

UNITED STATES DEPARTMENT OF THE INTERIOR  
Harold L. Ickes, Secretary  
GEOLOGICAL SURVEY  
W. C. Mendenhall, Director

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Bulletin 897  
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# MINERAL RESOURCES OF ALASKA

REPORT ON PROGRESS OF  
INVESTIGATIONS IN

1936

BY

PHILIP S. SMITH AND OTHERS



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Bulletin 897—A

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# MINERAL INDUSTRY OF ALASKA IN 1936

BY  
PHILIP S. SMITH

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Mineral resources of Alaska, 1936  
(Pages 1-107)



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# MINERAL INDUSTRY OF ALASKA IN 1936

By PHILIP S. SMITH<sup>1</sup>

## INTRODUCTION

The presentation of a yearly record of the Alaska mineral industry is a continuing service that has been rendered by the Geological Survey from almost the earliest years of extensive mining in Alaska, and the present report, for 1936, is the thirty-third of this series.<sup>2</sup> Such a record, especially when supplemented by the statistics for the preceding years, not only affords an authoritative summary of current conditions but also indicates trends that are of significance in suggesting the lines along which future developments of the industry are likely to proceed. These reports therefore serve miners, prospectors, and businessmen concerned with Alaskan affairs as useful historical records, statements of contemporary conditions, and starting points on which some conjectures concerning future operations may be predicated.

To obtain the information recorded in these reports the Geological Survey, in addition to its other investigations of mineral resources, conducts an annual canvass of the entire mineral industry of Alaska. 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 without undue delay and expense to gather all the desired information at first hand. The information used is therefore derived from many sources, which necessarily vary in reliability and completeness. Efforts are made, however, to reduce all the statements to a comparable basis and to give only those that appear to be well substantiated. Among the most reliable sources of information are the geologists and engineers who are sent out each

<sup>1</sup> The canvass of producers, the tabulation of their replies, and general assistance in all phases of the office work connected with the preparation of the statistics set forth in this report have been carried through effectively by Kathleen S. Waldron, of the Alaskan branch of the Geological Survey.

<sup>2</sup> 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, 722, 739, 755, 773, 783, 792, 810, 813, 824, 836, 844-A, 857-A, 864-A, 868-A, and 880-A. The reports for 1902 and 1903 were included with other "contributions to economic geology" in Bulletins 213 and 225.

year by the Geological Survey to conduct surveys in different parts of Alaska and who acquire not only much accurate information regarding the mineral production of the regions in which they work but also general information by contact with miners and operators in the course of their travels to and from the field. Members of other Government organizations—for instance, the Bureau of Mines, the Bureau of the Mint, the Alaska Railroad, the Bureau of Foreign and Domestic Commerce, and the Customs Service—in the course of their regular duties collect many data which are extremely valuable in these studies and the use of which avoids unnecessary duplication in collecting records. Most of the banks, express companies, and other business organizations in Alaska collect for their own use data regarding mineral commodities of their particular districts. Some of these data are extremely pertinent to the general inquiry conducted by the Geological Survey, and through the cordial cooperation of many of these companies important facts have been made available to the Survey, though some of this information is confidential and is not released for publication. Most of the larger Alaska newspapers and certain papers published in the States that feature Alaska matters are courteously sent by their publishers to the Geological Survey, and from these and the technical and scientific periodicals are gleaned many items regarding new developments.

In addition to all these general sources the Geological Survey each year sends out hundreds of schedules—one to every person or company known to be engaged in mining in Alaska—on which are 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 return them have not all the specific data desired, misunderstand the inquiries, or reply in such a manner that the answers may not be correctly interpreted when the schedules are edited. It is gratifying evidence of the general appreciation of these annual summaries that so many of the operators cooperate fully and cordially with the Geological Survey by furnishing the information called for on the schedules as well as volunteering much other pertinent information.

It is apparent, however, that facts collected from one source, although of themselves strictly accurate, are likely to be computed or stated on a different basis from equally reliable reports received from another source, so that considerable editing and revision must be done to bring all to one standard. It is not possible to know exactly all the corrections that should be applied in order to reduce the reports of production to a strictly uniform standard. However,

though some uncertainties necessarily remain, it is believed that they do not have significant effect on the results expressed and that the report is consistent within itself and with the other reports of this series which record the statistics of mineral production. The restriction of the statistics in this report to those relating to production should be stressed, so that the reader will realize that while the statistics are comparable among themselves, they necessarily differ from those published by some of the other Government bureaus, because these are primarily records of production, whereas those issued by the Bureau of the Mint, for instance, relate to receipts at the offices of that Bureau, those issued by the Customs Service relate to shipments recorded at its stations, and those issued by other organizations may be computed on still other bases.

Another reason why the totals used in this volume for certain mineral commodities may differ from the reports received from other sources is that all values here stated are computed on the average selling price for each of the individual mineral commodities for the year and not on the prices actually received by the individual producers. It is obvious that this method of computation disregards the amount received by individual mines, but it is believed to afford a more useful representation of the industry as a whole. Thus the reports of the operators of small placer mines who sold their gold at a discount in local trade, or those of the larger producers, from the value of whose output deductions were made for shipping, insurance, and other expenses incident to handling, were so edited that the full value of the gold produced was recorded.

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 does not use any facts that are furnished in a way that will disclose the production of individual plants, nor allow access to its records in any way disadvantageous either to 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.

#### ACKNOWLEDGMENTS

To all the mining operators and prospectors of the Territory who have so generously made available information regarding their recent activities special acknowledgments are made, as without their

friendly cooperation this report could not have been prepared. Thanks are also gratefully expressed to the various Federal and Territorial officials who have generously made available to the Geological Survey many helpful facts from their special fields of investigation. Among the private individuals and companies who have been especially courteous in supplying information of general significance outside that pertaining to their own operations may be mentioned the following:

The Alaska Weekly and Volney Richmond, of the Northern Commercial Co., of Seattle, Wash., and the agents of this company, especially C. B. Haraden at Eagle, J. W. Farrell at Hot Springs, and L. L. Laska at McGrath; Ralph and Carl Lomen, of Seattle and New York; the Alaska Juneau Gold Mining Co., the Daily Alaska Empire, and J. J. Connors, of Juneau; the Ketchikan Alaska Chronicle, of Ketchikan; the Cordova Daily Times, of Cordova; the Valdez Miner, of Valdez; the Kennecott Copper Corporation, of Kennicott and New York; Carl Whitham and M. J. Knowles, of Chitina; W. J. Erskine, of Kodiak; Elwyn Swetmann, of Seward; the Bank of Alaska, Walter G. Culver, and the Anchorage Weekly Times, of Anchorage; W. E. Dunkle, of Luckyshot; H. W. Nagley and B. H. Mayfield, of Talkeetna; Frank H. Waskey, of Dillingham; Charles Naughton, of Kodiak; Charles Zielke, of Ferry; A. W. Amero and W. Yanert, of Beaver; the First National Bank, R. B. Earling and other officers of the Fairbanks Exploration Department, the Fairbanks Daily News-Miner, and G. E. Jennings, of Fairbanks; John B. Powers, of Eagle; B. B. Green, of Jack Wade; Thomas J. DeVane, of Ruby; George Jesse, of Poorman; the Miners & Merchants Bank of Iditarod; Alex Mathieson and Harry Donnelley, of Flat; Jessie M. Howard and Frank Speljack, of Ophir; H. S. Wanamaker, of Wiseman; J. W. Wick, of Russian Mission; J. L. Jean, of Goodnews Bay; J. K. Crowdy, of the New York-Alaska Gold Dredging Corporation; the Nome Nugget, J. D. Harlan, of Hammon Consolidated Gold Fields, Grant R. Jackson, of the Miners & Merchant Bank, and C. W. Thornton, of Nome; A. S. Tucker, of Bluff; Arthur W. Johnson, of Haycock; Ethel Marx, of Teller; and Lewis Lloyd and James Cross, of Shungnak.

## MINERAL PRODUCTION

### GENERAL FEATURES OF THE YEAR

The total value of the Alaska mineral production in 1936 was \$23,594,000. This was furnished by a number of different mineral products, but gold accounts for about 78 percent. Compared with the mineral production of 1935, the output in 1936 was \$5,282,000 greater. This notable increase is, of course, a source of satisfaction

to those concerned with the general development of the mining industry in the Territory, especially as in large part it does not seem to be attributable to temporary conditions that are not likely to be repeated in the near future. In other words, this large output appears to be fairly representative of a reasonable average that may be expected to be maintained for some time by the mines of the Territory under the conditions now prevailing. That this by no means approaches the limit of production of which the Territory is capable must be apparent to anyone who is even moderately familiar with the developments in progress or in contemplation. A number of new enterprises were under way that had not yet reached the stage of production, and few of the larger operations that were active showed signs of nearing the point where they appeared likely soon to encounter difficulty in maintaining their present output.

The general improvement in economic conditions throughout the world was reflected in some measure by the revival of interest in Alaska mining properties by persons or organizations having funds they wished to set to work in productive enterprises. Such interest was displayed not only in projects in several of the old camps, but also in those of some of the more remote and less explored parts of the Territory. These projects embraced not only those in which gold was the principal valuable metal sought but also those undertaken to explore some of the potential resources of tin, platinum, antimony, and quicksilver.

The selling prices<sup>a</sup> of most of the metals other than gold that enter largely into Alaska's mineral output were, on the whole, higher in 1936 than in 1935, so that a small part of the increase in the value of the total production noted must be attributed to that cause. Gold, which accounted for more than three-quarters of the value of the mineral production of Alaska in 1936, continued to be priced at \$35 an ounce, though the producers were hopeful that the Government might take steps to bring about a further advance. The average selling price of newly mined silver that was eligible for purchase by the Government was 77.57 cents an ounce, silver that did not thus qualify was sold at an average price of 45 cents an ounce. Copper, which in 1935 sold at an average price of 8.3 cents a pound, sold in 1936 at an average of 9.47 cents, though during the year there was a marked advance from slightly more than 9 cents a pound in January to more than 10¾ cents a pound in December. The market for platinum metals was also much higher than in 1935, as the average price in 1936 is estimated as \$42.93 an ounce, as against \$34.15 in the preceding year. There was a wide fluctuation in the

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<sup>a</sup> All the prices quoted for the various mineral commodities in 1936, unless otherwise stated, are based on statistics published by the Engineering and Mining Journal.

price of platinum metals in 1936, as in January the average price was \$36 an ounce, which increased irregularly until in October it was more than \$68, but it dropped off again during the later part of the year until it had receded to about \$48 an ounce in December. Tin was the only metal entering to any considerable extent into the Alaska mineral production that sold in 1936 at an average lower price than in 1935; its average price in 1936 was about 46.4 cents a pound, against 50.4 cents a pound in 1935. The selling prices of coal and limerock appear to have been identical in the 2 years.

From the foregoing statements it should not be inferred, however, that only favorable conditions were experienced. During the later part of the summer labor troubles in the Copper River region interrupted the normal flow of business for several weeks, and shipments of machinery and supplies needed in the operations of many of the mining properties were jeopardized by threats of canceling all steamship transportation to Alaska early in September. This threatened cessation of transportation was, fortunately, put off from time to time, but late in October it became a reality, and throughout the rest of the year service was suspended to Alaska in American bottoms, except for a few vessels that were operated by the Government. This interruption of service necessarily adversely affected mining operations at some of the properties, but coming, as it did, late in the season, after the normal shutting down of most of the placer mines, it did less harm than it would have done at almost any other time of year.

Certain of the properties that customarily operate at least intermittently were idle during 1936. For example, there was no production of petroleum, marble, or quicksilver reported from the properties at Katalla, in the Alaska Gulf region; near Tokeen, in southeastern Alaska; and near Sleitmut, in the Kuskokwim region. None of the deposits at these places are exhausted, and cessation of production from them is regarded as due solely to extraneous causes, which will doubtless not continue long. Indeed, the intensive prospecting recently revived at the quicksilver deposits in the vicinity of Sleitmut gives promise that the property will be adequately examined and that, if the results warrant such action, the work of putting the property into production will be actively prosecuted.

The lack of employment throughout many parts of the States proper and the glamour that distance usually gives have induced increasing numbers to look to Alaska as an outlet for their activities, and some have gone there to try their fortunes. It should be realized, however, that for more than a third of a century hardy pioneers, who are at least somewhat experienced in mining, have toiled over most of the more accessible parts of Alaska. A novice

should therefore be warned that much more is required in finding a workable deposit than a mere desire for wealth, and that the chances of finding bonanza deposits that merely await the summons of the newcomer to disclose their treasures are extremely poor. While large parts of Alaska remain almost unknown and unexplored, other parts, especially those along the main avenues of communication, have lost most of their frontier characteristics, and their facilities compare favorably with those of many parts of the States proper. In many of these areas large, stable mining enterprises have already been built up, and there is the constant tendency to undertake operations on a larger scale than formerly, so that the unit cost of the work may be kept at a low figure. That mining may be done in parts of Alaska at an extremely low cost has been demonstrated by the past performance of one of the mines in southeastern Alaska, where costs are below those of any comparable enterprise in the world. This tendency to operate in larger units marks a distinct departure from the old days, when the search for mineral deposits was directed mainly toward the discovery of small rich deposits that could be worked by relatively crude methods and with little outlay of capital. Today, by far the larger part of all the mineral production of Alaska comes from mines utilizing extensive equipment to handle large volumes of relatively low grade material. The modern prospector is therefore not limited in his search to small rich stringers or concentrations but may well direct his attention to finding deposits that appear to hold promise of yielding large quantities of average or even low-grade ore. Such a prospector, however, must realize that usually he has neither the technical nor the financial capacity to carry through the development of such properties to a producing stage, and so if he places an excessive value on his discoveries he jeopardizes benefits to himself and to the mining industry, because the value of his service is but a small part of the heavy outlays and intricate planning that will be required for testing the property adequately and bringing it successfully into production.

In subsequent pages, in describing the individual mineral commodities, statements will be given as to specific factors that advanced or retarded certain developments in each of them, as well as general information on the accomplishments during the year.

#### **TOTAL MINERAL PRODUCTION**

From the time of the earliest records of mining in Alaska to the end of 1936 minerals to the value of over \$720,000,000, or one hundred times the purchase price of the Territory, have been produced

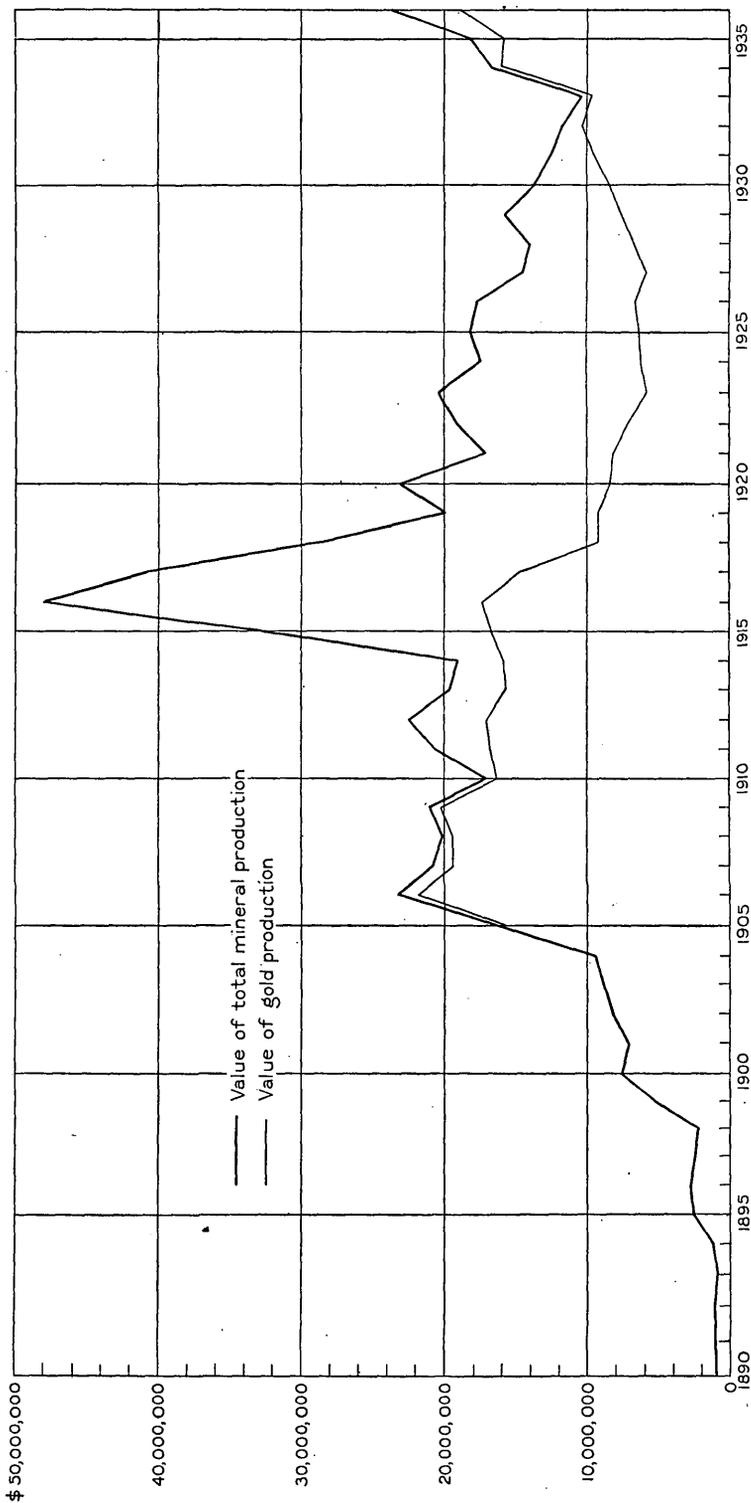


FIGURE 1.—Trends of mineral production of Alaska, 1880-1936.

by its mines. 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 is evident that prior to 1898 the annual production ranged from negligible amounts to a maximum of less than \$3,000,000. After the discovery of the Canadian Klondike and the entrance of a swarm of prospectors and miners into Alaska the production quickly mounted until in 1906 it reached a high point that marks the mining of many of the rich placers in the Nome and Fairbanks regions. For the next 8 years the annual production fluctuated somewhat but ranged around \$20,000,000. Then it mounted by leaps until it reached a maximum of more than \$48,000,000 in 1916. This rapid increase was due to the growth of copper production under the stimulus 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 post-war period Alaska has suffered through the fact that in the States scales of wages and opportunities for the employment of capital have seemed to offer more advantages, and as a result there has been more or less fluctuation in the mineral output from Alaska, the production during the last few years ranging between \$10,000,000 and \$14,000,000, until in 1934, owing largely to the advance in the price of gold, it approached \$17,000,000, and in 1936 it was almost \$23,600,000.

*Value of total mineral production of Alaska, by years, 1880-1936*

1880.....	\$6, 826	1900.....	\$7, 995, 209	1920.....	\$23, 330, 586
1881.....	15, 000	1901.....	7, 306, 381	1921.....	16, 994, 302
1882.....	23, 000	1902.....	8, 475, 813	1922.....	19, 420, 121
1883.....	67, 146	1903.....	9, 088, 564	1923.....	20, 330, 643
1884.....	72, 000	1904.....	9, 627, 495	1924.....	17, 457, 333
1885.....	425, 000	1905.....	16, 490, 720	1925.....	18, 220, 692
1886.....	540, 000	1906.....	23, 501, 770	1926.....	17, 664, 800
1887.....	657, 000	1907.....	20, 840, 571	1927.....	14, 404, 000
1888.....	667, 181	1908.....	20, 092, 501	1928.....	14, 061, 000
1889.....	847, 490	1909.....	21, 140, 810	1929.....	16, 066, 000
1890.....	873, 276	1910.....	16, 875, 228	1930.....	13, 812, 000
1891.....	1, 014, 211	1911.....	20, 720, 480	1931.....	12, 278, 000
1892.....	1, 019, 493	1912.....	22, 581, 943	1932.....	11, 638, 000
1893.....	1, 104, 982	1913.....	19, 547, 292	1933.....	10, 366, 000
1894.....	1, 339, 332	1914.....	19, 109, 731	1934.....	16, 721, 000
1895.....	2, 588, 832	1915.....	32, 790, 344	1935.....	18, 312, 000
1896.....	2, 885, 029	1916.....	48, 386, 568	1936.....	23, 594, 000
1897.....	2, 539, 294	1917.....	40, 694, 804		
1898.....	2, 329, 016	1918.....	28, 218, 935		
1899.....	5, 425, 262	1919.....	19, 626, 824		
					722, 222, 000

NOTE.—\$37,805 for coal produced prior to 1890 has been credited to 1890, as data are not available for distributing the value by years.

In the following table the value of the total mineral production from Alaska is distributed among the various metals and nonmetallic products. From the table it will be seen that gold accounted for

about 65 percent of the total value of the mineral production and that gold and copper together accounted for more than 95 percent.

*Total value of mineral production of Alaska, by substances,  
1880-1936*

Gold.....	\$469, 114, 000
Copper.....	219, 661, 400
Silver.....	12, 793, 000
Coal.....	10, 450, 800
Tin.....	1, 255, 100
Lead.....	2, 256, 800
Other mineral products (including platinum metals).....	6, 690, 900
Total.....	722, 222, 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 1936 and 1935, distributed by quantity and value among the main kinds of substances, so that a comparison between the two years may be readily made. From this table it is apparent that there was an increase in both quantity and value of the production of gold, silver, lead, tin, copper, coal, and miscellaneous mineral products, but a decrease in platinum metals.

*Mineral output of Alaska, 1936 and 1935*

	1936		1935	
	Quantity	Value	Quantity	Value
Gold..... fine ounces.....	526, 600	\$18, 433, 000	455, 429	\$15, 940, 000
Copper..... pounds.....	39, 267, 000	3, 720, 000	15, 056, 000	1, 249, 700
Silver..... fine ounces.....	475, 700	369, 000	286, 600	208, 000
Coal..... short tons.....	136, 600	573, 700	119, 425	501, 600
Tin, metallic..... do.....	113	105, 000	49. 4	49, 800
Lead..... do.....	1, 038	99, 900	815	65, 200
Platinum metals..... ounces.....	5, 664	241, 900	8, 685	259, 700
Miscellaneous mineral products.....		51, 900		40, 000
Total.....		23, 594, 000		18, 312, 000

**GOLD**

**GENERAL FEATURES**

Throughout 1936 the price of gold remained fixed officially at \$35 an ounce, the same as it has been since 1934. It should be borne in mind, however, in all comparisons made with the records given of the earlier years, that the value of gold produced prior to 1934 has been computed on the then prevailing price of slightly more than \$20.67 an ounce, or only about 60 percent of the present price. The value of the gold production of Alaska in 1936 was \$18,433,000, against

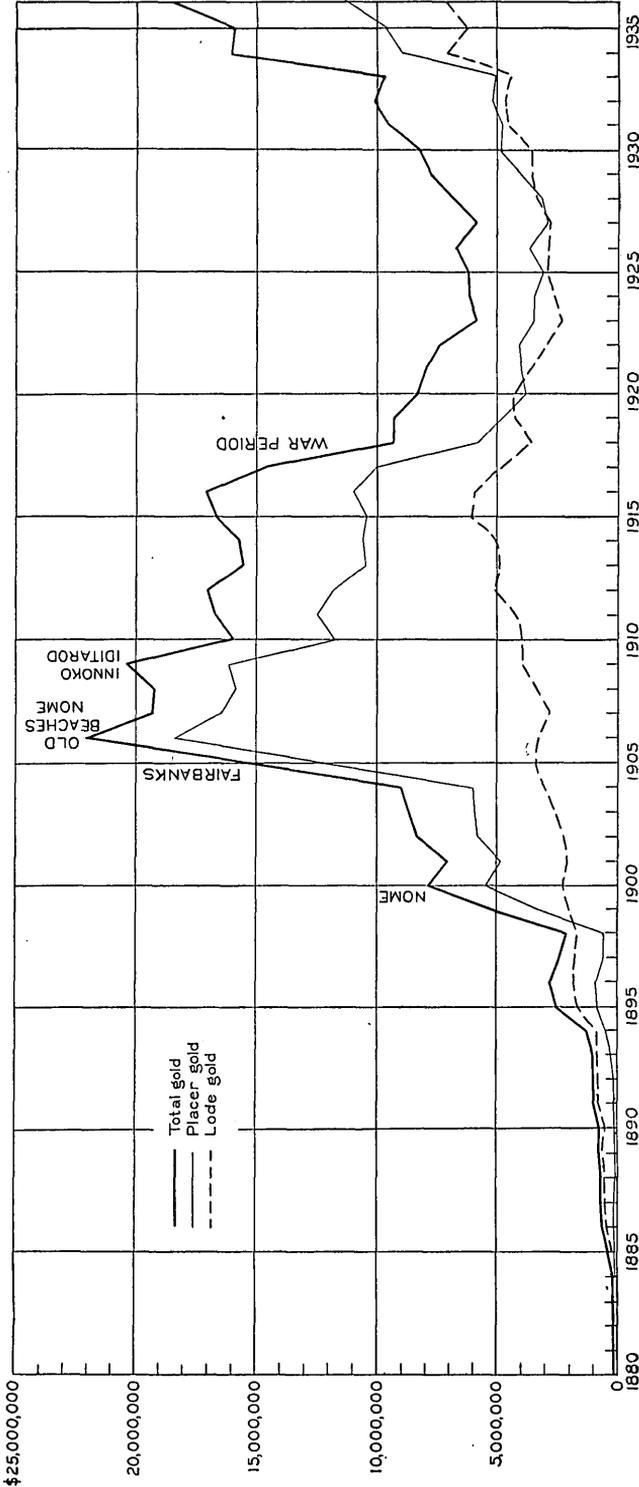


FIGURE 2.—Trend of value of gold production of Alaska, 1880-1936.

