central Copper River region; scale, 1:250,000; by T. G. Gerdine. In Professional Paper 41, 1905, 50 cents. Not issued separately. Reprint in Bulletin 498, 1912, 35 cents.

Headwater regions of Copper, Nabesna, and Chisana Rivers; scale, 1:250,000; by D. C. Witherspoon, T. G. Gerdine, and W. J. Peters. In Professional Paper 41, 1905, 50 cents. Not issued separately.

Controller Bay region (No. 601A); scale, 1:62,500; 1907, by E. G. Hamilton and W. R. Hill. 35 cents retail or 21 cents wholesale. Also published in Bulletin 335, 1908, 70 cents.

Headwater regions of Nabesna and White Rivers; scale, 1:250,000, by D. C. Witherspoon, T. G. Gerdine, and S. R. Capps. In Bulletin 417, 1910, 25 cents. Not issued separately.

Latouche Island, part of; scale, 1:21,120; by D. F. Higgins. In Bulletin 443, 1910, 45 cents. Not issued separately.

Chitina quadrangle (No. 601); scale, 1:250,000; 1914, by T. G. Gerdine, D. C. Witherspoon and others. Sale edition exhausted. Also published in Bulletin 576, 1914, 30 cents.

Nizina district (No. 601B); scale, 1:62,500, by D. C. Witherspoon and R. M. La Follette. In Bulletin 448, 1911, 40 cents. Not issued separately.

Headwater regions of Gulkana and Susitna Rivers; scale, 1:250,000; by D. C. Witherspoon, J. W. Bagley, and C. E. Giffin. In Bulletin 498, 1912, 35 cents. Not issued separately.

Prince William Sound; scale, 1:500,000; compiled. In Bulletin 526, 1913, 30 cents. Not issued separately.

The Bering River coal field; scale, 1:62,500; 1915, by G. C. Martin. 25 cents retail or 15 cents wholesale.

The Ellamar district (No. 602D); scale, 1:62,500; by R. H. Sargent and C. E. Giffin. In Bulletin 605, 1915, 25 cents. Not issued separately.

Nelchina-Susitna region; scale, 1:250,000; by J. W. Bagley, T. G. Gerdine, and others. In Bulletin 668, 1918, 25 cents. Not issued separately.

Upper Chitina Valley; scale, 1:250,000; by International Boundary Commission, F. H. Moffit, D. C. Witherspoon, and T. G. Gerdine. In Bulletin 675, 1918, 25 cents. Not issued separately.

The Kotsina-Kuskulana district (No. 601C); scale, 1:62,500; 1922, by D. C. Witherspoon. 10 cents retail or 6 cents wholesale. Also published in Bulletin 745, 1923, 40 cents.

Valdez and vicinity (No. 602B); scale, 1:62,500; 1929, by J. W. Bagley, C. E. Giffin, and R. H. Sargent. 10 cents retail or 6 cents wholesale.

Tonsina district; scale, 1:250,000; 1932, by C. F. Fuechsel and J. W. Bagley (preliminary edition). Free on application.

In preparation

Prince William Sound region; scale, 1:250,000; by J. W. Bagley, D. C. Witherspoon, and others.

COOK INLET AND SUSITNA REGION

REPORTS

Geologic reconnaissance in the Matanuska and Talkeetna basins, by Sidney Paige and Adolph Knopf. Bulletin 327, 1907, 71 pp. 25 cents.

* The Mount McKinley region, by A. H. Brooks. Professional Paper 70, 1911, 234 pp.

A geologic reconnaissance of the Iliamna region, by G. C. Martin and F. J. Katz. Bulletin 485, 1912, 138 pp. 35 cents.

Geology and coal fields of the lower Matanuska Valley, by G. C. Martin and F. J. Katz. Bulletin 500, 1912, 98 pp. 30 cents.

The Yentna district, by S. R. Capps. Bulletin 534, 1913, 75 pp. 20 cents.

* Geology and mineral resources of Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant. Bulletin 587, 1915, 243 pp.

The Willow Creek district, by S. R. Capps. Bulletin 607, 1915, 86 pp. 25 cents.

