MINERAL RESOURCES OF ALASKA, 1929

MINERAL INDUSTRY OF ALASKA IN 1929

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 formerly held by mining, though they have by no means displaced the hold that mining still 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 pertinent information on 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 the text and by illustrations and maps, the facts that have been determined and the technical inferences that may be drawn therefrom. Among the significant activities relating to the mineral industry is the collection from time to time of facts 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

[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 Miss L. H. Stone, of the Alaskan branch of the U. S. Geological Survey.

the end of the year to which the records relate. The present report, which is of this type, is the twenty-sixth 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 of the desired information at first hand. The information used is therefore derived from many sources, which necessarily vary in reliability and completeness. Every effort is made, however, to verify all the statements and to give only those that appear to be well substantiated. Among the most reliable sources of information are the field engineers and geologists who are sent out each year 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 Alaskan newspapers and certain papers published in the States that feature Alaskan 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 these schedules 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 even some of the operators who

[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, and 813.

return them have not all the specific data desired or 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 should be realized, however, that the data collected from one source, although strictly accurate, are likely to be computed on a different basis from equally reliable reports received from another source, so that considerable editing and revision must be undertaken to bring them to one standard. To illustrate: The operator of a small placer property reports producing so much gold dust, for which he was paid so much by the local storekeeper. If we could follow this individual lot of gold through its various travels before it comes to its ultimate goal in a mint or Government assay office, we would probably find that the original figures did not long hold. For instance, the dust as originally received was probably not thoroughly cleaned, so that when it was melted up in a bank or mint its weight after melting was considerably different from the weight given by the producer. Furthermore, every parcel of gold, even from the same creek, differs in its assay value from every other, but of course the storekeeper can not determine this value by examination, so that to protect himself he generally pays an extremely conservative price. Furthermore, the storekeeper or bank official realizes that there will be charges for melting the dust, for shipment, for insurance, etc., and he needs to make a profit on the transaction, so that the price set must include all these different items if he is not to suffer loss. The original operator's statement that he received $16 an ounce for his 100 ounces of gold dust (that is, $1,600), though true, may relate to the same lot of gold that a bank would accept as 96 ounces before melting and pay for at the rate of $17.50 an ounce (that is, $1,680) or that would be reported by a mint or assay office as 94½ ounces having a theoretical value of $18.25 an ounce (that is, $1,724). The spread in this example between the price paid by the original storekeeper and the true value reported by the mint is less than 8 per cent for all the handling incident to bringing out the gold from some remote camp. It is not possible to compute exactly all the factors involved so as to reduce the reports of production to a strictly uniform standard. However, though some minor uncertainties necessarily remain, the attempt is made to eliminate differences, so that the reports may be consistent within themselves and with the other reports of this series.

Another reason why the totals used in this volume for certain mineral commodities may differ from the reports received from the producers is that all values here printed are based 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 recognized that this method of computation obscures 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 material error in the totals, inasmuch as higher prices received by the more shrewd and efficient mine operators are about balanced by the 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 individual properties is regarded as strictly confidential. The Geological Survey will not use any facts that are furnished in any way to 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. In order to fulfill this obligation it has even been necessary to adopt certain rather artificial and unnatural groups, as, for instance, the "miscellaneous mineral products," which include petroleum, quicksilver, stone, or marble, and other materials produced in small quantity or by only one producer, whose output would otherwise be obvious.

Special acknowledgment is due to Frank J. Katz 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, 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 Pacific Coast Cement Co., the Alaska Weekly, and Volney Richmond, of the Northern Commercial Co., of Seattle, Wash.; the Solar Development Co. (Ltd.), of Ketchikan; the Hyder Weekly Herald, of Hyder; the Hirst-

Chichagof Mining Co. and the Chichagoff Mines (Ltd.), of Chichagof; the Alaska Juneau Gold Mining Co., the Daily Alaska Empire, and J. C. McBride, of Juneau; the Cordova Daily Times, of Cordova; the Kennecott Copper Corporation, of Kennecott; J. B. O'Neill, of McCarthy; Thomas Larson, of Kotsina; the Seward Gateway, of Seward; H. N. Evans, of Kanatak; A. F. Stowe, of Kodiak; the Anchorage Weekly Times and Alex Liska, of Anchorage; Ivan L. Peterson and son, of Chickaloon; H. W. Nagley, of Talkeetna; Charles Zielke, of Nenana; the First National Bank, the Fairbanks Exploration Co., G. E. Jennings, F. B. Parker, Henry Cook, Heath & Kearns, and Joe Henderson, of Fairbanks; A. J. Griffin, of Richardson; 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; George Jesse, of Ruby; Frank Speljack, of Ophir; the Miners and Merchants Bank, of Iditarod; H. S. Wanamaker and Capt. E. G. Rowden, of Wiseman; John W. Chapman, of Anvik; J. W. Wick, of Russian Mission; John Haroldson and J. L. Jean, of Quinhagak; C. M. Link, of Bethel; E. M. Whelan, of Medfra; S. M. Gaylord, of Casadepaga; Hammon Consolidated Gold Fields, R. W. J. Reed, the Miners and Merchants Bank, Lomen Bros., and C. W. Thornton, of Nome; A. S. Tucker, of Bluff; Arthur W. Johnson, of Haycock; T. P. Roust, of Candle; T. A. Peterson, of Teller; Art M. Hansen, of Kotzebue; Lewis Lloyd and James C. Cross, of Shungnak; and R. S. Hall, of Wainwright.

MINERAL PRODUCTION

GENERAL FEATURES

The total value of the mineral production of Alaska in 1929 was $16,066,000. This was furnished by a number of mineral products, of which the most valuable were gold and copper, these two accounting for more than 92 per cent of the total. This total was $2,000,000 greater than that of the preceding year and is attributable to the increased selling price of copper and a very notable increase in the output of gold from both lodes and placers. This increase in value of somewhat more than 14 per cent indicates the generally upward trend of the industry as a whole, though, as will be discussed in more detail later, there were notable changes in the trends of production of the individual mineral commodities that contributed to this total.

On the whole the market prices of most of the metals that enter into Alaska's metal production were better than for the preceding year. This statement of course does not apply to gold, for its price is constant. According to the Bureau of Mines, which computes the average price of metals for each year, copper brought 17.6 cents a pound in 1929, against 14.4 cents in 1928, and lead 6.3 cents a pound

in 1929, against 5.8 cents in 1928. On the other hand, the prices of some of the metals that enter less largely into the total were somewhat lower in 1929 than in 1928. Thus silver, which sold at an average price of 58.5 cents an ounce in 1928, brought only 53.3 cents in 1929; tin, 45.19 cents a pound in 1929, against 50.46 cents in 1928; and platinum, $67 an ounce in 1929, against $75 in 1928. The net result of the fluctuation in prices was to increase materially the value of the output in 1929; the increase of 3.2 cents a pound for copper affording an increased income of $1,296,000 over what would have been received at the price prevailing in 1928.

Although there were no outstanding new developments during the year that directly affected the mineral output, the general conditions were encouraging and distinctly pointed to the conclusion that mining activities were on the up grade. General facilities for transportation throughout the Territory are constantly showing improvement. The vessels plying between the States and Alaska to-day are far more attractive, commodious, and speedy than heretofore. The management of the Alaska Railroad is displaying more and more alertness and zeal in studying the needs of the community it serves and making the railroad an important agency in the development of the country. The Alaska Road Commission each year is extending its construction of roads and trails and maintaining more effectively those already built, thus making outlying parts of the Territory more accessible and lowering costs of prospecting. The development of commercial aviation is playing a marvelous part in linking together the distant parts of Alaska and, through the saving of time effected by the use of airplanes, lengthening the working season so that properties which otherwise might perforce remain dormant can be successfully mined. The tragic deaths during the year of two of the most efficient aviators, C. B. Eielson and R. H. Merrill, while engaged in flights, have been most serious losses but have served to stimulate rather than lessen popular interest in aviation throughout the Territory, and new organizations and new facilities are springing up in different parts of Alaska to meet the growing demand for airplane transportation of persons and freight.

All 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 constantly being made and are bound to exert a continuing and growing force, so that each year Alaska is becoming less and less of 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 creates an ever-widening circle of stimulation.

TOTAL MINERAL PRODUCTION

From the time of the earliest records of mining in Alaska to the end of 1929 minerals to the value of practically $616,000,000 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 about 1898 the annual production ranged from negligible amounts to a maximum of about $2,000,000. 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 the production 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 a more or less gradual decline in the mineral output from Alaska until in 1928 it fell to a total of only a little more than $14,000,000. In 1929, however, the total was more than $16,000,000, and it is believed that the decrease shown during the period from 1920 to 1928 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, 1880–1929

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	17,664,800
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		
1895	2,588,832	1913	19,547,292		615,501,000
1896	2,885,029	1914	19,109,731		
1897	2,539,294	1915	32,790,344		

[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.

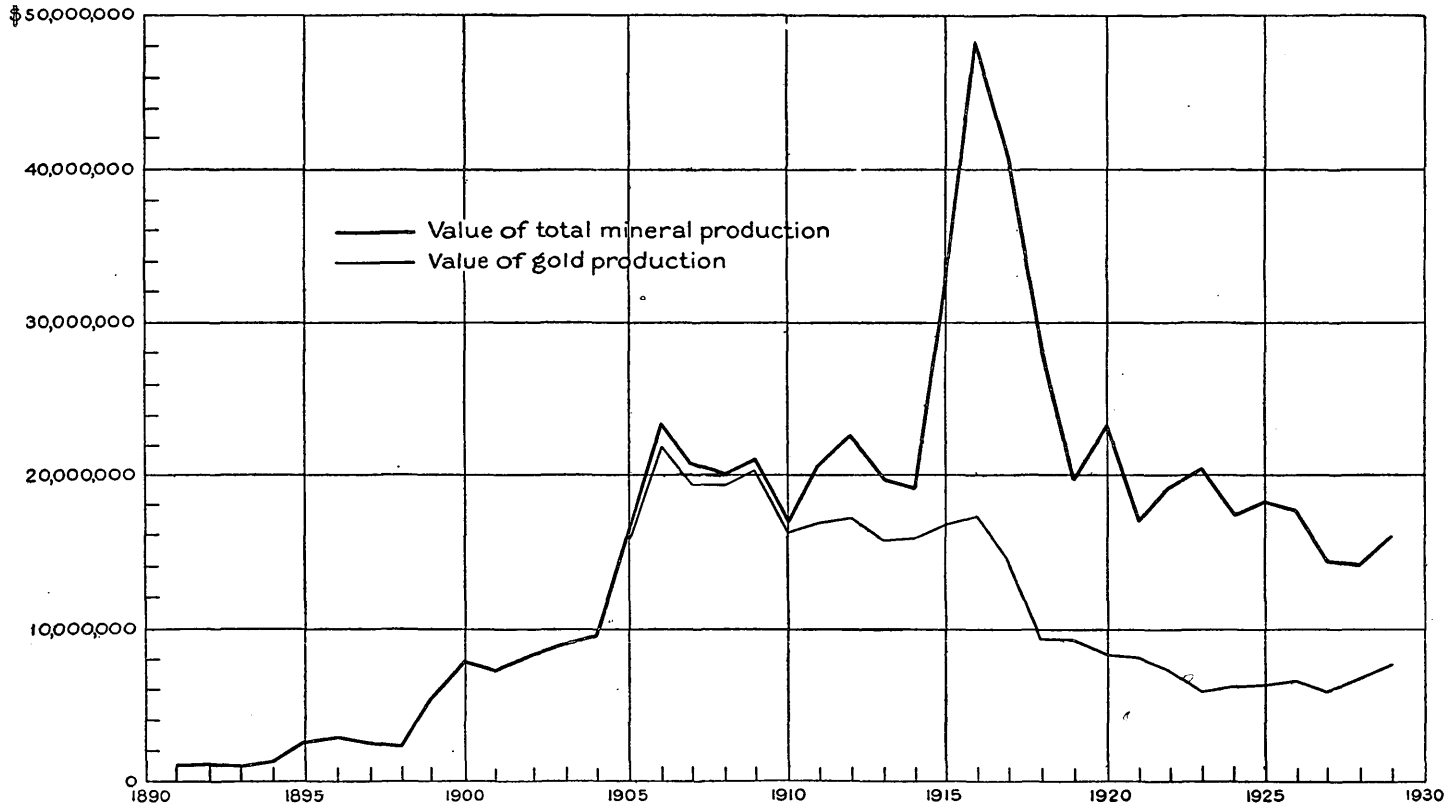

FIGURE 1.—Trends of mineral production in Alaska, 1890–1929

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, 1880–1929

Gold	$380,841,000
Copper	208,008,000
Silver	11,738,000
Coal	6,742,000
Tin	1,083,000
Lead	1,606,000
Marble and other products (including platinum metals)	5,483,000
	615,501,000

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 1929 and 1928, distributed by quantity and value among the main kinds of substances, so that a comparison between the two years may be readily made. Increases in value are shown for gold, copper, lead, and miscellaneous mineral products, and slight decreases in value for silver, tin, and coal. The same relation also holds with respect to quantities produced except that the quantity of silver was greater in 1929 than in 1928, though its value was less, and the quantity of copper produced was less in 1929 than in 1928, though its value was much greater.

Mineral output of Alaska, 1929 and 1928

	1929		1928		Increase or decrease, 1929	
	Quantity	Value	Quantity	Value	Quantity	Value
Gold, fine ounces	375,438	$7,761,000	331,140	$6,845,000	+44,298	+$916,000
Copper, pounds	40,510,000	7,130,000	41,421,000	5,965,000	−911,000	+1,165,000
Silver, fine ounces	472,900	252,000	454,700	266,000	+18,200	−14,000
Coal, short tons	100,600	528,000	126,100	662,000	−25,500	−134,000
Tin, metallic, do	38.6	35,000	41.0	41,000	−2.4	−6,000
Lead, do	1,315	166,000	1,019	118,000	+296	+48,000
Miscellaneous mineral products, including petroleum, platinum metals, marble, gypsum, etc.		194,000		164,000		+30,000
		16,066,000		14,061,000		+2,005,000

GOLD

GENERAL FEATURES

The total value of gold produced from Alaska mines in 1929 was $7,761,000, as contrasted with $6,845,000 in 1928, an increase of $916,000. 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 production 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 the value of the gold, marking the boom periods of many of the placer camps. From the peak of gold production in 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. After 1922 the gold production was fairly uniform and was between about $6,000,000 and $7,000,000 a year; the largest amount was produced in 1929.

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 14 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 $380,841,000 worth of gold that has been produced from Alaska mines, $254,125,000, or about 67 per cent, has come from placers and $126,716,000, or about 33 per cent, from lodes. The relation between the outputs from these two sources of gold 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. There is nothing in the record to indicate that the peak of lode-gold production has yet been reached.

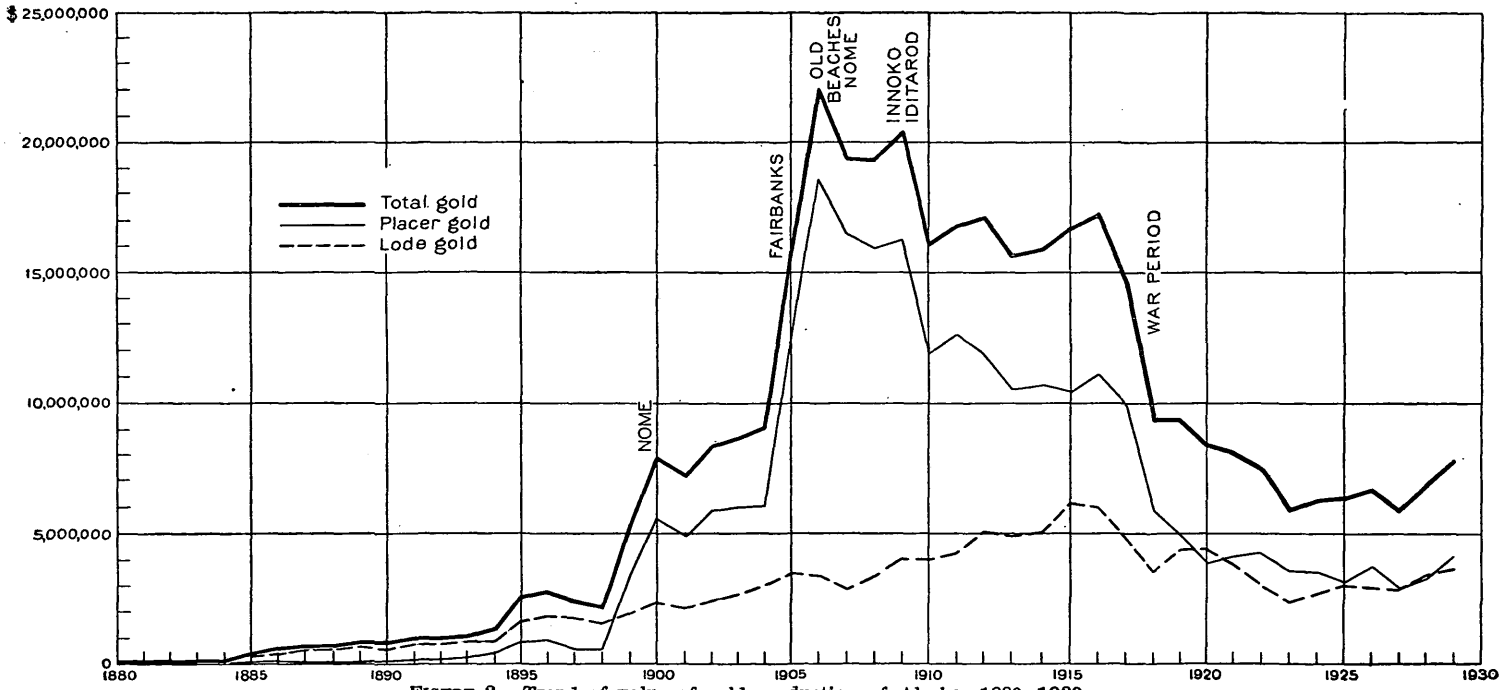

FIGURE 2.—Trend of value of gold production of Alaska, 1880–1929

Gold and silver produced in Alaska, 1880–1929

Year	Gold		Silver		Value of gold by sources	
	Fine ounces	Value	Fine ounces	Value	Placer mines	Lode mines
1880–1915	12,592,121	$260,302,243	4,923,198	$2,821,911	$185,200,444	$75,101,799
1916	834,068	17,241,713	1,379,171	907,495	11,140,000	6,101,713
1917	709,049	14,657,353	1,239,150	1,021,060	9,810,000	4,847,353
1918	458,641	9,480,952	847,789	847,789	5,900,000	3,580,952
1919	455,984	9,426,032	629,708	705,708	4,970,000	4,456,032
1920	404,683	8,365,560	953,546	1,039,364	3,873,000	4,492,560
1921	390,558	8,073,540	761,085	761,085	4,226,000	3,847,540
1922	359,057	7,422,367	739,945	729,945	4,395,000	3,027,367
1923	289,539	5,985,314	814,649	668,012	3,608,500	2,376,814
1924	304,072	6,285,724	669,641	448,659	3,564,000	2,721,724
1925	307,679	6,360,281	698,259	482,495	3,223,000	3,137,281
1926	324,450	6,707,000	690,000	430,500	3,769,000	2,938,000
1927	286,720	5,927,000	627,800	356,000	2,982,000	2,945,000
1928	331,140	6,845,000	454,700	266,000	3,347,000	3,498,000
1929	375,438	7,761,000	472,900	252,000	4,117,000	3,644,000
	18,428,198	380,841,000	15,891,600	11,738,000	254,125,000	126,716,000

In the foregoing table the amount of silver produced by Alaska mines has also been given, though a detailed discussion of the source of the silver minerals is given on a later page. All gold that is found in nature, either in lodes or in placers, contains some silver. Furthermore, many lodes contain more than one valuable mineral constituent, so that even those lodes that are principally valuable for their gold content may afford considerable additional return from the sale of their silver, copper, lead, or other subordinate minerals, and doubtless some of the operating mines could not be worked at a profit except for the additional value of those other minerals. It is therefore not practicable, except through an undesirable minute classification, to tabulate in detail all the sources of gold-bearing material. In the following table, which lists the sources from which gold was produced in 1929, all the ores from lode mines that yielded gold have been included, and the gold recovered from placers has been stated separately. It is a noteworthy feature that no gold is recovered from the Alaskan ores that are principally valuable for their copper content, though these ores are the sources of most of the silver that is recovered.

Gold and silver produced in Alaska, 1929, by sources

Source	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Gold ores	176,278	$3,644,000	94,370	$50,300
Copper ores			351,730	187,400
Placers	199,160	4,117,000	26,800	14,300
	375,438	7,761,000	472,900	252,000

GOLD LODES

Alaska lode mines in 1929 yielded $3,644,000 in gold, or about $150,000 more than in 1928. This gold derived from lodes was approximately 47 per cent of the entire gold production of the Ter-

ritory for 1929. The proportion of lode gold to placer gold was somewhat less in 1929 than in 1928, in spite of the increase in the output from the lode mines. The gold was recovered from widely distributed mines, but more than 96 per cent came from southeastern Alaska, as shown in the following table:

Gold and silver produced from gold-lode mines in Alaska in 1929 by districts

District	Gold		Silver	
	Fine ounces	Value	Fine ounces	Value
Southeastern Alaska	169,312	$3,500,000	92,560	$49,335
Willow Creek	581	12,000	160	85
Fairbanks district	4,015	83,000	985	525
Other districts	2,370	49,000	665	355
	176,278	3,644,000	94,370	50,300

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 more than 93 per cent of the total lode-gold output of the Territory in 1929. 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 1929 was 3,836,440 tons, an average of 10,510 tons a day. Of this amount 1,815,970 tons of coarse tailings were rejected and 2,020,470 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 19 cents a ton, and the value of the gold content of the rock that was further treated was about $1.94 a ton. Of this content gold worth 28 cents was lost during the treatment, $1.29 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, 1893–1929

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	49,404	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	2,481,780	1,537,884	1,943,896	2,030,067	55,971	1,288,974	2,184,384
1926	3,829,700	1,649,678	2,180,022	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	77,491	2,038,655	3,316,019
1929	3,836.440	2,020,470	1,815,970	3,410,408	90,635	2,501,832	3,627,247
	32,437,538	16,613,714	15,833,824	21,608,973	605,744	13,489,101	22,997,885

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 1929 the cost of mining is stated by the company to have been 27.95 cents for each ton of ore trammed to the mill, the cost of milling was 23.19 cents, and all other operating and marketing costs and expenses, including interest, amounted to 10.44 cents, making the entire cost for each ton of ore trammed only 61.58 cents. During the year not only have the mining and milling costs been kept at a low figure, but the tenor of the ore handled has been somewhat higher. As a result the value of the gold recovered from each ton of rock mined in 1929 was 89 cents, as against 84 cents in 1928 and 55 cents in 1927; in fact, the tenor of the ore and the gold recovery were the highest since 1915—that is, during the entire period of enlarged operations by this company.