\$15,940,000 in 1935, an increase of practically \$2,500,000. The value of the gold output of Alaska in 1936 reached a high point in the record of the Territory that has not been equaled in any other year since 1909 and has been exceeded during only 4 years in the entire history of gold mining in Alaska. In 1906—the banner year of Alaska gold mining—the value of the gold output was \$22,037,000, which topped that of 1936 by only about \$3,500,000.

The general trend of gold mining in Alaska since 1880 is graphically represented by one of the curves in figure 2. From 1880 to 1884 only negligible amounts of gold were produced. Then the curve of production gradually steepened, until in 1895 the former production nearly doubled, and this remained fairly constant until 1899, when the great increase marking the discovery of the rich deposits near Nome carried the value of the annual output of gold to about \$8,000,000, near which it remained until 1904. From 1880 to 1904 the curve of gold produced practically coincides with the curve for the value of the total mineral production of Alaska. From 1904 to 1906 there was an abrupt increase in gold production, marking the boom periods of many of the placer camps. From the peak of 1906 there was a gradual decline for the next 10 years, and during the period of the World War there followed a rather rapid decrease to less than \$10,000,000 a year. During the post-war period from 1920 to 1927 there was a still further decline in Alaska gold production, and it touched new lows in 1923 and 1927, when it was less than \$6,000,000 a year. Since 1927 there has been in general a marked increase in the value and quantity of gold produced, until in 1934 and 1935 the value of the output was about \$16,000,000 and in 1936 more than \$18,400,000.

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 21 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 annual production for each year from 1880 and the sources, from 1884, are shown graphically in

figure 2. Of the \$469,114,000 in gold that has been produced from Alaska mines \$304,464,000, or about 65 percent, has come from placers and \$164,650,000, or about 35 percent, from lodes. The relation between the outputs from these two sources has varied widely. Thus up to 1898 the lode production was greater than that from the placers. Then ensued a period of more than 20 years when the annual placer production far exceeded that from the lodes. From 1919 to 1933 the production was about evenly distributed between the two sources. Since then, with the growth in the mining of extensive low-tenor placer deposits by highly mechanized plants, the production of gold from the placers has exceeded that from the lodes, so that for a number of years the ratio of production from these two sources has been about 3 to 2. There is reason to believe that the current rates of production by no means mark rates that may not be maintained or exceeded in succeeding years. Although obviously the output of placer gold may be expected to lessen as time goes on, there is no evidence yet that such a point is near at hand, and increasing production from the lode mines may be predicted with all confidence.

*Gold produced in Alaska, 1880-1936*

Year	Fine ounces	Value		
		Total	Placer mines	Lode mines
1880-1915.....	12,592,121	\$260,302,243	\$185,200,444	\$75,101,799
1916.....	834,068	17,241,713	11,140,000	6,101,713
1917.....	709,049	14,657,353	9,810,000	4,847,353
1918.....	458,641	9,480,952	5,900,000	3,580,952
1919.....	455,984	9,426,032	4,970,000	4,456,032
1920.....	404,683	8,365,560	3,873,000	4,492,560
1921.....	390,558	8,073,540	4,226,000	3,847,540
1922.....	359,057	7,422,367	4,395,000	3,027,367
1923.....	289,539	5,985,314	3,608,500	2,376,814
1924.....	304,072	6,285,724	3,564,000	2,721,724
1925.....	307,679	6,360,281	3,223,000	3,137,281
1926.....	324,450	6,707,000	3,769,000	2,938,000
1927.....	286,720	5,927,000	2,982,000	2,945,000
1928.....	331,140	6,845,000	3,347,000	2,498,000
1929.....	375,438	7,761,000	4,117,000	3,644,000
1930.....	410,020	8,476,000	4,837,000	3,639,000
1931.....	459,900	9,507,000	4,842,000	4,665,000
1932.....	493,860	10,209,000	5,522,000	4,687,000
1933.....	469,286	9,701,000	5,152,000	4,549,000
1934.....	457,343	16,007,000	8,955,000	7,052,000
1935.....	445,429	15,940,000	9,703,000	6,237,000
1936.....	526,660	18,433,000	11,328,000	7,105,000
Total.....	21,685,697	469,114,000	304,464,000	164,650,000

**GOLD LODES**

Alaska lode mines in 1936 yielded \$7,105,000 in gold, or \$868,000 more than in 1935, when the production was \$6,237,000. The gold derived from the lodes was about 38½ percent of the entire gold production of the Territory, or practically the same rate as that which existed in 1935. The lode gold was recovered from widely

distributed mines, but nearly 81 percent came from mines in southeastern Alaska, as shown in the following table:

*Gold produced from gold-lode mines in Alaska in 1936, by districts*

District	Fine ounces	Value
Southeastern Alaska.....	163,857	\$5,735,000
Willow Creek.....	20,143	705,000
Fairbanks district.....	11,000	385,000
Other districts.....	8,000	280,000
Total.....	203,000	7,105,000

Of the Alaska lode-gold mines, the properties of the Alaska Juneau Gold Mining Co. in southeastern Alaska are by far the largest, and that company alone produced about three-quarters of the total lode-gold output of the Territory in 1936. The magnitude of the company's mining operations is set forth in its published report to its stockholders,<sup>4</sup> from which the following statements are abstracted: The total rock mined and trammed to the mill in 1936 was 4,366,800 tons. Of this amount 1,904,754 tons of coarse tailings were rejected and 2,462,046 tons were fine-milled. The average gold content of all the material mined was 0.0422 ounce to the ton. The amount of gold in that part of the rock which was rejected was about 0.0069 ounce to the ton, and the gold content of the rock that was further treated was about 0.0694 ounce to the ton. Of this content 0.0089 ounce to the ton was lost during the treatment, 0.0544 ounce was recovered as bullion, and 0.0061 ounce was recovered in the concentrates, which were subsequently smelted. The table on the following page, 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.

The cost of mining in 1936 was stated by the company to have been 34.38 cents for each ton of ore trammed to the mill, the cost of milling was 21.74 cents, and all other marketing costs and expenses amounted to 9.38 cents, making the entire operating cost for each ton of ore trammed only 65.50 cents. This indicates the exceedingly efficient operation of a deposit of this low-grade type, which could have been brought about only through capable management and the adoption of all technical means for maintaining and stimulating production in all stages of the enterprise.

The large increase in the output of gold from this company's mine in 1936, as compared with that of 1935, is attributed by the management to two main causes—namely, a somewhat higher tenor of the ore and less interruption in the work. The average value of the ore

<sup>4</sup> Alaska Juneau Gold Mining Co. 22d Annual Rept., for the year ended Dec. 31, 1936.

milled was about 8 cents a ton higher than in 1935. The serious interruption of operations at this property by strikes in 1935, which resulted in completely closing the mine for more than a month and disorganization for a much longer period, was not repeated in 1936.

*Production of Alaska Juneau mine, 1893-1936*

Year	Ore (tons)			Metals recovered			
	Total	Fine milled	Coarse tailings rejected	Gold (ounces)	Silver (ounces)	Lead (pounds)	Total value <sup>2</sup>
1893-1913.....	507, 254	330, 278	176, 976	34, 240	(1)	(1)	\$707, 730
1914-15.....	242, 328	239, 918	2, 410	12, 175	6, 192	117, 031	261, 326
1916.....	180, 113	180, 113	-----	5, 565	2, 844	61, 068	121, 379
1917.....	677, 410	677, 410	-----	20, 767	12, 248	296, 179	460, 666
1918.....	592, 218	574, 285	17, 933	20, 809	11, 828	273, 297	459, 445
1919.....	692, 895	616, 302	76, 593	24, 141	16, 431	359, 762	542, 714
1920.....	942, 870	637, 321	305, 549	35, 456	23, 348	487, 574	791, 390
1921.....	1, 613, 600	904, 323	709, 277	46, 914	40, 619	550, 913	1, 035, 251
1922.....	2, 310, 550	1, 108, 559	1, 201, 991	62, 707	49, 405	687, 315	1, 388, 679
1923.....	2, 476, 240	1, 134, 759	1, 341, 481	69, 047	41, 876	755, 423	1, 514, 774
1924.....	3, 068, 190	1, 367, 528	1, 700, 662	92, 277	63, 191	1, 256, 857	2, 055, 782
1925.....	3, 481, 780	1, 537, 884	1, 943, 896	98, 213	55, 971	1, 288, 974	2, 184, 384
1926.....	3, 829, 700	1, 649, 678	2, 180, 022	93, 423	52, 333	1, 300, 915	2, 067, 837
1927.....	4, 267, 810	1, 839, 695	2, 428, 115	112, 663	61, 232	1, 513, 306	2, 463, 262
1928.....	3, 718, 140	1, 795, 191	1, 922, 949	162, 047	77, 591	2, 038, 655	3, 316, 019
1929.....	3, 836, 440	2, 020, 470	1, 815, 970	164, 993	90, 635	2, 501, 832	3, 627, 247
1930.....	3, 924, 460	2, 066, 239	1, 858, 221	163, 312	97, 607	2, 640, 771	3, 551, 950
1931.....	4, 162, 350	2, 298, 998	1, 863, 352	179, 532	118, 508	3, 309, 176	3, 879, 839
1932.....	4, 001, 630	2, 414, 469	1, 587, 161	151, 578	94, 519	2, 509, 263	3, 263, 183
1933.....	4, 085, 960	2, 466, 832	1, 619, 128	160, 967	109, 483	2, 299, 777	3, 960, 166
1934.....	4, 302, 600	2, 387, 138	1, 915, 462	128, 015	86, 458	1, 062, 894	4, 582, 559
1935.....	3, 729, 660	2, 091, 475	1, 638, 185	118, 998	77, 787	1, 455, 167	4, 281, 110
1936.....	4, 366, 800	2, 462, 046	1, 904, 754	149, 235	101, 591	2, 102, 594	5, 400, 621
Total.....	61, 010, 998	32, 800, 911	28, 210, 087	2, 087, 064	1, 291, 697	29, 468, 743	51, 890, 313

<sup>1</sup> Lost in tailings.

<sup>2</sup> Based on company's valuation.

During 1936, in addition to the regular productive work, extensive prospecting and development work was conducted. Of that kind of work the headway made in preparing the deposits in the recently acquired area formerly known as the Perseverance property was perhaps the most noteworthy. As a result of that work connections with the main haulage system have been effected and one stope brought into production. The superintendent reports that altogether during the year more than 23,000 linear feet of underground openings were made and nearly 82,000 square feet of stope area was cut out. The larger part of the ore milled during the year came from the south ore body, but more than 900,000 tons was furnished by the north ore body. The output from the north ore body was about equally distributed between that from above and that from below the main level or no. 4 level. The tenor of the ore mined below the no. 4 level, according to the company's report, averaged more than two and one-half times that of the ore from the stopes above that level. In addition to the regular practice that had been followed in milling the ore, the management found that finer grinding of certain of the tailings and treatment of the resulting product by flotation effected

worth-while savings of metal that had heretofore been lost. As a result, the necessary equipment was installed to incorporate this new practice as a regular part of the milling procedure. Further experimentation was carried on to see what additional savings might be effected in the recovery of metal contained in certain of the slimes that are now discarded. This work had not progressed far enough to prove whether or not such treatment as could be devised would be profitable, but it will be continued until a conclusive decision is reached. The rehabilitation of the old power plant on Salmon Creek, which had been in progress by the company for 2 years, was satisfactorily completed, so that the additional power thus made available will take off the load from the steam-power plant during much of the year. Additions made during the year to the Annex Creek Reservoir increased its storage capacity to an extent equivalent to a million kilowatt-hours of power. Two articles relating to special phases of the developments at the Alaska Juneau property have appeared in recent issues of the technical journals and are of interest to mining engineers.<sup>5</sup>

The next most productive lode-gold mines in southeastern Alaska are situated on the west coast of Chichagof Island. At this place are the properties of the Hirst-Chichagof Mining Co., near Kimshan Cove, some 65 miles northwest of Sitka, and the Chichagoff Mining Co., near Klag Bay, a few miles to the southeast. Little specific information has been received by the Geological Survey as to current operations by either of these two companies, except as to the value of their output. From the quantity of gold produced it is evident that, on the whole, mining at both places proceeded on about the same scale as formerly, and that no notable changes in character of the ore were encountered. At the Hirst-Chichagof the mining and development in the deeper portions of the mine were somewhat interrupted owing to the installation of extensive electrical equipment, including a new hoist that will greatly increase the amount of ore that can be brought to the surface in a specified time. At both of these properties a large part of the gold contained in the ore is recovered at the mills operated in connection with the mines. In addition, each of these mills is equipped with apparatus for concentrating the sulphides and other valuable minerals in the ore, and these concentrates are shipped to smelters in the States for the recovery of these additional minerals.

The successful development of these two large properties on Chichagof Island and the high price of gold have had a stimulating

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<sup>5</sup>Bradley, P. R., Alaska Juneau deep-level mining: *Mining and Metallurgy*, vol. 17, pp. 391-392, 1936; Barges for waste disposal; *Eng. and Min. Jour.*, vol. 137, pp. 450-452, 1936.

effect on the search for valuable mineral deposits through that entire area, and several companies and individuals have been active during the year searching to find new leads, or reexamining and reopening some of the old properties that had been idle for many years. Among the operations of this sort may be mentioned the work that was in progress on the Clyde group of claims, in the vicinity of Mineral Hill, near Kimshan Cove. A small production was reported to have been made from this property. Other properties in the neighborhood have also disclosed veins on which some development work is in progress. Near the north end of Yakobi Island is the old El Nido property, which a few years ago was one of the highly productive mines but lately has been relatively inactive. In 1936 rumors were current that negotiations were in progress looking to the sale of this property, which, if carried through, would undoubtedly be followed by early resumption of extensive mining.

On Admiralty Island productive lode-gold mining was carried on at the properties of the Alaska Empire Gold Mining Co., a short distance north of Helm Bay. The milling facilities had proved inadequate to handle as much ore as was desired, and additional equipment was reported to have been ordered in the hope of raising the capacity of the mill to 100 tons a day. This equipment was not completed in time to be in full productive operation throughout the season, so that its benefits are not yet evident in its effect on the total production from this property. So far as reported, no productive lode mining was in progress on the property of the Admiralty Alaska Gold Mining Co., a few miles to the north, on Funter Bay.

Throughout the Juneau-Chichagof district, or the northern part of southeastern Alaska, in addition to these producing mines there were many other lode-mine developments in progress, which, though not yet placing the respective properties in the list of lode producers of notable amounts of gold, indicate the revival of interest in searching for and attempting to develop some of the more promising areas. Among the enterprises of this sort that seem to have been undertaken with the expectation of development on a large scale, if at all, perhaps the one of most general local interest has been the work done at the old Kensington and Comet properties, in the Berners Bay area, north of Juneau. At one time these properties produced a large amount of lode gold, and it is believed that under capable management they may be successfully reopened and resume production. The work at this place during 1936 is reported to have consisted mainly in constructing an all-weather road from the mine to the coast and in repairs and reconstruction of the surface plant. So far as could be learned, no new developments were made at the property of the Holland Alaska Gold Co., in the Herbert River area, north of Juneau.

Some further preparatory work was done by the Alaska-Windham Gold Mining Co. in the Windham Bay area, south of Juneau, but failure to perfect plans for the general operation of the property put off productive mining for at least another year. No definite steps appear to have been taken to reopen parts of the old Treadwell properties under the arrangement that had earlier been reported to have been under consideration. The rumors of possible reopening, however, were used as a basis for fraudulent representation of the need of laborers, and this caused mild excitement and many inquiries until that unwarranted statement was authoritatively disclaimed.

In the Ketchikan district of southeastern Alaska the greatest production reported came from the Gold Standard mine, near Helm Bay, and from the property of the Alaska Gold & Metals Co., on Kasaan Peninsula. The Gold Standard property was somewhat less productive in 1936 than it has been of recent years. Part of this falling off is doubtless attributable to the time that was lost owing to the need of rebuilding the bunkhouse, which had been destroyed by fire. Some further interruption was caused by negotiations that resulted in the property being reorganized under the title Gold Helm Mining Co. and the formulation and putting into effect of new plans of operation. The mine of the Alaska Gold & Metals Co., some 40 miles west of Ketchikan, was reported to have been in operation throughout the year. The ore consists of sulphides occurring in shoots in gabbro and pyroxenite. In addition to the gold, considerable copper and a little silver are recovered from the concentrates, but the most distinctive feature of the ore is that it contains considerable recoverable palladium, one of the group of platinum metals. All the metallic contents that are saved are recovered by crushing and concentrating the ore by flotation and shipping the concentrates thus obtained to the States for smelting. During the year, in addition to other work, about 200 feet of raises were driven. No detailed report has been received by the Geological Survey as to the recent work at the property on Thorne Arm, east of Ketchikan, which was formerly known as the Sea Level mine except that it and several nearby claims had been consolidated under the new name of Thorne Arm Consolidated. It is currently reported locally that work was in progress there during much of the summer and fall and that the property is fast being put into shape to become a significant producer of lode gold. The general revival of interest in mining in the Ketchikan region noted in the volume of this series for 1935 seems to have been maintained, and reports of prospectors and others reexamining some of the long-closed properties or searching for new leads are common throughout the district. A discovery of rich gold quartz in the vicinity of McLean Arm, on the east coast of Prince of Wales Island near the

southern tip of the island, led to considerable activity in that area and the undertaking of some tests by means of diamond drilling to determine the conditions beneath the surface.

In the Hyder district, which includes a considerable tract of country at the head of Portland Canal, in southeastern Alaska, no extensive lode development was in progress, and even the sudden increase of interest in prospecting that was earlier awakened by the great increase in the price of gold seems to have practically died out. So far as the Geological Survey is informed, the only prospecting of any moment done in 1936 in the district seems to have been that carried on at the group of claims known as the Cantu property. This work apparently did not lead to the production of ore in the sense used in this report. Some reason for the decline in prospecting activity may be found in the fact that many of the roads and trails in the district were rendered impassable and almost useless by the many serious washouts that occurred during the extremely high floods of the preceding fall. Such an explanation can hardly be accepted as more than a partial one, for most of the flourishing camps of Alaska and British Columbia were established without the advantage of well-built roads. In spite of the small amount of mining now in progress on the American side of the boundary in the Hyder district, there is every reason to believe, so far as can be determined from geologic evidence, that the conditions which produced the rich deposits on the British Columbia side of the line did not suddenly alter at the boundary but must have affected portions of the Alaska area as well. It therefore follows that thorough search of those places might well lead to the establishment of a significant mining industry in the Alaska part of the district.

The Willow Creek district, at the head of Cook Inlet, has long been the second most productive lode-gold district in the Territory, having produced gold worth nearly \$8,500,000 since lode mining started there in 1909. The principal producing property in the district is that of the Willow Creek Mines, Inc., which holds claims on Craigie Creek and gets its ore mainly from the Lucky Shot and War Baby mines, on the northern slopes of the valley of this stream. This company employs about 100 men in the various phases of mining and milling, and the property is in continuous operation throughout the year. One of the principal items of new work accomplished during 1936 was the completion of sinking a winze 500 feet below the old adit level in the War Baby mine and drifting from the bottom of the winze westward toward the Lucky Shot. During the summer a project was started by the company to explore by diamond drilling part of the area in the lowland of the Craigie Creek Valley between the War Baby and the old Gold Bullion property, to the east. This investiga-

tion was undertaken in the hope of picking up the extension of some of the faulted veins known on those properties and to determine their character at much greater depth than at any of the places in the district where the veins have heretofore been mined. The mill at the Lucky Shot is capable of handling some 40 tons of ore a day, and the treatment of the crushed ore consists of amalgamation of the table and flotation concentrates and cyanidation of the amalgamation tailings. The entire layout has been carefully planned and well carried out. In addition to milling the current output of ore from its mines, the cyanide plant that was erected a few years ago was also actively employed during 1936 in re-treating some of the tailings that had been impounded from earlier milling of the ore from this property. It is probable that as soon as these old accumulations are cleaned up some of the tailings from other properties farther up the creek will also be cyanided in this mill.

The second most productive mine in the Willow Creek district in 1936 was that of the Fern Gold Leasing Co., near the head of Archangel Creek. A crew of 20 to 25 men was employed almost continuously throughout the open season, and a smaller number continued underground work throughout the winter. A cave-in that occurred early in the season slowed down productive work somewhat, but the damage caused by it had been cleaned up early in July, so that throughout the rest of the year production was maintained at a much higher rate than in the recently preceding years. Smaller amounts of lode gold were also recovered from the properties of the Bralaska Mining Co. and the Gold Cord and New Bullion mines. The holdings of the Bralaska Co. are situated in the valley of Fishhook Creek and embrace the old Martin and Independence properties. About half of the content of gold in the ore is free and is recovered in a small Lane mill and on amalgamation plates. The rest of the gold is associated with the sulphides in the ore and at present is not recovered, though the tailings containing the sulphides are impounded and will subsequently be re-treated in a flotation unit, which the company expects to install shortly. At the Gold Cord mine most of the season was spent in recovering some of the ore that had been left in the walls of the stopes when earlier mining was done. Reports were current that the advisability of unwatering certain of the lower levels and prospecting for ore bodies there was under consideration, as was also the construction of a small plant in which the impounded tailings from earlier operations could be cyanided. At the New Bullion mine, on the divide between Craigie and Fishhook Creeks, little more than development work was in progress. This consisted in installing a compressor, stripping and open cutting the lead, and testing the ore in a small Straub mill.

In addition to these more actively operated properties, there was some prospecting on at least six other lode projects in this district. No mining is reported to have been done at the Mabel mine or at that of the Marion Twin Mining Co. In fact, it is said that before the end of the season the last-named company had sold out its holdings in the district.

The third most productive lode-gold district in the Territory is in the vicinity of Fairbanks. Its output of lode gold in 1936 was \$385,000. This marks a slight decrease from the lode-gold production in 1935. Such a comparison may at first give the erroneous impression that the industry is declining, but this is far from being true, for the decrease was due to the facts that 1935 was the year of highest lode production in the entire history of the camp and that in 1936 happenings not likely to be soon repeated interrupted the normal output from several of the larger producers.

There are two principal producing lode-gold areas more or less close to Fairbanks; one embraces the country adjacent to Pedro Dome and lies 15 to 20 miles north and east of the town, and the other embraces parts of Ester Dome and lies 6 to 10 miles west of the town. In the Pedro Dome area the largest production came from the property of the Cleary Hill Mines Co., near the junction of Bedrock and Cleary Creeks, formerly known as the Rhoads-Hall mine. The normal operation of this property was seriously interrupted by a disastrous fire that in May wiped out its power plant and mill. Fortunately, during the time its own plant was out of commission power to keep the pumps going and the mine from being flooded was made available from the lines of a nearby mining company. Work of reconstruction was rushed, so that in less than 2 months the mill was again running, and repairs to the other property that had been damaged were rapidly completed. The new equipment that was installed and the new layout of the plant provide for much more economical and convenient operation of the entire project.

The second largest producing mine in the district is the Hi Yu mine, on Too Much Gold Creek, a tributary of Fairbanks Creek. Here not only were the underground developments continued successfully and the milling plant operated efficiently during the year, but many general improvements were made throughout the surface plant, including new mess and bunk houses and an office. An additional 5-stamp battery and two flotation cells were put into operation, and a crew of 20 to 25 men was employed. The customary high tenor of the ore milled was maintained; a large part of the free gold was recovered in the milling operations, and that part intimately associated with sulphides is contained in the concentrates, which are shipped to a smelter in the States for treatment.

Some gold was also recovered from lodes in the American Eagle and Henry Ford claims, at the head of Fairbanks Creek, where reopening of the old adit and deepening of the old shaft were in progress. Other properties in the same general neighborhood that reported the production of some lode gold were the Soo mine, north of Dome Creek, and the property of the Alaska Mining & Development Co., which includes the old Wyoming mine, on Bedrock Creek. Reopening of the old Chatham mine was also reported to have been undertaken, and new lode developments at the head of Pearl Creek were in progress. In fact, at a large number of places throughout a more or less definite eastward-trending belt extending from Pedro Dome small camps were engaged in the search for or development of lodes, which are common and rather widely scattered in this belt.