The Broad Pass region, by F. H. Moffit and J. E. Pogue. Bulletin 608, 1915, 80 pp. 25 cents.

The Nelchina-Susitna region, by Theodore Chapin. Bulletin 668, 1918, 67 pp. 25 cents.

Platinum-bearing gold placers of Kahiltna Valley, by J. B. Mertie, jr. In Bulletin 692–D, 1919, pp. 233–264. 15 cents.

* Mining developments in the Matanuska coal fields, by Theodore Chapin. In Bulletin 714, 1921. (See also Bulletin 692–D, 1919, 15 cents; and Bulletin *712, 1920.)

* Lode developments in the Willow Creek district, by Theodore Chapin. In Bulletin 714, 1921. (See also Bulletin 642, 1916, 35 cents; Bulletin 692–D, 1919, 15 cents; and Bulletin *712, 1920.)

Geology of the vicinity of Tuxedni Bay, Cook Inlet, by F. H. Moffit. In Bulletin 722, 1922, pp. 141–147. 25 cents.

The Iniskin Bay district, by F. H. Moffit. In Bulletin 739, 1922, pp. 117–132. 25 cents.

Chromite of Kenai Peninsula, by A. C. Gill. Bulletin 742, 1922, 52 pp. 15 cents.

Geology and mineral resources of the region traversed by the Alaska Railroad, by S. R. Capps. In Bulletin 755, 1924, pp. 73–150. 40 cents.

An early Tertiary placer deposit in the Yentna district, by S. R. Capps. In Bulletin 773, 1925, pp. 53–61. 40 cents.

Mineral resources of the Kamishak Bay region, by K. F. Mather. In Bulletin 773, 1925, pp. 159–181. 40 cents.

A ruby-silver prospect in Alaska, by S. R. Capps and M. N. Short. In Bulletin 783, 1927, pp. 89–95. 40 cents.

The Iniskin-Chinitna Peninsula and the Snug Harbor district, Alaska, by F. H. Moffit. Bulletin 789, 1927, 71 pp. 50 cents.

Geology of the upper Matanuska Valley, Alaska, by S. R. Capps, with a section on the igneous rocks, by J. B. Mertie, jr. Bulletin 791, 1927, 92 pp. 30 cents.

Geology of the Knik-Matanuska district, Alaska, by K. K. Landes. In Bulletin 792, 1927, pp. 51–72. 25 cents.

The Skwentna region, by S. R. Capps. In Bulletin 797, 1929, pp. 67–98. 80 cents.

The Mount Spurr region, by S. R. Capps. In Bulletin 810, 1930, pp. 141–172. 50 cents.

The Chakachamna-Stony region, by S. R. Capps. In Bulletin 813, 1930, pp. 97–123. 40 cents.

The Lake Clark-Mulchatna region, by S. R. Capps. In Bulletin 824, 1931, pp. 125–154. 20 cents.

The eastern portion of Mount McKinley Park, by S. R. Capps. In Bulletin 836–D, 1933, pp. 219–300. 35 cents.

Progress of surveys in the Anthracite Ridge coal basin, by R. W. Richards and G. A. Waring. In Bulletin 849, 1933, pp. —. — cents.

Mineral investigations in the Alaska Railroad belt in 1931, by S. R. Capps. In Bulletin 844, 1933, pp. —. — cents.

In preparation

The Alaska Railroad route, by S. R. Capps.

The southern Alaska Range, by S. R. Capps.

Geology and mineral resources of the Moose Pass-Hope district, by Ralph Tuck.

The Girdwood district, by C. F. Park, jr.

The Willow Creek gold-lode district, by J. C. Ray.

The Valdez Creek district, by C. P. Ross.

Mineral deposits near the West Fork of the Chulitna River, by C. P. Ross.

Nonmetalliferous deposits of the Alaska Railroad region, by G. A. Waring.

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TOPOGRAPHIC MAPS

Matanuska and Talkeetna region; scale, 1:250,000; by T. G. Gerdine and R. H. Sargent. In Bulletin 327, 1907, 25 cents. Not issued separately.