In addition to the operations of the Alaska Juneau Gold Mining Co. on its properties at Juneau, the company during the year has taken an active part in the development of lode prospects in British Columbia, about 50 miles east of Juneau, in the newly discovered Taku district. At this place extensive indications have been found of ore carrying gold, silver, copper, lead, and zinc, and active prospecting has been in progress. The work, however, has not progressed far enough to warrant the company making a more definite statement of the results than the following: "The results obtained so far by diamond drilling, drifting, and crosscutting must await interpretation until more information is available as to the habits of the ore occurrence." The site where the company is carrying on the greatest amount of prospecting lies east of the international boundary, but it has also acquired options on properties on the Alaska side of the line, where some work is in progress, and there is geologic evidence to suggest that a considerable tract near Taku but in Alaska may be well worth prospecting. In practically all these prospecting ventures by the Alaska Juneau Co. the Treadwell Yukon Co. (Ltd.) is also participating. The early Geological Survey maps were in error in indicating that the eastern limit of the great Coast Range batholith in this part of southeastern Alaska lay to the east of the international boundary and thus suggesting that mineral deposits were probably not to be expected west of the boundary. Instead the eastern margin of the batholith in the Taku district makes a considerable westward jut, so that a strip of country 10 miles or so wide in Alaska now appears to have considerable likelihood of justifying careful search for indications of mineralization. Not only is the direct effect of this revival of prospecting by these large companies in the Taku region beneficial to that region, but its indirect effect in

stimulating search for ore deposits is having an even wider significance by the encouragement it gives to others to realize that opportunities still await earnest, energetic exploration.

The Alaska Juneau Gold Mining Co. also took part in the exploration of gold-lode claims adjacent to the international boundary north of Haines, both in Canada and in Alaska. Work on this group of claims, which is known as the Stampede group, has been in progress for some time. The report of the company for 1929, however, makes the following statement: "After prospecting the Stampede group of mining claims throughout the past summer with unsatisfactory results this option was dropped." No indication was given as to the respect in which the results were unsatisfactory, so that it is uncertain whether the tenor proved too low or whether the extent of the mineralization was too small to make the project attractive to a large company or whether some other reasons determined the decision.

The next most productive gold mines in southeastern Alaska were those of the Hirst-Chichagof Mining Co. and of the Chichagoff Mines (Ltd.). The Hirst-Chichagof is near the head of Mine Bay, on the west coast of Chichagof Island, about 60 miles northwest of Sitka, and the Chichagoff Mines are in the same general region, at the head of Klag Bay. In the past these and the other gold mines on Chichagof Island have produced gold to the total value of more than $13,000,000, but in 1928 and again in 1929 the larger mines were engaged chiefly in reconstruction and development work, so that there was a marked falling off in production. This condition is believed to be temporary, for the dead work that has now been done will put the properties into better operating condition. Thus at the Hirst-Chichagof the installation of a modern mill, with additional power facilities, which was completed during 1929, gives promise of a greatly increased production for 1930. Among the more notable improvements made at this property during the year were the construction of a power line 2½ miles long from Chichagof, which will supply electric power to replace the former Diesel plant, the remodeling of the old mill and the installation of a tube mill, the building and equipping of a new compressor plant, and the driving of nearly 1,000 feet of drifts and crosscuts and over 300 feet of raises.

At the Chichagoff Mines practically the only ore milled during the year was that derived in the course of prospecting and development work, so that the output was small. The exploratory work which has been in progress there for the last two years is proving up the extent and distribution of the ore and according to the operators is yielding results that are satisfactory to them, so that in the near future this mine may resume work on a scale as large as in

the boom period, some 8 to 15 years ago. Elsewhere on Chichagof Island there are several other gold mines or prospects, among them the formerly highly productive property of the Apex-El Nido Mining Co., but most of them are only small prospects. Work was said to have been in progress at some of these properties during the year, but none of them reported having made any material production.

In the Admiralty Island region, at Funter Bay and Hawk Inlet, development work was continued at the properties of the Admiralty Alaska Gold Mining Co., the Williams Mining Co., and the Alaska Dano Mines Co. At the Admiralty Alaska property the year was spent in underground development work, the erection of an aerial tram, and the construction and installation of a ball mill for the treatment of the ore. No production from this property was reported, but the improvements enumerated above were completed, so that production should commence shortly. At the Williams mine negotiations were in progress early in the season for the lease and option of the property. This project was later carried through, and a company was organized under the name of Hawk Inlet Mining Co. to make the necessary developments. A study of the best measures of handling the property will be made, and then plans will be laid for its development, so that probably it will be some time before the mine will be brought to a productive stage. At the property of the Alaska Dano Mines Co. a little development work, resulting in driving some 76 feet of tunnel, was done during the year. Rumors continue to be heard of the opening up of the old Kensington and Jualin mines, north of Juneau, but so far as known no active work on the ground with that end in view was undertaken. South of Juneau, in the vicinity of Windham Bay, at the property of the Jacob Marty Mines, little new work was reported. A new bond was taken on the property, and arrangements were made for carrying on considerable further development work in 1930.

The Hyder district, which embraces that part of southeastern Alaska lying at the head of Portland Canal and west of the international boundary, was the scene of continued prospecting during the year, but only a little gold was produced from any of its mines. According to the records of the commissioner, as reported in the local newspaper, about 132 new claims were staked in the district in 1929, and assessment work was recorded as having been done on 271 claims. The latter figure, however, must not be regarded as indicating the total number of claims on which work was done, because doubtless many of the owners neglected to record their assessment work, and many other properties have been patented and therefore are not required by law to have annual assessment work done on

them. The additions and improvements on the road leading up the valley of Texas Creek have stimulated interest in that valley, and several new propects have been disclosed by the work that has been in progress there during the year. Probably the greatest amount of work accomplished in the Texas Creek region was at the property of the Hyder Lead Mining Co., near the head of the valley of the West Fork, but the greatest general interest was afforded by the reported finding of especially rich ore west of the head of the West Fork, on Banded Mountain, which forms part of the area tributary to the Chickamin River. This find by Metcalf & Finley resulted in a small rush of prospectors into the near-by hills. The region is a difficult one to traverse because of the high, steep mountains and the large glaciers and snow fields, so that even to transport the necessary supplies and equipment needed for its exploration is costly and time consuming. Between Texas Creek and the Salmon River a considerable group of claims has been acquired and consolidated as a unit by the Cantu Mining Co. The plans announced by this company include extensive development work and the installation of the equipment necessary to put the property on a producing basis. Farther south in the valley of the Salmon River, at the properties of the Riverside Mining & Milling Co., the American Mining & Milling Co., and the Mountainview Gold Mining Co., prospecting and development work was carried on, and test shipments are said to have been sent to smelters in the States from at least one of them. The general opinion as to the outlook for the future held by most of the operators in the camp was one of healthy optimism.

In the Ketchikan district of southeastern Alaska lodes have long been known and up to a few years ago have yielded considerable gold, as well as other metals. During the last few years, however, there has been little production from any of the mines, though prospecting has been carried on at some of them. Probably the most significant event of the year as regards mining was the entry into this field of the Solar Development Co., which acquired under option the Salt Chuck and Rush & Brown properties on Kasaan Peninsula, Prince of Wales Island. Early in May the company began the active work of pumping out the Rush & Brown mine and preparing it for the preliminary work of sampling and examination. In November a development program was begun to determine the distribution and extent of the mineralization, and an adit 1,500 feet long was started to connect with the mine workings at the 300-foot level. Although the new company mined no new ore during the year, there was in the bins some ore that had been mined and sorted by earlier owners, and this was shipped to the Anyox smelter of the Granby Consolidated Mining, Smelting & Power Co. (Ltd.), in

British Columbia. It is also reported that considerable exploratory work was done under the direction of J. L. Freeburn and others on a lode property near Moth Cove, Revillagigedo Island, about 15 miles southeast of Ketchikan. If the conditions prove favorable, this will probably lead to extensive development work in 1930. A little development work leading to the mining of a small quantity of ore was also done on at least one of the old properties near Helm Bay, north of Ketchikan. A small shipment of ore from the Maid of Mexico Mining Co.'s property, near Petersburg, in the Wrangell district, was sent to one of the smelters in the States, mainly to serve as a test run. According to the reports of the operators the properties of the Kassan Gold Mining Co., near Hollis, and the Dolomi Gold Mines (Inc.), near Dolomi, both on Prince of Wales Island, which produced some ore in 1928, were either entirely shut down or the scene of only development or assessment work in 1929.

The Willow Creek district, at the head of Cook Inlet, has long been one of the productive gold-lode camps of the Territory and yielded some gold in 1929, though there was a very marked falling off in the amount reported by the different operators. The following notes regarding mining developments in this district are abstracted from data submitted by B. D. Stewart, supervising mining engineer, who received much information from E. F. Wann, collected in the course of his professional work at the Thorpe, Gold Mint, and Gold Cord properties. In spite of the falling off in production there was considerable mining activity that assures increased output as soon as the development work in progress has been completed. Thus at the properties of the Willow Creek Mines, on Craigie Creek, where the destruction of the mill by fire late in 1928 put a stop to milling, the company was busy throughout the open season in cleaning the site and erecting the concrete foundations for a new mill building. Underground and on the surface further search for ore was carried on, apparently with encouraging results. In connection with this property it is of interest to note that Paul Hopkins, chemist of the Bureau of Mines station in Fairbanks, definitely identified the presence of tellurides in samples of ore from the Lucky Shot mine. There have been numerous reports of the finding of tellurides at different points in the Willow Creek region in the past, but up to the time of Hopkins's report they have not been authenticated. This determination is therefore not only of immediate value but may have considerable economic significance in guiding developments. At the property of the Marion Twin Co., at the head of Craigie Creek, some ore was mined, and several tons of selected ore was shipped to a smelter in the States and yielded high returns. It is reported that the owners plan to install a portable compressor

and to erect a cable tram about 1,500 feet long from the mine to the Gold Bullion road. At the Gold Mint property of the same company, on the Little Susitna River, underground work consisted principally in driving on No. 5 tunnel a distance of about 40 feet to intercept a vein that is believed to lie some 75 feet still farther ahead. The Gold Cord mine was operated in 1929 by the Golden Bear Mining Co. A 20-ton Herman mill, operated by a 15-horsepower gas engine, and a small compressor operated by a 20-horsepower Diesel engine, were installed. The underground developments consisted mainly in crosscutting in the vicinity of a fault which had offset the vein, in order to find the displaced ore body. A crew of 10 to 12 men were employed for a large part of the open season, and some ore was treated. At the Mabel mine work was carried on throughout the year on about the same scale as during 1928. The Independence and Martin properties, on Fishhook Creek, were examined and sampled during the summer by engineers and a crew of three or four men, currently reported to have been sent in the interests of a Canadian mining company. A little ore was mined by Charles Bartholf from the Rae Wallace property. The work done during 1929 on the Thorpe property consisted almost entirely in digging numerous open cuts on the surface in order to trace out the course of the veins. The discovery of a rich vein about half a mile above the Gold Cord, on Fishhook Creek, was reported to have been made by Herman Kloss. This vein is said to be very narrow but to have been traced on the surface definitely for a distance of 1,500 feet and possibly may extend for an additional distance of 1,500 feet. A compressor run by power furnished by a Diesel engine and other equipment necessary to carry on the development work were installed, and a small test shipment of ore from the property was sent to the Tacoma smelter. Numerous smaller lode properties are reported at other places in the Willow Creek region, but at practically none of them was more than the required assessment work done.

In the vicinity of Fairbanks gold-lode mining was continued in 1929 in both the Ester Dome and Pedro Dome areas on practically the same scale as in 1928. In the vicinity of Ester Dome the greatest amount of gold came from the Mohawk mine, on the north flank of the dome, and from the Ready Bullion mine, on the southwest flank. Both these mines maintain their own mills, but the owner of the Mohawk mine made his mill available during part of the season for custom work and as a result treated several hundred tons of ore from some of the near-by prospects. This service enabled several of the smaller operators to obtain a reliable mill test of their ore and gave them gold with which they could pay for further development

work. The Elmes mine, on Happy Creek, a short distance west of the Mohawk mine, was idle during most of the season, owing to inability of the owners to agree on a satisfactory plan of operation. As a result Earl Pilgrim, the former manager, in the course of examinations in the same general region, discovered a considerable showing of lode mineralization at the bottom of an old shaft that had been sunk to prospect for placer ground. Mr. Pilgrim and associates took hold of the task of tracing out the course of the vein underground and doing the other necessary work. The work proceeded slowly because of gases encountered in the shaft, but when the property was visited in August, 1929, a strong vein had been disclosed that justified further explorations. This prospect was locally known as the Irishman claim. No active steps had been taken up to the end of 1929 in the opening up of the old Ryan lode, on Ester Dome, which it was reported had been taken over late in 1928 by an English company that proposed to carry on large-scale operations there. The current reports indicated that this project was only deferred and that probably in 1930 the necessary preliminary steps would be taken to open up the property.

In the vicinity of Pedro Dome the greatest production of lode gold was reported from the Hi Yu mine of Crites & Feldmann and the McCarty mine of the McCarty & Ewers Gold Mining Co., both of which are in the valley of Fairbanks Creek; from the Wild Rose mine of Heath & Kearns, on Dome Creek; from the Wyoming mine of Wackowitz Bros. & Nelson and the old Rhoads-Hall mine of the Cleary Hills Mines, both in the valley of Bedrock Creek, a tributary of Cleary Creek. Although all these mines are small, the returns on the capital involved or on the effort put forth in their development seems highly remunerative and encourage a belief that even larger returns might be received if the country were more thoroughly explored and developed on a larger scale. In addition to the productive mines specifically mentioned above there were other prospects widely scattered through the district at which some work was done during the year, though at most of them it amounted to but little more than the assessment work required by law.

Among the gold-lode producing districts grouped in the table on page 13 under the heading "Other districts" the most productive are the mines and prospects on Kenai Peninsula, including the Nuka Bay region, the region south of Hope, and the hills north of Girdwood; in the Kuskokwim region at the old Pearson & Strand mine, on a tributary of Nixon Fork; and in the vicinity of Valdez, in the Prince William Sound region. In the Nuka Bay region the greatest amount of gold was recovered from the Sonny Fox mine, operated by Babcock & Downey. The showings on this property

continued to be very encouraging, and the plant was in operation from the later part of May to early in October. The ore is a sulphide which is oxidized as far down as the developments have been carried. The ore is tested in an Ellis mill having a capacity of about 4 tons in 24 hours; the tailings from the mill are concentrated, and the concentrates are shipped to a smelter in the States. The amount of stoping ground that has been opened up and the small capacity of the mill have led the owners to consider enlarging the plant, and according to late reports a larger mill was to be ordered and placed in commission as early in 1930 as practicable. At the Alaska Hills mine only the usual assessment work was done during the year. At the property of the Nuka Bay Mining Co. about 95 feet of tunnel was driven in the course of development work, but the mill was not in operation.

In the vicinity of Girdwood some prospecting and development work for gold lodes was in progress at several places near the head of Crow Creek, but the projects were all small and yielded only a little ore or gold. Farther south on Kenai Peninsula proper the Lucky Strike mine, on Palmer Creek, under the management of John Hirshey, reported the greatest activity. The mill at this property was in operation from June 20 to October 4 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 concentrates were shipped to a smelter in the States. Most of the tailings were impounded so as to be available for further treatment by cyanide or some other process at a later time. Several small lode-gold prospects at which a little work was done during the season were also reported at a number of points near the Alaska Railroad in that part of its course that crosses Kenai Peninsula. At most of these places, so far as known, the work amounted to practically no more than the annual assessment work required by law. Among the largest of these properties may be mentioned that of the Lakeview Mining Corporation, near Seward, where considerable underground work was accomplished, necessary changes were made in the mill, and new machinery installed, and the Baughman & Swetmann claims, near Moose Pass, where about 140 feet of adit was driven.

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. 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 at approximately the same rate as in 1928. Although no other mine in this district reported having produced any lode gold in 1929, it was learned that prospecting was 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 in the course of this work some ore was found that appeared of sufficiently high grade to justify the owner in undertaking its development during the winter.

In the western part of the Kuskokwim Valley some prospecting was done by Henry Oman on quartz lodes that are said to carry some gold and to have been traced for several hundred feet. A company known as the Golden Butte Mines (Inc.) is reported to have been formed to develop this property.

Interest in the development of quartz lodes was revived in the Valdez and near-by parts of the Prince William Sound region by the entry of several new companies to undertake the operation of some of the old properties and by the finding of several new occurrences of ore. In addition to the prospecting and development work being carried on by the Solar Development Co. on certain copper deposits on Knight Island, the taking of the old Granite mine, in the Port Wells district, by a company known as the Port Wells Granite Mines was probably the most noteworthy mining event in this district. A crew of more than 20 men were employed during most of the open season in installing a hydroelectric plant, erecting new buildings, and putting in the necessary equipment for extensive underground developments. This preliminary work was nearly completed before the end of the year, so that the mine should return to the list of producers in 1930. On Mineral Creek, at the Little Giant mine, operated by William Quitsch, a little ore was mined and milled. Some excellent ore was disclosed by Devenney & Dolan in the course of prospecting their property on Mineral Creek. The ore is composed largely of galena but carries considerable gold also. Development work was also reported to have been done on the Ramsay-Rutherford property, near Valdez Glacier; at the Mayfield property, near Shoup Bay; and at a prospect at Portage Bay. Prospecting for gold lodes was continued in the Tiekel region, but no report has been received as to the results accomplished. The results of the season's work throughout the Valdez region have been such as to give good promise of an even greater increase in mining activities there in 1930.

Prospecting for gold lodes was also continued at many places throughout the Territory, though at none of them, so far as known, was any ore produced. In the Copper River region several prospects were under development in the Kotsina-Chitina area. On the property of the Nabesna Mining Corporation, under the management of Carl Whitham, prospecting by shafts and drifts was continued in 1929, and the company proposes to undertake a more extensive

development program in 1930, with the aim of putting the mine on a producing basis in 1931. In the McKinley Lake district the Lucky Strike Co. rebuilt several of the buildings that were destroyed by fire in 1928 and continued driving the crosscut, which is now estimated to have a length of 320 feet but whose breast is still 470 feet from the vein that the owners are seeking. In the Chandalar region no work was reported to have been done on the gold-lode properties during the year, but the owners stated that they planned to freight in a 4-stamp mill during the winter of 1929–30 and to erect it during 1930. In the hills west of the Chulitna River, between Ruth and Eldridge Glaciers, Roy and Elmer Boedeker report finding several ledges of mineralized rock carrying considerable gold. The leads are from 10 inches to 2 feet wide, trend southeast, and stand vertical in a country rock of slate and graywacke. The country is extremely difficult of access, so that the prospectors ran out of supplies and could not spend much time in their examinations. The assays of the specimens they brought out showed so high a tenor in gold that they plan to return in 1930 and carry on more extensive prospecting. No work was done at the Mint Ruby Silver mine during the year, but some prospecting was done in its general neighborhood.

A little prospecting was done on the Garnet claims, near Flat, in the Iditarod region, and a narrow stringer of gold-bearing quartz was found. In Seward Peninsula further development work was carried on at the Hed & Strand mine, north of Nome, but no reports have been received as to the work accomplished. A little search for gold lodes was carried on at a few other points in Seward Peninsula, but appears not 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 in 1929 to effect this purpose.

Announcement has been made in the newspapers of a discovery of rich leads of gold-bearing quartz on Popof Island, in southwestern Alaska. In addition to the gold the ore is said to contain sulphides of lead and zinc. In the period from 1890 to 1905 several million dollars in gold was recovered from mines on Unga Island, which lies not more than a few miles west of Popof Island, so that there is good likelihood of the geology of parts of the two islands being similar. Furthermore, in the past considerable gold has been won from the beach placers on Popof Island, which confirms the belief that mineralization has occurred there. No detailed information regarding the find has been received, so that fuller data regarding its character and location, as well as the results of its exploitation will be looked forward to with interest.

GOLD PLACERS

GENERAL CONDITIONS

Placer mining in Alaska in 1929 returned gold worth about three-quarters of a million dollars more than the amount produced in 1928, and on the whole the industry seemed to be in a flourishing condition for still further increase in the near future.

The annual production of placer gold and certain other data relating to Alaska's gold production are graphically represented 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, resulting in a golden period that 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 11 years since that time it has fluctuated between that amount and $3,000,000; in 1929 it was $4,117,000.

The increased production of placer gold in 1929 is to be attributed to the generally favorable weather conditions that prevailed in most of the placer districts of the Territory and to the realization upon the preparatory work that had been in progress through the preceding year. The success of so many of the placer operations depends upon an adequate supply of water that weather conditions which afford abundant rainfall are regarded by the placer miner as especially fortunate. During the open season of 1929 throughout most of the interior of Alaska, in which many of the placer camps are situated, the rainfall was especially good, so that the streams were maintained at a high stage. The times of break-up of the streams in the spring and freeze-up in the fall were normal.

The early cessation of work in the fall of 1928 by one of the large mining companies on Seward Peninsula, caused by adverse weather conditions in 1927, which prevented the company from preparing enough ground in advance to keep its dredges running late in 1928, was indirectly the cause of the rather large increase in the production in 1929, because the company began work that year with large areas of ground that had been well prepared for dredging. It was therefore able to keep its dredges at work with less interruption and drive them at fuller capacity throughout the open season.

In accounting for the increased production of placer gold the fact must not be overlooked that some of the increase must be attributed to the several years of preparatory work that had been done in developing the extensive project of the Fairbanks Exploration Co., in the Fairbanks district. Although this project began to yield some gold in 1928 it really had its first full season of mining in 1929, and even during part of that season two of its five dredges were in course of construction. There is therefore every reason to believe that an even greater output from this enterprise will be reached with no additional equipment in 1930.

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 that might follow in their footsteps prefer the higher wages, lighter physical labors, and social attractions of the town to the lure of the hills. There seems to be an increasing interest among capitalists 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, however, has little sympathy with the laments that are often heard as to the difficulties of carrying on prospecting work in remote tracts. 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. At the present time, it must be admitted, wages appear to be relatively higher and costs lower in the States than in Alaska, so that the wages obtainable offer no keen inducement for a new generation of prospectors to come to Alaska and take part in the search for new placers. This condition, however, is not regarded as permanent, and when conditions change active prospecting will be renewed in the Territory, for the opportunities that await the earnest worker still seem to be very great.