In the Ester Dome area of the Fairbanks district search for gold lodes was continued on essentially the same scale as heretofore, and some gold production was reported to have been made by six or eight properties. Probably the greatest amount of development work was done on the Mohawk mine, near Happy Creek, but most of this work was directed toward putting the mine into shape for the future rather than increasing its immediate output. Late in the season the discovery of a promising lead on Ester Dome between the heads of Sheep and Happy Creeks caused considerable revival of interest in that area. Prospecting and development of the claims of Stevens & Borovich on Ready Bullion Creek and of Nickolof at the old Elmes property were continued. The Little Eva claims were under lease from the owner, but apparently that arrangement did not result in the usual output of ore being maintained. There are still large areas on Ester Dome where surface showings are such as to encourage more intensive search, in the expectation that it will disclose deposits carrying a rather large quantity of high-grade ore that may be profitably developed.

Although concerned with a tract lying more than 100 miles to the east of Fairbanks, and therefore but remotely related to that camp, one of the main items of news discussed throughout the camp in 1936 was the projected gold-lode developments that were under way in the Goodpaster district. After some preliminary examination, a large number of claims in the Goodpaster district were taken up under option by a group said to be associated with the American Smelting & Refining Co., and arrangements were made for sending out a crew to carry on prospecting throughout the winter, to determine whether the claims could be worked at a profit. This deal was not completed until near the end of the open season, and the preliminary work of preparing quarters and getting material on the ground prevented much actual prospecting work in 1936, so that con-

siderable time will elapse before the explorations will have progressed far enough to determine with much certainty whether a successful camp can be established there. The opening of a permanent lode camp in that area would be so helpful, not only in its direct effects but also in aiding the general development of interior Alaska, that this venture will be watched with especial interest.

Among the districts producing lode gold grouped together in the table on page 14 under the heading "Other districts" the most productive, named in the order of output, are the Nabesna district, which lies north of the Wrangell Mountains of the Copper River region; the vicinity of Valdez and other parts of the Prince William Sound region; Kenai Peninsula, including the Nuka Bay area, the area south of Hope, and the hills north of Girdwood; the Nixon Fork district, in the Kuskokwim region; and the Bremner district, south of Chitina River, in the Copper River region. In practically each of these districts the production in 1936 came from a single mine, so that to avoid disclosing the individual output it has been necessary to combine the statistics.

In the Nabesna district the only producing gold-lode mine is that of the Nabesna Mining Corporation, which is sometimes referred to as the Carl Whitham mine, from the name of its principal owner and manager. This mine is on White Mountain, west of the Nabesna River, between its tributaries Jack and Jacksina Creeks. A good road to the mine from the Richardson Highway at Gulkana has now been completed and is available for trucking in supplies and equipment, thus greatly facilitating operations, though for speedy or emergency service the airplane is still extensively utilized. According to the published report of this company the principal underground work accomplished during 1936 was the driving of 3,203 feet of drifts and stope raises and the extraction of 11,653 tons of ore. In addition 1,293 feet of diamond-drill holes were bored to prospect for ore. The desirability of changing the practices that had been followed in the treatment of the ore led to the adoption of a new flow sheet and the installation of much additional equipment. Perhaps the most vital change was that by which the old leaching system in the cyanide plant was made over into a continuous-process agitation unit. Vexatious delays in getting the machinery from the States and installing it resulted in putting the milling plant out of commission for nearly 4 months, so that the production of gold was considerably less than in 1935. This is merely a temporary condition, and the increased output that the new equipment should make possible will doubtless be reflected in the future production of the mine. The new cyaniding unit has a rated capacity for treating 25 tons each 24 hours. The mine was operated continuously during 1936, and it is expected that in the

future both mine and mill will be kept running continuously and at as high speed as is feasible for maximum efficiency.

At several places within the Prince William Sound region there are gold-lode mines which in the aggregate afford a significant contribution to the yearly output of gold from the Territory. Unfortunately, the Geological Survey has received only meager first-hand information regarding the new activities at any of these properties in 1936. From such information as has been received it appears that the greatest production came from the properties of the El Primero Mining Co., on the west side of Port Wells, north of Bettles Bay; the prospect near the head of Bettles Bay, formerly known as the Herman-Eaton prospect and now operated by Ralph Merrill; and the Alaska Mayfield mines, some 7 miles west of Shoup Bay. The development work in progress by the Cliff Goldmines, Inc., at the old Cliff mine continues to be the most important mining activity in the area adjacent to Valdez. This work has not yet advanced far enough to place this mine on the list of producers, but it is said to be progressing to the satisfaction of the owners, and preparatory work should soon be sufficiently advanced so that the next stage in the program can be started. The work that had been in progress for several years on the Big Four claims on Mineral Creek was discontinued in 1936, and no announcement has been made public as to whether it will be resumed in the near future.

The principal districts in the Kenai Peninsula region in which some lode-gold production was reported in 1936 were Nuka Bay, Moose Pass-Hope, and Girdwood. The Nuka Bay district embraces country near the extreme southern part of Kenai Peninsula; the Moose Pass-Hope district embraces much of the country lying north of the Moose Pass station, on the Alaska Railroad, and extending to the old settlements of Hope and Sunrise on Turnagain Arm; the Girdwood district lies just north of Kenai Peninsula, extending a few miles northward from the shores of Turnagain Arm. The entire belt of rocks in which the deposits of these three districts occur and which extends even over into parts of the Valdez district is dominantly a deformed series of slate and graywacke which has locally been intruded by igneous dikes that are currently referred to as "greenstones." The veins occupy fractures of rather irregular form and moderate extent, and their gold content is largely free gold, though sulphides are by no means uncommon.

Prior to 1936 the mining developments in the Nuka Bay district had not been visited by any member of the Geological Survey, so that it was considered especially fortunate that S. R. Capps, in the course of his other duties, was able to spend a short time in the district. As the results of Mr. Capps' studies are not available for

general consultation elsewhere, it has seemed desirable to quote at this place the statement he prepared.

#### LODE MINING IN THE NUKA BAY DISTRICT

The Nuka Bay district comprises the area within the basin of Nuka Bay, which lies on the southeast coast of Kenai Peninsula about halfway between Seward and Port Chatham. It is accessible only by boat and is served by a gasoline boat that carries mail, passengers, and freight from Seward, making semimonthly trips in summer and monthly trips in winter. The geography of the immediate vicinity of Nuka Bay is shown in figure 3.

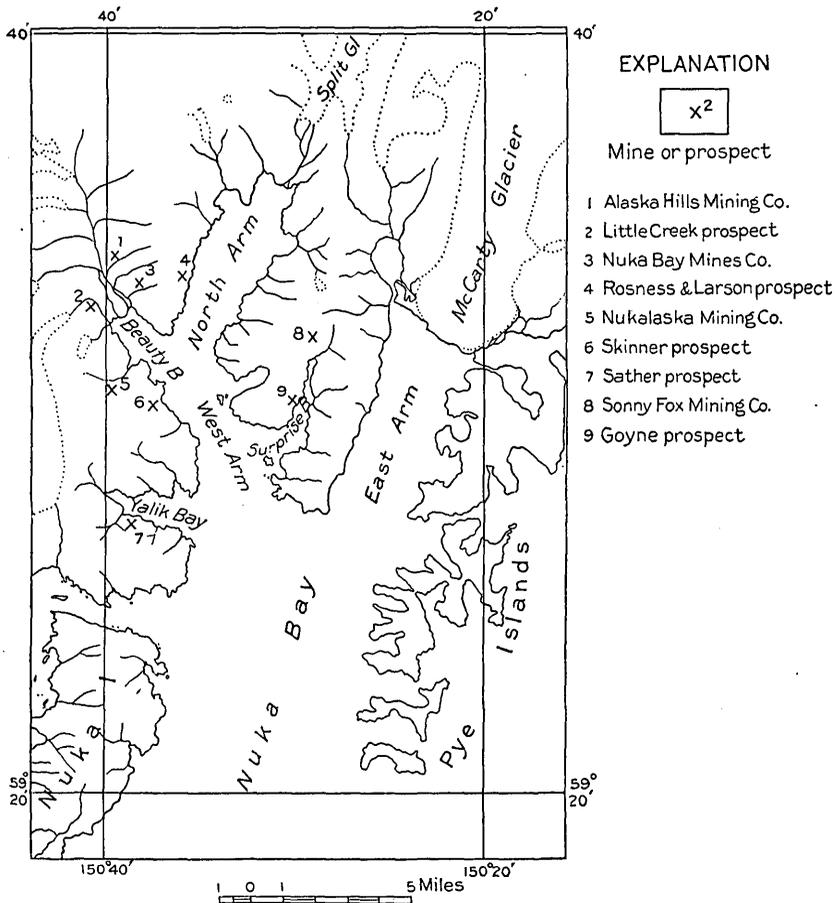


FIGURE 3.—Sketch map of Nuka Bay and vicinity.

The salient features of the geology of this region have been known since 1909, when they were studied and mapped by Grant and Higgins,<sup>6</sup> but at

<sup>6</sup> Grant, U. S., and Higgins, D. F., Coastal glaciers of Prince William Sound and Kenai Peninsula, Alaska; Geol. Survey Bull. 526, pl. 2, 1913. Martin, G. C., Johnson, B. L., and Grant, U. S., Geology and mineral resources of Kenai Peninsula, Alaska: Geol. Survey Bull. 587, 243 pp., 1915.

that time no gold lodes had been found in the district, and there was little interest in prospecting in it. The first gold discovery was made about 1918, and since that time many prospects have been staked, and milling plants have been placed on at least five properties. One mine, the Sonny Fox, has been in fairly continuous active production for the last 11 years, and the Nukalaska mine was operating successfully in 1936.

The district was visited in 1924 by Harry H. Townsend, in 1925 by J. G. Shepard, and in 1931 by Earl R. Pilgrim, all associate Territorial engineers, and the results of all three of those examinations were included in a report by Pilgrim,<sup>7</sup> published in 1933. The present report resulted from a visit of one week by the writer in August 1936. At the time of visit active mining or prospecting was under way on only a few properties, and many of the prospects described by Pilgrim had either been abandoned by the owners, or only the minimum amount of required assessment work was being done on them. An attempt was made to visit those properties on which the owners were present or on which active development was under way. For the others the descriptions given by Pilgrim are still adequate, and his report has been drawn upon for some data concerning the properties that are described herein.

Nuka Bay is a large embayment that, from the islands that form its entrance to its head, has a length of about 20 miles. It has a northerly trend, is about 6 miles wide for the outer or southern 9 miles, and toward its head forks into two arms, known as East Arm and North Arm. From both the lower bay and from each of its arms there are smaller bays that form reentrants into the mainland. All the productive lode mines and practically all the prospects on which work has been done are on North and West Arms and their projections Yalik, Surprise, and Beauty Bays.

The whole district is of extremely rugged, mountainous topography, the bays being glacial fiords and the valleys and ridges showing conspicuously the marks of severe glacial erosion. All the main streams head in active glaciers which are tongues of the extensive ice cap that occupies and inundates the Kenai Mountains in much of southwestern Kenai Peninsula. The shores almost everywhere rise steeply from the water's edge, and the mountains that surround the bay reach elevations of as much as 3,775 feet. In most places the surface is well timbered to an elevation of somewhat less than 1,000 feet, spruce trees with a diameter of 2 to 3 feet being common.

Travel in the district is almost entirely by water. All the mines and most of the prospects have roads or trails of a sort to the nearest point on the shore, but with these exceptions trails are lacking, and travel overland is slow and difficult.

All the claims that have been staked in this district and all the deposits upon which development work has been done are considered valuable primarily as gold lodes, though all contain minor quantities of silver, copper, lead, and zinc minerals. All consist of quartz veins that cut the Mesozoic slates and graywackes. Some veins are clearly related in position and probably also in origin to intrusive dikes or sills of granitic character, and such a relation is probable for other veins in which it is less evident. The veins so far found that have proved rich enough to mine are small, ranging in thickness from a few inches to 2 feet or more. In some of them native gold is present in unusual abundance, remarkable hand specimens having been obtained. One shipment of 5 tons of ore from the Sonny Fox mine yielded a net return of

<sup>7</sup> Pilgrim, E. R., in Stewart, B. D., Mining investigations and mine inspection in Alaska, biennium ending Mar. 31, 1933.

\$530 a ton, and ore milled at the Nukalaska mine averaged a yield of \$100 a ton for several weeks' run, even though the mill feed carried a dilution of two-thirds wall rock to one-third vein matter. The high gold tenor, however, is confined to rather definite shoots within the veins, high-grade ore giving place abruptly to vein matter of too low grade to be profitable. One unusually large and persistent vein, the Golden Goose vein, on the Skinner property on West Arm, is said to have been traced on the surface for 2,600 feet, and some 300 feet of tunnel has been driven on it. In the underground workings it ranges in thickness from 3 to 8 feet of quartz and carries abundant sulphides, but so far no high-grade shoots of free-milling ore have been found on it.

The deepest mining so far done in the district has reached a depth of only about 200 feet below the surface, and to that depth there is locally considerable oxidation of the sulphides. There is, however, no evidence of enrichment, the character of the mineralization is such as takes place at depth, and there is reason to believe that the same type of ore as that found near the surface will continue to depths much greater than have so far been attained.

The minerals so far identified in the quartz veins of this district include free gold, silver, and copper and the sulphides pyrite, arsenopyrite, chalcopyrite, sphalerite, galena, tetrahedrite, covellite, and chalcocite. Tellurides of the precious metals have also been reported, but chemical tests conducted by the Geological Survey on specimens collected for their supposed telluride content failed to show the presence of such minerals.

*Sonny Fox Mining Co.*—The Sonny Fox mine, often known also as the Babcock & Downey mine, is 1 mile above the mouth of Babcock Creek, the stream that enters the head of Palisade Lagoon, which itself is the headward extension of Surprise Bay. The property includes six claims, and the mining operations so far conducted have all been on the northwest side of the Babcock Creek Valley.

The original discovery on this ground was made on the Sonny Fox claim in 1924, and active mining was begun in 1926 and has been carried on since that time. The property is equipped with comfortable log mess house and dwellings, compressor house, and blacksmith shop. The mill, at an altitude of 35 feet above sea level, is about 1,000 feet south of the mine and is connected with it by an 800-foot car tramway over a trestle and fill and by an aerial cable tramway with a drop of 75 feet from the car tramway to the ore bin of the mill. The mill, equipped with a No. 2½ Wheeling jaw crusher, is a Denver quartz mill which has a rated capacity of 15 tons a day but which on this ore will crush 7 tons to 40-mesh. Power is furnished by a 45-inch water wheel supplied by water under a 100-foot head through 450 feet of 12- to 6-inch steel pipe. Auxiliary power may be had from a 25-horsepower Fairbanks-Morse gasoline engine. An Allis-Chalmers 10-kilowatt generator supplies light. From the mill the pulp passes over two amalgamating plates, one measuring 3 by 6 feet and the other 4 by 8 feet, thence to a 3- by 6-foot riffle board, thence through a home-made amalgamator with vertical baffle plates, mounted on the head of a Gibson concentrating table, from which the tailings move to a pond. The concentrates are shipped to a smelter. The earliest workings on this property were on the Sonny Fox claim and consisted of an open cut and two tunnels, between which the vein was stoped.

The present workings are on a vein which crops out near the camp and on which more than 800 feet of drifts have been driven on two levels, in addition to raises and stopes. The vein has a general northeasterly strike and a dip of about 60° SE., though it varies considerably in both strike and dip within short distances. It ranges from 10 inches to 5 feet in thickness and averages

about 2 feet. The quartz is white and locally shows banding. The most abundant metallic mineral is arsenopyrite; some pyrite, sphalerite, chalcopyrite, and galena are also present. Free gold is also present, often in coarse particles abundantly visible to the naked eye. This mine has yielded remarkably rich specimens, assays having shown a gold content of many thousand dollars to the ton and one shipment of 5 tons to the smelter having yielded a net return to the owners of \$530 a ton. One sample examined by the writer also contained native silver and native copper in small amounts. In 1936 four persons were employed on this property.

The ground formerly known as the Johnston and Degan claims, on the west side of Surprise Bay  $1\frac{1}{2}$  miles south of the Sonny Fox mine, has been incorporated into the Sonny Fox holdings. No recent work of note has been done on it.

*Nukalaska Mining Co.*—The property of the Nukalaska Mining Co. is on a high ridge some 2 miles from the beach in a southwesterly direction from the small bight at the southwest entrance to Beauty Bay. The ore body was originally discovered by Al Blair about 1926, but, his title having lapsed, the original three claims were relocated by Robert Hatcher in 1931–32. Fifteen additional claims have now been staked, giving a holding of eighteen claims by the Nukalaska Co. Active development on this ground was carried on in 1934–35 and included the construction of  $1\frac{1}{4}$  miles of road from the beach to the camp and thence to the lower terminal of the tramway, 2,000 feet upstream from the mill; a 3,500-foot 2-bucket  $\frac{7}{8}$ -inch cable gravity tramway from the mine to the lower terminal, with a difference in elevation of the ends of 1,800 feet; and a mill, office, bunk houses, cook house, and blacksmith shop. The mill is equipped with jaw crusher, ore bin, Western Iron Co. ball mill, with a capacity of 1 ton an hour ground so that 93 percent of the mill product passes a 60-mesh screen; Gibson amalgamator; 3-cell Fahrenwald flotation unit; and  $\frac{1}{2}$ -size Wilfley table. A recovery of 95 percent of the gold content is made, of which 75 to 80 percent is saved by amalgamation. The flotation and table concentrates, which amount to about 1 ton for each 100 tons of ore milled, are shipped to the smelter and carry from \$775 to \$1,775 in gold to the ton. The mill is driven by an 80-horsepower caterpillar Diesel engine. A Sullivan gasoline compressor at the mine supplies 165 cubic feet of air a minute for the drills. Twenty men were employed during the mining season of 1936, working in one shift in the mine and three shifts in the mill.

The vein crops out on the crest of a high, rugged ridge that rises about 2,500 feet above sea level and is so steep as to be difficultly accessible. To mine it an adit was driven  $30^{\circ}$  W., into the face of a cliff 200 feet below the outcrop, and at a distance of 230 feet it encountered the vein, which strikes west and along which crosscuts were driven 175 feet westward and 200 feet eastward. East of the adit little profitable ore was encountered, but to the west a rich pay shoot was cut, and from it all the gold so far recovered has been taken. At the time of visit, in August 1936, eight ore chutes 20 feet apart had been opened up, showing a width of the ore shoot of 140 feet, and stoping was in progress up to a point 80 feet above the adit level. The ore shoot rakes considerably to the west, perhaps as much as  $35^{\circ}$ . Surface prospecting indicates that a second ore shoot exists some 250 feet east of the one now mined, but this shoot has not yet been encountered in the underground workings.

The vein strikes about due east, almost at right angles to the east-northeastward-striking slate and graywacke of the country rock, dips  $80^{\circ}$  S., and lies parallel to and along the footwall of a 12-foot dike. The vein ranges from 10 to 18 inches in thickness and consists of banded quartz, more or less oxidized

to such depths as have so far been reached by mining. Spurs from the vein branch diagonally eastward into the dike, but these are of lower grade than the main vein. Some small lenses of ore show at the surface in the slate on the hanging wall of the dike but have not been found underground. Both vein and dike are cut and displaced by a small northwestward-trending fault at a point 275 feet west from the main adit, but vein matter persists along the jog formed by the offset. In the stopes some 30 inches of rock is broken, of which more than one-third is vein matter. All rock broken is trammed to the surface, where a rough hand sorting discards some of the coarser lumps of country rock, all the rest going to the mill.

The dike rock, as examined in thin section, proves to be a quartz diorite in which the principal minerals are quartz, lime-soda feldspars, and calcite, with sericite and chlorite as secondary minerals. The ore consists of somewhat banded quartz, carrying visible particles of arsenopyrite, pyrite, chalcopyrite, galena, and free gold. In an examination made for the owners by P. R. Yewell he identified tetrahedrite, chalcocite, and covellite also. The report is current that the ores from this district contain gold tellurides, and one assay return stated that sylvanite was present. Samples, collected by the writer, of ore that was considered most likely to carry tellurides were analyzed for tellurium in the laboratory of the Geological Survey, but no tellurides were present in them.

In August 1936 the material milled was yielding about \$100 to the ton in gold, notwithstanding the fact that about two-thirds of it was country rock that had to be mined along with the vein quartz. Plans were under way to sink a winze on the ore shoot to demonstrate its downward continuation, and if that is proved a lower adit may be driven. So far as is indicated by the general geology of the district and the character of the mineralization, veins of the type mined at the Nukalaska property may reasonably be expected to continue with depth, and except for a partial oxidation of some of the sulphides such as occurs in the present workings, the character of the deposit should not change greatly as greater depth is attained.

*Alaska Hills Mines Corporation.*—The claims of the Alaska Hills Mines Corporation, said to be five in number, are on the east side of the valley of the Nuka River some 2 miles north of the head of Beauty Bay. Only assessment work was being done in 1936, and the writer unfortunately failed to find the one man who was working on this ground at the time of visit. The property was examined in some detail by Pilgrim<sup>8</sup> in 1931, and only a small amount of mining has been done since that time. Pilgrim's description covers most of the work that has been accomplished on this property and has been drawn upon for some of the information here given.

The principal workings on the property consist of four tunnels on the main vein that range in altitude from 370 to 570 feet above sea level. The main working tunnel, at an altitude of 495 feet, is about 550 feet long, and above it all the profitable ore has been stoped to the surface. In this tunnel the vein is said to have ranged in width from 6 inches to 3 feet and to have been broken in at least two places by faults. Another crosscut tunnel, some 118 feet vertically below the main working tunnel, has now been driven a distance of 460 feet and has intersected the vein, but the vein where cut is small and carried too little gold for profitable mining.

The Alaska Hills mine is approached from the head of Beauty Bay by a narrow road graded into the steep valley wall and now partly washed out.

<sup>8</sup> Pilgrim, E. R., op. cit., pp. 46-48.

The property is equipped with an Ingersoll-Rand gasoline-driven compressor at the mine; a two-bucket gravity aerial cable tram from the mine to the mill, 1,000 feet distant; a mill equipped with a 7- by 10-inch jaw crusher; a Union Iron Works 4-foot ball mill; an amalgamator; and a Diester Overstrom concentrating table. Power is supplied by a 66-inch Pelton wheel driven by water under 94-foot head, brought through 1,000 feet of 16-inch wood-stave pipe. No ore had been milled in 1936 by the 1st of September.

*Nuka Bay Mines Co.*—The property of the Nuka Bay Mines Co. is on the mountain slope about half a mile northeast of the mouth of the Nuka River, at an altitude of about 1,200 feet. The route to it follows the narrow road from the head of Beauty Bay for half a mile and thence leads up a steep graded trail to the workings. This prospect was visited by Pilgrim<sup>9</sup> in 1931, and only assessment work has been done since that time. Developments include several open cuts and a shallow shaft at an altitude of about 1,500 feet on a quartz vein that strikes almost east and dips steeply to the south; an open cut on a 12-inch quartz vein some 330 feet lower down the mountain that strikes a little north of west and dips steeply to the north; and a tunnel some 400 feet long at an altitude of 1,150 feet, driven in a southeasterly direction in the hope of intersecting the veins showing in the open cuts above. At a point about 320 feet from the portal of this tunnel a crosscut 52 feet long has been driven southwestward. Except for some quartz near the portal the main adit lies in hard, barren graywacke that strikes N. 56° E. and dips 52° NW. and shows no vein matter. The crosscut at its face shows a small quartz vein that strikes N. 66° E. and dips 70° S.

Some years ago a small gasoline-driven Gibson mill was taken up to the property, but so far as can be learned it was never used, and it is now exposed to the weather and in bad condition.

*Goyme prospect.*—The mining property of Charles Goyme, which includes four claims, lies on the west side of Surprise Bay half a mile south of the narrows and extends from the shore line westward to the top of the divide between Surprise and Quartz Bays. Developments include two adits, one 30 feet above high-tide level and some 300 feet long, and the other at an altitude of 150 feet and about 150 feet long; also a large number of open cuts at various altitudes between the bay and the top of the ridge. Both adits and all the open cuts are on showings of vein quartz at or near the contact of a dike that ranges from 20 to 35 feet in thickness, strikes N. 63° W. and has a nearly vertical dip, and cuts black slates that strike N. 38° W. and dip 70° SW.

The lower and longer adit was driven in the years 1932 to 1934 by William Patterson and P. M. Ogle, who had an option on the property, now lapsed. It starts in black slate on the north side of the dike, curves southwestward to and across the dike, then curves back to the north and follows a devious course, mostly in slate. The adit, at about 150 feet from the portal, cuts a 6-inch quartz vein in the dike. This vein is oxidized and is said to carry minable quantities of gold. From that point to the face no other ore was found, but in the face a 1-foot vein that strikes westward and dips 70° S. was encountered. This vein carries abundant sulphides, principally arsenopyrite and pyrite, and is reported to have a satisfactory gold content.