Yentna district; scale, 1:250,000; by R. W. Porter. Revised edition. In Bulletin 534, 1913, 20 cents. Not issued separately.

*Mount McKinley region; scale, 1:625,000; by D. L. Reaburn. In Professional Paper 70, 1911. Not issued separately.

*Kenai Peninsula; scale, 1:250,000; by R. H. Sargent, J. W. Bagley, and others. In Bulletin 587, 1915. Not issued separately.

*Moose Pass and vicinity; scale, 1:62,500; by J. W. Bagley. In Bulletin 587, 1915. Not issued separately.

The Willow Creek district; scale, 1:62,500; by C. E. Giffin. In Bulletin 607, 1915, 25 cents. Not issued separately.

Lower Matanuska Valley (No. 602A); scale, 1:62,500; 1931, by R. H. Sargent. 10 cents retail or 6 cents wholesale.

Nelchina-Susitna region; scale, 1:250,000; by J. W. Bagley. In Bulletin 668, 1918, 25 cents. Not issued separately.

Iniskin-Chinitna Peninsula, Cook Inlet region; scale, 1:62,500; 1922, by C. P. McKinley, D. C. Witherspoon, and Gerald FitzGerald (preliminary edition). Free on application. Also published in Bulletin 789, 1927. 50 cents.

Iniskin Bay-Snug Harbor district, Cook Inlet region, Alaska; scale, 1:250,000; 1924, by C. P. McKinley and Gerald FitzGerald (preliminary edition). Free on application. Also published in Bulletin 789, 1927. 50 cents.

The Alaska Railroad route: Seward to Matanuska coal field; scale, 1:250,000; 1924, by J. W. Bagley, T. G. Gerdine, R. H. Sargent, and others. 50 cents retail or 30 cents wholesale.

The Alaska Railroad route: Matanuska coal field to Yanert Fork; scale, 1:250,000; 1924, by J. W. Bagley, T. G. Gerdine, R. H. Sargent, and others. 50 cents retail or 30 cents wholesale.

The Alaska Railroad route: Yanert Fork to Fairbanks; scale, 1:250,000; 1924, by J. W. Bagley, T. G. Gerdine, R. H. Sargent, and others. 50 cents retail or 30 cents wholesale.

Upper Matanuska Valley; scale, 1:62,500; by R. H. Sargent. In Bulletin 791, 1927, 30 cents. Not issued separately.

Girdwood district; scale, 1:62,500; 1932; by W. G. Carson (preliminary edition). Free on application.

Anthracite Ridge; scale, 1:12,000; 1932, by L. O. Newsome (preliminary edition). Free on application.

Lake Clark-Mulchatna River region; scale, 1:250,000; 1933, by R. H. Sargent, Gerald FitzGerald, C. E. Giffin, and D. C. Witherspoon. 50 cents.

In preparation

Mount Spurr region; scale, 1:250,000; by R. H. Sargent, Gerald FitzGerald, E. C. Hamilton, W. S. Post, D. L. Reaburn, and K. W. Trimble.

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*Geology and mineral resources of parts of Alaska Peninsula, by W. W. Atwood. Bulletin 467, 1911, 137 pp.

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The Lake Clark-central Kuskokwim region, by P. S. Smith. Bulletin 655, 1917, 162 pp. 30 cents.

Beach placers of Kodiak Island, by A. G. Maddren. In Bulletin 692–E, 1919, pp. 299–319. 5 cents.

Sulphur on Unalaska and Akun Islands and near Stepovak Bay, by A. G. Maddren. In Bulletin 692–E, 1919, pp. 283–298. 5 cents.

The Cold Bay-Chignik district, by W. R. Smith and A. A. Baker. In Bulletin 755, 1924, pp. 151–218. 40 cents.

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Mineral resources of the Kamishak Bay region, by K. F. Mather. In Bulletin 773, 1925, pp. 159–181. 40 cents.

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Kuskokwim River and Bristol Bay region; scale, 1:625,000; by W. S. Post. In Twentieth Annual Report, pt. 7, 1900. $1.80. Not issued separately.