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 much 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 1929 and 1928

Region	1929	1928	Decrease or increase, 1929
Southeastern Alaska	$10,000	$9,800	+$200
Copper River region	83,000	110,000	−27,000
Cook Inlet and Susitna region	98,000	72,800	+25,200
Yukon Basin	2,058,000	1,876,500	+181,500
Kuskokwim region	165,000	217,500	−52,500
Seward Peninsula	1,698,000	1,056,300	+641,700
Northwestern Alaska	5,000	4,100	+900
	4,117,000	3,347,000	+770,000

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 along 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 prospect of finding placers of local value.

As shown in the table on page 26, the entire placer production from southeastern Alaska in 1929 was worth only $10,000, or approximately the same as in 1928. As in 1928 it came principally from camps in the Porcupine River and Yakataga districts. The chief work in the Porcupine River district was done on the property of the Porcupine Mining Co., which embraces some 65 claims. A crew of 35 men are reported to have been employed during the open season in building flumes and otherwise making the ground ready for hydraulic mining. Most of the preliminary work is now reported to have been completed, so that productive mining can soon be undertaken and carried on continuously through the open season. At four or five small camps, having a total population of eight or ten men, there was some prospecting and development work during the year, but the amount of gold recovered by them was small. These small camps were reported to be situated on Nugget Creek; on the Klehini Flats, near the mouth of the Porcupine River, and on Marble Creek.

In the Yakataga district the placers are all of the beach type, occurring in the stretch of coast where sorting by the ocean is effective. Their position exposes the workings to the waves of the Pacific, so that except under favorable weather conditions they can

not be mined, and even then the use of extensive mechanical appliances is precluded. As a result only two or three small camps of two men or so each are engaged in mining, and though the amount of gold they produce is small, relatively to the size and expense of the operations it is large. Mining on the coast has been carried on at about the same scale as in 1929 for several years.

The only other place in southeastern Alaska at which some production of placer gold was reported in 1929 was on Montana Creek, a tributary of the Eagle River, a short distance north of Juneau. Two men were employed at this place, but most of their time was spent in prospecting and preparatory work, so that they produced only a little gold.

COPPER RIVER REGION

In the Copper River Valley there are four principal areas that yield placer gold, though there are a few small camps widely scattered throughout the river basin. These principal areas, named in order of their production, are the Nizina, Chistochina, Nelchina, and Tiekel districts. As will be noted from the table on page 26, the value of the placer gold produced from the Copper River districts in 1929 was $83,000, or nearly $27,000 less than in 1928. 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. At both these properties there was a slight falling off in production from that of 1928. Some difficulty was experienced and some damage was done by high water during the season. About 30 men were employed at these two properties, and there were a few others engaged in prospecting work on their own account elsewhere in the district.

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 1929 than in 1928. 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. In the Tiekel district one property on Fourth of July Creek reported having taken out a little gold in the course of its development work.

COOK INLET-SUSITNA REGION

In the Cook Inlet-Susitna region, as that 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. Owing to generally favorable conditions in 1929 the output of placer gold from this region showed an increase of about $25,000 above that reported in 1928 and was approximately $98,000.

In the Yentna-Cache Creek district there was considerable revival of prospecting, and new localities that appear to afford workable placers were found. Equipment of these properties, however, will be undertaken during the good period for freighting in the winter, so that it will be 1930 before some of them become productive. Heavy rains in the fall caused a freshet that is said to have been the greatest that has visited the Cache Creek district in years, and it caused many operators to cease their operations some three weeks earlier than usual. This high water was particularly disastrous on Cache, Falls, and Dollar Creeks and badly damaged the hydraulic plants and pipes on them. Altogether some 19 separate camps employing a total of 39 men are reported to have been active in the district in 1929. By far the largest operation was that of J. C. Murray, who was hydraulicking benches on Cache and Nugget Creeks. Two other small outfits did some mining on Cache Creek and one on upper Cache Creek. On Falls Creek, a tributary of Cache Creek, H. W. Nagley and associates did considerable work, and on Thunder Creek, also a tributary of Cache Creek, one small camp was reported. A new pay streak was reported to have been found in the creek bed on Dollar Creek, and that property, which has remained idle for several years, will probably be operated in 1930 by a crew of at least five men.

On Peters Creek two camps, consisting of one or two men each, were engaged in placer mining. Mining camps of one to three men each were reported as active on Bird, Poorman, Willow, and Long Creeks, which are tributary to Peters Creek. North of Peters Creek, in the valley of the Tokichitna River, some prospecting and development work was reported to be in progress, but no specific information is available as to the amount of gold obtained, though it was probably small. Southwest of the Yentna River, in the Kahiltna Valley and the Fairview district, there were only two or three small camps, consisting of one or two men each, and the production was little more than was recovered in the course of panning. This Fairview district has been very inaccessible, but it is now reached by trail from the Yentna River, and cable crossings have been installed across four of the dangerous streams between Cache Creek and Fairview Mountain.

The producing placer camps on the Kenai Peninsula are situated mainly in the vicinity of Hope, Sunrise, and Girdwood. All of these are small operations, the largest yielding only a few thousand dollars annually and some of them only a few hundred dollars. In the vicinity of Hope the only productive mining reported was on claims worked by Charles Harper and associates on the Resurrection River, which flows into Turnagain Arm near the town. The ground worked lies a few miles south of Hope and is part of the property formerly known as the St. Louis claims. The placer is mined by hydraulicking with water that is brought down by flume and ditch from a point some distance up the Resurrection River. Two or three nozzles were used for driving the pay gravel into the boxes and for stacking the tailings. Many large boulders are found in the deposits and seriously interfere with mining.

Near Sunrise mining was carried on by eight or nine small camps. On Sixmile Creek, near Sunrise, a small amount of placer gold was produced by two small camps, the northern one of which was worked mainly by prospecting methods and the southern one by means of a hydraulic plant. On Canyon Creek, which joins East Fork to form the Sixmile River, the largest camp was that of Plowman, Tolson, Miller & Davies, who were working ground that had been leased from the Canyon Creek Development Co. Farther up Canyon Creek, on the claims formerly owned by Wilson, it was reported that a placer camp was established by Oscar Dahl. About 10 miles above the large camp on Canyon Creek Michaelsen and others were hydraulicking gravels at the head of Blue Gulch. Only one group of miners were mining on Lynx Creek, which is a tributary of East Fork. North of Turnagain Arm, in the valley of Crow Creek, a tributary of Glacier Creek, about 5 miles northeast of Girdwood, some placer gold was recovered at the Holmgren property. Near Girdwood, on California Creek, Dawson and associates were engaged in prospecting and preparatory work required in opening up a tract of placer ground that will probably be mined in 1930. During the year this group cleared a considerable tract of lowland that is to be mined, constructed a dam about 3,000 feet above the bridge on Crow Creek, and built the necessary buildings, which include a sawmill. The hydraulic pipe and other required equipment will probably not be shipped in until 1930.

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 1929,

the returns to the few placer operators who were in the district appear to have been especially satisfactory, and plans were formulated for a much more extended program of mining in 1930. The supply of water was abundant through the open season, and as a result the output from that district was larger than it has been during recent years. The largest amount of gold came from hydraulic operations near the main stream and from some of the bench ground, especially on the left bank of Valdez Creek. Some of this ground was also worked by drift mining. Some gold was also recovered from the placers on Lucky Creek, a tributary of Valdez Creek. Twelve men appear to be the total number of miners engaged in productive work in the Valdez Creek district during the year. Considerable agitation has been started to induce the Alaska Road Commission to construct a road into the district from Cantwell, on the Alaska Railroad, and several petitions to further this object have been circulated. Such a road would doubtless be of great service in opening up this country, which can be reached during the summer time only over a trail that makes haulage charges almost prohibitive.

A small amount of placer gold was recovered from Grubstake Gulch, in the Willow Creek district. A very small amount was also recovered from beach placers on Kodiak Island. This may be significant as marking the renewal of prospecting of these beaches, which in the past have yielded considerable gold.

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 no possible commercial interest. For convenience of description in this report all the producing placer camps in this vast area have been grouped into 18 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 a number of 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 1929 was worth $2,058,000, an increase of more than $180,000 over the corresponding figure for 1928. The increase is largely attributable to the extensive dredging work on the property of the Fairbanks Exploration Co., in the Fairbanks district, but was in no small measure due to the generally favorable weather conditions and fairly abundant water supply in 1929. In the following table the districts are arranged in order of their placer production in 1929, and for comparison the production from the same districts in 1928 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 precaution has been taken to guard against 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.

Value of placer gold produced in Yukon Basin, 1929 and 1928, by districts

District	1929	1928	District	1929	1928
Fairbanks and Richardson	$1,145,000	$947,500	Ruby	$36,000	$24,800
Iditarod	277,000	296,200	Eagle	16,000	16,500
Innoko	142,000	113,200	Kantishna and Bonnifield	10,000	11,800
Tolovana	118,000	151,000	Chisana	7,000	16,000
Circle	109,000	80,500	Marshall	5,000	3,500
Hot Springs	82,000	77,000	Rampart and Gold Hill	5,000	7,500
Fortymile	68,000	79,100			
Koyukuk and Chandalar	38,000	54,900		2,058,000	1,876,500

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 principally 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 combinations that have been made do not affect the relative standing of the larger districts to which the smaller ones have been added.

The region adjacent to Fairbanks has long been and still is the main placer district in interior Alaska. The greatest amount of placer gold was produced by the dredges of the Fairbanks Exploration Co., on the Chatanika River and Goldstream; the Fairbanks Gold Dredging Co., on Fairbanks Creek; the Tanana Valley Gold Dredging Co. (Ltd.), on Fish 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. The placer gold recovered by other methods than dredging came principally from Ester, Pedro, Dome, and Big Chena Creeks, the upper Chatanika River, and their tributaries. Several thousand dollars' worth of placer gold, in addition to that produced by the dredges, came from placers on Fairbanks and Fish Creeks. 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, yet in the aggregate swelled the total production for the district.

By far the most noteworthy mining feature of the Fairbanks district was the work accomplished on the extensive project of the Fairbanks Exploration Co., embracing the dredging of extensive tracts on Goldstream and Cleary Creeks and the Chatanika River, as well as ditch maintenance and operation from water supplies as far distant as Faith Creek, near the head of the Chatanika. The actual mining operations on this project began in 1928 with the construction of three dredges, the last of which was not completed until September. Two of these dredges were built during the winter and one during the summer. The experience gained in the assembly of these dredges led the company to conclude that the work could be done more economically during the summer, and as a consequence the two dredges that were assembled in 1929 were both built during the summer but not completed early enough to have much more than trial runs during that year. All five of the dredges, however, have now been broken in and should be in excellent condition to put in a full season's work in 1930. One of the two new dredges was built in the Wagner pit, in Goldstream Valley a short distance above Fox, and the other was built on Cleary Creek a short distance below the old town of Cleary and just downstream from the point where the large siphon crosses the creek. In addition to the productive work on this property there was necessarily a great deal of preparatory work that was in progress. In order to prepare the ground which is to be dredged in 1930, extensive equipment for cold-water thawing had to be installed, and scores of miles of pipe required in this work maintained and operated. The long main ditch and even the shorter lower ones had to receive constant attention, as is necessary with any new construction of this sort. The general work of building these ditches had been so well done that no unusual difficulty in their maintenance was experienced, though in a few places where they crossed frozen ground some breaks occurred which, though troublesome, were quickly repaired. The whole development of this project has been

so thoroughly analyzed, carefully planned, and efficiently conducted that little of its success has been left to chance, and it is an illuminating example of sound modern mining practice.

In the ill-defined district east of Fairbanks, here called the Richardson district, from the principal settlement in it, and including the old camp known as Tenderfoot, the Big Delta and Jarvis Creek area, south of the Tanana, and parts of the Goodpaster and Salcha Valleys, to the northeast and northwest, about 25 men were doing a little placer-gold mining or prospecting. The output of this entire district amounted to only a few thousand dollars in gold. Four small camps on Tenderfoot Creek employed a total of four men during the season. Two small camps of two men each worked on Democrat Creek, a tributary of Banner Creek, and one prospector was reported to have taken out a little gold on Buckeye Creek, also a tributary of Banner Creek. No details are available regarding the placer-mining operations on the other creeks here included in the Richardson district, and practically all of them were only development work. In the vicinity of the Jarvis Creek Basin, however, prospectors were at work on Savage Creek and on McCumber Creek and its tributary, Morning Star, and are said to have taken out a small amount of gold. On Rainy Creek and its tributaries, which in turn are tributary to Big Delta Creek, two men did some work on four claims, but so far as reported this consisted of little more than prospecting and preliminary development.

Placer mining in the Iditarod region was carried on in 1929 at practically the same rate as in 1928, and both years mark an especially high production. The large output was due to the extremely favorable weather whereby there was an abundance of water for sluicing and other mining purposes. The bulk of the gold recovered was mined by the dredges of the J. E. Riley Investment Co. and the North American Dredge Co., the former situated on Otter Creek about 2 miles from Flat, and the latter digging on the site of the old town of Flat. In addition to the dredge at Flat, four other outfits were mining on Flat Creek. 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 of the Chicken Creek Mining Co., under the management of William Duffy, who employed about 20 men. Several camps were maintained on Willow Creek, the largest of which were those of Manley and of Manley & Loranger. Two placer camps were hydraulicking on Otter Creek, the larger of which was that of Peter Miscovich, and the other was that of Martin W. Roslund. Two or three camps on other creeks in this same general district, including those of Olsen & Co. on Happy

Creek, Sakow & Co., Frank Lusher, and Frank Salen, are reported to have produced some placer gold during the season. Throughout the district there was a feeling of satisfaction with the mining results achieved in 1929 and a conviction that if the water supply was as good in 1930 an equal or even greater output would be maintained.

Reports from the Innoko district indicate that placer mining there in 1929 yielded considerably more gold than in 1928. A considerable part of this output came from the four dredges that were mining on streams in the district—two on Ganes Creek and one each on Yankee and Little Creeks. The Little Creek dredge and the one near the head of Ganes Creek were run for only a short part of the season. The company mining with the dredge on Little Creek, however, carried on extensive cold-water thawing operations so as to prepare the ground for further dredging in 1930. Altogether about 75 men were mining in the district in 1929. In addition to the dredges, there were several camps mining on Little and Ganes Creeks, three camps on Ophir and Cripple Creeks, and one each on Anvil and Spruce Creeks and Victor Gulch, as well as one camp in the Tolstoi district, which in this report is considered part of the Innoko district. Most of the larger plants in the Innoko district other than the dredges used various forms of dragline scrapers or hydraulic methods. Near the lower end of Ganes Creek two prospectors have for several years been doing some extensive testing with a drill, in an attempt to determine whether that tract is suitable for dredging. No decision in this matter has yet been reached, but current reports indicate that the ground tested in 1929 was somewhat better than had been found heretofore.

In the Tolovana district, which in this report as well as in the preceding volumes of the series has been extended to include Nome Creek, a tributary of Beaver Creek, there was a falling off in placer-gold production in 1929 of over $30,000 from that of 1928. This decrease is attributed to the fact that whereas most of the placer camps of interior Alaska had a plentiful rainfall in 1929, the Tolovana district seems to have received very little rain, and as a result very little water was available for use in mining. The greater part of the placer gold produced in the Tolovana district was mined by the dredge of the Nome Creek Dredging Co., under the management of Sam Godfrey. This dredge is reported to have handled much more gravel in 1929 than in 1928, but the average tenor was lower, so that not quite as much gold was produced as in the earlier year. The difficulty and cost of bringing wood to the dredge for fuel has led the owners to plan to install Diesel engines on it next season. Exclusive of the gold mined by this dredge, about half of the placer gold produced by mines in the Tolovana district comes from drift

mines, which are worked mainly during the winter and the pay dirt sluiced during the summer, and the other half comes from hydraulic or open-cut mines. Most of the larger producing mines are on Livengood Creek and its tributaries, Lillian, Ruth, and Amy Creeks. 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 and Ester Creeks, which join the Tolovana from the north, and Wilbur Creek, which enters it from the south.

The production of placer gold from the Circle district in 1929 was almost $30,000 more than in 1928, although this was considerably less than in the preceding years when the dredge of the Berry Dredging Co. was in operation and there were many more miners in the region. From all accounts the water supply was unusually large, so that there was an abundance for mining. The largest mining operations in the district were those of the Berry Holding Co., on Eagle Creek, and of the C. J. Berry Dredging Co. and J. A. Anderson, on Mastodon Creek. In addition to these the hydraulic plants of Knutson & Larson, on Deadwood Creek, and of Langlow & E. Larsen, on Switch Creek, a tributary of Deadwood Creek, produced considerable placer gold. There were also eight or ten small camps on Bonanza, Miller, North Fork, Harrison, and Independence Creeks, where the ground was worked mainly by open-cut methods and the production from few if any of the individual claims exceeded a thousand dollars. No noteworthy new discoveries were reported to have been made during the year, but there was a general undercurrent of optimism that seemed encouraging. This spirit seems to have been fostered in part by the highway from Fairbanks to Circle, which now makes the district much more accessible, as it joins the formerly remote town of Circle with Fairbanks by less than a day's automobile travel.

The value of the placer gold produced in the Hot Springs district in 1929 was about the same as in 1928, though the source of the gold differed considerably in the two years. For instance, in 1928 the gold came largely from the dredge of the American Creek Dredging Co., on American Creek, and the production from mines of other kinds was rather small, whereas in 1929 the conditions were reversed. The lessened production from the dredge was by no means to be attributed to the exhaustion of the available ground but was due rather to difficulties of management whereby during a large part of the effective open season internal controversies as to the best plan to be followed tied up or hampered progress. Perhaps the most noteworthy news relating to the Hot Springs district was that an English company, which late in 1928 acquired options on large tracts

in the vicinity of Sullivan Creek after carrying on an extensive drilling program to prove up the gold and tin content of the tract, decided that the tenor was not high enough to warrant further work and abandoned the enterprise. In the vicinity of Tofty the largest operations were those of Bock & Hansen and of Tillison & L'Heureux. In the Eureka Creek section of the Hot Springs district the largest operation was that of J. R. Frank & Co., on Eureka Creek, where considerable gold was recovered by hydraulicking. This company also has extensive holdings on Doric, Seattle, and Skookum Creeks. In addition to these larger camps there were a number of others of only one or two men each, which produced some gold, though the output of most of the individual claims was valued at not more than a few hundred dollars.

Placer mining in the Fortymile district yielded somewhat less gold in 1929 than in 1928, but this decrease is in part attributable to the amount of development work in progress, which curtailed production this year but will bring results in 1930. All reports indicate an especially large volume of water available throughout the Fortymile district during most of the summer. In fact, some of the miners who usually work on the bars of the Fortymile River report that most of the bars were under water and therefore could not be mined during the greater part of the season. About 24 separate camps, employing a total of about 50 men, were mining in the Fortymile district in 1929. During the winter some drift mining is done, but most of the gold is produced during the summer by open-cut or hydraulic methods. The largest mine in the district is that of the Walker Fork Gold Corporation, which is on Walker Fork and operates a dragline scraper. During the year the Alaska Consolidated Gold Corporation, under the management of Lee Steele, acquired extensive holdings on Dome and Chicken Creeks and plans to carry on large-scale hydraulic mining. The principal other streams from which placer gold was obtained are the Chicken River, Franklin Gulch, and Napoleon Creek.

In the Ruby district there was considerable active mining during 1929 which resulted in recovering about two-thirds more gold than was produced from the same district in 1928. Altogether about 13 camps, employing from 30 to 35 men, were engaged in this work. The greatest amount of gold was recovered from placers on Poorman Creek, where four camps, employing a total of 15 men, were at work. The next most productive creeks were Flat, Greenstone, and Moose, but small amounts of gold were recovered from Tamarack, Solomon, Meketchum, Bear Pup, and Big Creeks. Although not properly pertaining to the year covered by this volume, it may be significant to note that early in 1930 the local papers and some published in

the States carried reports of a rich strike having been made on some of the creeks 10 to 20 miles below Poorman, and for a time there was a small stampede of miners into the district. The amount of gold that will be taken from this new strike in 1930 can not of course be determined until the end of the year, but on March 25, 1930, the Geological Survey issued the following statement regarding these reported discoveries:

> The reported finds of new productive ground in the vicinity of Poorman, in the Ruby district, have been made in the same general neighborhood where placer-mining operations have been carried on for many years. To judge from the meager details available the new discoveries seem to have disclosed placers formed under essentially the same conditions as those already known in the region. Although reports from this camp of pans of gravel carrying many dollars are probably true, it is likely to be several months before any real estimate of the production from this find will be available. * * * From what is known of the Ruby region it seems likely that there remain workable placers that have not yet been discovered and probably will repay thorough and intelligent prospecting.

The later newspaper reports from this camp have become much less glowing than those that were printed soon after the new finds were first announced.

There was a very marked shrinkage in the output of placer gold from the Koyukuk district in 1929—so great, in fact, that the production appears to have been less than at any time during the last 30 years. 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 tract, in the central part of the Koyukuk Valley; the Hogatza River and vicinity, 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.

Reports from the area near the head of the Koyukuk indicate that about 20 different camps, employing about 40 men, were engaged in mining there in 1929. By far the largest amount of work was done on Nolan Creek and on the benches near its mouth and for some distance upstream. Some gold was also recovered from placers on the Wiseman River, Lake and California Creeks, tributaries of the Bettles River, Smith, Vermont, Porcupine, and Myrtle Creeks, and the Wild River. Some excitement was caused in the late summer by the finding on Summit Creek of a small boulder of float quartz that was liberally spangled with gold. As the bedrock source from

which this material came may be remote from the place where the boulder was found, it furnished no justification for more than local interest. It does, however, give further proof of the long-known fact that in the upper Koyukuk there are many indications of rich gold mineralization and that diligent search is likely to disclose workable lodes or placers. This fact has led to many attempts to prospect the district more thoroughly, but as it lies in one of the more remote and inaccessible parts of Alaska the accomplishment of that purpose will almost certainly be expensive and call for the persistence and hardihood of the best pioneers. It is reported that plans are under consideration for undertaking the prospecting of part of this area by using airplanes as the means of transportation of the prospectors. The saving of time that could be effected by this means would be of especially great importance in the success of this venture, because the open season in this highland region is so short.