The upper adit, which strikes in a general westerly direction, is somewhat sinuous and is driven for the most part in the dike, though in places it swings to the slate walls. Three quartz veins from 2 to 16 inches thick that are cut

<sup>9</sup> Pilgrim, E. R., op. cit., pp. 48-50.

by this tunnel all cut diagonally across the dike to the southwest but do not continue into the slate.

In following the dike upward along the surface above the upper tunnel, natural exposures and open cuts show a series of lenses or stringers of vein quartz that make up along the north wall of the dike and then run into it diagonally southwestward, with only fingers of quartz extending into the slate south of the dike. These lenses show from 1 inch to 3 feet of quartz and vary greatly in thickness within short distances.

Assays of the vein quartz taken from many places on the property, both underground and on the surface, show a gold tenor ranging from a fraction of an ounce to many ounces to the ton. A commercial assay of a picked sample of ore taken from the surface at an altitude of 600 feet yielded 158.16 ounces of gold and 58.92 ounces of silver to the ton and 0.72 percent of tellurium, as sylvanite. A sample taken by the writer from the same part of the vein and examined for tellurides in the chemical laboratory of the Geological Survey failed to show the presence of telluride minerals. A selected lot of 6,710 pounds of ore from the upper tunnel was shipped to the Tacoma smelter in 1931 and yielded 4.10 ounces of gold and 1.72 ounces of silver to the ton. In order to verify the occurrence of tellurides a sample was collected from the part of the vein from which the earlier assay reporting sylvanite had been taken. This sample was tested in the chemical laboratory of the Geological Survey, which reports that no telluride minerals were present. There can be no doubt that ore having a high gold content occurs on this property, but the developments so far made have not yet demonstrated the presence of an ore body of sufficient size to justify the installation of milling equipment with the assurance that a continuous supply of profitable ore can be obtained.

*Skinner prospect.*—The mining claims of G. R. Skinner are on the west shore of West Arm, 1½ miles south of the entrance to Beauty Bay. They are developed by a 50-foot tunnel at the cabin, just above high-tide level; by a 300-foot tunnel on another vein, at an altitude of about 400 feet; and by a 50-foot tunnel on the same vein at an altitude of about 75 feet.

The lower tunnel at the cabin follows a quartz vein in massive graywacke that strikes N. 20° W. and dips 75° SW. The vein, which is actually a stockwork of branching quartz veinlets, strikes N. 35° W. and dips 65° SW. and shows from 4 inches to 2 feet of quartz. It carried considerable quantities of sulphides, chief of which is arsenopyrite, with lesser amounts of pyrite, sphalerite, and galena. No work has been done on this vein for some years.

The Golden Goose vein on the same property has been developed by a 300-foot adit driven in 1934 northwest of the cabin, at an altitude of about 400 feet. The vein cuts slate and graywacke and has a general strike to the northeast and a steep dip to the northwest. The workings are for the most part in the footwall of the vein, but it is apparent that the vein is continuous underground, ranges from 1 to 8 feet or more in thickness, and averages at least 3 feet. It is said to have been traced on the surface for a distance of 2,600 feet. The quartz is distinctly banded and in places forms a stockwork of quartz stringers separated by slate inclusions. Some of the quartz consists of parallel bands of quartz and sulphides in layers one-eighth to 1 inch thick. The most abundant sulphide is arsenopyrite, though locally chalcopyrite and pyrrhotite are plentiful, and sphalerite and galena are also present. It is said that assays showing as much as 4 ounces of gold to the ton have been obtained, though most of the vein matter carries much smaller amounts of gold. The ore is rather base, the sulphides are abundant, and most of the gold is probably

so intergrown with sulphides that little could be recovered by amalgamation. If this vein is mined it would be necessary to concentrate the ore and to smelt the concentrates.

*Sather prospects.*—It is reported that assessment work has been kept up on several claims in Yalik Bay, the property of Peter Sather. The writer had no opportunity to visit these claims, and it was learned that no one was resident on the ground during August, when he was in this district. Pilgrim<sup>10</sup> reports that seven claims are held on the south shore of Yalik Bay, a mile from its head, where the country rock of slate, striking a little east of north and dipping steeply west, is cut by granitic dikes of the type prevalent throughout the district. It is reported that two tunnels, some 700 feet apart, have been driven on separate quartz veins. One tunnel is 51 feet and the other 60 feet long, the latter on a quartz vein that is bordered on its footwall by a dike. A third vein, lying between the two tunnels and associated with a granitic dike, is said to have been exposed by open cuts for a distance of 1,500 feet. Assays made from quartz taken from these veins show a precious-metal content ranging from a trace to 0.80 ounce of gold and 1.40 ounces of silver to the ton. No commercial ore has yet been extracted from this property.

*Rosness & Larson mine.*—The property of Rosness & Larson is on the northwest shore of North Arm about 2 miles northeast of Moss Point. The owners were not on the ground at the time of the writer's visit to the district, and the claims were not visited. The following account is taken from reports of local persons who are familiar with this property, and from Pilgrim's description.<sup>11</sup> The property is developed by several open cuts and by three tunnels, one 28 feet long from which a 27-foot winze has been sunk, and the other two 110 and 105 feet long, all on separate quartz veins that cut slate and graywacke in the vicinity of granitic dikes. A small gasoline-driven Ellis mill has been installed, and some ore has been milled in the past. The mill was not operated in 1936.

*Little Creek prospect.*—The Little Creek property, often called the Earl Mount prospect, lies about a mile northwest of the head of Beauty Bay in the valley of a glacial stream that flows northeastward. Several distinct quartz veins have been explored to some extent, and active prospecting was carried on by lessees in 1932-34, when over 400 feet of underground tunnels and raises were driven. This work unfortunately failed to discover ore of sufficient value to justify the erection of a mill, and the lessees' option was not taken up. Since 1934 only assessment work has been done on this ground.

*Other prospects.*—From time to time many claims, in addition to those described above, have been staked in the Nuka Bay district, particularly on Surprise, Quartz, and Beauty Bays and on North and West Arms, and varying amounts of work have been done on them. So far as could be learned, however, assessment work has been kept up only on the properties mentioned in this report.

Farther north on Kenai Peninsula in the Moose Pass-Hope district and, in fact, at intervals between Seward and Moose Pass, are small gold-lode properties at which more or less prospecting and development work were in progress for at least part of the year. Among these properties at which some productive mining was done may be mentioned the old Primrose mine, the mine of the Crown Point

<sup>10</sup> Pilgrim, E. R., op. cit., pp. 38-39.

<sup>11</sup> Idem, pp. 41-42.

Mining Co., and the Grant Lake property, all within a short distance of the Alaska Railroad, and the Lucky Strike mine and Nearhouse property, which are somewhat more remote from the railroad, though easily accessible from the excellent road that extends from Moose Pass through Hope to Palmer Creek.

In the Girdwood district, north of Turnagain Arm, the principal area in which some development of gold lodes was in progress in 1936 was near the head of Crow Creek, a tributary of Glacier Creek. The only mine in this camp is the Monarch mine of the Crow Creek Gold Corporation, under the management of H. I. Staser. The work at this mine in 1936 is reported to have been done almost exclusively in the upper level on the south vein. A winze on ore that is said to be of good grade was sunk some 30 feet below the old adit level, and drifts were turned off along the vein in both directions from its bottom. Seven men were more or less continuously employed at the property during the open season. North of the divide, at the head of Crow Creek and on the Eagle River, some distance above the mouth of Raven Creek, prospecting was in progress on a vein that carries principally lead and silver but has also some gold. This vein has been opened up by only a few open cuts, but the showings so far made apparently are highly encouraging for further development.

In the Kuskokwim Valley the only producing lode-mining area is in the vicinity of Nixon Fork, north of Berry Landing. The principal producing mine in this area is the Nixon Fork mine, operated by Mespelt & Co. Work at this mine was continued throughout the year on about the same scale as heretofore, and the value of the output of gold was about the same. Only a small crew is engaged on the property, and the general practice has been to do most of the underground work during the winter and get a sufficient stock of ore on hand to supply the mill during the open season. Then when water for milling becomes available the underground work is suspended and the men are mainly busy in the mill or in preparing for the next winter's work. The mill is equipped with 10 gravity stamps, but its capacity is limited by the small supply of water that is available in normal seasons. In 1936 the supply was so short that only a small part of the ore mined was milled.

Prospecting for gold lodes was continued at many other places throughout the Territory, though at none of them, so far as reported to the Geological Survey, was any ore mined or any gold produced except the little that may have been recovered in the course of testing the ore during development work. Among places of this sort the more significant were the Chulitna, Valdez Creek, Kantishna, McKinley, Copper River, and Bonnifield districts.

In the Chulitna district one of the most extensive projects for prospecting a large mineralized tract was in active operation during 1936. The property was visited by S. R. Capps, of the Geological Survey, who has compiled the following statements as to the general work in progress, as well as an outline of the plans of development that the operators expect will probably be put into effect as rapidly as conditions warrant.

Active development is under way on the Golden Zone property on the West Fork of the Chulitna River. The work is being done under the direction of W. E. Dunkle, who has a 50-percent interest, the other half being owned by "Partners' Mines." Fifteen men were employed on July 20, 1936. At that time a tractor road had been graded from the bars of the West Fork up to the mine, a distance of  $3\frac{1}{2}$  miles by road; a large bunk house at the mine was about completed; a power plant was installed on Bryn Mawr Creek, where 1,650 feet of 22- to 14-inch steel pipe carried water under a 350-foot head to a Pelton wheel capable of producing 200 horsepower. A 75-horsepower generator was in place, and a power line from the plant to the mine was being installed.

This small power plant was considered to be of temporary nature only, the plan being later to turn Costello Creek into Colorado Creek, with a large power plant situated in the lower canyon of Colorado Creek.

Underground developments to be started as soon as the power line was completed were to extend the old lower adit a distance of about 200 feet to cut the ore body shown in the upper tunnel. If the ore there is satisfactory, another adit 500 feet lower in altitude will be driven, and if that shows the tenor to be as anticipated a  $2\frac{1}{2}$ -mile working adit will be driven from the bars of the West Fork of the Chulitna to give a stoping height of about 1,700 feet. The manager already feels assured of several hundred thousand tons of ore carrying about \$7 to the ton and several million tons carrying \$3.50 to \$5 to the ton. It is believed that ore carrying \$3.50 a ton can be worked at a profit. Future underground work will determine whether a mill with a capacity of 100 tons a day, to mill \$7 ore, or a mill to handle 1,000 tons a day of \$3.50 ore will be installed.

A flow sheet to handle this complex ore has been worked out, as follows:

1. Log washer to get rid of gouge and natural slimes that carry \$0.50 or less to the ton.
2. Crush to one-quarter inch and jig, discarding 65 percent of mill feed, carrying \$0.55 to the ton, and saving only the sulphides.
3. Flotation to remove copper and 20 percent of the total gold, making a concentrate that will carry 15 percent copper, 10 to 35 ounces of silver and  $2\frac{1}{2}$  to 4 ounces of gold to the ton.
4. Cyanide the other sulphides, saving gold and some silver. The ore also carries  $\frac{3}{4}$  ounce of silver to the ton and 0.25 percent of copper. The principal sulphides are arsenopyrite, pyrite, sphalerite, and some galena.

In the Valdez Creek district there were several lode developments in progress, the largest of which was that of the Alaska Exploration & Mining Co. No significant amounts of gold are reported to have been produced at any of these properties during the year, and the work was carried on only during the open season. The camp was studied by Ralph Tuck, of the Alaska Railroad, and through his

courtesy and that of Colonel Ohlson, general manager of the railroad, the results of these studies have been made available to the Geological Survey and are published as a separate chapter of this volume.

In the Kantishna district the principal item of mining interest was the undertaking of development of the property long known as the Stampede claims. The ore at this place is valuable principally for its high content of antimony, consisting, as it does, of a large mass of stibnite, an antimony sulphide. The ore also, however, carries some gold, which will be recovered in the course of the metallurgical treatment to which the material will be subjected. The new work at the property was not started until late in the season, so that the production during 1936 was small, but mining was to be continued during the winter of 1936-37, and the entire production during that period will be credited to the season of 1937. The ore will be freighted during the winter to the Alaska Railroad and thence shipped to the States for treatment. The successful development of this mine would give a great impetus to mining in that part of Alaska, as well as revive interest in some of the antimony ores in other parts of the Territory. In the vicinity of Slippery Creek, on the northern foothills of the Alaska Range about due north of Mount McKinley, a crew of men was actively engaged in prospecting an extensive tract in which the results of several assays indicate the presence of large gold-bearing quartz veins of moderately low grade that appear to be capable of commercial development. The examinations have not yet been carried far enough to be regarded as conclusive, but they seem to be distinctly encouraging, though they indicate that the deposit would require large-scale development rather than the mining of small rich stringers, if it is to be mined successfully.

In the Bremner district of the Copper River region the lode prospecting that had been in progress for several years at the head of Golconda Creek encountered various difficulties, which resulted in considerable rearrangement of plans and reorganization of the company. These changes occupied much of the usual working season, so that little new work was accomplished in 1936, but it is expected that they may lead to beneficial results later. Elsewhere in the Copper River region practically no new development work was in progress, though in the McKinley Lake and Kotsina districts and near Tiekel there has been lode-mining activity in the past, and many claims are still held there, some of which may justify further exploration.

In the Bonnifield district of the Yukon region the prospecting that had been in progress during the winter of 1935-36 at the old Eva mine, near the head of California Creek, was discontinued in

midsummer, as apparently the results obtained had not been sufficiently encouraging to induce the owners to make further outlay. Some of the machinery at the mine was sold and removed, so that it is doubtful whether the property will be given another test soon. No work was done in 1936 on the lode properties farther down California Creek from which shipments of ore had been made in preceding years.

#### GOLD PLACERS

##### GENERAL CONDITIONS

Placer mining in Alaska in 1936 returned gold worth \$11,328,000. This marks a great increase in value as well as in quantity over the output of the preceding year. In fact, the quantity and value of the placer production were larger than for any other year since 1909. The annual production of placer gold and certain other data relating to Alaska's gold production are represented graphically in figure 2. From this diagram may be traced many of the changes that have taken place in the industry. Thus, in no year from the beginning of the industry in 1880 to 1898 did the production of placer gold amount to as much as \$1,000,000, and the average during that period was less than \$280,000. In 1899 there was a sudden increase, marking the discoveries of Nome and some of the camps in the upper Yukon Valley, which were soon followed by the discovery of Fairbanks and many of the other camps of the interior. The resulting golden period lasted through 1916, during which the annual yield of placer gold averaged more than \$10,000,000 and in 1906 reached the peak of nearly \$19,000,000. In 1918, after the entry of the United States into the World War, placer production dropped to about \$6,000,000, and in the 15 years from that time to 1933 it fluctuated between that amount and \$3,000,000. Since 1934, owing in part to the great increase in the price of gold and in part to the revived interest in placer mining, the value of the output has jumped to the abnormally high figure stated above.

The trend of placer mining in Alaska for the last few years has been toward the development of larger enterprises requiring the installation of expensive equipment, such as dredges or other mechanical devices, and the mining of relatively low-grade deposits through careful control of costs. Such enterprises are not undertaken casually, nor can they be made productive quickly, so that in spite of the stimulation brought about by the increased price of gold there must necessarily be a considerable lag before the larger new enterprises become noteworthy producers. Small operations, which do not require such elaborate preparations, show less lag in attaining production, and consequently many small new prospecting ventures

have already reached a stage where they are productive, and some have made good showings.

The stimulus of the high price of gold and unemployment in many businesses in the States have led many to think about turning to prospecting. To such it may not be amiss to offer the following comments. The life of the prospector has in it much that is attractive to offer to a man who enjoys the simple life, working more or less as his own boss, when, where, and how he pleases, and with the allurements of possibly discovering a real prize as a result of his efforts. Such a career obviously should be undertaken only by the physically fit and those reasonably skilled in understanding nature's secrets and the ways of acquiring what she has to offer. Many of the incidents in the life of the prospector are hard, and outstanding success comes to few in any line of endeavor; but it is believed that Alaska still holds opportunities for the capable placer prospector to find tracts that, while not bonanzas, will well repay his best endeavors. There also seems to be an increasing interest among capitalists and others in the mining development of the Territory, and doubtless, as they hold out incentives for finding workable properties, they will discover men ready and willing to undertake the quest. Anyone who remembers the difficulties of the early days and sees the present enormously better facilities and lower costs, however, has little sympathy with the laments that are often heard as to the difficulties now involved in carrying on prospecting work. It sometimes seems as if we had become so tied to automobiles, railroads, and wagon roads that we forget that the bulk of the placer gold of Alaska was produced practically without dependence on these facilities. While it is true that there are still large tracts of Alaska that have not yet been thoroughly prospected or adequately examined, it should not be forgotten that all the readily accessible parts of Alaska have been at least traversed by prospectors and hunters in the past, so that the newcomer, unless he possesses keener insight or some other qualities that these earlier searchers lacked, is not likely to have his quest for fortune rewarded by stumbling on rich deposits they missed. None of the open unworked areas appear to give promise of holding bonanza deposits that can be won easily and cheaply, but it is believed that there are extensive areas in which well-organized and well-managed companies will find placers as yet undiscovered that can be mined profitably for many years.

The season of 1936 was in general unusually favorable for placer mining, as at most of the camps there was somewhat more than the normal amount of water for the operations of sluicing, thawing ground, and the many other purposes for which water is used in placer mining. Of course, the statement that water was more than

usually plentiful does not necessarily mean that many of the placer miners had enough to satisfy them, for each plant always plans to use up to the limit of the available supply, so that in practice the plans usually exceed the amount available. The temperature conditions were also favorable for the camps to start early in the spring and continue fairly late in the fall, so that most of them had a long working season. The available working season, however, was curtailed at some of the mines because of the threatened tie-up of ocean shipping. This threat was not carried out until so late in the season that it need not have affected most of the placer operators, but as this could not be known in advance, it caused premature closing for the season at some mines. Labor in sufficient quantity was available in most of the camps, and no labor troubles of moment interrupted the operations. New enterprises were springing up in almost all the camps, and though some of them did not reach a producing stage in 1936, they give assurance of continued placer production at a high rate for many years to come. Above all, there was a healthy spirit of optimism that indicated a revival of the old desire to push mining developments.

#### 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, for it may appear in the reports of the individual and then lose its identity by being lumped with other gold by the storekeeper who took it in exchange for supplies, and still further consolidated by the bank, perhaps in some distant district, to which it was sent by the merchant, and its course perhaps still further obscured by being shipped to another bank before being turned in to the mint. Every reasonable effort has been made to check the information from different sources and to adjust discrepancies so far as possible. As a result it is believed that the figures given for the total placer production are in accord with the actual facts. The distribution of this total among the different districts, however, is open to more serious errors, as gold produced in one district, unless reported to the Geological Survey by the original producer, may be credited to some other district through which it passed in the course of trade. In spite of the possibility of some error in the distribution of placer gold among the different regions,

the following table has been prepared to show the comparative standing of the different regions as accurately as possible. It should be remembered that in this table all statements relating to the value of the gold are based on the present standard price of \$35 an ounce.

In the following table the different regions are arranged in geographic order from southeast to northwest. The largest amount of placer gold came from the Yukon Basin, and the next largest from Seward Peninsula. Placer mining in each of these main regions is discussed in some detail in the following pages, and the more notable events of the year are recorded for each region.

*Value of placer gold produced in Alaska in 1936 and 1935*

Region	1936	1935	Decrease or increase, 1936
Southeastern Alaska.....	\$5,000	\$6,000	-\$1,000
Copper River region.....	109,000	105,000	+4,000
Cook Inlet-Susitna region.....	265,000	194,000	+71,000
Yukon Basin.....	7,639,000	6,837,000	+852,000
Kuskokwim region.....	152,000	228,000	-76,000
Seward Peninsula.....	3,074,000	2,327,000	+747,000
Northwestern Alaska.....	34,000	6,000	+28,000
Total.....	11,328,000	9,703,000	+1,625,000

#### SOUTHEASTERN ALASKA.

Although southeastern Alaska is rich in lodes of gold and other metals, 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 relatively recent past by glaciers that there is an almost complete lack of deposits produced through the long-continued sorting action that is so essential for the formation of rich placers. Even along the coast there are almost no beaches where concentration has long been effective. In the lowlands of the larger streams, in some of which great amounts of detrital material have been dumped by past geologic processes, sorting action such as is conducive to the formation of rich placers has been relatively slight, and much of the material handled by the streams has not been subjected to weathering and similar processes, which unlock the mineral grains of different kinds and thus promote their separation through physical differences. There is, therefore, small likelihood that southeastern Alaska as a whole holds much promise as a placer region, though in a few places where special geologic conditions prevail there is a chance of finding placers of value.

The entire placer production from southeastern Alaska in 1936 is estimated to have been worth only \$5,000, so that even the largest operations were small camps of two or three men each, who took out only enough gold to make a very modest grubstake. There are three areas in southeastern Alaska in which, in the past, placer mining has been active—near Juneau, in the valley of the Porcupine River, and on the beaches between Lituya and Yakataga Bays. No placer mining is reported to have been in progress in the Juneau district in 1936, though a small amount of gold is said to have been recovered in the course of casual one-man operations. None of the placer claims in the Porcupine district afforded a production worthy of mention. There was, however, a revival of activity in testing some of the gravel deposits of the Klehini River, and reorganization of the company that formerly was active in the district was said to have been in progress. Plans for the early resumption of productive work by this company have been much hampered by the death of several of the associates who were aiding in financing the new operations, and by the litigation involved in changing the ownership of the property. In the Lituya-Yakataga district placer mining was continued on about the same scale as for several years. The placers there are all of the beach type, exposed to the waves of the Pacific Ocean. This position, though in a measure favorable for concentration of the beach material, is disadvantageous, because except under suitable weather conditions the placers cannot be mined, and even then the use of extensive mechanical appliances is precluded by the necessity of removing them during times of storm.

#### COPPER RIVER REGION

In the Copper River Valley there are two principal areas and one minor area that have yielded placer gold, though a few small camps are widely scattered elsewhere throughout the river basin. The principal areas, named in order of their production, are the Nizina and Chistochina districts, and the minor area is the Nelchina district. The value of the placer gold produced from the Copper River region in 1936 was \$109,000, an increase of about \$4,000 over that from the same region in 1935. The greater part of the gold from placers in the Nizina district came from the properties of the Andrus estate, on Chititu Creek and Rex Gulch, and of the Nicolai Placer Co., on Dan Creek. The latter property was operated in 1936 under lease by the Partners Mines Corporation, but work there was closed down August 19, after a short season, and the mine turned back to the owners. An average of about 17 men were employed. The work on Rex and Chititu Creeks was carried on at about the same rate as in the preceding years, and no noteworthy new developments were re-

ported. About 16 men were employed during most of the working season, which did not end until September 10. A small amount of placer gold was recovered from a few small operations elsewhere in the Nizina district. Among these may be mentioned two other mines on Rex Creek, at one of which the gold-bearing material was being taken out by underground drifting. Two small mines were worked on Copper Creek. Presumably desultory placer mining was being done in the vicinity of Monahan and Golconda Creeks, but no reports of the results of that work have been received by the Geological Survey.

At the head of Copper River, in the Chistochina district, the greatest amount of mining centered around Slate Creek and Ahtell Creek. On Slate Creek the two larger mines were those of Arne Sundt and J. M. Elmer. At the Sundt property 14 men were employed, and the season's production was very much more than in 1935, when almost the entire season was lost in repairing the damage done by earlier floods. At the Elmer property seven men were employed, but the large-scale development which has been planned was put off pending the acquisition of some additional tracts. In the vicinity of Ahtell Creek the most active camp was that conducted by G. F. Johnson on Grubstake Gulch, a small tributary of the main creek. A crew of four men was employed at this camp, and apparently the work progressed satisfactorily, although it by no means disclosed bonanza deposits. On the Middle Fork of the Chistochina River M. W. Jasper and a crew of four men were engaged in prospecting. Most of the season was spent in dead work preparatory to getting the ground in shape for another season.

In the Nelchina district, which is in the extreme western part of the Copper River region and is most conveniently approached by way of the Matanuska Valley, tributary to Cook Inlet, all the placer mining was done by a few small camps, consisting of only two or three men each. The mining centered mainly around Albert Creek, and the total production amounted to only a few thousand dollars.

#### COOK INLET-SUSITNA REGION

In the Cook Inlet-Susitna region, as the term is used in this report, are included the placer camps in Kenai Peninsula and adjacent country, the Yentna-Cache Creek district, and the Valdez Creek district, near the head of the Susitna River. In the past many of these districts have been highly productive, but their annual production has dwindled until now in most of them it is only a fraction of what it was, and in some of them only a few score miners are now at work, where formerly there were hundreds. However, a considerable amount of placer gold still comes from these camps, and in 1936 their

combined production was valued at \$265,000, or \$71,000 more than the production of the same camps in 1935. In the relative order of their placer production in 1936 these districts ranked as follows: Yentna-Cache Creek, Valdez Creek, Kenai Peninsula, and Southwestern Alaska.