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Goodnews Bay district; scale, 1:250,000; 1930, by R. H. Sargent and W. S. Post (preliminary edition). Free on application.

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Water-supply investigations in the Yukon-Tanana region, 1907 and 1908 (Fairbanks, Circle, and Rampart districts), by C. C. Covert and C. E. Ellsworth. Water-Supply Paper 228, 1909, 108 pp. 20 cents.

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* Mount McKinley region, by A. H. Brooks, with descriptions of the igneous rocks of the Bonnifield and Kantishna districts, by L. M. Prindle. Professional Paper 70, 1911, 234 pp.

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The Lake Clark-central Kuskokwim region, by P. S. Smith. Bulletin 655, 1918, 162 pp. 30 cents.

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The eastern portion of Mount McKinley National Park, by S. R. Capps. In Bulletin 836–D, 1933, pp. 219–300. 35 cents.

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Mining development in the Tatlanika and Totatlanika Basins, by F. H. Moffit. In Bulletin 836–D, 1933, pp. 339–345. 35 cents.

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Koyukuk and Chandalar region, reconnaissance map; scale, 1:500,000; by T. G. Gerdine, D. L. Reaburn, D. C. Witherspoon, and A. G. Maddren. In Bulletin 532, 1913, 25 cents. Not issued separately.

Fairbanks quadrangle (No. 642); scale, 1:250,000; 1911, by T. G. Gerdine, D. C. Witherspoon, R. B. Oliver, and J. W. Bagley. 50 cents retail or 30 cents wholesale. Also in Bulletin 337, 1908, 25 cents, and Bulletin 525, 1913, 55 cents.

Fortymile quadrangle (No. 640); scale, 1:250,000; 1902, by E. C. Barnard. 10 cents retail or 6 cents wholesale. Also in Bulletin 375, 1909, 30 cents.

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Fairbanks special (No. 642A); scale, 1:62,500; 1908, by T. G. Gerdine and R. H. Sargent. 20 cents retail or 12 cents wholesale. Also in Bulletin 525, 1913, 55 cents.

Bonnifield region; scale, 1:250,000; by J. W. Bagley, D. C. Witherspoon, and C. E. Giffin. In Bulletin 501, 1912, 20 cents. Not issued separately.

Iditarod-Ruby region; scale, 1:250,000; by C. G. Anderson, W. S. Post, and others. In Bulletin 578, 1914, 35 cents. Not issued separately.

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The Fairhaven gold placers, Seward Peninsula, by F. H. Moffit. Bulletin 247, 1905, 85 pp. 40 cents.

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Geology of the Seward Peninsula tin deposits, by Adolph Knopf. Bulletin 358, 1908, 71 pp. 15 cents.

Geology and mineral resources of the Solomon and Casadepaga quadrangles, Seward Peninsula, by P. S. Smith. Bulletin 433, 1910, 234 pp. 40 cents.

A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, by P. S. Smith and H. M. Eakin. Bulletin 449, 1911, 146 pp. 30 cents.

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Metalliferous lodes of southern Seward Peninsula, by S. H. Cathcart. In Bulletin 722, 1922, pp. 163–261. 25 cents.

The geology of the York tin deposits, by Edward Steidtmann and S. H. Cathcart. Bulletin 733, 1922, 130 pp. 30 cents.

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Seward Peninsula, northeastern portion, reconnaissance map (No. 655); scale, 1:250,000; 1905, by D. C. Witherspoon and C. E. Hill. 50 cents retail or 30 cents wholesale. Also in Bulletin 247, 1905, 40 cents.

Seward Peninsula, northwestern portion, reconnaissance map (No. 657); scale, 1:250,000; 1907, by T. G. Gerdine and D. C. Witherspoon. 50 cents retail or 30 cents wholesale. Also in Bulletin 328, 1908, 70 cents.

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Nulato-Norton Bay region; scale, 1:500,000; by P. S. Smith, H. M. Eakin, and others. In Bulletin 449, 1911, 30 cents. Not issued separately.

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The Noatak-Kobuk region, by P. S. Smith. Bulletin 536, 1913, 160 pp. 40 cents.

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