In the Eagle district the production of placer gold in 1929 was slightly less than in 1928. There were 10 camps, employing about 25 men, engaged in mining. The largest amounts of gold appear to have been produced by the July Creek Mining Co. on Fourth of July Creek and by Froelich, Kummer, Ott & Scheele on Crooked Creek, but some gold was recovered from Dome, Alder, American, Nugget, and Broken Neck Creeks, and the Seventymile River. According to local reports much of the season was spent by the miners on Crooked and Dome Creeks in dead work, preparing their ground for more productive development in 1930 and thus curtailing their production in 1929. It is also said that in 1930 a hydraulic plant will be installed on Barney Creek and mining will be more active on Broken Neck and Fox Creeks. The water supply throughout most of the Eagle district was large during 1929—in fact, one prospector reports "floods unlimited."

The Geological Survey has received very little first-hand information regarding mining developments in the Chisana (locally called Shushanna) district. Apparently mining was in progress on not more than five properties during the year, and only about 12 men were employed. The water supply of the district is said to have been especially good, but in spite of this favorable condition the production from the district appears to have been only half as large as in 1928, a year when the supply was rather small. No new discoveries were reported from this district, and the production appears to have come from the less accessible patches of ground that were passed over in the boom days of the camp. The largest amount of gold recovered from this district in 1929 appears to have come from placers on Little Eldorado Creek, owned by Carl F. Whitham and mined under lease by B. J. Lewis. A method of removing the over-

burden through two lengths of sluice boxes with riffles is reported to have worked especially satisfactorily in handling the ground of Bert McKinney on Gold Run Creek in this district.

In the table on page 32 the placer-gold production of the Chandalar district has been combined with that from 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 1929 came from two properties—those of Bart C. Buckley on Little Squaw Creek and of A. L. Newton on Big Creek. At these properties only about five men were employed. Work at the property on Little Squaw Creek was mainly of a prospecting character, consisting in crosscutting the valley to determine the position and extent of the old channel. No new developments were reported to have resulted from the work of the season.

Placer mining in the Bonnifield district was carried on by six or seven small camps, the largest of which employed five men and was situated on Grubstake Creek, a tributary of Tatlanika River. The smaller camps were on Marguerite, Daniels, Moose, and Gold Run Creeks and the Bonnifield River, and produced not more than a few hundred dollars in gold each. 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 each district was approximately half of the combined total. In the Kantishna district there were a number of small camps at work on several of the creeks, notably Eureka, Little Moose, Glen, and Martin Creeks. None of these camps, however, recovered gold worth as much as $2,000, and most of them only a few hundred dollars' worth. All the ground worked is shallow and is mined by simple methods.

Records received by the Geological Survey regarding placer mining in the Rampart district indicate that six or eight camps were active during 1929, and most of these were small 1-man operations that recovered only a few hundred dollars' worth of gold. The greatest amount of gold was recovered from the placers on Little Minook Creek, where there were three camps. Other camps that reported producing some gold were two on Hunter Creek, one on Little Minook Jr., and one each on Slate and Quail Creeks. 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 1929 on Grant, Mason, and Moraine Creeks. Only a little gold was recovered in the course of this work, but it is significant as indicating a renewal of mining interest in this district.

Willow Creek was the source of most of the placer gold that was mined in the Marshall district in 1929. This stream enters the Yukon

a few miles upstream from the settlement of Marshall (Fortuna Ledge post office) and heads in hills composed principally of Upper Cretaceous sediments and Paleozoic greenstones and related rocks. Within the hills Willow Creek flows in a narrow-floored valley whose deposits contain many large boulders that interfere seriously with mining. Only a few miners or prospectors still remain in the district, and consequently the annual work that they accomplish in thoroughly prospecting this large tract of country is small. Some placer gold was also recovered from the gravel of Montezuma Creek. About 50 miles northeast of Marshall, in the valley of the Stuyahok River, a tributary of the Bonasila River, one man is said to have done some prospecting during the year, but no report as to the results has been received by the Geological Survey.

KUSKOKWIM REGION

Included in the Kuskokwim region are four principal districts where gold placers were mined in 1929. 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 about 30 miles east of the settlement of Bethel, and the Aniak enters the Kuskokwim about 50 miles 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 placer-gold production from the Kuskokwim region in 1929 was about $50,000 less than in 1928. The falling off was in large measure due to decreased production from the dredge in the Tuluksak-Aniak district, for apparently there was an increase in the production of placer gold by other mining methods. The decreased dredge production appears to have been due to the closing up of the project, for it is reported that that company intends next season to mine in the Fairhaven district of Seward Peninsula, as that district appears to afford an opportunity for much larger operations. No other dredges were in operation elsewhere in the Kuskokwim region in 1929. The dredge that for many years has been so productive in the district near McGrath was again idle, as it was in 1928, and ap-

parently no plans are now under consideration for its early reconditioning. In fact, it is reported that some of the machinery from this dredge has been removed to be used in one of the dredges in the Innoko district.

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 from which some placer gold was produced in 1929 may be mentioned Candle, Ruby, Hidden, and Eagle Creeks and Holmes and Riddle Gulches. There were less than a dozen men 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 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.

Mining in the Georgetown district appears to have been restricted to work on Donlin Creek, where one camp was engaged in mining a bench deposit by means of a small hydraulic plant. Although only a small amount of gold was recovered, the returns in relation to the amount of work and expense involved appear to have been very satisfactory to the operators. In the Tuluksak-Aniak district, in addition to the dredge output, considerable gold was recovered from placers on Marvel Creek, a tributary of the Salmon River, which in turn flows into the Aniak River, and from Canyon Creek, a tributary of the Kwethluk River, on the western slopes of the Kuskokwim Mountains, east of Bethel. The largest camp on Marvel Creek was that operated by Dahl & Wilson on ground owned by L. C. Hess. Six men were employed at this camp, and the reports indicate an especially good season. A few prospectors were reported to have been carrying on a search for placers on several of the streams that head in the general vicinity of Marvel Dome, and there is said to be some 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. The mine on Canyon Creek was on ground owned by Koamme & Co., which was worked by open-cut methods by two men.

Placer gold mining activities in the Goodnews Bay region were largely suspended during 1929. No mining was reported to have

been done on Wattamuse Creek, though one man did a little sluicing on Bear and Olympic Creeks. The test drilling of a large tract in the Arolic Valley that was in progress in 1928 was not resumed in 1929, and apparently the conditions that were found were not regarded as favorable for undertaking extensive development of the tract at this time. The interest that has been awakened in searching for placers carrying platinum in the country to the south of Goodnews Bay has evidently called away many of the prospectors who heretofore have been searching for gold. As a result the production of gold from this district has gone down while the production of platinum has gone up. As has been noted heretofore in these reports, very little gold is found closely associated with platinum in the placers that are being worked, notably on Clara, Squirrel, Platinum, and Fox Creeks, which are all tributary to Salmon Creek, which in turn empties into Chagvan Bay. Further notes on this work are given in the section of this report which treats of platinum.

SEWARD PENINSULA

The production of placer gold from Seward Peninsula in 1929 was $1,698,000, or about two-thirds of a million dollars more than in 1928. With the exception of 1926, this year marks the greatest production of placer gold since 1917 and has consequently given rise to much optimism as to the revival of mining in Seward Peninsula—a feeling that is by no means unjustified when all the conditions that contributed to this large output are considered. The weather conditions affecting the water supply in the peninsula throughout the open season were good, though by no means abnormal. No new strikes of bonanzas that quickly swell the output and then as suddenly drop off were made. Instead, the greatly increased production seems to have been due mainly to the fact that adequate quantities of ground had been thawed in advance of the large dredges in the Nome region, so that they could be kept running at their full capacity during most of the season. Part of the reason why so much ground had been prepared lies in the fact that, owing to a shortage of adequately prepared ground in 1928, the dredges had been compelled to close down early in the fall, and this and the good supply of water in 1928 gave an opportunity for thawing operations in that year to get ahead and thus prepare more ground for the dredges to mine in 1929.

Approximately $1,519,000, or nearly 90 per cent of the total gold recovered from Seward Peninsula placers, was mined by 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 1929 the mining districts of Seward Penin-

sula stood as follows: Nome, Fairhaven (including the Candle and Inmachuk districts), Council, the Koyuk River region, Solomon (including the Casadepaga River region), Kougarok, Port Clarence, and Bluff. 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 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 Wonder Creeks, its scores of claims, and its extensive ditches and other equipment for properly conducting its work. The sound mining practice and experimental research into the mining problems that arise in connection with its operations make the work of this company watched with great interest by all mining engineers who have to contend with analogous conditions. Near Nome there were three other dredges that reported some production of placer gold in 1929—those of the Dry Creek Dredging Co., the Bangor Dredging Co., and the Osborn Mining Co. The Dry Creek dredge has long been in operation in the district, but it was compelled to stop work early in September because of a conflict as to the ownership of the ground it was mining. The dredge of the Bangor Dredging Co., which for the last few years has been mining on Anvil Creek, completed work there and closed down early in the season. It is understood that the owners are negotiating for the removal of this dredge to a new locality, but the site has not been made public. The Osborn dredge was formerly operating on the Solomon River but was dismantled in 1928 and moved to Osborn Creek, in the Nome district, and reconstructed. It began mining in July and continued throughout the rest of the open season, with satisfactory results. Work on rehabilitating the old dredge on Hastings Creek that has laid idle for many years was continued throughout the year, and at the end of the season that work was reported to be 90 per cent completed, so that it should be ready to resume mining early in 1930. In addition to the dredges, small open-cut mines were being developed on several of the creeks adjacent to Nome. Most of these mines 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 Snake River, where 8 to 10 men were employed for most of the open season. The generally favorable stage of water throughout most of the district caused many of these smaller operators to produce somewhat more gold than in the preceding year, and although the production from many of the individual mines did not exceed a few hundred dollars each, they collectively contributed a considerable amount to the total production of the district.

The greatest amount of placer gold mined in the Fairhaven district came from three main tracts—Candle Creek, the Inmachuk River, and Bear Creek. 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. Reports received in March, 1930, indicate that the company which has heretofore operated the dredge on Bear Creek in the Kuskokwim region has taken a long lease on the property of the Keewalik Mining Co. and if present plans are carried through will operate the dredges there in 1930. 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. At this property about 24 men were employed throughout the open season, and mining was carried on for 157 days. On the main Inmachuk River, R. Hoogendorn carried on considerable productive placer mining. A little placer mining and prospecting was carried on at other points in the valley of the Inmachuk and its tributaries. Prospecting was continued in search of any auriferous channels that might have been buried under the lava flows which cover large tracts of the country at the heads of the Inmachuk and of the neighboring streams adjacent to Imuruk Lake. This search has been in progress for several years, but no deposits that appear to warrant mining have yet been reported, though indications of placers have been encountered in many of the shafts that have been sunk in the course of this work. It was reported that a drilling outfit was shipped to Deering during the summer and was to be used to prospect a tract on Humboldt Creek, which is a tributary of the Goodhope River and which has produced considerable gold in the past, though it has been mined only by simple open-cut methods. The third tract in which placers were mined in the Fairhaven district, that on Bear Creek, lies 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, but the absence of news indicates that there have not been any notable developments during the year and that the production was probably maintained at about the same rate as the last few years, when not more than a few thousand dollars was produced annually.

In the Council district, as in the other larger producing districts of Seward Peninsula, most of the placer gold produced in 1929 came from dredges. Two dredges belonging to the Ophir Gold Dredging Co. and the Northern Star Dredging Co. mined on Ophir Creek and report good operating conditions. One hydraulic mine was also being operated on Ophir Creek, and small outfits were working on Melsing Creek and its tributary Benson Gulch. A little gold was also recovered from Rock and Aggie Creeks, which are tributaries of the Fish River. Although there were several individual prospectors scattered through the region adjacent to Council, the amount of mining has been so reduced that in 1929 the office at Council for recording claims was officially closed, the district was formally made part of the Nome district, and all the records were removed to Nome. In the report for 1928 attention was called to the finding of some showings of gold on June Creek, a small stream that rises in the conglomerate hills between the Kwik and Tubutulik Rivers. Apparently further prospecting in this valley failed to disclose workable placer ground, for in 1929 the stream was reported to be deserted.

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, the bulk 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 5 camps employing a total of about 12 men, during the summer. All these camps were situated on Dime Creek except one on Sweepstake Creek. No mining was in progress on the right fork of Sweepstake Creek, although some work had been in progress there during 1928.

Only one dredge was engaged in placer mining in the Solomon district in 1929. This was the dredge of the Goldsmith Dredging Co., on the Solomon River near Coal Creek. The dredge of the Shovel Creek Mining Co., which for several years had been mining on Shovel Creek, a western tributary of the Solomon River, was sold to an organization composed of Fred Jones and others, who have dismantled it and are moving it to a tract of placer ground on Spruce Creek, where it will be rebuilt and, it is hoped, will be in condition to mine during the season of 1930. Spruce Creek lies some 6 to 7 miles east of Solomon and flows directly into Bering Sea. The dredge of the Casadepaga Mining Co., formerly known as the Peck dredge, which mined in the main valley of the Casadepaga River near the mouth of Canyon Creek, was practically the only producer of any appreciable amount of gold in the entire Casa-

depaga region in 1929. Few details regarding mining other than dredging in the Solomon district have been received by the Geological Survey, and the very absence of reports indicates that few mining enterprises were active and that no new finds of significance were made. In the Bluff area, which lies east of Solomon and which for convenience is grouped with that district, only a few small placer mines were operated in 1929. The largest amount of placer gold came from a mine on Koyana Creek and one on Swede Gulch, but some was also taken from claims on Daniel, California, and Eldorado Creeks. No work was done in 1929 on the beach claims at Bluff, which had been equipped during an earlier year with a novel scraping plant.

Placer mining in the Kougarok district, in central Seward Peninsula, was done entirely by hydraulic and open-cut methods. Most of the camps in the Kougarok district were small one or two man affairs, and the largest employed only three or four men. Their individual output of gold was small, none reporting a yield of more than a few thousand dollars. These camps were situated not only in the valley of the Kougarok River and its tributaries but also were reported from some of the more remote valleys. One of the rather remote properties is that of the Dick Creek Mining Co., on Dick Creek, which lies north of the Kougarok and flows into the Serpentine River. At this place a unique method of stacking tailings has been in use for several years. The ground for most of the season was of very low grade, but just before the end of the season it prospected much better, and the owners look forward to a much larger production in 1930. One of the items of general interest regarding the Kougarok district was that the Coffee Creek Mining Co. spent much of the summer in surveying for patent a tract of some 1,400 acres of placer ground on Coffee Creek and its tributary Camp Creek. The lower 2 miles of Coffee Creek and much of the bench ground near it had already been patented several years ago, so that with the newly surveyed ground the company will hold more than 2,000 acres in that valley. No plans for the development of this tract have yet been announced. 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 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 region, however, was so small that it amounted to little more than wages for the men concerned.

In the Port Clarence district a little placer gold was mined on the Bluestone River and some of its tributaries, especially Windy and

Gold Run Creeks. A little placer gold was also mined on Coyote Creek, which enters Grantley Harbor about 2 miles east of Teller. No first-hand information is available regarding mining operations in the region north of Teller, but it is currently reported that one camp on the Agiapuk River produced a little placer gold and that there were also one or two prospectors in that region. For the last few years reports have been current that a dredge was to be installed on an extensive tract of placer ground on the Bluestone River. No further steps appear to have been taken during 1929 to carry out this plan. Several other projects to build dredges in the Port Clarence district have been rumored. Thus, it is stated that a company was dismantling one of the old dredges in the Nome region preparatory to transporting it to Deese Creek, some 4 miles east of Teller, where it would be reconstructed and commence mining. Another area where it was reported that dredging might be undertaken in the near future was on Budd Creek, a tributary of American Creek, which in turn is a tributary of the Agiapuk River, which flows into Imuruk Basin.

Lying east of Seward Peninsula but more or less closely related to it is the Bonanza district, so named from the small stream in it which has long been known to carry some placer gold. Prospecting has been carried on at several places in this general area and for the last two or three years has been especially active 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 bedrock throughout most of the placer camps in Seward Peninsula. The history of the coastal plain at this place in the main seems to have been comparable to the history of the coastal plain at Nome and elsewhere in Seward Peninsula, so that prospecting for ancient beaches in this region is well justified. Whether the ancient beaches will prove to be gold bearing, however, depends on the occurrence of mineralization in the material forming 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 thousand 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 1929. 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 Squirrel Creek 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 three men were reported to have done a little prospecting and recovered a small amount of gold from two 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 most of the workers.

In the tract that lies near Shungnak the placer deposits occur in the lowland adjacent to the Kobuk, close to the places where the small streams that debouch from the hills to the north traverse that lowland. The source of the placer gold found in these deposits appears to be local, as in general it is rough and appears to have been transported only a short distance. 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 1929 there were five small camps, employing a total of 14 men, established on streams in the vicinity of Shungnak. Two of these were on Dahl Creek and one each on 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 that settlement. The largest camp is that on California Creek, where about five men are employed and mining is carried on by hydraulicking. On the Shungnak River most of the work was directed toward testing and prospecting the ground to determine the practicability of mining on a large scale by dredging or hydraulicking. This work was done by the Northwest Alaska Mines under the general direction of Col. G. W. Rathjens, formerly of the Fairbanks Exploration Co. This company recognizes the fact that the Shungnak region is in general so inaccessible that an extensive tract of placer ground must be found if a mining enterprise in that region is to be successful, and therefore the company is not interested in finding small local deposits. Though no official statement has been given out by the company as to the results of its tests, the fact that it proposes to continue its prospecting of the area in 1930 indicates that the results so far have been encouraging. The most serious difficulty apparently has been that

of developing adequate transportation facilities to the region. Airplanes have been extensively used in transporting the men and equipment from Fairbanks, but with the breaking down of the regular airplane service to assist in the search for Col. C. B. Eielson a delay of several months in transporting one of the men resulted.

Near the head of the Kobuk a little prospecting is said to have been carried on by three men on the Reed River, but no report has been received as to the results of their search. The party of miners that visited the Walker Lake region in 1928 apparently did not return to that region in 1929, and so far as learned no prospecting was in progress there during the year. A group of natives is said to have gone into the Lucky Six region, at the head of the Noatak, for the purpose of prospecting that area, but no news has been received as to the work they accomplished.

DREDGING

Over 71 per cent of all the placer gold produced in Alaska in 1929 was mined by dredges. The total gold recovered by dredges was $2,932,000, of which the greater part came from 12 dredges in the Seward Peninsula region and the rest from 18 dredges in other parts of Alaska, notably in the Fairbanks district of the Yukon region. This total exceeds by nearly three-quarters of a million dollars the amount recovered by dredges in 1928, and the increase is largely due to increased production from the Nome dredges and to the new large dredges installed in the Fairbanks region. In fact, this total exceeds the amount heretofore produced by dredges in any year since this method of mining was started in Alaska. 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, 1903–1929

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
		39,008,000		

The total value of the gold produced by dredges since 1903 is about 15.3 per cent of the total value of gold produced from all kinds of placer mining since 1880, and lately there has been a constant tendency each year for a greater and greater percentage of the placer production to be mined by dredges. During 1929 the ratio of dredge production to the output from all other kinds of placer mining was 71 to 29, and there are no signs of a future diminution in dredge mining—in fact, an even higher ratio seems probable.

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 $2,729,257 in gold, or a little more than 93 per cent of the total mined by dredges, report that that amount came from 8,107,276 yards of gravel. The average yield thus shown is about 33⅔ cents in gold to the cubic yard. Applying this average to determine the unreported yardage gives a total of 8,709,600 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 six years, so that the quantities and values given for 1929 are comparable with those reported for the preceding years. If this value as stated is correct, it will be evident from the table that the average tenor of the ground dredged in 1929 was slightly less than the average of the ground dredged in 1928, though considerably lower than the average for most of the preceding years.

The length of time that the different dredges were operated varied widely. The longest season reported was 232 days for one of the dredges of the Fairbanks Exploration Co., which was operating in the Fairbanks district of the Yukon-Tanana region. This stands as the record for the longest working season that has been attained by any of the dredges operating in Alaska. The longest season reported for any of the Seward Peninsula dredges in 1929 was for one of the dredges of the Hammon Consolidated Gold Fields, at Nome, which mined for a period of 158 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 mining May 3 and did not stop its last dredge until December 22. The earliest date for beginning dredging on Seward Peninsula in 1929 was May 18 and the latest date for ending was October 24, both reported by the Hammon Consolidated Gold Fields. The average length of working season of the 14 dredges for which information is available (and in determining this average only one dredge each is counted for the Fairbanks Exploration Co. and the Hammon Consolidated Gold Fields, instead of the five and three operated by these companies, respectively) was 109 days. Obviously, the shorter average season was not imposed by climatic conditions but was due to breakage or some purely personal reasons at the different dredges. The lesson that is demonstrated by the record of the long working season of the dredge at Fairbanks is that for moderate-sized dredges handled skillfully a season of more than 200 days may be achieved at almost any camp in interior Alaska, and that under ordinary conditions a working season of more than 175 days may be attainable by most modern dredges almost anywhere in the Territory south of the Arctic Circle.

Although, as stated, the longest working season for any one dredge so far reported was attained in 1929, it must not be inferred that climatically this was an exceptional season. The records for 1926 show that in that year a dredge began work in the Cache Creek district on May 5 and a dredge in the Nome region did not shut down until December 4. In other words, in 1926 these two dredges spanned a working period of 213 days.

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

Yukon Basin:	
Fairbanks district—	
Chatham Gold Dredging Co	Chatham Creek.
Fairbanks Exploration Co. (5)	Goldstream and Chatanika River.
Fairbanks Gold Dredging Co. (2)	Fairbanks Creek.
Tanana Valley Gold Dredging Co. (Ltd.)	Fish Creek.
Hot Springs district—American Creek Dredging Co	American Creek.
Iditarod district—	
North American Dredge Co	Otter Creek.
J. E. Riley Investment Co	Do.
Innoko district—	
Flume Dredge Co. (2)	Yankee and Little.
Gibbs & Eison	Ganes Creek.
Innoko Dredge Co. (Hans Erickson, lessee)	Do.
Tolovana district—Nome Creek Dredging Co	Nome Creek.
Kuskokwim region:	
Tuluksak-Aniak district—New York Alaska Gold Dredging Co	Bear Creek.

Seward Peninsula:	
Casadepaga district—Conner, Erichinger & Hanot	Casadepaga River.
Council district—	
Northern Star Dredging Co	Ophir Creek.
Ophir Gold Dredging Co	Do.
Fairhaven district—Keewalik Mining Co	Candle Creek.
Koyuk district—Dime Creek Dredging Co	Dime Creek.
Nome district—	
Bangor Dredging Co	Anvil Creek.
Dry Creek Dredging Co	Dry Creek.
Hammon Consolidated Gold Fields (3)	Old beach line.
Osborn Mining Co	Osborn Creek.
Solomon district—Goldsmith Dredging Co	Solomon River.