In the Yentna-Cache Creek district at least 100 men were engaged in productive mining and about 20 more were doing casual prospecting and development work, which in many localities amounted to little more than that required by law to hold the claims. By far the largest producing mine in the district was that of the Peters Creek Mining Co., under the management of J. I. McDonald. This mine was equipped with a Bucyrus-Erie drag-line scraper, having a 1½-cubic-yard bucket and 60-foot boom, operated by a 200-horsepower caterpillar Diesel engine. The material being dug is about 6 to 12 feet thick and rests on a bedrock of the Tertiary coal-bearing series. The scraper dumps the gravel it has excavated into a revolving trommel, the oversize from which is carried away by a stacker, and the rest passes through slime in which the gold is caught. Mining is carried on by two shifts a day, and an exceedingly good record was made as to the amount of material handled. The property has also considerable hydraulic equipment, but this was not used in 1936, owing to a shortage of water. A little more than a mile north of the Peters Creek Mining Co.'s camp, on the north wall of the canyon of Peters Creek, hydraulicking was in progress on bench deposits that stand some 100 feet above the water level of Peters Creek and consist of 25 to 40 feet of very bouldery material. Three or four other small camps were mining on Peters Creek below the mouth of Bird Creek. Half a mile above the mouth of Bird Creek the interesting experiment was in progress of trying to break up the hard semi-indurated till in which the placer gold occurs by means of blasts of black powder instead of by slow normal disintegration and the use of hydraulic giants. While the method proved to speed up the work somewhat, it was not entirely satisfactory, as many of the large fragments did not disintegrate completely enough to release the gold they contained.

The other main center of placer-mining activity in this district was on Cache Creek and its numerous tributaries. An interesting new operation on this stream was that of the Gold Placers, Ltd. This was studied by S. R. Capps, and his account of the work in progress there is as follows:

Extensive drilling and exploration by many shafts had disclosed the presence of a body of gold-bearing gravel lying on a bedrock of glacial till at the point where Cache Creek, after leaving its canyon, begins to broaden its alluvial deposit in the valley of the Kahiltna River. The surface appearance of the deposit is like that of an alluvial fan, but drilling shows that the deposit, instead of being constructional, consists of a moderate thickness of stream gravel that lies on terraces cut in glacial morainal material. Promising

amounts of gold have been found, but the abundance of large granite boulders derived from the ancient moraine of Kahiltna Glacier makes mining difficult. Water for hydraulic mining was taken from Cache Creek through 1,900 feet of 34-inch, 2,100 feet of 16-inch, 750 feet of 15-inch, and 750 feet of 14-inch steel pipe, giving an abundant supply of water under 160-foot head to the nozzles. Two giants were being installed in the cut, and one to stack tailings. Three-foot sluice boxes with pole riffles were in place. At the time of visit (July 7) preparations to begin mining were about completed. The success of this venture will depend largely upon whether or not means can be found to handle the abundant boulders economically. About 20 men were employed.

On Dutch Creek, nearer the head of the Kahiltna Valley, the camp of the Dutch Creek Mining Co., employing 8 men, opened up a new piece of placer ground on First Creek, one of the tributaries that was reported to have been of especially high tenor, besides hydraulicking on other claims included in the company's holdings. In addition two or three other camps were prospecting in the vicinity of Bird Creek.

Southwest of the Kahiltna River, in the area usually referred to as the Fairview district but included in this report as part of the Yentna-Cache Creek district, there were several small camps doing prospecting or development work. The largest of these appears to have been that of Hamberg & Gliska on Pass Creek, where a new hydraulic plant had been put into commission that was being operated by a crew of three men.

The producing camps in the Kenai Peninsula region are situated mainly in the vicinity of Hope, Sunrise, and Girdwood. In the area near Hope and Sunrise mining was in progress at many of the old properties that have been consistent though small producers for many years. These mines are situated principally in the valleys of Resurrection Creek and its tributaries near Hope and Sixmile, Canyon, Lynx, and other creeks south of Sunrise. No notable discoveries of new placer areas are reported to have been made during 1936. Perhaps the work of most general interest is that being done by the Kenai Dredging Co. on its property on Sixmile Creek, a short distance below the forks. This company, according to S. R. Capps, has 25 claims and has acquired the machinery from the old Cache Creek dredge that was formerly in the Yentna district. From 10 to 15 men were employed in the construction of a hull on which to install this machinery, and others were busy in prospect drilling. According to current reports the ground that the company expected to mine ranges from 20 to 120 feet in depth, and it planned to construct the dredge designed to dig to a depth of 55 feet below the level of the water. Before the end of the season it was learned that work on the property had been discontinued and that late in August the machinery was still lying along the railroad track at Talkeetna. No information was available as to the future plans of the company.

In the Girdwood district, which lies north of Turnagain Arm and includes the valleys of Glacier Creek and its tributary Crow Creek, the only placer property that reported any notable production of gold was that managed by A. S. Erickson about 4 miles north of Girdwood. The placer that is being mined is a thick deposit of bench gravel on the north side of Crow Creek. A well-planned and efficiently managed hydraulic plant has been in operation here for several years and has about reached the limit of the property that can be profitably mined under existing conditions. Neither at the old Girdwood property, upstream, nor at the property on California Creek, downstream from the ground mentioned above, was any placer mining reported to have been in progress.

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. Altogether about five separate placer camps were productively mining in the district, and individuals were prospecting at other points. In addition to those engaged in work on lodes, there were about 30 miners in the district. Both hydraulic and drift placer mining was carried on at the different camps, and the output of gold from the camp in 1936 was considerably more than it has been in any of the recent preceding years. During 1936 Ralph Tuck spent considerable time in studying the mineral resources and developments in the Valdez Creek district, and a comprehensive report of his conclusions is published in a separate chapter of this bulletin. The report of Mr. Tuck should be consulted by those desiring more detailed information regarding the district.

#### YUKON REGION

The Yukon Valley embraces a tremendous extent of territory, and scattered through it from one end to the other are 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 commercial significance. 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 chief purpose of this grouping is to combine areas having in general similar interests and similar conditions and to separate those that

are dissimilar. This results in throwing some large tracts together and in splitting up some other parts of the Yukon Valley into several small districts. In some places the boundaries of the different districts almost overlap; in others the boundaries of one district lie far from those of its nearest neighbor.

The placer gold from all the camps in the Yukon Valley in 1936 had a gross value of \$7,689,000, which was \$852,000 more than in 1935, when the value was \$6,837,000. This very large increase is attributable to the especially favorable supplies of water that were available at most of the camps and to the coming into production of a number of new enterprises that had been in course of development in preceding years. It cannot be viewed as a mere temporary spurt resulting from some spectacularly rich finds, but marks rather a rate that, under reasonably expectable conditions, can be maintained, if not bettered, in the next several years.

In the following table the districts are arranged in order of their placer production in 1936, and for comparison the production from the same districts in 1935 is given. The total is believed to be correct as stated, but the distribution of this total among the districts is open to some uncertainty, owing to the great number of small producers, their wide distribution, and the failure of some of them to supply the essential information. However, every reasonable precaution has been taken to guard against serious errors and to keep the estimates in accord with all the available facts, so that the figures stated are regarded for all practical purposes as accurate and comparable with similar figures for earlier years.

*Value of placer gold produced in Yukon Basin, 1936 and 1935, by districts*

District	1936	1935	District	1936	1935
Fairbanks and Richardson	\$5,642,000	\$5,317,000	Marshall	\$72,000	\$72,000
Iditarod	546,300	458,000	Koyukuk and Chandalar	54,000	61,000
Circle	346,000	124,000	Chisana	37,500	21,000
Innoko	293,200	269,000	Kantishna and Bonnifield	15,000	21,000
Hot Springs	277,000	165,000	Eagle	17,000	20,000
Fortymile	158,500	121,000	Rampart and Fort Gibbon	11,200	8,000
Tolovana	136,300	95,000			
Ruby	83,000	85,000	Total	7,689,000	6,837,000

In the foregoing table three small districts, the Richardson, Fort Gibbon, and Chandalar, have been grouped with the nearby larger districts, Fairbanks, Rampart, and Koyukuk, respectively, and two other small districts, the Kantishna and Bonnifield, have been combined. These combinations have been made to conform with earlier reports, when it was necessary 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. It may be stated, however, that the Koyukuk and Chandalar districts produced in 1936, respectively, \$38,000 and \$16,000, and the Bonnifield and Kantishna districts produced, respectively, \$12,000 and \$3,000. None of the other small districts that have been combined with larger ones produced as much as \$5,000 in placer gold in 1936.

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

The extensive mining project being carried on by the United States Smelting, Refining & Mining Co., Fairbanks Exploration Department, embracing large tracts on Goldstream and Cleary Creeks and the Chatanika River, continued to be the outstanding placer-mining enterprise not only in the Fairbanks district but throughout the Territory. At present the work of this company may be considered to be divisible into three more or less separate enterprises that are closely knit together in their broader aspects. Two of these parts embrace the productive mining in progress on Goldstream, the Chatanika River, and Cleary Creek, and the third is the preparatory work in progress in the vicinity of Ester and Cripple Creeks. The work on Goldstream and Cleary Creeks was essentially a continuation of the dredging that had been in progress on these streams for several years. Three modern dredges were engaged in this work on Goldstream and two in the Chatanika River and Cleary Creek area, and both projects were supplied mainly by a long ditch line that picked up its water far up the Chatanika River and led it by ditches, flumes, and gigantic siphons to the areas where it was put to work. During 1936 at one of the dredging areas on Goldstream the work had been carried so far that the dredge that had been used there could be released for other purposes. As a conse-

quence, late in the season this dredge was dismantled so that it could be moved to a new site of operations on Ester Creek. The moving and reconstruction will be carried on as rapidly as required, so that the dredge can be put into commission again and begin its new service early in 1937.

Reference to the Goldstream and Cleary areas as being the producing areas should not be understood as meaning that preparatory work is not in progress there also. It takes at least 3 years to prepare a tract for dredging, as the surface vegetation must be taken off, the overburden thawed and disposed of, and the frost in the gold-bearing gravel thoroughly removed before it can be excavated. All these processes are going on simultaneously in different parts of these so-called producing areas.

In addition to the preparatory work for dredging operations in the Chatanika Valley, the Fairbanks Exploration Department started examinations of some of the deeper gravel farther west, down the Chatanika Valley. These deposits were being explored by a vertical shaft, from the bottom of which drifts were to be run in different directions. Determination of the tenor of the gravel was to be made by running all of the material from the section in which pay might occur through regular controllable sluice boxes instead of relying on panning small samples, as is the usual practice. This work had not progressed far enough to show what the conditions are, and consequently no plans for the development of the gravel have been announced.

In the area in the vicinity of Ester and Cripple Creeks only preparatory work is still in progress, as even after 2 years of preparatory work several million yards of overburden must still be removed before a dredge can be effectively utilized. It will probably be 1937 before productive mining on any significant scale will be undertaken in this area, and 1938 before the large new dredge that the company proposes to build for mining the deep ground is constructed. The great thickness of the gravel in places and its complex composition raise many technical problems which must be taken care of in designing the large new dredge. As noted in a preceding paragraph, one of the dredges from the company's ground on Goldstream was to be moved to the Ester Creek area during the winter of 1936-37, so as to be in readiness for mining in the headward portion of Ester Creek early in 1937. Water for most of the development work in the entire project is pumped from Chena Slough to a nearby high-line ditch by which the water is distributed to the different parts of the area. This new work in the Ester-Cripple Creek area will greatly prolong the operations of this company in the Fairbanks district and thus give added assurance of the stability, not only of the mining industry in

this camp but also of all forms of business activity in the contiguous country and, in fact, throughout much of interior Alaska.

East of the main mining area adjacent to Fairbanks are a number of small camps at intervals all the way to Richardson and south of that old settlement, including parts of Jarvis Creek and other tributaries of the Big Delta, south of the Tanana River. In years gone by the Richardson or Tenderfoot camp had a rather large placer production, but at present there are not half a dozen men mining in that district. Therefore, the use of its name in combination with Fairbanks in this report is not so much to designate two separate camps as to indicate a single ill-defined area between Fairbanks on the west and Richardson on the east. Thus between what may be called the real Fairbanks district and the Richardson district gold was taken out by fairly large camps on Big Chena, during at least part of the open season, as well as by small camps on the Salcha River and its tributaries. No information has been furnished to the Geological Survey as to the placer mining south of Richardson in the valley of Big Delta and its tributaries. However, from current reports it appears probable that only a few prospectors were in that region and that such work as they did was mainly prospecting or preliminary development work.

The placer camps in the Iditarod district, in the west-central part of the Yukon region, retained their standing of 1935 as being the second most productive in the region. The production from this district in 1936 is estimated to have been \$546,300, or nearly \$90,000 more than in 1935. This increase is attributable to an especially abundant water supply for sluicing and to the coming into full production of several plants using extensive mechanical equipment. Altogether there were between 125 and 150 men engaged in placer mining in the district, besides a score or more who are engaged in prospecting and related work that did not yield any notable amount of gold. As in the past, the largest amount of gold recovered in the district was obtained by two dredges—that of the J. E. Riley Investment Co. and that of the North American Dredging Co. Both these dredges are operating almost in the town of Flat. In fact, several buildings were moved out of the way of the dredge of the North American Dredging Co., and the other dredge was on Otter Creek, only half a mile from the town. In addition to the dredges there were at least a dozen other outfits on Otter Creek and its tributaries, on Willow Creek, and on tributaries of Bonanza Creek that recovered considerable amounts of gold, and a score of smaller camps in the same area that furnished smaller amounts. At most of the large mines mechanical shovels or power-operated scrapers of one type or another were used, but at several others mining was done by hydraulic methods, and at a few only

hand labor of shoveling in was employed. At most of the smaller mines the work was done by simple hydraulicking or hand methods. Among the larger producers of placer gold in this district, by methods other than dredging, may be mentioned the following: The Northland Development Co. on Willow Creek, which employed 12 men and was mining bench placers with a bulldozer and stacking tailings with a dragline scraper and pumping water from a sump by means of a caterpillar Diesel engine; the mine operated by Pete Jensen, which is on Willow Creek a short distance below that of the Northland Development Co. and is equipped with a dragline scraper working on a 100-foot boom; the property of Olson & Co. on Happy Creek, a tributary of Willow Creek, which employed a crew of 12 men and mined with a bulldozer and two dragline scrapers; the property of Peter Miscovich on Otter Creek, at which 10 men were employed and two bulldozer and the three others piping into sluice boxes; and Uotila & Scott, and Stuver Bros., all four near the head of Flat Creek and each employing crews of about 4 men, the first-named mining with a bulldozer and the three others piping into sluice boxes; and Uotila & Ogris, on Slate Creek, where a crew of 12 men were employed and the equipment consisted of a bulldozer and dragline.

Of all the districts in the Yukon region the Circle district showed the greatest percentage of increase in placer-gold output in 1936 over that of 1935, comparative figures for the two years being, respectively, \$346,000 and \$124,000. In quantity of output, as well, the Circle district showed a remarkable increase, being outstripped in actual amount of increase only by the Fairbanks district and in 1936 ranking as the third district in the Yukon region in the total value of its placer-gold production. By far the larger part of the increase is to be attributed to the commencing of mining by two dredges—one on Coal Creek, belonging to the Gold Placers, Inc., and the other on Mammoth Creek, belonging to the Berry Dredging Co. The dredge on Coal Creek was in operation practically throughout the season, and though it encountered some of the difficulties experienced in any new enterprise, it proved to be capable of performing even better than had been expected. The dredge on Mammoth Creek was in course of construction throughout most of the season and was not completed in time to engage in productive mining for more than a short time before the season ended. It should therefore show a marked increase in production when in continuous operation. The success of the Coal Creek project led to the start on building another dredge on Woodchopper Creek, where the geologic conditions are comparable with those on Coal Creek. This project is being carried on by Alluvial Golds, Inc., but the dredge will not be ready for mining before 1937. It is reported that the Deadwood Mining Co. has ordered a

new dredge for installation on the company's property on Deadwood Creek, but delivery and construction of this dredge will not be undertaken until 1937. In addition to these dredging operations, there were more than a score of camps in the Circle district that were hydraulicking or using other methods of mining. Most of these camps were visited by J. B. Mertie, Jr., of the Geological Survey, in 1936, and a report of his investigations is published as a separate chapter of this volume, so that further statements as to the year's activities in the district may be dispensed with here except to state that, as has been the condition for several years, the bulk of the production from camps other than the dredges came from mines on Mastodon, Miller, Switch, Deadwood, Eagle, Harrison, and Porcupine Creeks, with smaller amounts from Ketchem, Portage, and Bottom Dollar Creeks, and some prospecting was done on at least half a dozen other creeks in the district.

Detailed reports from the Innoko district were far less complete than from many of the other camps in the Yukon region, but general information shows that it somewhat bettered its output of placer gold of the preceding year, as in 1936 the district is estimated to have produced \$293,200, against \$269,000 in 1935. Here, as in most of the other districts in which dredging is active, the largest amount of gold was recovered by this method of mining. Four dredges contributed to this total—two on Ganes Creek and one each on Yankee and Little Creeks. In addition there were one or more outfits on Ganes, Ophir, Little, Spruce, Spaulding, Anvil, and Esperanto Creeks and Victor Gulch, in what is known locally as the Ophir district, and several others in the so-called Cripple Creek district, which lies somewhat to the northeast of these camps. At most of these other properties little mechanical equipment has been used in the past, most of the mining having been done by hydraulicking or hand methods. At the property of the Cripple Creek Mining Co. and that of Vibe & Schwaesdall, on Spaulding Creek, draglines have been installed, and the adoption of more effective equipment is in contemplation for several of the other properties. The difficulty of transportation to areas as remote as many parts of the Innoko district has doubtless retarded many large-scale developments that might otherwise have been undertaken. The extensive use of the airplane is, however, now overcoming some of that handicap, and an even greater use of this facility will doubtless aid in opening up that area. Already the Cripple Creek Mining Co. has built its own flying field and brings in many of its supplies by airplane. The extension of roads and trails would also be extremely beneficial in reducing transportation costs in the remote parts of the district.

The Hot Springs district, as the term is here used, consists of two rather widely separated tracts—one including the western part of the

district from Tofty to Woodchopper Creek and extending as far west as American Creek, the other including the eastern part, which centers around Eureka Creek and is locally referred to as the Eureka Creek district. The district showed a remarkable increase in production in 1936 over that of 1935. This was brought about not only by the continued successful operation of the dredge of the American Creek Operating Co. and the modern dragline scraper of the Cleary Hill Mines Co. in the Sullivan Creek Valley, but also by the general stimulation of activity and output by the smaller operators, many of whom were able to step up their output materially because of the somewhat higher than usual tenor of the ground mined. Besides the dredge and scraper already mentioned as mining in the Tofty area, the largest amount of work in progress was that of Albrecht & Hanson and Bock & Co., but smaller camps were working on American and Boulder Creeks. In the Eureka Creek area some difficulty was experienced through shortage of water. The principal production of placer gold from the area came from Glen Gulch, but considerable quantities of placer gold were also recovered from the deposits on Pioneer and Rhode Island Creeks, Eureka Creek and its benches, and Chicago, Thanksgiving, and Omega Creeks. There were several prospectors at other places throughout the district, and undoubtedly in the aggregate their finds swelled the total, though individually some of them got only small amounts.

In the Fortymile district the exceedingly good showing made in 1935 was bettered by the output of placer gold in 1936, when \$158,500 was produced, against \$121,000 in the earlier year. In the main this increase is to be attributed to the output of three dredges. The full capacity of these dredges was not realized, because two of them were not completed until after the season had become well advanced and so had only a short working period, and even then they experienced some of the unavoidable difficulties that occur in starting up almost any new enterprise. Between 45 and 50 outfits, most of which were small and employed only 1 or 2 men each, were mining, in addition to the dredges. Many of these camps, as well as other parts of the Fortymile district, were visited by J. B. Mertie, Jr., of the Geological Survey, during the season of 1936, and his report of the results of those studies is published as a separate chapter of this volume, so that further details regarding the work in the district may be omitted here.

The Tolovana district, as the name is used in this report, embraces a considerable tract of country lying north and northwest of Fairbanks. It has long been difficult to reach, except by airplane or by a circuitous, time-consuming journey, but the construction of a road connecting it with Fairbanks, which is fast becoming available for travel in all weathers, will doubtless aid much in its develop-

ment, as well as open up some of the intervening tracts. The output of placer gold in 1936 was considerably larger than in 1935—an increase that may be in part attributed to the fact that in 1935 the shortage of water caused the output of placer gold to be considerably less than the normal amount. Much of the current production of placer gold from the Tolovana district is obtained by drift mining, though there are shallow diggings, especially adjacent to the Tolovana River. The occurrence of deep placers that give employment throughout the year has a very stabilizing effect on the camp as a whole, though the difficulty of getting sufficient water often necessitates leaving the gold-bearing dumps unsluiced for more than a year. According to the reports received by the Geological Survey, the largest amounts of placer gold recovered in 1936 were mined by the following operators: On Livengood Creek, W. G. Mahan, Spall & Livengood, Tony Barry, Silva & Co.; on Gertrude Creek, the Glen Gulch Mining Co.; on Olive Creek, N. R. Hudson; on Lillian Creek, Nick Mandich. In addition to these larger producers, smaller camps were mining on many of these same creeks, as well as on Amy, Ruth, and Wilbur Creeks. Revival of the hope that further tests of the extensive tract in the Livengood Valley that had been hitherto examined as an area that could be mined by dredge might disclose new facts that would lead to development was aroused by the undertaking of further drilling of the tract. This work was not started until late in September, and no public announcement has yet been made as to the results obtained, so that the decision is being anxiously awaited, as the successful undertaking of a major project such as this would have a very vital effect on the general welfare of the camp.

The Ruby district, as described in this report, is a rather ill defined area extending southward from the settlement at Ruby, on the Yukon, for 50 to 60 miles to include the settlement of Poorman and the various camps adjacent thereto. By far the larger part of the production from this district is recovered by drift mining, which is done mostly during the winter, and the dumps are sluiced during the following open season when water is available. There are two principal centers of mining activity in the district—one near Long, about 25 miles south of Ruby, and the other near Poorman, some 25 miles farther south. According to the information available to the Geological Survey, in the area near Long there were two drift mines and one summer camp in operation on Long Creek which appear to have had an especially profitable season. Also in the Long area there was one drift mine on Birch Creek, a tributary of Flint Creek, and one summer mine on Greenstone Creek. Much interest is displayed in the fact that leases have been negotiated for

a strong company to start extensive operations on Long Creek next season. It is proposed that that work shall be done by means of dragline equipment and bulldozer. In the area adjacent to Poorman about 10 outfits were engaged in drift mining and 2 in summer work on Poorman Creek or its tributaries, Flat and Moose Creeks, and on Spruce Creek, a tributary of the Sulatna River. Small camps of one or two men each were prospecting at various places in the district. One of the most prominent residents of the district and one in close touch with all the activities there is quoted as saying that one of the most encouraging guaranties for continued mining growth he had noticed lately was the number of young men who were out in the hills of the district prospecting.

The production of placer gold from the Marshall district in 1936 is estimated to have been identical in value with that produced in the preceding year. It is rather remarkable that the high rate of production established in 1935 was maintained, for in that year the camps in the Marshall district showed the greatest percentage of increase of all the Alaska placer districts. The Marshall district, as the name is used in this report, includes practically all of the western part of the Yukon Valley below Holy Cross and is somewhat more inclusive than the so-called Wade Hampton recording precinct. In this large area there is relatively little placer mining or prospecting, and this was more or less localized at two points—one near Marshall and the other in the Stuyahok or Bonasila Valley. The greatest production came from Willow Creek, to the east of Marshall settlement, and the largest camp on this stream was that of Johnston & Ostnes, as laymen, using hydraulic methods. Ten men were employed on this property during the summer. Also in the vicinity of Marshall some mining was done on Montezuma Creek, where two men were employed most of the summer. About 50 miles northeast of Marshall, but still considered in the Marshall district, in the valley of Flat Creek, which is a tributary of the Stuyahok River, itself a tributary of the Bonasila River, new owners took over the property that had been mined to some extent in earlier years, and adopted a new plan for working the ground. This plan called for the abandonment of the hydraulic lift formerly used and its replacement by a dragline which scraped the pay gravel into sluice boxes mounted on a movable trestle. The overburden was removed by hydraulicking and stripping, with a bulldozer. About 12 men were employed, and the work, which was not started until August, was continued into early October.