During 1929 one dredge that had been active in 1928 was idle, but some mining was done by three old dredges that had not been in operation in 1928 and by two new dredges that were constructed in 1929. The net result of these changes was that the total number of active dredges in 1929 was 30. The dredge that was active in 1928 but idle in 1929 was that of the Shovel Creek Mining Co. on Shovel Creek, in the Solomon district of Seward Peninsula. This dredge was sold during the year and was being dismantled and moved to Spruce Creek in the same district. It was being reerected in 1929 and should be in operation in its new location before the end of 1930. The three old dredges that renewed mining in 1929 were one of the dredges of the Flume Dredge Co. and the second dredge on Ganes Creek, in the Innoko district, and the dredge of the Osborn Mining Co. on Osborn Creek, in the Nome district. The Osborn dredge was formerly on the Solomon River and was moved to its new location and reconstructed during 1928, so that by July, 1929, it was ready to resume mining at the new tract.

The two new dredges were both the property of the Fairbanks Exploration Co. and were erected during 1929 on the company's property near Fairbanks. One of the dredges was built in the old Wagner mining pit, a short distance east of the town of Fox, and the other was built just opposite the old settlement of Cleary, on Cleary Creek below the point where the large siphon crosses that stream. Both of these dredges were built during the open season of 1929, so that it was late in the fall before they were completed and began mining. Evidently the experience that the company gained in 1928, when it built two of its dredges in the winter and early spring and one in the summer, had proved that construction during the summer was much more economical than during the winter, even if by so doing the company lost the use of the dredge for most of that season. All the five dredges now owned by the Fairbanks Exploration Co. are models of up-to-date, efficient machines so designed as to be adapted to the special conditions that will be met in the indi-

vidual places they are to mine. Much of the placer ground at practically all the places where dredges are now working in Alaska is more or less completely 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 the largest force of workmen required comprises those employed in the various tasks connected with the thawing of the ground in advance of mining. Another large expense connected with most of the dredging camps in interior Alaska and Seward Peninsula is the obtaining of an adequate water supply. 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 requires the constant attention of a considerable force of men throughout the working season, especially if the construction is new and adjustment has not taken place.

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 all 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 before any further step is taken.

Among the places where prospecting is said to have been in progress recently with a view to determining their suitability to dredging operations may be mentioned the tracts in the vicinity of the Bluestone River, in the Port Clarence district of Seward Peninsula; in the vicinity of Shungnak, in northwestern Alaska; on the Goodhope River, in Seward Peninsula, a short distance west of Deering; in the northern part of the Nome River and adjacent parts of the Beaver River, in the Yukon-Tanana region; on Budd Creek,

north of Imuruk Basin in Seward Peninsula; and near Bonanza, on the coastal plain east of Norton Sound. It is reported that the New York Alaska Dredging Co. proposes to drill extensively in the Livengood region with a view to testing out a tract that may be suitable for dredging. The prospecting for dredging ground that has been going on for some time in the Arolic Basin in the lower Kuskokwim region appears to have been suspended, and no further drilling was done there in 1929. In addition to these projects that may be regarded as perhaps approaching a prospective stage, there are of course many others that have not yet advanced so far, though some of them may be even more meritorious.

COPPER

Deposits containing some copper minerals are found throughout most of the length and breadth of Alaska. At present, however, practically all of the Alaska copper comes from two mines in the Copper River region that are operated practically as a single unit, though owned by different companies, and one mine on Latouche Island that is owned and operated by the same company that operates the two mines in the Copper River region. Besides the copper recovered from these mines a few tens of thousands of pounds of copper was reported to have been recovered in 1929 at a smelter in the States from ores and concentrates shipped from southeastern Alaska. Also some placer copper was shipped to the smelter from the gold placers in the Nizina district. The total amount of copper recovered from Alaskan ores in 1929 has been taken as 40,510,000 pounds, valued at $7,130,000. 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 40,000,000 pounds a loss of only 1 per cent is equivalent to 400,000 pounds. It is therefore obviously essential to recognize just what stage in the process of converting ore into metal is represented by the figures given. As an illustration of this condition the following facts, taken from the report of the Mother Lode Coalition Mines Co.,[3] are significant. This

[3] Mother Lode Coalition Mines Co. Eleventh Ann. Rept., for 1929, 7 pp., 1930.

company in 1929 mined 57,177 tons of ore that assayed on the average 11.14 per cent of copper, which would be equivalent to 12,738,935 pounds of copper. Shipments to the smelter from the mine, however, were reported to contain only 12,242,740 pounds of copper. Evidently nearly 500,000 pounds of copper was lost during the process of handling and milling, by which the bulk of the valuable copper minerals were separated from the worthless material with which they are associated. Although this amount at first sight seems to be enormous, it represents a loss of less than 3.9 per cent, which really indicates a very high mill recovery and exceptionally good practice.

The total copper-bearing ore mined in Alaska in 1929 is estimated to have been 590,400 tons and to have had a copper content of about 43,340,000 pounds. When this ore had been concentrated and was ready for shipment to the smelter it had been reduced so that it had a copper content of 40,510,000 pounds, which represents a recovery of nearly 93.5 per cent of the copper that was contained in the original ore as mined. For the purposes of the present report this has been adopted as the amount of copper yielded by Alaska mines during 1929.

In attempting to set a value for this copper many different methods may be employed, and the results obtained 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 1929, according to computations by the Bureau of Mines, was 17.6 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 $7,130,000. 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 of the copper as possible during periods of high prices and hold it during periods of low prices. That the Alaska copper mines were successful in obtaining better than average prices for their

output is indicated by their reports. In fact, the average price received by the Mother Lode Coalition Mines Co. for that part of its copper which it sold is stated in its annual report to have been 18.157 cents a pound, and the other large company apparently received approximately as much. The figures relating to 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 value of the copper production 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 1928 and that of 1929 there was a decrease of about 911,000 pounds in quantity, though because of the higher price received in 1929 the smaller amount of that year was valued at $1,165,000 more than the larger amount of the earlier year.

Copper and silver produced at Alaska copper mines, 1880, 1900–1929

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
	10,387,200	1,189,989,000	208,008,000	11,373,260	8,577,400

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 1929. On the same diagram has also been plotted the average price of copper for each year. It is significant to note that up to very recent times there has been a very close relation 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 13.1 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.

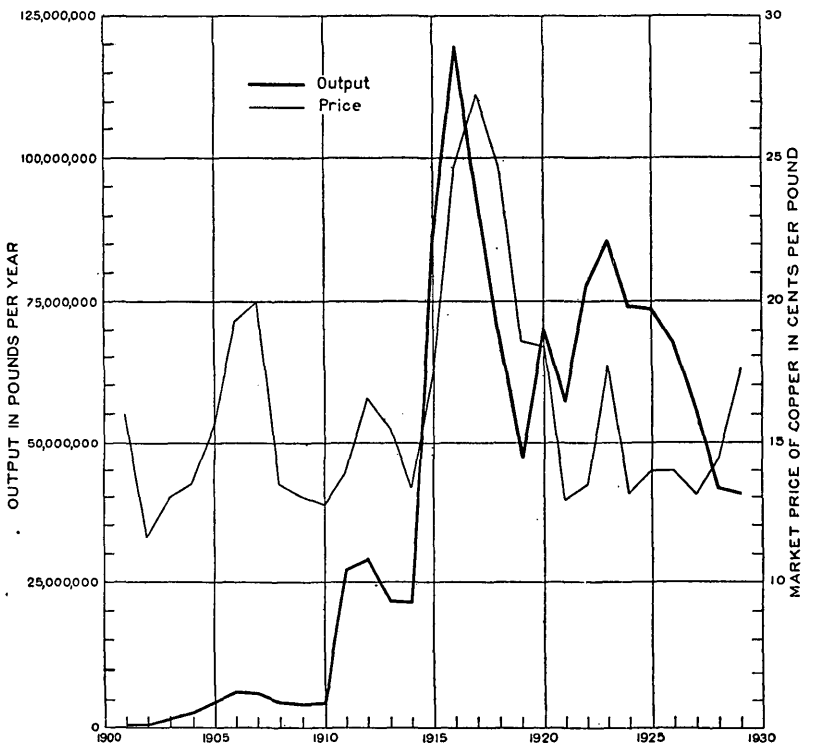

FIGURE 3.—Copper produced from Alaska mines, 1900–1929, and fluctuations in the price of copper during that period

No new developments of note were reported at the productive mines of the Kennecott Copper Corporation at Kennecott, in the Copper River region, during 1929. 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] 79,955 tons of ore was mined during

[4] Kennecott Copper Corporation Fourteenth Ann. Rept., for 1929, p. 7, 1930.

the year, which was estimated to have an average content of 11.86 per cent of copper and 2.25 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 57,177 tons of ore was mined, which had an estimated content of 11.14 per cent of copper and 1.85 ounces of silver to the ton.

The ore of the Beatson mine of the Kennecott Copper Corporation, on Latouche Island, is entirely different from that of the mines in the Copper River region, just described, being a low-grade copper-iron sulphide, mined by a system of caving. All the ore is concentrated at mills near the mine, and only the concentrates are shipped to the smelter in the States. According to the published report of this company[6] 452,962 tons of ore was produced in 1929, which had an estimated content of 1.28 per cent of copper and 0.243 ounce of silver to the ton.

One new company was added to the list of Alaska mines that produced a significant amount of copper in 1929. This was the Solar Development Co., which has recently taken over the old Rush & Brown and Salt Chuck properties on Kasaan Peninsula, Prince of Wales Island, in the Ketchikan district. Some notes regarding this property are given on page 17, in the descriptions of the places where lode gold was produced. This company during 1929 was engaged principally in development work and did not mine any ore. However, the operators found considerable ore in the bins that had been mined and sorted by the earlier owners, and this ore they shipped to the Anyox smelter in British Columbia. From this ore gold, silver, and several tons of copper were recovered. As plans were in progress for the active reopening of this mine, it seems probable that an increasing output of copper from this part of the Territory may be looked for in the near future, unless the decreased price paid for copper dissuades the operators from pressing on the development until better prices prevail.

Some of the copper produced in Alaska in 1929 came from float copper nuggets recovered in placer-mining operations. Copper nuggets of this sort have been found for many years in the course of gold-placer mining in the Nizina district, and at some of the properties the copper is put aside when the gold is being separated from the concentrates of the other heavy minerals. In the course of time

[5] Mother Lode Coalition Mines Co. Tenth Ann. Rept., for 1929, p. 3, 1930.
[6] Kennecott Copper Corporation Fourteenth Ann. Rept., for 1929, p. 7, 1930.

these accumulations of copper nuggets are shipped to the smelter and the copper recovered. During 1929 several tons of copper was recovered from this source, and it has been credited to the production of that year, though probably the material was collected during a period of several years.

Probably the most active prospecting for copper lodes that was in progress during 1929 was at the Nelson prospect on Glacier Creek, in the Chitistone region, and at the Dickey property, on Knight Island, Prince William Sound. The ore found on the Nelson property was of the same general type as that being mined at the large producing mines near Kennecott. An arrangement was entered into whereby the Kennecott Copper Corporation was to undertake the exploration of this ground. As a result a crew of 15 to 20 miners were employed throughout most of the year in carrying on the necessary investigations. No statement as to the results of this work has been given out by the company, and it will doubtless take considerable outlay of time and money to determine the true value of the deposit. The keenness of the Kennecott Copper Corporation to find and develop ore deposits in the region tributary to the Copper River & Northwestern Railroad gives assurance that a thorough test will be given to the property and that every effort will be expended in trying to develop it into a producing mine.

The prospecting of the Dickey property has been carried on by the Solar Development Co., a subsidiary of the Consolidated Mining & Smelting Co., a Canadian company. Prospecting and development work has been proceeding at this place for more than a year with a considerable crew. Although no authoritative statement regarding the results so far obtained has been given out, the continuation of the work indicates that the finds have been adequate to encourage the operators to complete a thorough examination of the property.

More or less prospecting and development work is reported to have been done at several of the mines in the Copper River region and adjacent country that have produced some copper in the past, but so far as learned none of them shipped any ore during 1929. Among these more or less inactive properties may be mentioned the Copper Creek mines, in the Kotsina district, and the property of the Alaska Nabesna Corporation, north of the Alaska Range. Plans for more active development at both these properties are contemplated in the near future. No work was reported to have been in progress during the year at the Green Butte mine, on McCarthy Creek. Considerable renewal of interest in mining of all kinds was manifested in the Valdez district, and as a result not only have some of the old gold mines been reopened, as already noted, but prospecting for lodes of copper and other metals has been stimulated.

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 $187,400 was received in 1929 from ores that are valuable principally for the copper they contain. This source alone accounts for nearly 75 per cent of all the silver that was produced in Alaska in 1929. 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 two-thirds of an ounce to a ton of ore, and the ore from the mine that reported the highest average silver content contained only 2.25 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 90,635 ounces of silver in 1929, according to the company's published report.[7] The silver from all the gold-lode mines amounted to 94,370 ounces, and it was worth $50,300. 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 26,800 ounces, worth $14,300.

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 the quantity and value of the production from each source in 1929 and 1928 are set forth in the following table:

Silver produced in Alaska in 1929 and 1928

Source	1929		1928	
	Ounces	Value	Ounces	Value
Gold lodes	94,370	$50,300	80,340	$47,000
Gold placers	26,800	14,300	23,930	14,000
Copper lodes	351,730	187,400	350,430	205,000
	472,900	252,000	454,700	266,000

It is evident from the table that the total output of silver in 1929 was worth about $14,000 less than the output in 1928, in spite of the fact that the quantity produced in 1929 exceeded that produced in 1928 by nearly 20,000 ounces. The explanation of this condition lies

[7] Alaska Juneau Gold Mining Co. Fifteenth Ann. Rept., for 1929, p. 13, 1930.

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 1929 was 53.3 cents an ounce, as against 58.5 cents in 1928. If the price of 53.3 cents had prevailed in 1928 the value of the silver production of that year would have been nearly $24,000 less than the value stated, so that the production of 1929 would have shown an increase of $10,000 over that for 1928 instead of a decrease of $14,000. It should be remembered that the bulk of the silver is merely an accessory to the 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, as has already been pointed out, the production of copper decreased somewhat over 900,000 pounds in 1929, and yet the amount of silver recovered from the copper ores was about 1,300 ounces greater than in 1928. On the other hand, the rule holds regarding the production of silver from the gold-lode ores as well as for that recovered from the gold placers. In the lode gold there was an increase in silver produced of more than 14,000 ounces and in the placer gold of nearly 3,000 ounces. The increase in value of the silver from these two sources was not great, owing to the lower price of silver in 1929, as explained above, so that the increase in value of the silver recovered from the gold lodes was only about $3,000 and from the gold placers only about $300.

The development in Alaska of ores that are principally valuable 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 it in a readily salable metallic state than to recover gold. As a result it is more or less unfeasible 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 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 Hyder district, at the head of Portland Canal, near the international bound-

ary. In 1929 no shipments other than small test lots were reported, though more than a score of prospectors were engaged in prospecting and development work, and on several properties promising leads were said to have been found. The Hyder district adjoins the mineralized region north of Stewart, in British Columbia, in which the famous Premier silver and gold mine is situated. This very rich deposit occurs under geologic conditions by no means unlike those that are found in parts of the adjoining Hyder district, and this similarity has sustained interest in the search for profitable silver and gold deposits on the Alaska side of the boundary. During 1929 one of the mines in the Hyder district that had been brought to a producing stage in an earlier year was closed, but the suspension was reported to be only temporary, and it should soon be operating again. A summary statement regarding general mining activity in this district is made in the section of this report describing the gold lodes (pp. 16–17).

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. 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 two years ago, little development work was in progress, and the property lay practically idle throughout the season of 1929. 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 acts as a strong deterrent against attempting to mine silver deposits at this time. In spite of talk of legislative action to raise the price of silver, there seems to be little likelihood that action of this sort will be taken in the near future, and as a result 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 1929 amounted to 2,630,000 pounds, an increase over the production of 1928 of about 590,000 pounds. This stands as the greatest quantity of lead that Alaska has ever produced in a single year. The value of the output at 6.3 cents a pound, the average market price of the lead sold in the States in 1929, according to the Bureau of Mines, was $166,000. This was a large increase and was due both to a great increase in quantity produced and in the price per pound, for in 1928 the average market price of lead was only 5.8 cents a pound, or half a cent less than in 1929.

Lead produced in Alaska, 1892–1929

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			
1903	30	2,520	1917	852	146,584		12,145	1,606,000
1904	30	2,580	1918	564	80,088			
1905	30	2,620	1919	687	72,822			

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. The larger part of the lead that is reported in the foregoing table as produced in 1929 was recovered in the course of treatment of the gold ores of the Alaska Juneau mines, in southeastern Alaska. According to the published reports of this company for 1929 it produced 2,501,832 pounds of lead in addition to other metals during that year. This represents a recovery of a little less than two-thirds of a pound of lead from each ton of ore that is mined and trammed to the mill, or about 1¼ pounds of lead from each ton of ore that is fine milled.

All the information regarding the recent developments on ores that contain lead as well as other metals has already been given in other parts of this report, especially those that describe the gold or the silver lodes. These statements show that lead ores are widely known throughout the Territory, and in the past shipments valuable in part at least for their lead content have been made from many areas in southeastern Alaska, especially the Hyder district; from the Yukon-Tanana region, especially from the Kantishna district; and even from far-away Seward Peninsula at the Omalik mine, and from the

Kobuk 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 thus offers little incentive to development 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 as well. 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 in the near future seems almost equally certain. An increase in the output of lead is therefore looked for with considerable assurance.

PLATINUM METALS

Platinum is one of a 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 1929 is estimated to have been approximately 528¼ crude ounces, or 475.4 fine ounces, which at $67, the average market price for platinum as computed by the Bureau of Mines, was worth about $32,000.

The only occurrence of a metal of this group in a lode that has produced any appreciable quantity was at a mine formerly operated by the Alaska Palladium Co., on Kasaan Peninsula, Prince of Wales Island, about 30 miles west of Ketchikan. The principal platinum metal found at this mine was palladium. Unfortunately, decrease in the price paid for palladium and some internal difficulties resulted in the closing of this mine in the fall of 1926, and it has not been reopened since. As this mine while it was running produced several hundred thousand dollars' worth of platinum metals a year and in addition a good deal of gold and some copper, its cessation of production has not only made a very decided drop in the Alaskan output of platinum metals but has been felt in the total mineral production of the Territory. This mine is part of the property taken over during 1929 by the Solar Development Co., and although no work was done on it during the year it will undoubtedly be included in the general plans of that company for developments on Kassan Peninsula.

The only platinum metals that were mined in Alaska in 1929 were recovered from placers in the Dime Creek district, of Seward

Peninsula, and in the Goodnews Bay region, south of the mouth of the Kuskokwim River. The Seward Peninsula deposits have been known for a long time and have been more or less continuous producers, though their annual yield has amounted to only a few ounces. The occurrence of platinum in the Goodnews Bay region has also been known for several years, but interest in the deposits was especially keen during 1928, when for a time it appeared that a small stampede was in progress, and this interest was maintained during 1929. 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 several men were engaged during the summer in the search for places where concentration has been great enough to form deposits that can be worked at a profit. The most extensive work is reported to have been done in the vicinity of Salmon Creek, a small stream lying between Goodnews and Chagvan Bays, about 2 miles north of the native village of Kiniginagimut. This region has not been surveyed, and the position of the different streams in that region is not accurately known to the writer. According to local reports, however, the camps that produced some platinum were on Clara, Squirrel, and Platinum Creeks and Fox Gulch. 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. 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 are 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 1929, when the prices paid for platinum fluctuated widely but on the whole tended downward. As is probably not generally known, none of the Government mints or assay offices pay for platinum sent to them, so that the seller must sell to private purchasers, and the transaction becomes one of bargaining, which at the distance that separates the Alaskan producer from the purchaser in the eastern United States is time consuming to conduct and rather disadvantageous to both parties.

Although no other places in Alaska are known to have produced platinum metals that were sold in 1929, 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. Some platinum is reported to have been found in the gold ores of the Nuka Bay region, in Kenai Peninsula. This report has not been definitely verified, and its accuracy seems doubtful, as the general geology of that district is unlike that in known platinum fields and does not appear favorable for the occurrence of the metal.

TIN

Alaska's tin production in 1929 showed a slight falling off in both quantity and value from 1928, but they were both in excess of the production for any of the years from 1920 to 1927, though far below the production for 1911 to 1919, when the industry was at its height. In spite of the smaller amount produced in 1929 than in 1928, it appears that, on the whole, the tin industry is growing, and developments already in progress may result in the near future in yielding quantities comparable with those during the period of high tin production. The decrease in quantity was only about 2½ tons of metallic tin, but the decrease in value represented not only the lessened output but also a decrease of over 5 cents a pound in selling price. The output of tin was all derived from placers, and consequently the ore reported represents really concentrates running from 68 to 76 per cent of metallic tin. The output of tin ore was 51.6 tons, containing a metallic tin content of 38.6 tons. The average price of metallic tin for the year as computed by the Bureau of Mines was 45.19 cents a pound, so that the value of the Alaska production was $35,000. Practically all this tin ore was shipped out of Alaska for treatment, only a few hundred pounds remaining unsold in the hands of the producer. Almost all the ore is shipped to Singapore for reduction.

Tin produced in Alaska, 1902–1929

Year	Ore (tons)	Metal (tons)	Value	Year	Ore (tons)	Metal (tons)	Value
1902	25	15	$8,000	1917	171	100	$123,300
1903	42	25	14,000	1918	104.5	68	118,000
1904	23	14	8,000	1919	86	56	73,400
1905	10	6	4,000	1920	26	16	16,112
1906	57	34	38,640	1921	7	4	2,400
1907	37.5	22	16,752	1922	2.3	1.4	912
1908	42.5	25	15,180	1923	3	1.9	1,623
1909	19	11	7,638	1924	11	7	7,028
1910	16.5	10	8,335	1925	22.2	13.8	15,980
1911	92.5	61	52,798	1926	12.85	8	10,400
1912	194	130	119,600	1927	37.5	26.7	34,000
1913	98	50	44,103	1928	58.6	41	41,000
1914	157.5	104	66,560	1929	51.6	38.6	35,000
1915	167	102	78,846				
1916	232	139	121,000		1,806.2	1,130.6	1,083,000

Tin minerals have been found in the veins and mineralized country rock of the York and Port Clarence districts, Seward Peninsula, and at one time were extensively mined. The tin produced in 1929, however, did not come from lodes but from placer deposits, principally in the York district, of Seward Peninsula, and the Hot Springs, Ruby, and Gold Hill districts, of the Yukon Valley. In the York district the placer tin, or cassiterite, is mined principally for itself, though some placer gold is also found with it. In the Yukon Valley districts the tin ore is a by-product obtained from deposits that are mined primarily for their gold. In the York district the tin ore was mined by two small camps, the larger of which is on Goodwin Gulch. In the Hot Springs district the tin ore was mined at several small camps on Deep and Miller Creeks, in the vicinity of Tofty. In the Ruby district the tin ore was produced in connection with mining operations on Cox Gulch, and in the Gold Hill district, west of Tanana, the placer tin was collected in connection with placer mining on Grant Creek.

Revival of interest in the development of the tin lodes of western Seward Peninsula was noted during the year, though so far as reported no ore was mined. Some prospecting and development work was done at the old Crim, Randt & O'Brien property, near the Lost River, which has been taken over by the National Tin Mining Co. Although no active field work was undertaken on the property of the Empire Tin Mining Co., near Cape Mountain, it is understood that negotiations were in progress to get this property opened up again, and possibly some work will be started there in 1930.

Considerable interest in tin mining was revived in the Hot Springs district by the acquisition, late in 1928, of options on most of the lowland areas in the vicinity of Tofty and Woodchopper Creeks by an English company which proposed to dredge the placer deposits there to recover the tin and gold that they contain. This transaction was not completed until so late in the open season that the only steps taken in 1928 were to have engineers of the company examine the ground and make such preliminary tests as the time at their disposal permitted. These tests were followed in 1929 by more complete examinations, and as a result the project was abandoned. No specific reasons for this decision have been made public, but evidently the returns were not such as to encourage the large expenditures that would be necessary to put the property on a producing basis. Although the withdrawal of this company was a severe disappointment to the people of the district, it is believed to be more advantageous in the long run for all concerned if projects are not undertaken unless they appear to hold good promise of successful accomplishment.

During 1929 considerable activity was shown in searching for tin in the Ruby district. This work was being carried on at a score or more claims on Cox Gulch, a tributary of Big Creek, and on the contiguous tracts some distance east of the town of Ruby, and finds of tin ore both in the placers and in masses that apparently had not traveled far from the parent ledge encouraged search for both lode and placer deposits that might be mined at a profit. This ground has been examined by several mining engineers, and although their reports have not been made public the general conclusions seem to be favorable, as the ground has been taken under option and prospecting carried on consistently.

COAL

The amount of coal produced from Alaska fields in 1929 showed a falling off from the high mark established in 1928, but otherwise in the whole period that Alaska coals have been mined the production in 1929 was exceeded only by that of the years 1923 and 1927. In other words, the production of coal in Alaska is showing a fairly constant increase, with only minor declines. It must be remembered, however, that the industry is still only small, for a total production of around 100,000 tons a year is not as much as many of the moderate-sized mines in the States produce individually, and the Alaska product does not even supply the local markets. Thus about 57,000 tons of coal was imported from fields outside of Alaska in 1929, 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 statistics set forth in the following table:

Coal produced and consumed in Alaska, 1880–1929

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	1,814,047
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	166,700
1928	126,100	662,000	39,184	32,521	197,805
1929	100,600	528,000	32,762	24,172	157,544
	1,213,154	6,742,000	1,236,788	1,650,568	4,087,349

[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 1929 is stated to have been $528,000. This value can only be regarded 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 company is not a fair 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 1929 was approximately $5.25 a ton, which is the same as in 1928 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 three mines—two in the Matanuska field and one 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 that of the Alaska-Matanuska Coal Co. in the valley of Moose Creek. The Evan Jones mine was active throughout the winter and early months of 1929, but its production gradually tapered off until in July it amounted to only a few hundred tons, and after August until the end of the year it was idle. Mining at the Premier and the Alaska-Matanuska property, which were being worked essentially as a single unit, was practically at a standstill throughout the early part of the year, but beginning in July the company again began work to fill the new contract that it had obtained for furnishing the larger part of the coal used by the Alaska Railroad. The litigation regarding the Premier property, which had been in course of settlement for several years, was still pending at the end of the season. In addition to the two principal producing mines a little work was 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 homemade 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 entirely possible that a more extended use of this coal for that purpose, not only by the railroad but by others, will be made. The old Government-owned mine at Eska was maintained in a more or less stand-by condition throughout the year, so that if anything should happen that might endanger the supply of coal needed to run the railroad it could be quickly reopened 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 mine is connected with the main line of the Alaska Railroad by a standard-gage spur track which crosses the Nenana River on a steel bridge. Unfortunately, during the spring high water and break-up this bridge was so seriously damaged that it was out of commission for nearly two months, thus severely handicapping this company in making its shipments. During this delay the company was able to utilize some of the time in improving conditions underground and on the surface. The plant of this mine has been well laid out and is now equipped with the necessary modern machinery to handle 200 tons or more of coal a day. The corporation has a contract for supplying the coal used by the Fairbanks Exploration Co. in 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 1929 and yielded nearly half of all the coal mined in Alaska that year.

The coal claims of Roth & Manley, farther up the Healy River, apparently lay dormant throughout the year. That there is coal of good quality in this part of the Healy River Valley, as well as in the valley of Lignite Creek, to the north, has been abundantly proved. That it is of better quality than the other coals and can be mined more cheaply has not been demonstrated. Furthermore, the one mine that is now operating seems to have ample facilities for supplying all of the market that is now in sight. Consequently the expense of opening up additional mines, with the construction of the accompanying haulage and transportation facilities, as well as the extra haul necessary to bring the coal to market, would place an additional charge against it without any adequate compensating offset, unless the coal can be mined more cheaply or has a higher heating value, which seems extremely doubtful.

A small amount of coal was mined in 1929 on the property of the Admiralty Island Coal Co., in southeastern Alaska, but difficulties in management and finances caused the cessation of productive work early in the summer. This development was at the old Harkrader coal claims, on Kootznahoo Inlet, on the west coast of Admiralty Island. An inclined shaft continuing the old shaft on the property has been driven to a depth of several hundred feet, and several levels have been turned off to drift along the bed of coal. A sketch map showing the general developments at this place is shown by Figure 4. This map was prepared by B. D. Stewart, who supple-

mented his own surveys by notes furnished by R. S. Donaldson, formerly manager of the company, and by Louis Bridges, foreman. Several small shipments of coal have been taken to Juneau from this mine and used locally with satisfactory results. The coal is said to occur in two benches, the upper one about 2 feet thick and the lower one about 3 feet thick. The conditions for mining are in general regarded as favorable, but only further work can determine ade-

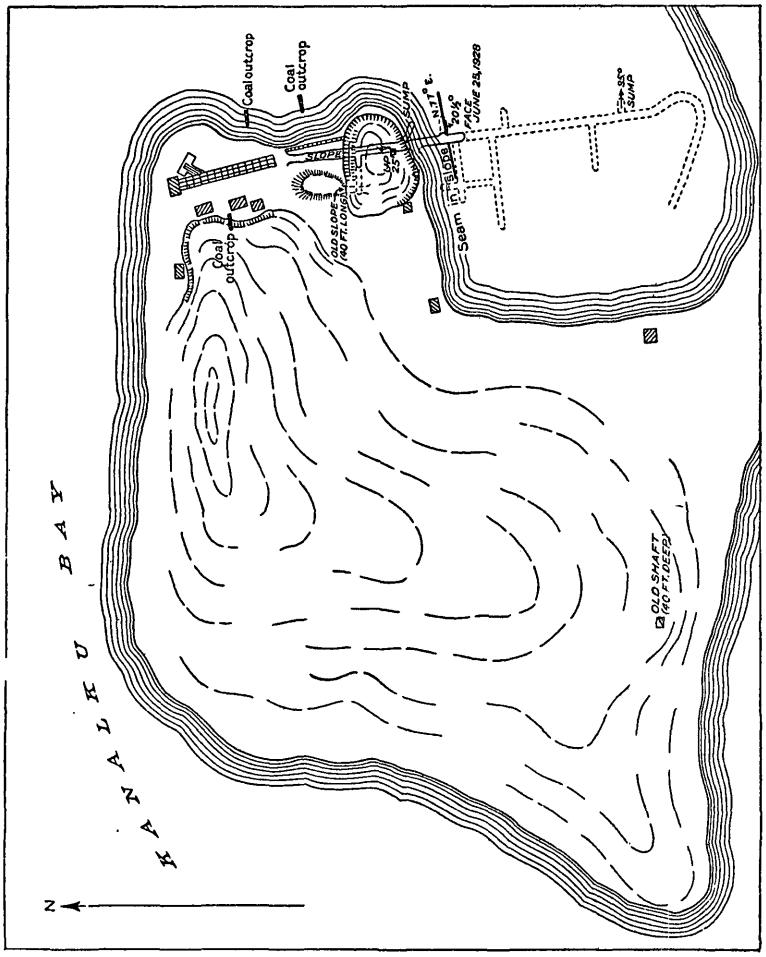

FIGURE 4.—Sketch map of coal property at Harkrader, Admiralty Island, Alaska. By B. D. Stewart. Developments later than June, 1928, shown by dotted lines and plotted from notes furnished by R. S. Donaldson and Louis Bridges

quately the extent of the deposits and, what is of perhaps even more importance, the cost of mining and making the coal available for shipment. The solution of these problems as well as the transportation and marketing of the coal will require careful investigation if the enterprise is to be successful.

Elsewhere in Alaska there are numerous deposits of coal, and from some of them small supplies are taken to supply local needs. In

northwestern Alaska, in the vicinity of Wainwright, are extensive coal beds that furnish some coal to the people living in that region. According to reports, more than 100 tons of coal from these deposits was mined in 1929, mostly by natives, and carried by them in their skin boats to Wainwright, where it was disposed of to the traders and others. Some of this coal was said to have been loaded aboard the *Bowser*, the boat belonging to the Office of Education, and delivered to a few of the schools along the coast that are under the jurisdiction of that bureau. This coal has long been known, but as the coal mined is that lying close to the surface and is weathered and mixed with much dirt it is not of as good a quality as the coal that is shipped in from other fields. In fact, it is said that the local people prefer to import coal from outside rather than use the local coal, even though the outside coal costs nearly three times as much. It is believed that the apparent inferiority of this local coal is not inherent in the coal but is due to the methods of mining and the fact that the coal is taken too close to the outcrop.

In the Bering River field, where extensive deposits of coal, ranging in composition from bituminous to anthracite, have long been known, prospecting or other development work relating to the coal resources was apparently at a standstill in 1929. 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 too much potential value to be allowed to remain idle long, 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 the 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.

PETROLEUM

The only petroleum produced in Alaska comes from the wells of the Chilkat Oil Co., in the Katalla field. This company obtains oil from a number of relatively shallow wells, few of which are more than 1,000 feet deep and none more than 2,000 feet. A small refinery is operated at Katalla by the company, and the products—gasoline and distillate—find a ready market near at hand, especially

for use by boats of the fishing fleet near Cordova. According to the published report of this company [8] it did no new drilling during the year, and the only significant new development was the granting by the Secretary of the Interior of several new permits covering an area of 1,347 acres.

The small domestic production of petroleum from the Katalla field is not at all 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 that is brought out by the data of the subjoined table is the constant increase since the war in the amount of gasoline and related lighter products of distillation imported. This increase is 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.

Petroleum products shipped to Alaska from other parts of the United States, 1905–1929, 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
	389,527,307	73,723,425	20,312,354	9,076,149

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

Search for new oil fields in Alaska has not been vigorously carried on during the year, and at only two places was any drilling done. Hundreds of permits for prospecting for oil that have been issued by the Government and cover tracts in all parts of Alaska are out-

[8] Chilkat Oil Co. Twelfth Ann. Rept., Seattle, 1930.

standing in the hands of individuals and companies, but most of them were evidently taken up solely for speculative purposes and will lapse after a short time if no active work is done under them. The lack of success that followed the drilling of one or two deep test wells put a damper on further prospecting for oil, as it proved that the discovery of commercial pools would require much work, careful study, and the expenditure of large sums of money. The failure of these few wells, however, by no means indicates that the probability of finding other oil pools in the Territory is remote. From what has already been learned about the geology of the potential oil areas there is no reason to believe that the chances of finding oil in Alaska have been exhausted, and the experience with these first wildcat wells is not unlike the results of the early drilling in some of the fields in the States that subsequently have proved to be immensely productive. There are many tracts in Alaska that are believed to show favorable geologic structure that will warrant extensive tests when the pressure to find new supplies of oil becomes stronger. These tests, however, should not be undertaken by any but a strong organization that is able to carry through the exploration of the tract selected to a determinative conclusion and that is advised by a technical staff competent to interpret and utilize to the fullest the facts that are disclosed in the course of the work.

One of the two places where prospecting for oil by the use of the drill was in progress in 1929 was in the Katalla field not far from the tracts that were producing oil. This work was done by the Alaska Consolidated Oil Co., which is said to have taken over much of the ground formerly held by an old English company which was among the pioneers in this field. A drill rig was shipped in from the States in July and was taken to the ground soon afterward. So far as known, however, little more than the necessary construction and setting up of equipment to begin drilling was accomplished in 1929, but the company should be in a position to push the work forward vigorously in 1930. It is generally assumed that the oil that may be found in this tract does not lie at a depth of more than 2,000 feet or so, but the geologic conditions under which it occurs are not well understood, so that the result of the drilling will be watched with keen interest, not only for the information it will afford regarding the specific tract tested but also for its bearing on the general region perhaps even as far east as Yakataga. Rumors of other developments to be undertaken in prospecting for oil in the Katalla field have also been current, but none of them seem to have advanced to the stage of field work in 1929.

The only other place where drilling for oil was in progress in 1929 was in the Matanuska Valley, a few miles west of Chickaloon,

on the property of the Peterson Oil Association. Work at this place was started in 1926, and when operations were suspended in the winter of 1928 the well had been put down to a depth of 1,300 feet. Early in 1929 the Star rig that had been used theretofore was dismantled, a Standard rig was put in its place, and various changes were made in the surface plant. After drilling began difficulties were encountered because of caves and open spaces in the formations penetrated, so that progress was slow. To cap the climax a bit broke off in the hole, and more than a month was lost in getting the necessary tools and fishing for it. The heavy rains that prevailed during most of the summer caused many washouts and slides on the railroad, which put the track out of commission and necessitated the expenditure of much extra time and effort in getting the needed supplies and equipment to the property. As a result the company finally stopped drilling at a depth of about 1,360 feet and closed down its camp early in the fall, though it expects to resume work in 1930. Apparently the showings are still regarded by the owners as sufficiently promising to warrant continuance of drilling for at least another year, and inasmuch as they have carried the work so far that decision is probably justified, so that the question as to whether or not oil occurs there may be definitely settled. 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. 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, that it is earnestly hoped that the enterprise may be successful.

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 1929 in the broadest sense of that word, but with the exception of stone, marble, and quicksilver none of them were reported to have been produced and

sold in quantities that justified their inclusion as contributing materially to the mineral output of the Territory.

In the following table, as well as in certain of the other tables accompanying 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 elsewhere in this report but are included in this table are platinum and petroleum.

Value of output of miscellaneous mineral products of Alaska, including platinum, petroleum, gypsum, marble, and other products, 1901–1929 [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		
1909	86,027	1920	372,599		5,483,000
1910	96,408	1921	235,438		
1911	141,739	1922	266,296		

[a] $112,000 of placer platinum metals mined prior to 1926 and $238,000 of antimony mined prior to 1927 is not distributed by years but carried in total.

Practically the entire output of Alaska marble comes from quarries of the Vermont Marble Co. For a number of years the principal quarries of this company were in the vicinity of Tokeen, off the west coast of Prince of Wales Island, in southeastern Alaska. Later the company opened quarries in the vicinity of Calder, also in southeastern Alaska, but the company reports that in 1929 it obtained no new stone from its Alaska quarries, its shipments during that year being blocks on hand that had been quarried in previous years. These rough blocks are shipped to the company's finishing plants in Tacoma, Wash., and San Francisco, Calif., and the product is used principally for interior decoration. In the past several marble quarries have been in operation in southeastern Alaska, but they are now standing idle. It seems strange that more limestone deposits favorably situated with respect to ocean transportation have not been profitably developed. A recent report by Buddington is accompanied by a map [9] which shows, among other things, the distribution and extent of some of the large belts of limestone that traverse much of southeastern Alaska. According to Burchard,[10] many dif-

[9] Buddington, A. F., The geology and mineral deposits of southeastern Alaska: U. S. Geol. Survey Bull. 800, pl. 1, 1929.

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

ferent types of marble occur in these deposits, some even approaching statuary grade.

The quarrying of large quantities of a high-grade limestone rock in southeastern Alaska to be used in the manufacture of cement at the plant of the Pacific Coast Cement Co. in Seattle was announced in the Alaska progress report for 1928. Since that time the work has been carried on and large shipments of limestone made. A comprehensive description of the whole operations and equipment of the company's plants has recently been published,[11] and the following abstract of the more significant facts relating to the development of the industry is based on that description:

The quarry site was selected after thorough examination, involving surveying, sampling, tunneling, and drilling on all known limestone deposits in western Oregon and many deposits in British Columbia and southeastern Alaska. The limestone is remarkably uniform in quality and with a considerable mixture of top soil averages 94.5 per cent calcium carbonate. The deposit is estimated to contain more than 20,000,000 cubic yards of rock, most of which runs over 97.5 per cent of calcium carbonate. The quarry is on Dall Island between Baldy Bay and Tlevak Strait, about 40 miles west of Ketchikan. During the winter of 1925–26 a thorough study of all literature relating to limestone on the west coast was made. In the summer of 1926 three parties of mining and consulting engineers and geologists prospected the territory and selected the Dall Island deposit. During the winter of 1926–27 parties spent a month surveying the deposit, examining possible worthy sites, and making soundings. In March and April, 1927, a topographic survey was made and drill holes were put down and further soundings made. In spring of 1927 the United States Coast and Geodetic Survey surveyed a tract and wire-dragged Baldy Bay. In February, 1928, the company sent the *Mazama*, with a construction crew of 65 men, supplies, and materials, to View Cove. The first cargo of crushed rock was delivered in Seattle October 31, 1928. During the development period drilling was done with pneumatic machines, but during the season of 1929 a Sanderson-Cyclone No. 14 standard well drill was used. Rock is loaded at the face with a 50–B Bucyrus electric shovel, with Ward-Leonard control, into 8-yard steel-pan standard-gage quarry cars. Two 8-ton Plymouth gasoline locomotives haul the cars over 56-pound rails to the crushing plant, which contains one Traylor 48-inch by 12-foot feeder, one Traylor steel-frame 42 by 48 inch Bulldog jaw crusher and one No. 5040 Dixie Mogul standard hammer mill, the crushers being driven by General Electric 125-horsepower and 150-horsepower motors, respectively. The plant is designed to handle over 100 to 125 tons of rock an hour. Crushed rock is delivered by an 18-inch belt conveyor from the hammer mill to the rock-storage pit cut into the solid rock of the hillside above the wharf. A 36-inch belt, running about 300 feet a minute on Rex Chainless Belt Co. rolls, receives the rock through shoots in the roof of a tunnel under the storage pit and delivers it through a loading tower on the edge of the wharf into the holds of the rock-carrying ship at the rate of 700 tons an hour. During dry seasons no fresh water is available, and consequently a Diesel electric-power plant was installed, consisting of

[11] Hutton, S. E., Outstanding Portland cement plant—the Pacific Coast Cement Co. plant at Seattle, Wash.: Rock Products, vol. 32, No. 25, pp. 33–51, Dec. 7, 1929.

two Fairbanks-Morse 6-cylinder 360-horsepower 240 kilovolt-ampere 2,300-volt 3-phase generating sets, pumps, Ingersoll-Rand air compressors, etc. The limestone is carried to Seattle in 6,200 to 6,400 ton cargoes. From 8 to 10 days is required for the round trip, and the average for the season of 1929 was approximately 8½ days. The ship is loaded in 8 to 12 hours, and its cargo is discharged in 30 to 36 hours.

Late in the fall of 1928 it was reported tnat arrangements were in progress for an English company to take over the development of a group of claims on Stampede Creek, in the Kantishna district, that were known to contain numerous showings of antimony ore. The promotion of the project was handled principally by George F. Lemon. Before development is undertaken here, however, very complete examinations will be required to determine the extent of the mineralization and the tenor of the ore. This is especially essential because there is small likelihood that the project will be undertaken unless it is worth carrying through on a large scale, as the company was not interested in taking hold of a small or moderate-sized venture in that rather remote region, realizing that economical development would call for considerable outlays for transportation and other facilities.

Antimony minerals are widely distributed through Alaska, and the common antimony mineral, stibnite, is recognized in most of the mineralized areas in the interior. In the past antimony ore valued at more than a quarter of a million dollars has been mined in the Territory and sold. There has been little demand for this metal lately, and the market for it is said to be fairly closely controlled. As a consequence there has been little interest in the search for deposits of this metal or development of those properties already known which might prove profitable if the ore were readily marketable.

Prospecting and development work 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.

No detailed information has been received by the Geological Survey regarding the developments during the year at the quicksilver deposits in the Kuskokwim Valley. It is currently reported that at the Parks property, lying north of the Kuskokwim River, between Georgetown and the mouth of the Holitna River, a small amount of quicksilver was mined and the metal recovered in a crudely built home-made furnace that was in operation for about two weeks. The owner reports that he expects to start up more extensive developments at this place early in the season of 1930. Most of the quicksilver from this property is sold to the placer mines in the Iditarod district or the near-by parts of the Kuskokwim

Valley. In the Bluff district of Seward Peninsula there was some activity during the year in prospecting and development work on one of the old lodes on Swede Gulch near the town of Bluff that carries some quicksilver. Several claims are included in the tract on which most work is being done, and some veins were uncovered that encourage further search. The ore is said to be on the whole of low grade, but the tenor is believed by the owners to be high enough to pay for mining if there is any considerable quantity of ore. At this property two men were employed in the underground developments. It is reported that work will be continued here on a small scale as long as the showings continue to be encouraging. A lode carrying quicksilver ore is reported to have been found in the Livengood or Tolovana district, on the ridge at the head of Olive and Lillian Creeks. A tunnel 300 feet long from which a shaft 100 feet deep has been sunk, was driven to prospect the deposit. The ore is said to carry considerable gold in addition to the quicksilver.