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 subordi-

nate areas are the Indian Creek-Hughes area, in the central part of the Koyukuk Valley; the Hogatza River area, somewhat north of Hughes and embracing country north of the Koyukuk River; and the upper Koyukuk area, which includes that part of the Koyukuk Valley lying north and northeast of Bettles and the country near Wiseman. Though practically no productive mining was in progress in the Indian Creek area, L. McGee, formerly of the Star Airways, in Anchorage, with a crew of 12 men, spent much of the open season in prospecting his holdings on Utopia Creek, which is a tributary of Indian Creek, as well as at other points both in the valley of the main stream and in the valley of the Hogatza River. The deposit is reported to carry workable amounts of gold and apparently should not be difficult to mine, as it contains no boulders that cannot be readily rolled out of the way by hand. Present plans contemplate using a dragline scraper and bringing the needed water from a nearby source through a short ditch.

The production in 1936 from the camps in the northern part of the Koyukuk Valley was about the same in quantity as in 1935. The bulk of the production seems to have centered around Nolan Creek and its tributaries, especially Archibald Creek, both of which are about 8 miles northwest of Wiseman. Among the other streams on which there were productive mining camps were the Hammond River, Wakeup, Smith, Vermont, and Myrtle Creeks, the Wild River, the South Fork of the Koyukuk River, the Bettles River, and Sheep and Porcupine Creeks. More meager grubstakes are reported to have come from a number of one- or two-man camps at half a dozen or more places through this vast northland tract. The remoteness of this district, its short season, and the poor transportation facilities, except by air, necessarily increase greatly the difficulties and costs of mining, so that its deposits have by no means been given the thorough examination they otherwise would have received.

In the table on page 45 the production of placer gold in the Chandalar district is combined with that of the Koyukuk, because in earlier years there were not three placer producers in the Chandalar, and to state the output from the district would have disclosed confidential information. In 1935 and 1936, however, there were three or more producers in the Chandalar, so that it has now become permissible to state the placer production of the district, but in order that the table might be comparable with those of earlier years, the combination has been retained here. The production from the Chandalar district is estimated to have been \$16,000 in 1936, as against \$18,000 in 1935. The largest production in the Chandalar district is reported to have come from Little Squaw Creek, where there are two mines, one operated by Manuel Mello and the other by Carlson &

Buckley. The second most productive stream was Tobin Creek, where work was done by Ellis Anderson. A smaller amount of placer gold was recovered from property on Big Creek, mined by A. L. Newton. All the properties except the one on Big Creek are reported to be developed as drift mines.

Reports from the Chisana district, locally called Shushanna, indicate that the season of 1936 was generally regarded as better than the average. This seems to have been due not so much to any single new development as to the general revival of activity throughout the district. Altogether some 20 men were engaged in placer mining or prospecting, and mining was carried on in at least 5 separate sites. The largest camp was that of the Nelson Mining Co. on Bonanza Creek, which employed five or more men through a large part of the season. A new hydraulic plant mining bench ground on the left limit of Bonanza Creek is reported to have had a short but successful season. Mining is also reported to have been in progress at other camps on Bonanza and Little Eldorado Creeks and on Discovery Gulch, a small tributary of Gold Run Creek.

The placer-gold production of the Eagle district in 1936 was practically the same in value and amount as that of the preceding year, and came from essentially the same general areas. From 10 to 15 camps were mining in the district, and of these the largest producers were R. A. Bauer, on Fourth of July Creek; A. L. Hagen, on Crooked Creek; and R. L. Steele, on Fox Creek. In addition, mining was also in progress at camps on Broken Neck, Barney, Nugget, Alder, Mission, and American Creeks and at some of the bar diggings on the Seventymile River. In the course of the open season the various mining areas in the Eagle district were visited by J. B. Mertie, Jr., of the Geological Survey, and a report of the results of his investigations there, as well as in other districts in the eastern part of the Yukon region in Alaska, is published as a separate chapter of this volume.

Placer mining in the Bonnifield district showed a somewhat smaller production in 1936 than in the preceding year, but that is perhaps to be explained in part by the fact that the production in 1935 was rather more than the average. Practically all of the mining that is now being carried on is done by one- or two-man camps, and the deposits are shallow, so that simple open-cut methods are used without the help of mechanical devices. In the past some drift mining has been done. According to the reports received by the Geological Survey, eight camps did some productive mining in 1936, though at many of them the receipts were little more than extremely modest grubstakes. The three largest producers who have reported their output to the Geological Survey were Nels Giske, on Portage Creek;

C. W. Holt, on Grizzly Creek; and James Muir, on Marguerite Creek. In addition, other productive camps, some of which did not report their output, were working on Moose, Eva, Platte, and Homestake Creeks.

In the Kantishna district placer mining was almost at a standstill, according to such information as the Geological Survey has received. The output in 1936 was valued at only a few thousand dollars and was recovered by individuals working at only a few places in the district, each of whom took out only a few hundred dollars. So far as the Geological Survey is informed, the streams on which this mining was done were Eureka, Yellow, and Crooked Creeks, though doubtless there were small camps on other streams whose activities were not reported.

Reports from the Rampart district indicate that placer mining there was continued at about the same rate and at the same places as in the immediately preceding years and that at most of the camps the returns had amounted to little more than exceedingly modest grubstakes. The largest amount of gold appears to have come from properties on Little Minook Creek and in the vicinity of that stream. Considerable difficulty was experienced, owing to the small amount of water available on account of the light rainfall in the neighborhood. Several new prospectors are said to have gone into the Troublesome Creek and Mike Hess areas during the summer, which indicates a revival of activity there that may lead to productive developments another season. In the area lying west and north of the town of Tanana and forming part of the Fort Gibbon precinct, which for convenience has been grouped in this report with the Rampart district, there are several places which in the past have afforded in the aggregate considerable placer gold. At one of these properties, on Grant Creek, a revival of mining activity was shown in 1936, which resulted in placing the camp again among the list of producers. It is understood that plans are being perfected not only for continuing the present work at this property, but also, if adequate finances can be arranged, to expand it by installing mechanical equipment to enable the lower-grade deposits to be mined cheaply.

#### KUSKOKWIM REGION

Included in the Kuskokwim region are four principal districts where gold placers were mined in 1936. For convenience of description they may be called the Mount McKinley, Georgetown, Tuluksak-Aniak, and Goodnews Bay districts. The Mount McKinley district, as the term is here used, 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 the settlement of Georgetown, on the Kuskokwim, about 45 miles in an air line south of Iditarod, is situated near the center of the southern border of the district. Although lying in the Kuskokwim drainage basin, the district has closer affiliation with the Iditarod district, to which it has better transportation facilities than to any of the Kuskokwim points. The Tuluksak-Aniak district is named from two rivers that traverse parts of it; the Tuluksak enters the Kuskokwim from the south some distance east of the settlement of Bethel, and the Aniak enters the Kuskokwim about 50 miles still farther upstream, to the east. Goodnews Bay is a small indentation of the coast on the east side of Kuskokwim Bay, about 125 miles in an air line south of Bethel.

The production of placer gold in the Kuskokwim region in 1936 is estimated at \$152,000. Considering the enormous area of the Kuskokwim region, the amount of the present production is extremely small, but when it is remembered that there are probably less than 100 white miners in the whole region, that their activities are much handicapped by their remoteness from supplies, and that their expenses are consequently large and their funds small, the wonder is that the production is as much as it is. From such geologic information as is available regarding the Kuskokwim region, it seems certain that there are areas in this region that well deserve more intensive investigation and that there is a fair probability that close examination and intelligent prospecting in the vast, totally unexplored areas that fall within its confines might disclose not only workable gold placers but also other valuable mineral deposits.

In the Mount McKinley district in 1936, as in the past, there were three main areas in which placer mining was in progress. One of these is the Moore Creek area, which lies about 50 miles southwest of McGrath and is near the head of the Takotna River Valley. On Moore Creek one camp, which was the largest in the entire district, was hydraulicking and was reported to have had a somewhat better than normal season. The second area includes Candle Creek, which is a tributary of the Takotna River and lies just west of McGrath. On Candle Creek, about 8 miles in an air line from McGrath, one camp employing 4 men was active, hydraulicking throughout the open season. The third area in the Mount McKinley district lies to the east of McGrath and embraces the valleys of a number of small streams north of Medfra, including Hidden and Ruby Creeks and Holmes Gulch. No direct information has been received by the Geological Survey as to the season's work on any of these streams, but apparently there was very little mining in progress, and the production from the whole area was apparently very small, amounting, at most, to a few thousand dollars.

Placer mining in the Georgetown district in 1936 appears to have been restricted to Donlin and Julian Creeks. The mineralized areas on these streams lie only about 25 miles south of the town of Flat, in the Iditarod district, and as they are reached most easily from that district, they might really be considered as outliers of the Iditarod deposits. They are about 25 miles in an air line respectively northwest and north of Georgetown, on the Kuskokwim. The principal producing camp was apparently one on Julian Creek, but no details as to the work in progress there have been received by the Geological Survey, though apparently mining was carried on at about the same rate and at the same places as in recent years. South of Georgetown, in the valley of the Holitna River, repeated reports of finds of rich placer ground have frequently aroused a flurry of more than local interest. The remoteness of that area and the report that many of the deposits in the likely-looking areas were too wet to be prospected by ordinary hand methods have discouraged adequate examination. The availability now of light prospecting drills and of airplane transportation should remove some of these handicaps and lead to more thorough prospecting. The region has not been surveyed by the Geological Survey, so that any statement as to the likelihood of finding worth-while placer deposits in it must rest mainly on long-range speculation and conjecture. It seems likely, from what is known of the geologic character of adjacent areas, that parts of the country south of the Kuskokwim and including some of the valley of the Holitna River may contain intrusive rocks that may have induced mineralization and, if so, that in the vicinity of their contacts with other rocks there are good places to prospect for stream concentrations that might yield workable placers.

In the Tuluksak-Aniak district the bulk of the placer gold produced in 1936 came from the property of the New York-Alaska Gold Dredging Corporation on Bear Creek, where one dredge was in operation during most of the open season. In addition to the productive work, the company did considerable prospecting and development work and perfecting of plans for new and enlarged operations during 1937 on its claims farther west, on the Tuluksak River. These plans include bringing in parts of a new dredge during the winter and supplementing these by parts from the company's old larger dredge, which will thus be more or less completely dismantled. The new dredge will have buckets capable of handling about 5 cubic feet each. The small dredge now in use, which was built in 1935, has buckets rated at a capacity of  $1\frac{1}{2}$  cubic feet and has proved very satisfactory in operation. The supply center for operations at this property is at Bethel, and the long circuitous route necessarily followed in bringing in supplies overland from that place has led the company to utilize airplanes almost exclusively for its freighting.

As a result a large saving in time and cost has been effected, as it is said that the freight from Bethel is delivered at the mine for about \$40 a ton and that the trip takes only about half an hour.

Next in volume to the dredge production in the Tuluksak-Aniak district was the output from the hydraulic and open-cut mines. The largest of these are on Canyon and Marvel Creeks. Canyon Creek is a small tributary of the Kwethluk River, which in turn is a tributary of the Kuskokwim, a short distance west of the settlement of Akiak. Marvel Creek is a tributary of the Salmon River, which flows into the Aniak River, and that stream in turn joins the Kuskokwim about 75 miles in an air line northeast of Akiak. The principal property on Canyon Creek was that of Kvamme & Co., under the management of Andersen Bros., and the one on Marvel Creek was operated by Dahl & Wilson for Luther C. Hess. Several other small outfits of a few men each are reported to have been working on some of the other streams that head in the same general group of hills, which, for want of a specific name, may be referred to as "Marvel Dome and vicinity." No detailed reports from any of these smaller camps have been received by the Geological Survey, and apparently they recovered only a little gold.

In the Goodnews Bay region the prospectors lately have been so much more interested in the search for platinum placers and their efforts have been so much better repaid that the search for gold placers and their development have been more or less abandoned. However, in 1936 there was a considerable revival of interest in gold mining, and small outputs were reported from Fox Gulch (a tributary of Slate Creek), Butte Creek, and the Goodnews River. Considerable prospecting was in progress in the vicinity of the headward portion of Slate Creek and on Malaria Creek, a tributary of Granite Creek. Bradford & Associates were reported to have taken in a hydraulic outfit for installation on ground they had acquired on the Arolic River. The equipment for this enterprise was not brought in early enough to be set up and put into operation until late in the season, so that it was in use only a short time. During the winter many rumors were current as to rich strikes having been made in the Arolic area, and for a while it appeared that a mild stampede was in progress. The early accounts appear to have been much exaggerated, but reliable information as to the real conditions must await another season. It should be realized by any inexperienced person who contemplates going to the district that it is a difficult country to prospect and would probably require the use of drilling equipment; that it is almost entirely undeveloped, so that facilities for transportation and supplies are meager or remote; and that its physical character is such as to call for knowledge of and adaptability to pioneer conditions.

## SEWARD PENINSULA

The production of placer gold from Seward Peninsula in 1936 is estimated at \$3,074,000, or nearly \$750,000 more than in 1935. This large increase cannot be attributed to any single cause, nor were the general conditions in 1936 so favorable that they may not be repeated in the succeeding years. It is true that the water supply and general climatic conditions were rather above normal in 1936, but so they were in 1935. The real explanation of the increase must be found in the fact that in practically every district throughout Seward Peninsula there were new enterprises under way and increased interest in mining, which led to the undertaking of new projects of various degrees of magnitude, from that of the humblest pick-and-shovel worker to expensive dredges. So that, while temporary fluctuation in production must inevitably be forecast, it seems likely that for some time to come the general trend of production from the placer camps of the peninsula is not likely to fall far below the present rate and may well rise considerably above that level.

A large part of the gold recovered from Seward Peninsula placers is mined by dredges. In 1936 gold worth \$2,618,000, or slightly more than 85 percent of the placer output of the peninsula, was mined by 20 dredges, one or more of which was active in practically every one of the larger districts of the peninsula. Additional data regarding dredge mining in this and other parts of Alaska are given on pages 68-73.

In the relative order of their output of placer gold in 1936 the mining districts of Seward Peninsula stood as follows: Nome, Fairhaven (including the Candle, Inmachuk, and Bear Creek areas), Kougarak, Port Clarence, Council, Solomon (including the Casadepaga River region), Bluff, and the Koyuk River region (including the areas adjacent to and east of the head of Norton Sound). 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 individuals.

The outstanding placer enterprise in the Nome district, as well as in the whole of Seward Peninsula, and the second largest in the Territory continues to be that of the Hammon Consolidated Gold Fields, with its three dredges in the valley of the Snake River and tributaries near Nome, its extensive ditches, some of which are more than 20 miles long, and its other equipment for properly conducting its work. Some discussion of the situation at this property is given on page 70. This whole property in 1936 was operating at near a capacity load during most of the season, not only in excavating the pay gravel but in the necessary preparatory work on adjacent tracts, so

that the dredges would be able to work uninterruptedly when a year or more later they were ready to mine those particular tracts. The complex interrelation between the many diverse processes that must smoothly mesh together if the enterprise is to function efficiently has called for high engineering talent and resourcefulness and a capable and alert field personnel, all of which the company has had to a marked degree.

Three other dredging companies were operating in the Nome district in the season of 1936—the Alaska Sunset Mines Co., on Sunset Creek; the Dry Creek Dredging Co., on Dry Creek; and the Greenstone Mines Co., near the junction of St. Michael and Osborne Creeks. There were also open-cut and hydraulic mines on many of the creeks around Nome. Perhaps the most productive area for this sort of mining was in that centering around Anvil Peak and including the headward portions of Dry and Dexter Creeks and of the tributaries to Anvil Creek. On the northwestern slopes of Anvil Peak a number of old high-line channels, presumably marking the earlier course of Anvil Creek and its tributaries, have been opened up and found in places to carry considerable gold. Some of the successive stages in the history of these old channels have been determined by the facts disclosed in these mines, which reveal an astonishingly intricate history of the region. The entire sequence of events connected with these changes has by no means been deciphered, and further intensive study of the field relations should be of great significance, not only theoretically, but also in directing more profitable search for these old channels, some of which seem to carry considerable pay gravel. Altogether within a radius of 20 miles of Nome there were nearly a score of small camps engaged in placer mining. According to current reports more men were engaged in prospecting than there had been for several years, and there was practically no unemployment among any of the whites who were physically fit to work.

The placer gold mined in the Fairhaven district comes from three main tracts—Candle Creek, the Inmachuk River, and Bear Creek. Altogether more than 100 men were employed on different mining properties in this district in 1936. Candle Creek is a large tributary of the Kiwalik River from the west, close to the town of Candle. The principal mining operation in this part of the district is that of the Arctic Circle Exploration, Inc. This company has acquired extensive tracts along Candle Creek, which include not only the lowlands along the creek but also bench gravel high on the valley slopes. The different types of deposits necessarily must be mined by different methods, so that both dredging and hydraulicking are resorted to. The dredge for much of the season was mining the gravel at

the mouth of Candle Creek, practically up to the houses in the town. Early in the season the dredge had been moved across the Kiwalik River to test the gravel deposits in the lowland east of that river, but their gold tenor evidently had not proved as attractive as that of the other ground, so the dredge had been brought back to the west side of the river. Much of the ground to be excavated by the dredge in the northern part of Candle Creek is frozen, so that an extensive cold-water thawing system similar to that in use in the Fairbanks and Nome areas was in operation. An extensive area of bench ground on the west slope of the Candle Creek Valley had been stripped and hydraulicked as water was available, but at the time of the writer's visit in August work there had been discontinued. Besides the large company, there are several small camps scattered in the area not far from Candle. On Jump Creek the camps of French and others and Smith & Shane are said to have had an especially favorable season. Farther from 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. A little mining was also being done on the Kugruk River.

In the Inmachuk Valley, which lies some 30 to 40 miles west of Candle, one of the principal producers was the Forsgren Dredging Co., which is mining with a small dredge a short distance south of Deering. This is a dredge that has been remodeled from time to time and is said to be giving very satisfactory service for its size. Farther upstream in the Inmachuk Valley, on the Purnell River a short distance above the junction of these two streams, the property that has been in litigation for the last several years was again in operation under an order from the court. Necessarily, the task of reopening the property, which had lain idle in 1935, and of handling it under the required arrangements led to delays and difficulties, which prevented production at as high a rate as in some former years. In spite of these handicaps, a large amount of gold was recovered as a result of the season's work. Several small hydraulic plants were established on other nearby creeks. The largest of these—that of Hoogendorn on Discovery Creek and a camp on Humboldt Creek—are understood to have had a fairly successful season.

The third tract in which placers were mined in the Fairhaven district includes Bear Creek and adjacent areas on the eastern flank of hills that form the divide between the Buckland and Kiwalik Rivers. The largest production from this area was that reported to have been mined by hydraulicking from a claim on Bear Creek,

leased to Wallace Porter. Seven men were employed at this mine, and it was not necessary to discontinue work there until the first of October. Altogether this area seems to have had a somewhat larger production of gold in 1936 than it has averaged in recent years.

The season of 1936 set a high record for recent years in the output of placer gold from the Kougarok district, in central Seward Peninsula. This was due to unusual activity in all types of mining in the district, but, as in so many other camps, dredging accounted for the greater part of the output. Two dredges were in operation in the district, but of these only one, that of the Fox Bar Dredging Co., under the management of C. B. White, was mining throughout the open season. The other dredge, that of the Kougarok Consolidated Placers, Inc., under the management of Carl Halberg, was a new one that was built during the summer and not put into commission until September 3. The remarkably short time taken in transporting the materials from Davidson Landing to the junction of the Kougarok River and Henry Creek, where the dredge was to start work, and the rapidity of assembling and constructing the parts and putting the dredge into operation indicate the efficiency with which each step of the difficult program was carried out. The dredge is reported to be of the pontoon type and has buckets rated as having a capacity of  $2\frac{1}{2}$  cubic feet. The bucket line is close-connected, and the power for it and the other mechanical devices used on the dredge will be furnished by two 68-horsepower Diesel engines. Hydraulic mining is also said to have been in progress at several places, both in the Dahl Creek area near Coffee Dome and farther north along the valley of the Kougarok and its tributaries and even north of the divide of that basin in the valley of Dick Creek. At most of these properties simple open-cut methods of mining were used, and few of them had any extensive mechanical equipment. A notable exception to this statement is that of the Grant Mining Co., which, under lease from the Coffee Creek Mining Co., was stripping and developing a tract on Coffee Creek by means of a Bagley scraper and two pressure pumps. Work at this property was rather restricted to putting it into condition for more extended operation another year. A camp of half a dozen men was mining near Buzzard Gulch a short distance west of Goose Creek, on the western slopes of the valley of the Noxapaga River. Water for this work was being supplied by a small pressure pump.

South of what is locally known as the Kougarok district, but included in that district for statistical purposes in this report, in the vicinity of Iron Creek, six 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 three men was said to

have been engaged in constructing a ditch to lead water for use there in hydraulicking placer ground on that stream. A little work was also in progress on Benson Creek. The entire production of gold from the Iron Creek area, however, so far as known, was so small that it amounted to little more than wages for the few men concerned.

Placer mining in the Port Clarence district was decidedly on the upgrade in 1936, owing principally to the highly successful operation of two dredges. These were situated on Gold Run, a tributary of the Bluestone River, and on Dese Creek, which flows directly into Grantley Harbor. By far the larger of these dredges was that on Gold Run, owned and operated by the Bartholomae Oil Corporation. This dredge is of the flume type, with  $2\frac{3}{4}$ -foot buckets, was constructed in 1935, and consequently was in running order for only a short time that season, but was able to put in a full season in 1936 and showed a corresponding increase in its production. Furthermore, it had passed out of the more constricted portion of the Gold Run Valley to a point farther upstream where the digging was somewhat easier because boulders were smaller and less numerous. Much of the gold recovered is heavy and nuggety. One nugget weighing  $22\frac{1}{4}$  ounces, two of  $12\frac{1}{4}$  ounces, and twelve of more than 5 ounces each were recovered in the course of the year's work. A curious feature of the gold in the nuggets is that it seems to have a higher fineness than the rest of the gold. Thus, while the greater part of the gold recovered had a fineness of 0.880, the nuggets that were tested as a separate lot had a fineness of 0.892, which is contrary to the usual rule or the condition that would seem to accord with theory. The dredge on Dese Creek is owned and operated by N. B. Tweet & Sons. It experienced considerable difficulty in the early part of the season, owing to the slowness with which some of the frost disappeared from the material to be dredged. As a consequence nearly 2 months' productive time was lost through the necessity of running a pumping plant to hydraulic off some of the frozen overburden. The power plant for the operation of the dredge was much improved during the year by replacing the old equipment with an 80-horsepower Diesel engine. So far as reported to the Geological Survey, the dredge that had formerly done some mining on Swanson Creek, to the north of Teller, was idle throughout 1936.

Reports from the Council district that have been received by the Geological Survey indicate that although that district stood second of the Seward Peninsula districts in point of production in 1935 it dropped to fifth place in 1936. This change was brought about more by the great increase in the output of the other districts than by a great slump in production from the mines near Council. There was an actual decrease in the output from some of these mines, and

two of the dredges that were active in 1935 were operating only part of the season in 1936. By far the greater part of the output of placer gold from the Council district was that recovered by the dredges of the Council Dredging Co. and the Northern Star Dredging Co., both of which are mining in the gravel deposits of the Niukluk River at and above the Ophir Creek Valley; the Ophir Gold Dredging Co. on Ophir Creek; and the Kimball dredge on Melsing Creek. At the dredge of the Northern Star some time was lost through breakage of machinery, and the company has been building a new hull and proposes to move the dredge to a new site near the mouth of Melsing Creek. The Ophir dredge was being brought downstream from its former site near the head of the valley to a point near Discovery, where it will commence digging upstream again. As a consequence the amount of productive mining it accomplished during 1936 was considerably less than usual. Considerable difficulty with frozen ground was experienced by the dredge on Melsing Creek, but the Council Dredging Co. appears to have had a good season. All the hydraulic and open-cut mines in the district are small, few of them employing more than two or three men each. In addition to the dredges on Ophir Creek there were three or four open-cut mines in the valley of that stream and its tributaries, Sweetcake and Crooked Creeks and Albion Gulch, employing altogether perhaps 8 to 10 men. On Aggie Creek, a tributary of the Fish River about 10 miles east of Council, a small hydraulic plant was in operation throughout most of the open season. One or two small open-cut mines were also in operation in the valley of Melsing Creek and its tributaries. There were doubtless a few other small camps scattered through the district, but no direct reports have been received from them, and nothing specific is known about the progress of their work, although, to judge from the total amount of gold received from this district by the banks and other purchasers or the shippers of gold from the region, most of them made at best only modest grubstakes.