In the Kobuk district, northwestern Alaska, search for workable deposits of asbestos and jade is said to have been undertaken in the vicinity of Shungnak and the Ambler River. That these minerals occur in that remote district has long been known, but the expense and difficulty of developing them, unless they should be of higher quality than any samples so far seen, seems to shut out the possibility of their being mined at a profit or in appreciable quantities at present. However, it is reported that a shipment of nearly 1,000 pounds of the jade was made to dealers in New York and created considerable interest, the entire lot having been disposed of at a price satisfactory to the owner, though the jade was not considered to be of first quality. In southeastern Alaska on Bear Creek, near the north end of Admiralty Island and about 2½ miles from the shore, are several claims on which some asbestos has been found and considerable prospecting done. Attempts to develop the deposits to a producing stage have been made but have encountered various difficulties, some of which arose more through questions of management and finance than through the quality or extent of the material. Some of the samples of asbestos from this place have fibers more than a foot long, but they are rather weak and brittle. Possibly their physical character is due to the fact that the samples seen have been taken near the surface and are badly weathered, so that the strength of the material farther underground may be better. A microscopic examination of a specimen of this asbestos was made by J. B. Mertie, jr., who identifies it as belonging to the chrysotile variety.

A few years ago there was a considerable production of gypsum from a mine on Iyoukeen Cove, on the east coast of Chichagof

Island, southeastern Alaska, but this work was discontinued, and there has been no production from that place since. Prospecting near this place is being continued, however, and a deposit of gypsum that appears to be worthy of more thorough exploitation has been discovered. Tunnels aggregating several hundred feet in length have been driven lately to explore the deposit. This region was recently visited by B. D. Stewart, and a short statement regarding the results of his examination is given as a separate section elsewhere in this volume.

Although the various mineral commodities here grouped under the heading "miscellaneous mineral products" yield small monetary returns—only $194,000 in 1929—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 that they are destined to become even more significant as the development of Alaska proceeds.

ADMINISTRATIVE REPORT

By PHILIP S. SMITH

INTRODUCTION

The task of obtaining information regarding the mineral resources of Alaska and assisting the industry in every practicable way has for many years devolved upon the Alaskan branch of the Geological Survey, and each year Congress appropriates certain funds to support the work. To give an account of the work that has been accomplished during the year just closed, so that the people may know how and where their money has been expended, is the prime object of this report. The details of the geologic results that are achieved are described more fully in reports covering the individual projects, which are published as soon after the completion of the work as possible.

In the third of a century that this work has been in progress the Geological Survey has published several hundred reports on various phases of the mineral industry of Alaska, and these have been accompanied by several hundred maps of different parts of the Territory. Practically every known mineral-producing camp has been visited by the geologists, engineers, and topographers of the Geological Survey, and reports regarding these camps have been issued. There still remain, however, extensive tracts of Alaska that have not yet been surveyed, though some of them are believed to hold promise of containing mineral deposits that may be of value. In fact, although more than 40 per cent of the Territory has been surveyed, at least on exploratory standards, there is probably an area of more than 200,000 square miles that is regarded as of potential mineral value which should be studied as soon as funds and personnel can be assigned to the work. This is a conservative estimate and would exclude more than 100,000 square miles of country, such as the Yukon Delta and Yukon Flats, where, though there may be deposits of value, the services that can be rendered by geologists in a preliminary search would not be great enough to warrant much work until studies in other more promising areas have been completed.

Furthermore, it should be evident that the exploratory and reconnaissance standards that have been adopted for practically all the work so far accomplished in Alaska are adequate to give only general information, so that detailed investigations, such as are essential to the solution of most mining problems, are required for higher standards of work. The task of making a thorough inventory of the mineral resources of Alaska is a large one, on which only a start has yet been made.

In attempting to set forth in this report the recent activities of the Geological Survey in its Alaska work difficulty is at once encountered, in that the work is essentially a continuing project which has no clearly marked steps or interruption to serve as distinct breaks from which to report progress. Most of the work bears little relation to the calendar year. Many of the field projects start in May and may last a few months or several years, but some have been started in February and others in July or August. The fiscal year, which so clearly forms a basis for defining much of the other Government work, has little significance in reporting on the Geological Survey's work in Alaska, especially because most of the appropriations for the Alaska work are made immediately available on the passage of the act through which the money is appropriated. For example, the appropriations for the Alaska work in the act providing funds for the Interior Department covering the fiscal year 1929–30 became effective on March 4, 1929, and was available for expenditure at any time after that date until June 30, 1930. At the same time the similar appropriation contained in the act for 1928–29 was available until June 30, 1929, and the act for 1930–31, which was passed May 14, 1930, was available after that date until June 30, 1931. 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 is more likely to be based on administrative convenience than on any real difference in the character or object of the work. To describe as two jobs what was undertaken really as 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 mere accounting procedure. For this reason the projects have been described principally on the basis of what may be called field seasons, though it should be realized that not all the time devoted to a project is spent in the field. Thus the field season of 1929 for many projects began early in the spring of 1929, when the field men began to assemble their supplies and equipment. It continued through the period of actual field operations and was followed in the fall and winter of 1929 and the spring of

1930 by the office and laboratory work of preparing the report of the results accomplished. The last stages of this work may have gone on more or less coincidentally with the beginning of preparations for the field season of 1930 and may have ceased only when the geologist or engineer left headquarters to undertake the new project; in fact, the final revision of this report and the reading of the proof may not have been completed even in the succeeding season.

Certain of the projects, of course, naturally fall better into other periods. 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 year succeeding that to which the statistics relate. Thus, though collection of data and sending out of questionnaires for the 1929 canvass went on throughout 1929, the bulk of the replies were not received until the end of the year, and the final compilations could not be made until well into the spring of 1930. Although the project of collecting these data relating to the calendar year 1929 might logically be counted as belonging to either or both years, the practice that has been followed in this report has been to consider that work as belonging to the season of 1929.

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, broadly speaking, the expenditures for starting parties in the field season of 1929 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 1930 in advance of July 1 and were paid from the next appropriation. In other words, the sum of the expenditures during a field 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 two fiscal years. No marked change has been made in the appropriations available for the field expenses of the Alaska work in the last few years.

The funds used by the Geological Survey in its Alaska work are provided in two items in the general act making appropriations for the Interior Department. One of these is " for continuation of the investigation of the mineral resources of Alaska." In the act for 1929–30 the amount appropriated was $67,500. In the similar act for 1930–31 the amount appropriated was $75,000. Each of these appropriations was made available immediately on the passage of the act in which it was contained.

The other item is an allotment made from the appropriation " 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. In the fiscal year 1928–29 an allotment of $10,000 was made for work of this kind in Alaska, and for the fiscal year 1929–30 a similar amount was allotted.

The two types of work indicated by the different phraseology of the appropriation items will be described in some detail in the following pages. For convenience the work done under the first item will be referred to briefly as the work on mineral resources and the work under the second item as the leasing work.

WORK ON MINERAL RESOURCES

PRINCIPAL RESULTS OF THE YEAR

The principal products of the Alaska work of the Geological Survey are reports and maps based on original surveys or investigations. During the year 21 such official reports have been issued or have been completed by their authors and approved for publication, as follows:

The Chandalar-Sheenjek district, Alaska, by J. B. Mertie, jr. (Bulletin 810–B).

The Mount Spurr region, Alaska, by S. R. Capps (Bulletin 810–C).

Mineral industry of Alaska in 1928, by Philip S. Smith (Bulletin 813–A).

Administrative report, 1928–29, by Philip S. Smith (Bulletin 813–A).

The Chakachamna-Stony region, Alaska, by S. R. Capps (Bulletin 813–B).

Mining in the Fortymile district, Alaska, by J. B. Mertie, jr. (Bulletin 813–C).

Notes on the geology of upper Nizina River, by F. H. Moffit (Bulletin 813–D).

Mineral resources of Alaska: Report on progress of investigations in 1926, by Philip S. Smith and others (Bulletin 797).

Mineral resources of Alaska: Report on progress of investigations in 1927, by Philip S. Smith and others (Bulletin 810).

Geology and mineral deposits of southeastern Alaska, by A. F. Buddington and Theodore Chapin (Bulletin 800).

Geology of the Eagle-Circle district, Alaska, by J. B. Mertie, jr. (Bulletin 816).

Geography and geology of northwestern Alaska, by Philip S. Smith and J. B. Mertie, jr. (Bulletin 815).

Mineral industry of Alaska in 1929, by Philip S. Smith (Bulletin 824–A).

Administrative report, 1929–30, by Philip S. Smith (Bulletin 824–A).

Phototopographic work in southeastern Alaska in 1929, by R. H. Sargent.

The occurrence of gypsum at Iyoukeen Cove, Chichagof Island, Alaska, by B. D. Stewart.

The Slana district, upper Copper River region, by F. H. Moffit.

The Lake Clark-Mulchatna region, by S. R. Capps.

Recent mining developments in the vicinity of Circle, by J. B. Mertie, jr.

The Upper Cretaceous floras of Alaska, by Arthur Hollick, with a description of the Upper Cretaceous plant-bearing beds, by G. C. Martin (Professional Paper 159).

Glaciation in Alaska, by S. R. Capps.

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

A report entitled "A geologic reconnaissance of the Dennison Fork district," by J. B. Mertie, jr., prepared during the previous year, has not yet been sent to the printer.

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

The Tertiary flora of Alaska, by Arthur Hollick.

The igneous geology of Alaska, by J. B. Mertie, jr.

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

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

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

Geographic dictionary of Alaska, 3d edition, by James McCormick.

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

Practically all the completed reports are accompanied by maps, the bases of which have been made principally from surveys conducted by the topographers of the Alaskan branch. The following have been published during the year:

Topographic map of Valdez and vicinity, by J. W. Bagley, C. E. Giffin, and R. H. Sargent; scale, 1:62,500. Published as a sale map.

Topographic map of Revillagigedo Island, by R. H. Sargent; scale, 1:250,000. Compiled principally from aerial photographs taken by the Alaska Aerial Survey Expedition of the Navy Department, 1926. Issued as preliminary photolithographic edition.

Map of Alaska; scale, 1:5,000,000. Containing index of Alaska maps and list of Alaska publications.

Topographic map of Goodnews Bay district, by R. H. Sargent and W. S. Post; scale, 1:250,000. Issued as preliminary photolithographic edition.

Progress was also made in the preparation of a map of the Mount Spurr region and a map of the Lake Clark-Mulchatna region, both on a scale of 1:250,000, compiled from surveys in recent years in the Skwentna, Mount Spurr, Chakachamna-Stony, and Lake Clark-Mulchatna districts. Considerable work has been done in compiling the results of recent surveys on a topographic map of the Yukon-Tanana region on a scale of 1:500,000, which has been in progress for several years, and in the revision of the map of Alaska on a scale of 1:2,500,000, with a view to the publication of a new edition as a sale map. The small general map of Alaska on a scale of about 80 miles to the inch is kept currently revised and reissued as frequently as required,

Several other maps are in preparation, but so little progress has been made in putting them into shape for publication that they are not listed here.

Besides the official reports, several articles were prepared by the scientific and technical members of the Alaskan branch for publication in outside journals, and 26 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:

Mountain building in Alaska, by J. B. Mertie, jr. (delivered before the Geological Society of Washington).

Alaska gold resources, by Philip S. Smith (published in Economic Geology).

Scientific work of the United States Geological Survey in Alaska in 1929, by Philip S. Smith (published in Journal of the Washington Academy of Science).

A new species of Tertiary cycads, by Arthur Hollick (for publication in Memoirs of the New York Botanical Garden).

Molybdenite deposit at Shakan, Alaska, by A. F. Buddington (for publication in Economic Geology).

Aerial photographing in southeastern Alaska, by R. H. Sargent (delivered at meeting of Association of American Geographers).

A study of the results of ice flow as shown in oblique and vertical photographs taken of glaciers in Alaska, by R. H. Sargent (delivered at meeting of Association of American Geographers).

Photographing Alaska from the air, by R. H. Sargent (published in Military Engineer).

Glaciation in Alaska, by S. R. Capps (presidential address delivered before Geological Society of Washington).

Albert Perry Brigham, geologist, by Philip S. Smith (published in Annals of Association of American Geographers).

PROJECTS IN PROGRESS DURING THE SEASON OF 1929

The work done by the Geological Survey in connection with the study 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 readily definable in terms of square miles mapped, but other parts concern examinations in mining camps which areally cover only small tracts and yet require the outlay of much time and effort, and other parts may involve 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 1929 may therefore be gained best from the following descriptions of the projects undertaken during that season.

In addition to the routine duties of supplying information in answer to hundreds of inquiries received from the public and from the various branches of the Government, as well as disposing of the

administrative details attendant on the general conduct of the work, the work of the Alaskan branch consisted of seven principal projects. These were topographic supervision of the aerial photographing of parts of southeastern Alaska, geologic reconnaissance in parts of the headwater region of the Copper River region, geologic and topographic reconnaissance surveys in the Lake Clark, Mulchatna, and Stony River region of the Alaska Range, geologic reconnaissance of parts of the Circle district and adjacent regions in the Yukon-Tanana Valley, general studies at some of the principal mining camps in southeastern and central Alaska, investigations carried on by the local field offices maintained by the Geological Survey in Alaska, and the statistical canvass and resulting compilations relating to the output of minerals from Alaska during the year.

The aerial photographic work in southeastern Alaska was a continuation of a project started in 1926, when the Navy Department, at the request of the Geological Survey, sent a detachment of aviators with the necessary equipment to photograph from the air parts of southeastern Alaska so that the resulting pictures might be used for preparing maps of the region. The work done was so successful and of such inestimable value, not only to the Geological Survey but also to other Government bureaus, notably the Forest Service, that in the winter of 1928–29 the Geological Survey joined with the Forest Service in urging the Navy Department to send another expedition to extend similar work into the tracts that had not been photographed. The Navy Department, recognizing the need of these bureaus and wishing to meet their desires as well as recognizing the splendid training that it afforded for its own members, assigned the necessary personnel and equipment to the task, under command of Lieut. Commander A. W. Radford. This unit performed its allotted task with speed, precision, and high technical competence, so that some 12,000 square miles of difficult country was photographed and the resulting films were turned over to the Geological Survey for cartographic use. In the course of this work many services were rendered to the other Government bureaus concerned with various phases of Alaskan development, and several hundred photographs were made with cameras other than the special phototopographic instruments. The successful accomplishment of this difficult piece of work without accident demonstrates the great value of the airplane as a means of transportation in a country that is almost untraversable by any other means and shows the economy that can be effected in many phases of the Geological Survey's work by this modern method of attack. In order that the naval officers might have knowledge of the requirements that must be met in the photographs if they were to be suitable for carto-

graphic purposes, a skilled topographic engineer of the Alaskan branch, R. H. Sargent, was attached to the expedition and served throughout its field work.

The completion of the field work and the turning over of the developed films ended the Navy Department's share of the work, though many subsequent steps must be taken before the data thus obtained are worked up into maps. One of the first things to be done was to print the films, and as both the Geological Survey and the Forest Service required a print of each picture this required the production of nearly 50,000 separate prints—a task that required the combined efforts of three men for about six months. This was a surprisingly good record, for two-thirds of the films required special manipulation to take out certain inclinations caused by the particular type of camera used, and all the work had to be done with close mathematical adjustments as well as photographic skill. This phase of the work was completed near the end of the fiscal year. The next step will be the mounting of these prints, most of which are assembled in groups of three on specially prepared cards. The prints must be accurately trimmed and mounted so that certain identifying marks on them will be brought into exact accord with other marks that were printed on the cards. This is a precise, time-consuming job that it is estimated will take the equivalent of one man's time for a full year. Then will come the taking off from these mounted prints of the desired cartographic data and their compilation on a working sheet, the inking of this sheet, and its completion by adding names and data from other sources to form a drainage map. It will then be sent into the field to serve a topographer as a base on which to determine the elevation of all the natural features and represent them by means of contours. It is estimated that at the current rate of progress more than 20 years will elapse before the photographs now on hand from the two Navy expeditions to southeastern Alaska will be worked up to this final stage. Obviously the rate should be greatly accelerated. A more complete account of the work on this project is given by R. H. Sargent elsewhere in this volume.

The geologic reconnaissance of parts of the area lying near the headwaters of the Copper River and extending over into the drainage basin of the Tok River, which flows into the Tanana River, north of the Alaska Range, was carried on by F. H. Moffit with a small pack train and the necessary camp gear and two camp helpers. This region was mapped topographically in 1902, on exploratory standards of that day, and some geologic exploration was carried on at the same time. The geologic results were never published in full, so that little information about the tract was available. Furthermore, the great

amount of geologic information that has been collected from near-by regions in the more than a quarter of a centry since that work was done raised many questions that could be answered only by a thorough field review and extension of the earlier field observations. The region is one of direct and indirect importance in the search for workable mineral deposits in Alaska. It is of direct importance because it lies adjacent to areas that have long been known to be mineralized and to have afforded evidence of the presence of gold and lead and some indications of the presence of copper. Placers that have long been worked and have yielded more than $2,700,000 in gold lie to the west, in the Chistochina district, and the mineralized areas of the Nabesna River Valley and the placers of the Chisana (Shushanna) district lie to the east. Indirectly the area is of great geologic significance, as it lies athwart the Alaska Range, and consequently the correct interpretation of its geologic history will throw light on the general history of the mountain-building and related processes which doubtless were more or less closely connected with the mineralization that was so significant in parts of Alaska. The tracing of the geologic sequence of events from the Copper River region, on the south side of the mountains, and their correlation with the features in the Tanana and Yukon Valleys, to the north, will greatly strengthen and supplement the information obtained from either district alone. The region is difficult of access and therefore has not been adequately examined or prospected, but the extension of the Abercrombie Trail from the Richardson Highway at Gulkana, a piece of road construction that is being carried on by the Alaska Road Commission, will help in opening up the country and make transportation less expensive, so that further exploration is likely to be undertaken in the near future. A more complete statement regarding the scope and results of this investigation has been prepared by Mr. Moffit and is given in a separate chapter of this volume.

The combined geologic and topographic reconnaissance surveys in the Lake Clark-Mulchatna region were conducted by S. R. Capps, geologist in charge, with Gerald FitzGerald, topographer. This party was landed at Iliamna Bay early in June and proceeded by the usual route along Iliamna Lake to the lower end of Lake Clark, where the new surveys were started from the hitherto surveyed tracts. The surveys were carried northward along the western flanks of the Alaska Range as rapidly and completely as conditions permitted until junction was made with areas surveyed in 1928 by the party that crossed the mountains from Trading Bay by way of Merrill Pass and traversed parts of the Stony River Valley. This party mapped more than 1,300 square miles of hitherto unsurveyed country and completed the general areal work of blocking out

the major features of an immense tract of the Alaska Range, though there still remain within that tract unsurveyed areas that were not reached, either because of lack of time or because they were in the most inaccessible part of the high mountain range. The geologic results obtained show that in this part of the Territory the Alaska Range consists primarily of a great granitic intrusive mass which is flanked on the west by sediments and extrusive igneous rocks of Mesozoic age. Little prospecting has been done in the region, and although placer gold has been recognized in a number of the stream valleys no deposits of commercial value have been found. Practically nothing has been done in prospecting for lode deposits of the metals, though the presence of the great intrusive mass cutting a variety of other rocks offers some hope that lodes of value may be found in the vicinity of the contacts. Much information was obtained as to the late glaciation of this part of Alaska that supplements and is correlative with that hitherto gathered from near-by and other parts of the Territory. Evidence was found at one place of a glacial stage, probably of early Pleistocene age, that much antedated the last great ice advance. A more complete statement of the results of this work will be found in a report by Mr. Capps that forms a separate section of this volume.

The geologic reconnaissance work in the Yukon-Tanana region was part of the general project which has been undertaken with a view to coordinating the many observations that have been made in that region in the last 30 years as well as to studying with more care certain tracts that had been passed by in the earlier survey or given only cursory examination. The particular part of this large tract that was examined for this purpose in 1929 lies north of Fairbanks and west of Circle. The field work consisted mainly in visiting a number of remote and hitherto unmapped areas in several ranges of hills that flank the Yukon Flats on the south, including the Crazy Mountains. This work was done by J. B. Mertie, jr., who with a small pack train and the necessary camp equipment and two camp assistants revised or completed the mapping of the geology of about 1,500 square miles of country and visited almost all the producing placer camps in the Circle district. No new geologic formations were distinguished, but the hard rocks, which range in age from lower Ordovician to Pennsylvanian, were mapped at a number of new localities. The completion of this season's work brings to an end the field work on the major project of revising the whole geology of the tract lying between the Yukon and Tanana Rivers, but the office studies and preparation of a report and the maps to accompany it will require much additional time and effort. The results of this critical study when finished should be of much

significance in explaining the general geologic history of the region and the conditions under which the mineralization that has taken place was effected. That information will be useful in suggesting the places where further prospecting for mineral deposits is most likely to be worth while. Some notes by Mr. Mertie regarding the recent mining developments in the Circle district, that were obtained during his work in 1929, are published as a separate chapter of this volume.

The collection of information 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 organizations, 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 is freely placed at the disposal of the Geological Survey. Most of the larger Alaskan newspapers, as well as certain papers published in the States that feature Alaskan matters, are courteously sent 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 most authoritative information is obtained. These annual production reports are conducted on the basis of the calendar year, but the work of canvassing the different producers and assembling the data is practically continuous. For example, the task of accumulating the facts regarding the production of minerals for 1929 commenced early in January, 1929, and was not completed until June, 1930, when the report was transmitted for publication. Necessarily during the period from January to June, 1930, data relating to two separate calendar years, 1929 and 1930, were being collected coincidentally. The statistical data are compiled principally by Miss L. H. Stone, and the material is coordinated and the resulting report prepared by the chief Alaskan geologist. The report on the mineral industry in 1929 is published as part of the volume accompanying this administrative report.

The Geological Survey maintains in Alaska two district offices, one at Juneau and one at Anchorage. The main duties of the personnel attached to these offices relate to mineral leasing, but a part of their

service relates to general investigations of mineral resources. Up to July 1, 1928, both kinds of work were conducted under a single appropriation, but on that date the two were separated, and although no change in the actual handling of the work was involved, the accounting was changed. Under this arrangement approximately two-fifths of the time of B. D. Stewart, who is in direct charge of the local offices, is allotted to general investigations of mineral resources, including, besides office duties, visits to different parts of the Territory as conditions warrant. Mr. Stewart's 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 in furnishing the main office at Washington with information on many phases of the mineral industry of the Territory. The suitable coordination of the mineral investigation work done from the Alaskan offices with that done from the Washington office is still in process of 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. It was proposed that in 1929 the main task undertaken by Mr. Stewart should be the investigation of mineral properties that might yield tonnage to the Alaska Railroad. The plans for carrying out this project unfortunately miscarried, so that little was accomplished in getting it under way during the season of 1929.