In the Solomon district by far the larger part of the placer gold produced was obtained by three dredges, situated on Spruce Creek and the Solomon and Casadepaga Rivers. The dredge of the Spruce Creek Dredging Co. mined on Spruce Creek, about 6 miles east of Solomon. Most of the ground that was mined was distinctly creek gravel, but some spots of beach material were encountered. The ground is shallow, few of the deepest places being more than 18 feet deep. The conditions for mining appear to have been especially good, as the working season was longer than usual and rather less frost was encountered. On the average a crew of six men was employed. The dredge on the Solomon River was operated under the

management of R. E. Lee for a short period near the end of the open season. Much of the early part of the season had been spent in reconditioning the dredge, which had long lain idle. This work consisted in removing the old screen and stacker and replacing them by a flume and in changing over the power plant from steam to a Diesel engine. The dredge on the Casadepaga River was the property of the Casa Gold Mines Co., and the work was directed by Donald Stewart. This dredge was mining the deposits of the main river about 2 miles from Ruby. The configuration of the bedrock there makes dredging difficult, as successive bands of hard rock run transverse to the course of the river and thus make it difficult to maintain flotation in crossing them. Some small open-cut mining by small outfits was also in progress in various parts of the valleys of these two main streams. None of them, however, employed more than two or three men, and many of them were mere individual workers. The aggregate production from all this simpler type of mining probably did not exceed a few thousand dollars, and few of the miners made more than a modest grubstake.

Almost the entire placer production from the Bluff district was afforded by the high-line scraper plant installed near the mouth of Daniels Creek. About 30 men are employed at this camp, and the output of gold from it in 1936 was maintained at essentially the same high rate as in 1935. The material mined consists of both stream and bench gravel and a considerable amount of the decomposed surface of the underlying bedrock, which is mainly a metamorphic limestone. The excavation of this material is carried to such a depth that in places the bottom of the pit is below sea level.

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 other streams in the vicinity of Haycock. The largest amount of placer gold mined in this district was recovered by the dredge of the Dime Creek Dredging Co. from claim 3. Altogether in this district there were, in addition to the dredge, two drift mines operated during the winter and eight open-cut mines that have been worked during the summer. The total number of men employed in productive mining was between 25 and 30. The two drift mines and six of the open-cut mines were on Dime Creek, and the other two open-cut mines were on Sweepstake Creek, a few miles to the west.

Lying east of Seward Peninsula but more or less closely related to it and forming the eastern border of Norton Sound is the Bonanza district, so named from a small stream which has long been known to carry some placer gold. For convenience it has here been treated as part of the Koyuk district, though the productive parts of the

two areas are widely separated. Prospecting has been carried on at several places in this general area in the past and for the last 2 or 3 years has been localized in the narrow coastal plain that lies between the waters of Norton Bay and the hills to the east. The bedrock in this part of the area consists mostly of dark slate and sandstone and thus differs markedly from the schist bedrock that occurs in most of the other placer camps in Seward Peninsula. The history of the coastal plain at this place, in the main, seems to have been comparable to that of the coastal plain at Nome and elsewhere in Seward Peninsula, so that prospecting for ancient beaches in this district is well justified. Whether the ancient beaches will prove to be gold-bearing, however, depends on the occurrence of mineralization in the material that formed this coastal plain and, if it occurred, on the effectiveness of any subsequent concentration. The present production from this entire tract amounts at most to only a few hundred dollars a year.

## NORTHWESTERN ALASKA

The Kobuk River Valley is the only area in northwestern Alaska that is reported to have been the scene of any placer mining in 1936. In this valley there are two principal areas where placer mining is being done. The western area is near Kiana, and the principal placer tract is in the valley of the Squirrel River and especially in the valley of its tributary, Klery Creek. The eastern area is in the vicinity of Shungnak, a small settlement about midway between the head and mouth of the Kobuk River. Kiana is about 50 miles in an air line above the mouth of the Kobuk, and Shungnak is about 90 to 100 miles in an air line east of Kiana. Both of these tracts are so remote and so poorly served by any means of regular transportation or communication that their development is much retarded and hampered by high costs, unavoidable delays, and short working season.

In the Kiana area there has been considerable activity on Klery and Central Creeks, which are tributaries of the Squirrel River from the north. The greatest amount of gold was recovered by the Klery Placers, Inc., which continued its effective use of a dragline scraper and other mechanical equipment on its claims that it had commenced developing late in 1935. The results of the work appear to have been so encouraging that even more extensive operations are planned for 1937. The successful operation of this company is of special significance because it is the only intensive mining in progress in an enormous tract of northern Alaska, where potentialities have not been adequately tested. Although the tests so far made can by no means be regarded as giving more than hints as to some of the queries raised, they indicate that even in this remote area, where the season is short, costs are high, and unsolved problems of operation beset the

work on many sides, there are gold-bearing placer areas that can be successfully developed by a reasonable outlay of funds and skill and enterprise in management.

In the tract near Shungnak the placer deposits occur in the lowland adjacent to the Kobuk, close to the places where the small streams that come down from the hills to the north traverse that lowland, or in the valleys of the streams within this belt of hills. The source of the placer gold found in these deposits appears to be local, as in general the gold is rough and shows little evidence of having been transported far. This conclusion is further supported by the occurrence 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 1936 nine small camps, some of which accomplished little more than assessment work, employed a total of about 20 men, some of whom were natives, on streams in the vicinity of Shungnak—4 on Dahl Creek, 1 on the Shungnak River, and 1 each on Boulder, Riley, Lynx, and California Creeks. Lynx, Riley, and Boulder Creeks are tributaries of the Kogoluktuk River, which joins the Kobuk some 3 or 4 miles east of Shungnak, and the Shungnak River enters the Kobuk about 15 miles west of Shungnak. No noteworthy new developments were reported to have been in progress at any of these camps, and the work proceeded at about the same rate as in recent years. One prospector is reported to have been scouting through parts of the valley of the Ambler River to the north and west of Shungnak, but so far as known he found no new placer areas of consequence. This whole section of Alaska is so remote and so poorly served by regular transportation service that it is among the most difficult places in the country in which to carry on mining development, and therefore placers must either be especially extensive or have an especially high gold content to prove attractive. For the transportation of persons or small or light commodities airplanes make the district relatively accessible, and already some of the prospectors are using this means of travel extensively.

#### DREDGING

Nearly 79 percent of all the placer gold produced in Alaska in 1936 was mined by dredges. The total value of the gold thus recovered was \$8,905,000, of which the greater part came from 18 dredges in the Yukon region and the rest from 20 dredges in Seward Peninsula and 1 in the Kuskokwim region. This total is more than \$1,200,000 in excess of the value of the gold recovered by dredges in 1935, and the quantity is about 34,000 fine ounces more. The accompanying table gives the value of the gold output and the yardage handled by Alaska dredges, beginning in 1903, the earliest year for which records are available.

The total value of the gold produced by dredges since 1903 is nearly 26 percent of the total value of gold produced from all kinds of placer mining since 1880, and lately there has been a general tendency each year for a greater and greater percentage of the placer output to be mined by dredges. During 1936 the ratio of dredge production to the output from all other kinds of placer mining was nearly 2.7 to 1, and there are no signs of a diminution in dredge mining in the near future—in fact, an even higher ratio seems not unlikely.

*Gold produced by dredge mining in Alaska, 1903-36*

Year	Number of dredges operated	Value of gold output	Gravel handled (cubic yards)	Value of gold recovered per cubic yard (cents)
1903-15.....		\$12,431,000		
1916.....	34	2,679,000	3,900,000	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	8,709,000	33.6
1930.....	27	3,912,600	9,906,000	39.5
1931.....	28	3,749,000	10,214,000	36.7
1932.....	25	4,293,000	10,310,700	41.6
1933.....	25	4,146,000	8,889,000	46.6
1934.....	30	6,725,000	10,445,000	64.4
1935.....	37	7,701,000	12,930,000	59.6
1936.....	39	8,905,000	14,632,000	60.9
Total.....		78,439,000	135,823,000	148.6

<sup>1</sup> Since 1915.

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 \$7,995,628 in gold, or a little less than 89.8 percent of the total mined by dredges, report that that amount came from 13,137,552 yards of gravel. The average yield thus shown is about 60.86 cents in gold to the cubic yard. Applying this average to determine the unreported yardage gives a total of 14,632,000 cubic yards, and this is the figure that has been used in the table. This procedure is obviously open to criticism, because the companies that reported fully the amount of gravel mined were the larger ones, and doubtless they worked ground of a lower tenor

than that mined by some of the smaller companies. As a result the average value adopted may be too low and consequently may indicate a larger volume of gravel than was actually handled. This method, however, has been followed for the last 12 years, so that the quantities and values given for 1936 are comparable with those reported for the recent preceding years.

Obviously the extremely high value per cubic yard in 1936 was due principally to the new price of gold, for if the old standard price of gold had prevailed in 1936 the average value per cubic yard would have been a little more than 36 cents a yard, or considerably less than the average for the entire period since 1915, shown in the table.

The length of time that the different dredge companies were operating varied widely. The longest season reported for 1936 was 272 days for dredges of the United States Smelting, Refining & Mining Co., Fairbanks Exploration Department, operating in the Fairbanks district of the Yukon-Tanana region. This was only slightly less than the working season for dredges in 1934, which marked an all-time record for Alaska of 275 days and was also set by the Fairbanks Exploration Department. The longest season reported for any of the Seward Peninsula dredge companies in 1936 was 186 days for the Hammon Consolidated Gold Fields at Nome. The earliest date for beginning work in the spring of 1936 and the latest date for ending work in the fall were reported by the Fairbanks Exploration Department, which began mining March 20 and did not stop its last dredge until December 16. The earliest and latest dates in 1936 on Seward Peninsula were May 17 and November 18, both reported by the Hammon Consolidated Gold Fields. The average length of the working season in 1936 of the 15 companies for which information is available, exclusive of those that were completed only in time to make the test run of a few days, as determined from the beginning and ending dates reported by each company, irrespective of how many dredges it operated, was 130 days. Obviously, the shortness of this average season as compared with the record of 272 days for the longest working season was due not to climatic conditions, but to breakage or some other purely local cause at the different dredges. The fact that is demonstrated by these dredging records is that at practically any of the productive placer camps throughout Alaska a moderate-sized dredge reasonably well handled may be expected to have an average working season of at least 4 months, and that, with skill and special provisions against unfavorable climatic conditions, the season may be considerably extended in practically any of the placer camps south of the Arctic Circle.

The following is a list of the dredges that did some productive mining during 1936.

## Yukon region:

## Circle district:

Gold Placers, Inc.----- Coal Creek.  
 Berry Dredging Co.----- Mammoth Creek.

## Fairbanks district:

United States Smelting, Refining &  
 Mining Co., Fairbanks Exploration  
 Department (5)----- Goldstream and Cleary  
 Creeks.

J. R. Murphy, lessee from Fairbanks  
 Gold Dredging Co.----- Fairbanks Creek.

## Fortymile district:

Walker's Fork Gold Corporation----- Walker Fork.  
 Jack Wade Dredging Co.----- Jack Wade Creek.  
 Alaska Gold Dredging Corporation----- Fortymile River.

Hot Springs district: American Creek Op-  
 erating Co.----- American Creek.

## Iditarod district:

North American Dredging Co.----- Flat Creek.  
 J. E. Riley Investment Co.----- Otter Creek.

## Innoko district:

Waino F. Puntila (2)----- Ganes and Little Creeks.  
 Felder & Gale----- Yankee Creek.  
 Ganes Creek Dredging Co.----- Ganes Creek.

## Kuskokwim region:

Tuluksak-Aniak district: New York-Alaska  
 Gold Dredging Corporation----- Bear Creek.

## Seward Peninsula:

Casadepaga district: Casa Gold Mines Co.--- Casadepaga River.

## Council district:

Northern Star Dredging Co.----- Ophir Creek.  
 Ophir Gold Dredging Co.----- Do.  
 Council Dredging Co.----- Niukluk River.  
 Charles E. Kimball----- Melsing Creek.

## Fairhaven district:

Forsgren Dredging Co.----- Inmachuk Creek.  
 Arctic Circle Exploration, Inc. (for-  
 merly Keewalik Mining Co.)----- Candle Creek.

Kougarok district: Fox Bar Dredging Co.  
 (formerly Coal Creek Dredging Co.)----- Kougarok River.

Kougarok Consolidated Placers Co.----- Do.

Koyuk district: Dime Creek Dredging Co.--- Dime Creek.

## Nome district:

Hammon Consolidated Gold Fields (3) -- Snake River area.  
 Dry Creek Dredging Co.----- Dry Creek.  
 Alaska Sunset Mines Co.----- Sunset Creek.  
 Greenstone Mines, Inc.----- Osborne Creek.

## Port Clarence district:

N. B. Tweet & Sons.----- Dese Creek.  
 Bartholomae Oil Corporation----- Gold Run.

Solomon district: Spruce Creek Dredging  
 Co.----- Spruce Creek.

Lee Bros. Dredging Co.----- Solomon River.

The dredges that were active in 1935 but not in operation in 1936 were those of the Fish Creek Mining Co. on Fish Creek, and dredge no. 1 of the Fairbanks Gold Dredging Co. on Fairbanks Creek, in the Fairbanks district; one dredge of the New York-Alaska Gold Dredging Corporation; and of C. L. Peck on Swanson Creek, in the Port Clarence district of Seward Peninsula. Six dredges that were not in operation in 1935 were mining in 1936—in the Yukon region the Gold Placers, Inc., on Coal Creek and the Berry Dredging Co. on Mammoth Creek, in the Circle district; the Jack Wade Dredging Co. on Jack Wade Creek and the Alaska Gold Dredging Corporation on Fortymile River; in the Fortymile district; in Seward Peninsula the Kougarok Consolidated Placers Co. on the Kougarok River and the Lee Bros. on the Solomon River. Of these dredges that were operating in 1936 and not in 1935 the dredges on Coal Creek, the Fortymile River, and the Kougarok River were new, but the other three were old dredges that had been acquired by new mining organizations, moved to new locations, and rebuilt and otherwise reconditioned. Several of the dredges that are not here listed as "new" dredges were completed so late in 1935 that they actually contributed little gold to the output of that year and for practical purposes might be regarded as starting their work in 1936.

In addition to those mentioned above, dredges were in course of preparation or construction at several camps. As none of them took part in production in 1936, it is not worth while listing them here, but it is desirable to point out that growing interest in and adoption of this type of mining is being shown, so that the present rate of production is certain not only to be maintained but even to be increased in the near future.

Much of the placer ground at practically all the places where dredges are now working in Alaska is frozen, so that extensive plants for thawing it must be available. This adds heavily to the cost of the work, and unless the thawing has been done adequately it slows up or actually stops 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 operations, such as at Nome or Fairbanks, miles of pipe are used for the thawing process, and a larger force of workmen is required in the various tasks connected with the thawing than in actual mining. In addition to the labor costs for thawing operations, there is need for large quantities of water, both for thawing and for sluicing. Adequate supplies of water for most of the dredging camps in interior Alaska and Seward Peninsula are difficult to find and costly to develop. In places it has been necessary to go scores of miles to get water under sufficient head and then lead it by means of long

ditches and siphons to the mining ground. The regulation of this water and the maintenance of the ditches require the constant attention of a considerable force of men throughout the working season, especially if the construction is new and the ground has not settled. As a result of this continuing high cost of maintenance, many of the camps where transportation is not too difficult are turning to or considering the practicability of obtaining the necessary water by means of pumps. Supplying large quantities of water by pumping is already in successful operation in the Fairbanks district and the procedure is by no means uncommon at small mines in many other parts in the Territory.

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 almost from one end of interior Alaska to the other. Unquestionably these projects deserve most careful consideration, and some of them will doubtless be successfully carried through, but there is a tendency to regard the dredge as a magic method by which even worthless deposits may be mined at a profit, so that a word of caution may not be amiss to those who are considering investment in some of the projects. The amount of money needed to finance the building of even a small dredge and furnish the necessary equipment is so great that the cost of a thorough report by a competent engineer is relatively insignificant, and such a report should be obtained as almost the first step in any well-advised project. Obviously, for the preparation of a reliable report, considerable prospecting and testing of the ground must be done to determine the quantity and tenor of the materials to be handled. Furthermore, adequate prospecting in advance well repays the outlay, because, in addition to preventing unwise commitments, it enables the competent manager to effect savings throughout the life of the project by wise planning in advance.

#### 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. As is evident from the following table, nearly 69 percent of the silver that has been produced from Alaska in the past has been derived from ores that are valuable mainly for their copper content. How small the percentage of silver is that occurs in these copper ores may be gathered from the fact that it is seldom as much as 2 ounces to the ton of ore,

and the average amount recovered is rarely as much as 1½ ounces to the ton. For 1936 it is estimated that 304,600 ounces of silver was derived from the copper ores and was recovered in the course of treatment at smelters in the States.

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 101,591 fine ounces of silver in 1936, according to the company's published report. The extremely small proportion of silver in the ore from this mine is shown by the fact that this quantity of silver came from 2,462,046 tons of rock that was fine-milled—in other words, the quantity of silver recovered was only little more than 0.041 ounce to the ton. The silver from all the gold-lode mines amounted to 119,800 ounces and was worth \$93,000. Some silver is also contained in all the gold that is recovered from Alaska placer mines. This silver is not recognizable in the crude gold dust or nuggets received from these mines, 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 51,300 ounces, worth \$40,000.

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, quantity, and value of the production from each source in 1936 as well as for the earlier years are set forth in the following table:

*Silver produced in Alaska, 1880-1936, by sources*

Year	Total		Copper lodes		Gold lodes		Gold placers	
	Ounces	Value	Ounces	Value	Ounces	Value	Ounces	Value
1880-1918.....	8,389,398	\$5,598,314	5,327,852	\$3,666,820	1,319,889	\$931,396	1,741,657	\$1,000,098
1919.....	629,708	705,273	488,034	546,598	108,691	121,734	32,983	36,941
1920.....	953,546	1,039,364	682,033	743,416	246,292	268,458	25,221	27,490
1921.....	761,075	761,075	545,229	545,229	193,281	193,281	22,565	22,565
1922.....	729,945	729,945	622,978	622,978	80,598	80,598	26,369	26,369
1923.....	814,649	668,012	715,040	586,333	77,237	63,334	22,372	18,345
1924.....	669,641	448,659	572,078	383,292	75,284	50,440	22,279	14,927
1925.....	698,259	482,495	606,929	419,294	67,186	46,445	24,144	16,756
1926.....	690,000	430,500	605,190	377,600	59,940	37,400	24,870	15,500
1927.....	627,800	356,000	525,100	297,800	79,400	45,000	23,300	13,200
1928.....	454,700	266,000	350,430	205,000	80,340	47,000	23,930	14,000
1929.....	472,900	252,000	351,730	187,400	94,370	50,300	26,800	14,300
1930.....	408,570	157,300	279,990	107,800	102,080	39,300	26,500	10,200
1931.....	352,000	102,000	193,850	56,200	129,800	37,600	28,350	8,200
1932.....	234,050	66,000	81,150	22,900	115,300	32,500	37,600	10,600
1933.....	157,150	55,000	-----	-----	128,150	44,850	29,000	10,150
1934.....	124,700	100,000	-----	-----	118,250	76,440	36,450	23,560
1935.....	286,600	206,000	134,400	96,600	106,600	76,600	45,600	32,800
1936.....	475,700	360,000	304,600	236,000	119,800	93,000	51,300	40,000
Total.....	17,960,391	12,792,937	12,386,613	9,101,260	3,302,488	2,335,676	2,271,290	1,356,001

From the foregoing table it is evident that after 1923 there was a more or less regular decline in the quantity of silver produced,

until a low point of 154,700 ounces was reached in 1934, but since that time there has been a pronounced upward trend. These variations are closely tied to the rise and fall in the output of copper and, as explained in more detail in the section of this report that deals with copper, a waning in that industry appears inevitable shortly, and therefore a corresponding downward trend in the annual output of silver is also to be predicted. Not only was there a marked decline in the quantity of silver produced by Alaska mines in the period from 1924 to 1934, but there was also a marked progressive drop in the price of silver, from 100 cents an ounce in 1922 to 28.2 cents in 1932. Since then the price has improved considerably, owing to natural demands and in part to the stimulation brought about by the Government setting the price it would pay for newly mined silver from American sources. Throughout 1936 this price, as set by the Government for silver that qualified under the terms of the law, was 77.57 cents an ounce. According to the *Engineering and Mining Journal*, the average price during this period for silver that did not so qualify was a little over 45 cents an ounce. On the assumption that all the silver produced from Alaska mines in 1936 qualified as eligible for purchase at the Government price, its value, as stated in this report, has been calculated at that price.

The striking fluctuation in the average selling price of silver is clearly shown by the following table:

*Average selling price of silver, 1880-1936*

Year	Cents an ounce	Year	Cents an ounce	Year	Cents an ounce
1880-1918.....	66.7	1926.....	62.4	1934.....	64.6
1919.....	112.0	1927.....	56.7	1935.....	71.9
1920.....	108.0	1928.....	58.5	1936.....	77.57
1921.....	100.0	1929.....	53.2		
1922.....	100.0	1930.....	38.5	Average for period since 1918.....	67.4
1923.....	82.0	1931.....	29.0		
1924.....	67.0	1932.....	28.2		
1925.....	69.1	1933.....	35.0		

The development in Alaska of ores that are valuable principally for their silver content is necessarily attended by many more difficulties and expenses than are likely to be met in developing gold mines. Among the most obvious reasons for this difference are the much lower value per unit of weight of the silver and the fact that more elaborate and expensive processes are usually required to recover silver in a readily salable metallic state than to recover gold. As a result, it is more or less unwarranted at this time to attempt to develop or even to search for silver lodes in remote parts of Alaska unless the ore has an especially high tenor. Therefore, although silver-lead lodes have been reported at many places in interior

Alaska, none of them have been very thoroughly examined or seriously considered by capitalists. It is true that several years ago some shipments of silver-lead ores were made from interior Alaska, especially from the Kantishna district, north of the Alaska Range, but although the ore was of high grade and the price of silver much higher than at present, the expense of transporting it to smelters in the States and having it smelted consumed practically all the profits. In southeastern Alaska, however, where the region is much more accessible to deep-water transportation and all operating costs are lower, there have been many attempts to find and develop silver-lead deposits. The greatest amount of work of this kind has been done in the region at the head of Portland Canal, near the international boundary. The richest deposits that have been found lie on the Canadian side of the boundary, and it is there that the famous Premier silver and gold mine is situated. The geologic conditions on the Alaska side of the boundary, in the Hyder district as it is locally called, in places seem to be comparable to those on the Canadian side, and this similarity has sustained interest in the search for profitable silver and gold deposits there. Several claims have been taken up and more or less prospecting and development work done. The much greater unit price of gold and its more ready recovery have focused the search on gold lodes rather than on silver lodes, so that some of the claims that in the early days of the camp showed indications of prospective value mainly in silver and lead have been neglected. This does not mean, of course, that rich showings would necessarily be overlooked, but simply that work has not been pressed on deposits that appeared only moderately promising. In the past mines in the Hyder district have made shipments of silver ore or concentrates to smelters in the States, but in 1936 so far as the Geological Survey is informed, no shipments of silver ores were made from any of the mines near Hyder, and only a small amount of development work was in progress in that entire district.

#### COPPER

The production of copper from Alaska mines in 1936 is estimated as 39,267,000 pounds, valued at \$3,720,000. This is an enormous increase over 1935—in quantity of over 24,000,000 pounds and in value of nearly \$2,500,000—but these are small quantities compared with the Alaska copper production for the period from 1915 to 1927, when it practically never fell to less than 50,000,000 pounds a year, with a value of at least \$7,000,000, and in 1916 it reached the high mark of 119,654,839 pounds, with a value of \$29,484,291. The value of the copper produced from Alaska ores mined in 1936 has been computed on the basis of the average selling price for the year, as computed

by the Engineering and Mining Journal. This price for domestic copper was 9.474 cents a pound, or about  $1\frac{1}{6}$  cents higher than in 1935. Those who have followed the market price of copper throughout the year are probably aware that there was a more or less steady upward climb in price so that, commencing at about 9 cents a pound in January, it rose to about  $10\frac{3}{4}$  cents a pound in December. At the average price of copper, as stated above, the total value of the Alaska production in 1936 is estimated to have been \$3,720,000.

It is realized that this method of calculating the value does not take into account the fact that an efficient and fortunate selling agent would take advantage of fluctuations in the price of copper and thus dispose of as much as possible during periods of high prices and hold as much as possible during periods of low prices. The figures given for the value of the Alaska output of copper cannot, therefore, be regarded as representing the amounts received by the different companies for their copper. They do, however, serve to indicate within close limits the magnitude of the industry and are comparable with the figures for earlier years as stated in these reports.