One other piece of field work that was done during the season of 1929 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. Earlier in the year Mr. Smith had attended the Fourth Pacific Science Congress in Java, as one of the official delegates of the United States, and he did not get back to this country until late in July. He proceeded immediately to Juneau, where he visited the detachment engaged in the aerial photography of southeastern Alaska already described and had the opportunity of participating in some of the flights and seeing all the phases of the work in progress. In addition he visited the Juneau office and met and discussed problems with many of the men concerned with Alaskan developments. From Juneau he went

to Seward and Anchorage, where he conferred with Colonel Ohlson and other representatives of the Alaska Railroad and the members of the Geological Survey attached to the Anchorage office, and then visited the coal-producing camps in the Matanuska field and discussed mining conditions with operators. He then went to Fairbanks and spent some time visiting the recent lode developments in the vicinity of that town and going over the extensive placer-mining plant of the Fairbanks Exploration Co. The general familiarity with the mining industry such as may be gained by inspection trips of this sort is regarded as essential in keeping track of recent developments and laying out plans for future work of the Geological Survey in Alaska, so that they will fit the needs of the mining industry.

A field project that really does not fall within the jurisdiction of the branch, although it relates to Alaska, was carried on by the volcanologic section of the geologic branch. The representative of this section who was in Alaska in 1929 was Austin E. Jones, who reports that during the open season of July and August he installed specially designed and constructed seismographs at Dutch Harbor and Kodiak, Alaska, to obtain records of earth movements. These records will also be studied in connection with general volcanologic investigations relating to the whole northern Pacific Ocean basin and that are being carried on simultaneously at stations in Hawaii and California.

Each of the projects above described involves considerable office work in examining and testing the specimens collected, preparing the illustrations and maps, and writing the reports. In addition, considerable work of this sort was required on projects that had been started in earlier years. Some of the work represents only the normal routine of seeing a report through the press, such as proof reading the text and illustrations, but some represents the advancement of work that for some reason or other was not finished during the year in which the project was undertaken. Progress was also made during the year toward the completion of certain of the older reports listed on page 87 as still in the authors' hands.

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, G. H. Girty, J. B. Reeside, jr., Edwin Kirk, David White, and E. W. Berry, paleontologists, have examined and reported on the fossils collected in the course of the field surveys. The map editors have been especially helpful in critically scrutinizing the Alaska maps 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 has been performed

under the direction of Miss Lucy M. Graves, who has been assisted in the Washington office by Miss L. H. Stone and Miss L. F. Nelson. During the year J. B. Torbert, who for nearly 30 years had done the greater part of the expert map drafting for the branch, died. No one appearing to have the drafting skill to fill his place satisfactorily, the position has remained vacant. The ordinary drafting requirements of the branch have been taken care of by J. I. Davidson.

Some of the results of the season's work described in the foregoing paragraphs, as well as that done in earlier years, may be expressed in terms of the area covered. The following tabular statement indicates the areas covered by the surveys of different types and the percentage of the total area of Alaska that has been covered by all types of surveys. The areas reported in this table 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 1930 but remained uncompleted at the end of the fiscal year 1929–30. This procedure has been adopted in part because at the end of the fiscal year most of the parties at work during the field season of 1930 were out of communication and so could not report the extent of the work they had accomplished, but in part it has been adopted because, as already explained, the field season is regarded as a more practicable unit of measurement.

Areas surveyed by Geological Survey in Alaska, 1898–1929, in square miles

Field 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)
1898–1928	75,150	[a]174,305	4,277	55,630	208,530	4,066
1929		3,675			1,375	
	75,150	176,330	4,277	55,630	209,905	4,066
Percentage surveyed of total area of Alaska	43.6			46.0		

[a] Includes 1,650 square miles revised extensively in 1929 and included also under 1929 and therefore counted only once in total given below.

In the table given above only the net areas surveyed are listed in the appropriate column under geologic surveys or topographic surveys, 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 larger scale, and if the areas thus revised were not excluded from the totals the same areas would be counted twice. It is for this reason that an area of 1,650 square miles which was reexamined geologically in 1929 has been deducted

from the total in the column of reconnaissance geologic surveys. The necessity for resurveying some areas in more detail is generally not due to faulty execution of the earlier surveys but to the need 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 desirable information. To cover the entire tract with that same degree of care would unduly delay the work and cost far more than would be warranted. Therefore the resurvey of certain tracts here and there as required is really the most economical and logical procedure. Even in those 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 is well illustrated by the procedure adopted in surveying the Seward Peninsula placer camps. Within two or three months after the return of the Federal 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 were later 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, has been called the reconnaissance scale and is 1:250,000, or about 4 miles (250,000 inches) on the ground represented by 1 inch of paper on the map, with a contour 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 can be made expeditiously and cheaply. It is obvious, however, that so small a scale can not effectively show detailed features of topography or geology, and yet many of these features are of prime importance in their relation to the mineral resources of the region. Therefore, although more than two-fifths of the Territory has been mapped on reconnaissance or exploratory standards, there is a constant demand for more detailed work, and this demand will become more and more insistent as the Territory develops. But even for the reconnaissance type of mapping there still remains about 200,000 square miles of country holding promise of containing mineral deposits of value that has not been surveyed. The present rate at which the work is being carried on is entirely inadequate to meet even the most general needs. At this rate it will be many decades before even the reconnaissance mapping of the prospective mineral areas can be completed, and the requisite detailed

mapping of the most promising tracts must be postponed far into the future or must supplant the equally pressing reconnaissance work unless more funds are available with which to speed up the work.

PROJECTS FOR THE SEASON OF 1930

Nine projects have been approved for the season of 1930. These projects had been under way for only a short time at the end of the fiscal year 1929-30, and on most of them only a start had been made. Furthermore, almost all the parties were out of touch with ordinary means of communication, so that no specific details were available regarding the work actually accomplished. Under these conditions it has seemed practicable at this time to outline only the principal objects of these projects. Seven of these projects that involve field work are as follows: Reconnaissance topographic mapping in the Ketchikan district, southeastern Alaska; geologic and mining studies, principally in the Taku Valley near Juneau; geologic investigations in the vicinity of the Alaska Railroad in central Alaska; geologic reconnaissance mapping of part of the Chulitna Valley and adjacent parts of Broad Pass, in central Alaska; exploratory and reconnaissance topographic surveys in the Nushagak and adjacent areas of southwestern Alaska; geologic reconnaissance of the region lying north of the Yukon and adjacent to the international boundary; and a study of the general mining developments and conditions, with visits to such of the camps as time and other conditions permit. Two projects that do not directly involve field work are the annual canvass of the mineral production from Alaska in 1930 and the preparation of the photographs resulting from the airplane flights in southeastern Alaska by the Navy Department in 1929.

The topographic work in southeastern Alaska is a continuation of mapping parts of Revillagigedo Island, on which Ketchikan is situated, and of the adjacent mainland, a project that was started during the field season of 1928, during which about 1,000 square miles was mapped. The mapping of this region is needed by the Geological Survey in its studies of mineral resources, because the region contains several localities where strong indications of mineralization have been found and gold mines have from time to time been worked. The especial urgency for a map of this region at this time has been brought about by the need of the Forest Service and others who are concerned with the development of the power and pulpwood resources of the region. The work of this Geological Survey party, which is in charge of R. H. Sargent, topographic engineer, should be much facilitated by the fact that a drainage map of the entire area had been prepared before the party started its field

work. This drainage map was compiled from the aerial photographs taken by the detachment sent by the Navy Department in 1926, so that the work of Mr. Sargent's party will be mainly concerned with determining the elevation of the different natural features and sketching the contours so that they will show the appearance and height of all parts of this tract. Doubtless in the course of this work the more precise ground methods will disclose places where readjustment of the compilation from the photographs will be required. Such changes, however, will probably be more in the nature of refinements of position than the correction of any noteworthy discrepancies, and the availability of these compilations should obviate a large part of the difficult, costly, and time-consuming traverses through almost impenetrable thickets and over precipitous slopes that would otherwise be required. The transportation of the party in the field will be effected by a power boat which will also serve as a camp, a necessity in this region of heavy precipitation and few sites for suitable camps ashore. The topographer will be assisted by the necessary boatmen and field helpers. The work was started early in May and will be continued as late as weather conditions permit, which will probably be well into September.

Late in 1928 and early in the spring of 1929 finds of sulphide ore in the Taku region, mostly within British Columbia, were reported and created considerable interest in the region, not only locally but sufficiently far away to induce many outsiders to visit the field. In the course of the Navy's photographic work in southeastern Alaska in 1929 its planes were made available for certain members of the Geological Survey to view part of this region from the air. On these flights it became apparent that the former geologic map of part of this region was incorrect and that there was a strip about 10 to 15 miles wide adjacent to the international boundary but within Alaska that might be worth prospecting. In order to obtain more adequate information regarding this area, B. D. Stewart was assigned to the task of carrying on investigations in this region during the season of 1930. The finding of new deposits in this general region will have great influence in stimulating further search for ore deposits, and from what is known of the general geology of the region the chances of discovering deposits that may materially add to the mineral output of Alaska appears to be promising. In addition to his studies in the Taku region, Mr. Stewart has been directed to utilize such time as may be available in studies in some of the other mining camps in southeastern Alaska, in order to bring up to date the information regarding late developments.

The work in the vicinity of the Alaska Railroad was undertaken primarily in response to repeated requests from Col. O. F. Ohlson as

head of the railroad that the Geological Survey assist by advising him as to ore deposits that might contribute to the tonnage carried by the railroad and by considering some of the technical problems relating to mining that from time to time arose in connection with the railroad operation. The need for information of this sort and the advantage that would accrue from it not only to the railroad but to the whole mining development of central Alaska were so obvious that the Geological Survey welcomed the opportunity to assist. F. H. Moffit, who for more than 25 years has been engaged in the Alaska work, was assigned to the project. The precise service that can be rendered will have to be determined in the course of the work, but much of the time of the party will doubtless be devoted to the field examination of areas known to be more or less mineralized. One such area is that of the Kantishna district, where lodes of gold, silver, copper, lead, zinc, and antimony, as well as gold placers, have long been known and from which some shipments of ore have been made in the past, but whose development has been badly hampered by the lack of transportation facilities. The problem of building up a volume of freight for the railroad to handle is of course directly a matter for the railroad to face, but the larger problem of assisting the mining industry of the Territory to take full advantage of this opportunity is one that falls closely within the scope of the investigations that the Geological Survey has been carrying on for nearly a third of a century. In this connection it may not be amiss to point out that the building of the railroad was undertaken largely as a measure to help in the development of the mineral resources of the country adjacent to it and thereby to aid the development of the Territory as a whole.

Related to the general problem of determining the mineral resources of the country near the Alaska Railroad are the investigations that have been undertaken for the season of 1930 in the region adjacent to the head of the Chulitna River, near Broad Pass. This work involves the geologic reconnaissance of a tract of nearly 1,000 square miles that had been surveyed topographically in earlier years but had not been examined geologically. S. R. Capps, geologist, will be in charge of this survey and will work with a small pack train and the necessary camp equipment and camp hands. The region is known to be mineralized in part and lies on the southern flanks of the high mountains of the Alaska Range. It is rather difficult of access, in spite of its nearness to the railroad, because of its ruggedness and the large glacial streams that traverse it. Close cooperation will be maintained between the Moffit and Capps parties, so that if time is available they may supplement the work of each other and examine additional mining camps adjacent to the railroad,

knowledge of whose general conditions will have a bearing on the general problems of the region. Work in the Chulitna region commenced as early in June as forage for the horses was available and will be continued until terminated by frosts that kill the grass or snow that obscures the outcrops.

In southwestern Alaska, north of Bristol Bay, is one of the largest unsurveyed tracts in Alaska, about which almost nothing is known. Near-by regions that have been examined by Geological Survey parties have been found to be mineral bearing, and there is strong reason for believing that the mineralization may have extended into this region also. To determine these conditions, as well as the major features of the topography and other geographic facts, the Geological Survey has turned its attention to that area. One of the projects that was undertaken in the season of 1930 was to survey as much of the topography in the vicinity of Nushagak and the country to the north as time and field conditions permit. This work has been assigned to Gerald FitzGerald, who left the States in May and was landed in Nushagak by airplane from Anchorage early in June. His surveys will be carried on principally along the course of the larger streams, with such back-packing trips into the more remote tracts as opportunity allows, with the aim of obtaining general information regarding the larger aspects of the region. Although these surveys will doubtless be of general direct value, their principal purpose will be to serve as guides in formulating more comprehensive plans for the geologic and topographic reconnaissance of the whole tract between Bristol Bay and the Kuskokwim River, if the results obtained from this preliminary survey indicate the desirability of undertaking such a project. This larger project would necessarily involve several years' work and would require the sending in of a number of topographic and geologic parties equipped with transportation facilities that would best meet the conditions that would be encountered. The remoteness of this region from ordinary lines of travel makes it difficult and expensive to survey, so that every precaution will have to be taken in advance to adopt plans that will permit the greatest amount of work to be accomplished.

The large tract of country lying north of the Yukon River, adjacent to the international boundary and south of the Porcupine River, is another of the great areas of Alaska about which almost nothing is known and in which practically no surveys have been made. A preliminary reconnaissance geologic survey of the southern part of this area is one of the projects that has been undertaken in 1930. This work is in charge of J. B. Mertie, jr., who, with a pack train and the necessary equipment, started work near the mouth of the Tatonduk River early in June and will carry the work as far

north and west as conditions allow. So little is known about this region that no prediction as to whether or not it contains minerals of value can be made. Some lines of evidence suggest that conditions favorable for local mineralization may be found in the region, especially if intrusions of deep-seated igneous rocks are discovered. The area lies so close to the Yukon that if deposits of value occur in it the problem of transportation to and from them should be relatively easily solved. Even if search should not disclose mineral deposits of value, the area is likely to be of great geologic significance because observations made near its borders indicate that it probably contains one of the most complete Paleozoic sections to be found anywhere in Alaska and one that has undergone relatively little metamorphism. The general light that such a section would be able to shed on the whole Paleozoic geology of Alaska can hardly be overestimated. If the results obtained in this preliminary survey show satisfactory conditions, it will probably be the forerunner of more comprehensive surveys, both geologic and topographic, to be started next year and continued for several years until the entire triangle between the Yukon and the Porcupine has been mapped.

The general survey of Alaskan mining conditions to be conducted by the chief Alaskan geologist will resemble similar work in the past, though the individual points visited will necessarily differ, in order that the itinerary may include visits to as many of the field parties as are reasonably accessible and that some of the more productive mining camps, as well as others that have not recently been studied, may be visited. 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 hoped that opportunity may be found to visit the new placer developments south of Ruby and possibly parts of the Innoko, Tolstoi, and Takotna districts and some of the camps in the western part of the Kuskokwim Valley that have not recently been visited by members of the Geological Survey. Owing to duties in Washington this work will not be started until after the first of July.

The collection of statistics regarding the mineral output of Alaska in 1930 will in general be similar to the work done on the corresponding project in 1929 and described on page 93 of this report. The collection of material for this purpose should be completed about the middle of 1931.

The second of the office projects that was undertaken for the season of 1930 is the assembling and mounting of the thousands of photographs resulting from the printing of the films taken by the detachment of Navy aviators in southeastern Alaska in the season of 1929. There are approximately 25,000 views on hand to be pre-

pared for cartographic use, and this work, it is now estimated, will keep one man completely employed for a working year. This work is necessary not only to preserve the prints but so that they may be available for use in map compilations. If time and funds are available, a start will be made on the compilation of drainage maps of additional areas in southeastern Alaska, so that these maps may be available for the use of engineers engaged in topographic mapping in that region in the field season of 1931. In fact, the compilation of drainage maps from these photographs should be expedited as much as possible, even if it may not be practicable to follow up at once with complete topographic surveys of the areas thus compiled. The reason for this is that the drainage maps are of considerable use to other Government bureaus, especially the Forest Service, and to persons interested in the development of Alaska, as they furnish much general geographic information as well as data regarding possible power sites and sources of water supply. The Geological Survey has already received letters stating that the small drainage map of parts of the Ketchikan-Hyder region alone has saved thousands of dollars to persons developing the timber and power resources of that region. There is an equally urgent demand that a start on a similar mapping program be made in the vicinity of Juneau and on Admiralty Island, for which pictures are also available.

EXPENDITURES

The funds used for the work of the Geological Survey on Alaska's mineral resources during the field season of 1929 were made available through the Interior Department appropriation acts for 1928–29 and 1929–30. The amount appropriated by the act of 1928–29 was $64,500, to which was later added through the deficiency act $3,000 to take care of salary adjustments brought about through the Welch Act. The amount appropriated by the act for 1929–30 was $67,500. During the field season of 1930 the funds used were made available through the Interior Department appropriation act for 1929–30, already noted, and the act for 1930–31, which appropriated $75,000. From the foregoing statements it is evident that for a large part of the time two appropriations were running concurrently. All the expenditures from these different items have, of course, been properly accounted for under the usual system of bookkeeping, but the analysis from that standpoint, as has already been pointed out, gives only an imperfect picture of the real conduct of the work. An attempt here has been made to summarize the expenditures approximately and group them under a number of major heads, so as to show the principal objects for which the funds appropriated during the fiscal year 1929–30 were expended.

Expenditures from funds appropriated for investigation of mineral resources of Alaska for the fiscal year 1929–30

Projects for the season of 1929	$13,016
Projects for the season of 1930	12,700
Administrative salaries, July 1, 1929, to June 30, 1930	3,410
All other technical and professional salaries, July 1, 1929, to June 30, 1930	29,168
All other clerical and drafting salaries, July 1, 1929, to June 30, 1930	7,894
Office maintenance and expenses	1,312
	67,500

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 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 1929 from the appropriation for 1929–30 amounted to $13,016, which includes $9,062 for geologic and general investigations and $3,954 for topographic work. These figures are based on the assumption that in combined geologic and topographic parties the expenses are divided equally between the two types of work. A similar analysis of the expenditures for the season of 1930 shows that expenditures from funds for the fiscal year 1929–30 amounted to $12,700, of which $7,800 was for geologic work and $4,900 for topographic work. Of the $25,716 allotted to field projects for both seasons from the appropriation, $16,862, or about 65 per cent, was allotted to geologic or related general work and $8,854, or 35 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 1929–30 the chief Alaskan geologist was on leave without pay from July 1 to 19 and then was engaged in field work until September and later spent the equivalent of one and a half months on the preparation of the statistical report, as well as several months in

the preparation of other reports. During his absence in the field Miss L. M. Graves served for the chief of the branch. Part of Mr. Stewart's salary has been included in this item, as the local administration of the Alaska offices is in his charge. The low cost of administration is due principally to the fact that the administrative officers are engaged also in technical projects, to which is therefore charged a proportional part 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 branch whose personnel has long been familiar with the work to be done and is well qualified to solve for itself many of the problems that arise.

The item for clerical and drafting salaries covers part of the salary of the chief clerk and of two junior clerks 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 directed to the canvass and compilation of data regarding the production of minerals in the Territory and the necessary office work related thereto. 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 purposes. 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 the work. This condition was the result of curtailments in appropriations, which have been met by curtailments in the clerical force, so as to make as much money as possible available for the field projects. This procedure is having an injurious effect on the work as a whole and is really uneconomical.

The item for office maintenance and expenses 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 all 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 than those taken in the course of the airplane work. 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 for use in designated projects. One of the largest single expenses charged to this item was the photolithographic reproduction of a topographic map of the Goodnews Bay region, which was issued as an advance edition subject to correction, at a cost of about $140. As will be seen, the total

charged against this item represents an amount equivalent to less than 2 per cent of the total appropriation.

In the following tables has been set down the cost of the work, including field expenses and the salaries paid from different appropriations, by geographic regions or by classes of work. The figures for the cost 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 maintenance or expense. 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 104 for a single fiscal year. Furthermore, the expenses from the appropriation for 1930–31 are necessarily all estimates, as actual expenditures will not be known until the end of the field work in the winter. The figures used therefore simply represent the allotments that have been made for the different projects.

Approximate cost and distribution of work by geographic divisions for the season of 1929

Region and work	Appropriation for 1928–29		Appropriation for 1929–30		Total
	Expenses	Salaries	Expenses	Salaries	
Southeastern Alaska, Navy project	$2,350	$833	$600	$4,167	$7,950
Southeastern Alaska, printing films			1,929	940	2,869
Copper River region, geologic reconnaissance	1,800	833	2,680	4,375	9,688
Lake Clark-Mulchatna, geology and topography	4,650	1,534	2,850	7,784	16,818
Yukon region, geologic reconnaissance	2,550	800	2,452	4,000	9,802
General mining developments			668	3,176	3,844
Alaska offices, field work			1,837	[a] 1,363	3,200
Mineral-resources statistics				[b] 2,015	2,015
	11,350	4,000	13,016	27,820	56,186

[a] Includes 2 months' salary of clerk in district office.
[b] Includes 1½ months' salary of geologist and 9 months' salary of clerk.

Approximate cost and distribution of work by geographic divisions for the season of 1930

Region and work	Appropriation for 1929–30		Appropriation for 1930–31		Total
	Expenses	Salaries	Expenses	Salaries	
Ketchikan district, topographic mapping	$2,400	$834	$5,250	$4,167	$12,651
Taku district and southeastern Alaska, mining geology			2,000	1,042	3,042
Alaska Railroad region, geology	2,500	625	2,200	4,167	9,492
Chulitna district, geologic mapping	2,050	934	2,800	4,667	10,451
Nushagak district, topographic mapping	2,500	632	2,300	3,167	8,599
Upper Yukon region, geologic mapping	3,250	800	2,500	4,000	10,550
General mining development investigations			1,000	2,133	3,133
Preparing airplane prints			3,550	1,140	4,690
Mineral-resources statistics				[a] 2,160	2,160
	12,700	3,825	21,600	26,643	64,768

[a] Includes 1½ months' salary of geologist and 9 months' salary of clerk.

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, and the amount that is allotted for the different districts, including Alaska, is determined by the relative needs of each. For the fiscal year 1929–30 the allotment for Alaska leasing work was $10,000. This was the same amount as was allotted for the leasing work 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 Alaskan 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 that conduct such mineral-resources work 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 really 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. At present about three-fifths of Mr. Stewart's time, all of Mr. Corey's time, and two-thirds of the time of a clerk in the Anchorage office are considered to be devoted to the leasing work. The charges for the maintenance of the local office are shared between the leasing and mineral-resources work on ratios of about 2 to 1. In the fiscal year 1929–30 the allotment for field expenses was approximately $1,500, 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 Government has therefore an especial 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 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.

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 is not comparable with the number required in certain of the States. Neither is the need to be measured by the revenues received by the Government, nor by the number of leases or permits outstanding. In Alaska the open season is so short, the distances so great, and the regular means of transportation so slow and infrequent that either a proportionately much larger force must be maintained, or supervision in the more remote parts must be reduced to a mere gesture.