In the following table are shown the amount and value of the copper produced in Alaska since the earliest recorded mining of copper:

*Copper produced by Alaska mines, 1880, 1900-1936*

Year	Ore mined (tons)	Copper		Year	Ore mined (tons)	Copper	
		Pounds	Value			Pounds	Value
1880		3,933	\$826	1927	645,000	55,343,000	\$7,250,000
1900-1915	1,232,396	220,773,969	35,031,225	1928	579,500	41,421,000	5,965,000
1916	617,264	119,654,839	29,484,291	1929	590,400	40,510,000	7,130,000
1917	659,957	88,793,400	24,240,598	1930	531,000	32,651,000	4,244,600
1918	722,047	69,224,951	17,098,563	1931	88,000	22,614,000	1,877,000
1919	492,644	47,220,771	8,783,063	1932	56,900	8,738,500	550,500
1920	766,095	70,435,363	12,960,106	1933		29,000	1,900
1921	477,121	57,011,597	7,354,496	1934		121,000	9,700
1922	581,384	77,967,819	10,525,655	1935		15,056,000	1,249,700
1923	731,168	85,920,645	12,630,335	1936		39,267,000	3,720,000
1924	761,779	74,074,207	9,703,721				
1925	860,023	73,855,298	10,361,336	Total		1,308,465,500	219,661,400
1926	670,000	67,778,000	9,489,000				

In the foregoing table no quantity of ore mined is shown in the appropriate column for the years subsequent to 1932. This has been omitted for the years 1933 and 1934 because the copper produced in those years was but a minor byproduct from the gold ores mined, which are not at all comparable with the ores reported for the preceding years, mined primarily for their copper content, and for 1935 and 1936 the amounts were omitted because the large copper-producing companies no longer publish that information.

The general trend of the copper-mining industry in Alaska is graphically indicated by one of the curves in figure 4, which shows the output of copper for each year from 1900 to 1936. On the same diagram has been plotted the average price of copper for each year. The diagram tells its own story of the growth of the copper industry from a meager start in the early boom days of the Territory, through fabulous strides in the days of the World War, when all nations were clamoring for copper and paying almost any price to get it, and Alaska copper production rose to nearly 120,000,000 pounds a year, then fluctuating up and down until 1923, when the trend became definitely downward and at an accelerating rate, until production practically ceased in 1933 and remained at an extremely low point in 1934 and then turned sharply upward.

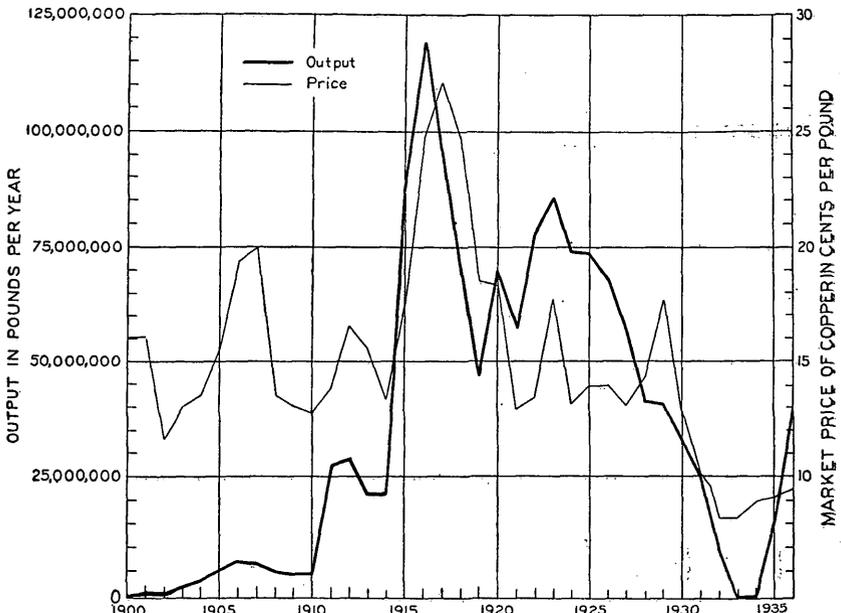


FIGURE 4.—Copper produced from Alaska mines, 1900–1936, and fluctuations in the price of copper during that period.

Practically all of the Alaska copper comes from mines that have been developed primarily for the copper content of their ores, but there is a small amount of copper that is recovered as a byproduct through the treatment of ores principally valuable for their content of gold or of some other metal. The ore mined primarily for its copper content came from mines in the Copper River region near Kennicott, owned by the Kennecott Copper Corporation and the Mother Lode Coalition Mines Co. and operated as a more or less single unit, except for accounting purposes. The ore at these mines

consists mainly of high-grade copper sulphide and carbonate containing considerable silver but no gold. The ore deposits lie near the contact of a thick limestone formation and an effusive greenstone. The deposits are of a unique type and have yielded hundreds of millions of pounds of copper in the 25 years that they have been actively mined. Obviously, all mineral deposits are exhaustible, so that it is not strange that after these years of heavy output the further life of these deposits appears to be short. That this is recognized by both these companies is clear from statements in their recently published annual reports. Regarding its Alaska property the Kennecott Copper Corporation states:<sup>12</sup> "Exploration was carried on [at its Alaska property in 1936] without disclosing any new ore bodies or favorable indications of ore. It is the present expectation that operation of the Alaska properties will cease in not to exceed 2 years."

As this company owns and operates extensive mining properties in the States and South America, ultimate cessation of work on its Alaska property is not regarded by the company as likely to affect its total earnings adversely. As to the life of the Mother Lode mine, the company, wishing to learn all the facts that thorough examination could disclose, employed a skilled engineer to make such studies in 1936. According to the report published by the company,<sup>13</sup> this work

revealed that no commercial ore remains except as backs of drifts, sill floors, and pillars within the stoped section between the 1,000- and 1,400-foot levels. Mr. Levensaler advised that, after the reclamation of these blocks of ore, the mine will necessarily have to be abandoned. He further advised that the remaining development possibilities of the mine are too weak to justify prospecting and should be dropped from consideration.

To these conclusions the company's officials agree, for the report goes on to state:

No further prospecting seems justified. Therefore it is obvious that after extraction of the small tonnage of ore still remaining the mine will be abandoned. The ore still left will be extracted at a rate judged most economical and company's copper sold as deemed to its best advantage.

Considerable difficulty was experienced at both these large copper mines because of strikes and labor troubles at Cordova, which tied up the railroad and normal business there for several weeks during August and the early part of September and threatened for a while to necessitate closing the mines. This situation had not been cleared

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<sup>12</sup> Kennecott Copper Corporation 22d Ann. Rept., for the year ended Dec. 31, 1936, p. 6, New York, 1937.

<sup>13</sup> Mother Lode Coalitlon Mines Co. 18th Ann. Rept., for the year ended Dec. 31, 1936, p. 2, New York, 1937.

up very long before it was followed by the complete cessation of all regular commercial shipping through strikes. As a consequence, during the rest of the year practically no further shipments of ore or concentrates were made to the smelters in the States, though large quantities had been mined and milled and were held pending the resumption of transportation.

Among the mines whose principal mineral content of value was some metal other than copper, but which furnished concentrates from which copper was obtained, were those of the Nabesna Mining Corporation in the Alaska Range region, at the head of the Copper River region, in the valley of the Nabesna River, which is a tributary of the Tanana, and the Alaska Gold & Metals Co., on Prince of Wales Island, in the Ketchikan district of southeastern Alaska. No considerable change in the amount of copper derived from these mines is to be expected in the future unless they greatly alter the size of their general mining operations.

That there are other places in Alaska where copper minerals occur is well known. That some of these deposits contained enough copper to enable them to be worked at a profit under past conditions is a matter of history. It is extremely doubtful, however, whether any of the known copper deposits that are not now being mined can be worked at a profit under present conditions. As a consequence, practically all activity at properties of this kind has been discontinued and doubtless will not be resumed until the price of copper has materially advanced. That there may be deposits, as yet unknown, which might repay development is possible, but the incentive to search for them is so small and the probability of failure so great that prospectors are not willing to take the gamble. At present, therefore, search for new copper deposits or development of those already known has practically ceased. Obviously, no forecast can be made as to when these conditions are likely to change. Various remedial or palliative measures have been proposed which might encourage the copper-mining industry, but it seems doubtful whether much improvement can be looked for in the near future. Probably the only thing that is likely to keep the production of copper from Alaska ores from declining seriously will be the more extensive mining of ores in which the copper is a byproduct and gold or some other metal more sought after is the principal object.

#### LEAD

The lead produced from Alaska ores in 1936 is estimated to have been 2,116,000 pounds, or nearly 490,000 pounds more than in 1935. This great increase is attributable to the very great increase in the output of ore from certain of the lode mines that are principally

valuable for their gold content, because all the lead is recovered as a byproduct from the gold ores, the concentrates being shipped to smelters in the States for treatment to recover the metals they contain. From the table on page 15, showing the recovery of metals at the Alaska Juneau mine, it is evident that up to 1936 the quantity of lead obtained from the ores of this mine has consistently decreased since 1931, though at the same time, except for 1934 and 1935, there has been a rather steady increase in the amount of ore fine-milled. The average market price of lead in 1936, according to the Engineering and Mining Journal, was 4.71 cents a pound, which was 0.71 cent higher than the price that prevailed in 1935. At this price the value of the Alaska lead production was \$99,500, which, while greater than in any other year since 1931, was much less than in some of the preceding years, when the quantity produced was only about one-half as great.

*Lead produced in Alaska, 1892-1936*

Year	Tons	Value	Year	Tons	Value	Year	Tons	Value
1892.....	30	\$2,400	1908.....	40	\$3,360	1924.....	631	\$100,899
1893.....	40	3,040	1909.....	69	5,934	1925.....	789	140,571
1894.....	35	2,310	1910.....	75	6,600	1926.....	778	124,400
1895.....	20	1,320	1911.....	51	4,590	1927.....	1,008	127,000
1896.....	30	1,800	1912.....	45	4,050	1928.....	1,019	118,000
1897.....	30	2,160	1913.....	6	528	1929.....	1,315	166,000
1898.....	30	2,240	1914.....	28	1,344	1930.....	1,365	136,500
1899.....	35	3,150	1915.....	437	41,118	1931.....	1,600	126,000
1900.....	40	3,440	1916.....	820	113,160	1932.....	1,261	75,600
1901.....	40	3,440	1917.....	852	146,584	1933.....	1,157	85,600
1902.....	30	2,460	1918.....	564	80,088	1934.....	840	62,100
1903.....	30	2,520	1919.....	687	72,822	1935.....	815	65,200
1904.....	30	2,580	1920.....	875	140,000	1936.....	1,058	99,500
1905.....	30	2,620	1921.....	759	68,279			
1906.....	30	3,420	1922.....	377	41,477	Total.....	20,301	2,256,400
1907.....	30	3,180	1923.....	410	57,400			

Practically all of the lead that is reported in the foregoing table as produced in 1936 was recovered in the course of treatment of the gold ores of the Alaska Juneau Co.'s mines in southeastern Alaska. According to the published reports of this company, it recovered about half a pound of lead from each ton of ore that it mined and trammed to the mill, or about 0.85 pound of lead from each ton of ore that is fine-milled.

Ores containing greater or less quantities of lead minerals are widely known throughout the Territory, and in the past shipments valuable at least in part for their lead content have been made from many areas in southeastern Alaska, especially the Hyder district; from the Yukon-Tanana region, especially the Kantishna district; and even from far-away Seward Peninsula, at the Omalik mine, and from the Kobuk district in the vicinity of Shungnak. Lead is, however, a heavy, low-priced commodity which requires rather elaborate treatment to produce in readily salable metallic form, and these

drawbacks, coupled with the low current price for the metal, act as deterrents to the development of lead deposits in remote regions. The outlook for any notable increase in the production of this metal, therefore, seems to depend on the stimulation of the mining of other metals and the consequent increase in the production of lead as a by-product. That this increase in mining lodes of mixed metallic content is likely to take place is regarded as a certainty, and that some of the silver-lead deposits which are now lying idle will be opened up again seems almost equally certain. As general business conditions throughout the world improve, an increase in the output of lead from Alaska ores is 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 1936 is estimated to have been a little more than 5,654 ounces, which had an estimated value of \$241,900. In the past it has been the practice in these volumes to express the production of platinum metals in Alaska in terms of fine ounces of platinum, but the complex constitution of the larger amount of the platinum metals recovered recently makes such computation almost worthless, so that for 1936 only the weight of clean metallic platinum metals is stated in troy ounces, and the price given is arrived at by taking into account all the available factors, including price paid the producer, current market price of the major component of the special lot, and an item for loss on melting. Curiously, the average price of the quantity of platinum metals stated above, as determined by this means—\$42.78 an ounce—is almost identical with the average price of pure platinum as quoted by the *Engineering and Mining Journal*—\$42.926 an ounce. This close correspondence is remarkable when it is realized that a large part of the platinum metals produced from Alaska mines contain such a range of different platinum metals as palladium and iridium, which in 1936 at times sold at \$20 and \$167 an ounce, respectively. As an illustration of the complex composition of the native platinum metals contained in a shipment of more than 1,000 ounces from one of the placer mines in the Goodnews Bay district, the following determination by Wildberg Bros., of San Francisco, as recomputed by the writer, is instructive:

	<i>Percent</i>
Platinum-----	90.91
Iridium-----	6.14
Osmium-----	.98
Ruthenium-----	.37
Palladium-----	.37
Gold-----	1.23
	100.00

At the time this shipment was received the current market price of fine platinum was \$67 an ounce, but the prices for the other platinum metals were such that the value of the composite material represented by the foregoing analysis was practically \$72 an ounce.

The outstanding development in the placer platinum-mining industry in Alaska, as well as in the United States proper, was in the Goodnews Bay district, in the lower Kuskokwim region, in the extreme southwestern part of the Territory. In this district there are two principal operators—the Goodnews Bay Mining Co. and the Clara Creek Mining Co.—and a few scattered one- or two-man camps. The two large companies are using dragline scrapers and bulldozers of the same general type as those used so successfully in many of the placer-gold camps. The principal streams on which these companies were mining were Clara and Squirrel Creeks, both of which are tributaries of the Salmon River, which enters Kuskokwim Bay about 12 miles south of Goodnews Bay. Other streams in this district from which some platinum metals were recovered were Fox and Platinum Creeks. The Goodnews Bay Mining Co. had been active in the district for 2 years, but the Clara Creek Mining Co. was a new organization and had to spend considerable time getting its equipment to the ground to be mined and starting work. The Goodnews Bay Mining Co. has an extensive program outlined which calls for the installation of a dredge on its properties in the Salmon River Valley, which it has more or less blanketed with its claims. During 1936 extensive test drilling was in progress on some of these claims in order to check their value as a basis for the granting of a loan from the Reconstruction Finance Corporation for the desired developments. Reports indicate that the results of these tests were so satisfactory that the loan was arranged, and construction of a dredge was authorized and it will be installed in time to be productive in 1937. This should furnish a great impetus to mining in the district and assure a continued high output of platinum metals and gold from it for many years.

Another large contributor to the output of platinum metals from Alaska in 1936 was one of the old lode mines on Kasaan Peninsula, in the Ketchikan district of southeastern Alaska. The principal platinum metal recovered at this mine is palladium, which usually sells for a much lower price than most of the other platinum metals and

which in 1936 brought between \$20 and \$25 an ounce. The development of this ore is being undertaken by the Alaska Gold & Metals Co., which it is understood was continuing the work along the same general plan as had been successfully tried out in 1935. During the year about 200 feet of raise was driven. The metal-bearing material passes through various crushing and grinding devices, including a Hardinge mill, and the product is passed through a flotation concentrator. The concentrates are shipped to a smelter in the States for further treatment. The platinum metals in this mine form only a small part of the metallic content of the ore, which contains considerable amounts of gold and copper—in fact, so small a part do the platinum metals form that the individual particles cannot be identified in the ore by the unaided eye.

The only other region in Alaska where some platinum metals are reported to have been recovered in 1936 is Seward Peninsula. In that region a few ounces of platinum metals were recovered from gold placers on Dime Creek, a tributary of the Koyuk River, and on Quartz Creek, a tributary of the Kiwalik River, in the Fairhaven district, and in nearby areas in the extreme eastern part of the peninsula. The Koyuk district has long been a small though consistent producer of platinum as a byproduct. The streams derive their gravel in large part from the hills formed of Mesozoic basic effusive rocks which have been cut by granite intrusives and in part from lower country in which Paleozoic schists and limestones predominate. No bedrock source of the platinum metals has yet been discovered.

Although no other operators in Alaska are known to have produced and sold platinum metals in 1936, 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 nearby 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.

#### TIN

For many years Alaska has been a small but regular producer of tin, and in the course of the more than 35 years since tin minerals were discovered in Seward Peninsula and later elsewhere in the Territory, it has shipped tin worth more than \$1,250,000. During this

period the greatest annual production was in 1916 and was equivalent to 139 tons of metallic tin. In the period between 1920 and 1935 the average yearly output has been only about 13 tons. In 1935, however, there was a great increase in tin production, brought about mainly through a new company, the American Tin Fields, Inc., starting work in the vicinity of Tin City, near the extreme western tip of Seward Peninsula. This company continued its work in this field in 1936 and made a notable increase in output. The mining operations at the plant of this company present many interesting technical features that are unique. The deposits mined are placers lying a mile or so inland from the coast and have evidently developed in proximity to the contact of granite that intrudes the country rock, which is a somewhat metamorphic limestone. The bulk of the placer materials, including those containing the tin, do not appear to have been transported far from their source of origin, because well-formed crystals of tin ore and large angular pieces of quartz and feldspar intimately mixed with the cassiterite are common and show little if any abrasion. The placer material is dug with a power shovel, which loads it into trucks that carry it over a well-built road, constructed by the company, to the mill, about a mile distant, close to the shore of Bering Sea. Here the material is dumped over a grizzly, by which the large masses of country rock are gotten rid of and the rest passed through a revolving trammel which eliminates more of the worthless material. The fine material is then passed through a series of sluice boxes so arranged in three lines that, whenever necessary to clean up the concentrates from one line of boxes, the feed can readily be diverted to another without interrupting the flow. The coarse concentrates from the boxes are broken into small pieces in a jaw crusher, and these, together with the rest of the concentrates from the boxes, are still further cleaned by passing through jigs. Experimentation with treating on concentrating tables some of the waste product from the jigs showed that losses from that source were so small that this additional step did not pay, and consequently it was discontinued for most of the time. The general limestone bedrock of the region is unfavorable for the maintenance of much water on the surface, and it is to obviate this difficulty that the mill was built close to Bering Sea, where an inexhaustible supply is ready at hand that can be pumped at a moderate cost, as ocean-going vessels can bring freight practically to the door yard of the property. The foundation of this enterprise has obviously depended on the good quality of the placer material available, but no little credit must be given to the ability of the management and the energy of the crew that have planned and carried on the work at this place so successfully.

In addition to this main camp there were several smaller ones at various points in the same general region that produced small amounts of tin by ordinary open-cut methods of placer mining. A small amount of placer tin was also recovered from the gold-mining operations in the Hot Springs and Circle districts of the Yukon region. At present all the Alaska tin is sent to Singapore for reduction, but doubtless, if there were a constant reliable supply available, some arrangement would be made to smelt it in the States.

The complete record of tin production from Alaska is given in the accompanying table:

*Tin produced in Alaska, 1902-36*

Year	Ore (tons)	Metal (tons)	Value	Year	Ore (tons)	Metal (tons)	Value
1902.....	25	15	\$8,000	1920.....	26	16	\$16,112
1903.....	42	25	14,000	1921.....	7	4	2,400
1904.....	23	14	8,000	1922.....	2.3	1.4	912
1905.....	10	6	4,000	1923.....	3	1.9	1,623
1906.....	57	34	38,640	1924.....	11	7	7,028
1907.....	37.5	22	16,752	1925.....	22.2	13.8	15,980
1908.....	42.5	25	15,180	1926.....	12.85	8	10,400
1909.....	19	11	7,638	1927.....	37.5	26.7	34,000
1910.....	16.5	10	8,335	1928.....	58.6	41	41,000
1911.....	92.5	61	52,798	1929.....	51.6	38.6	35,000
1912.....	194	130	119,600	1930.....	21	14.7	9,300
1913.....	98	50	44,103	1931.....	5.6	4.1	2,000
1914.....	157.5	104	66,560	1932.....			
1915.....	167	102	78,846	1933.....		2.9	2,300
1916.....	232	139	121,000	1934.....		4.14	4,300
1917.....	171	100	123,300	1935.....		49.4	49,800
1918.....	104.5	68	118,000	1936.....		113	105,000
1919.....	86	56	73,400				
				Total.....		1,318.44	1,255,100

As to the future of the tin industry in Alaska the facts at hand are not yet sufficiently definite to warrant expressing any fixed conclusions, but a personal visit to parts of the tin fields of western Seward Peninsula gave the writer certain very definite impressions as to the desirability of much further prospecting there. Some of the principal points may be summarized as follows: The tin deposits have been proved to be rather definitely associated with granitic intrusives, so that the area to be prospected critically can be more or less closely defined. There are such intrusive masses at intervals of nearly 100 miles so that there is a large area in which workable deposits of placer tin may be found. Much of the placer material at present being mined has undergone almost no transportation from its bedrock source, as is shown by the perfection of many of the crystals of tin ore recovered. There is, however, the possibility that other agents than streams may have effected concentration of some of the material from tin-mineralized areas, and old beach concentrations of that sort should by no means be overlooked. The tenor of much of the placer ground being mined runs from 20 to 30 pounds of tin ore to the cubic yard of material, which, at a price of 50 cents a pound

for metallic tin and with the ore containing about 75 percent of tin, gives a value per cubic yard that seems extremely attractive. The conditions for mining offer some drawbacks, as there are no trees in the region, so that it is extremely difficult in most places to get even enough wood to maintain a campfire; much of the bedrock is limestone, so that in few places is there enough fresh water to maintain even a meager sluicing operation; and the climate is bad and the season short. On the other hand, few parts of the prospective tin area are far from the sea, so that transportation charges are moderate and sea water might be advantageously used for many of the mechanical operations at the plant; the limestone bedrock offers good footing over much of the country and allows the construction of adequate inexpensive roads; and the use of airplanes makes the district by no means inaccessible, the flying time from Nome being only about an hour. There is also the likelihood that in the course of placer operations areas of bedrock that were sufficiently mineralized to be worked as lodes might be disclosed and thus an industry established that might be carried on uninterruptedly throughout the year, more or less regardless of weather conditions.

In thus focusing the discussion of the possibilities of the development of tin on the area in western Seward Peninsula, it should not be forgotten that the occurrence of tin minerals in other parts of Alaska has been amply demonstrated. That further intensive examination of some of these other deposits is highly desirable is obvious, but their geologic settings are more obscure and their physical surroundings are such that determination of their real merits is likely to present difficulties that cannot easily be solved.

### COAL

The coal produced from Alaska fields in 1936 is estimated to have amounted to 136,600 tons. This marks an increase of about 17,000 tons over the production in 1935 and has not been exceeded in any year since coal mining began in the Territory. In addition to the coal mined in Alaska, 39,449 tons of coal was imported from fields outside Alaska, and no Alaska coal was exported. The consumption of coal in Alaska in 1936 was thus 176,049 tons, or about 14,000 tons more than in 1935. The growth in the consumption of coal is being supplied more and more by increased output of the domestic mines, as is shown by the dwindling amounts of coal that are being imported. A comparison of coal production and consumption in Alaska for the entire period for which records are available is afforded by the table on page 88.

In this table the total value of the coal produced in Alaska in 1936 is stated to have been \$573,700. This value can be regarded only

as a fair approximation, because records are not available for precise determination of the actual selling price of the coal. Much of the coal is purchased by the Alaska Railroad on contract for large quantities, so that the price paid by the railroad is not an accurate index of 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 the coal mined in Alaska in 1936 may be taken as \$4.20 a ton. This is the same as the estimated price in 1934 and 1935 but is 80 cents a ton less than the price that was considered to be the average for 1933 and for the immediately preceding years and is about \$1.25 less than the average price that prevailed during the period from 1880 to 1933.

*Coal produced and consumed in Alaska, 1880-1936*

Year	Produced in Alaska, chiefly subbituminous and lignite		Imported from States, chiefly bituminous coal from Washington <sup>1</sup> (short tons)	Imported from foreign countries, chiefly bituminous coal from British Columbia <sup>1</sup> (short tons)	Total coal consumed (short tons)
	Short tons	Value			
1880-1915.....	71, 633	\$456, 993	679, 844	1, 079, 735	1, 831, 212
1916.....	12, 676	57, 412	44, 934	53, 672	111, 282
1917.....	54, 275	268, 438	58, 116	56, 589	168, 980
1918.....	75, 816	413, 870	51, 520	37, 986	165, 322
1919.....	60, 894	345, 617	57, 166	48, 708	166, 768
1920.....	61, 111	355, 668	38, 128	45, 264	144, 503
1921.....	76, 817	496, 394	24, 278	33, 776	134, 871
1922.....	79, 275	430, 639	28, 457	34, 251	141, 983
1923.....	119, 826	755, 469	34, 082	43, 205	197, 113
1924.....	99, 663	559, 980	40, 161	41, 980	181, 804
1925.....	82, 868	404, 617	37, 324	57, 230	177, 422
1926.....	87, 300	459, 000	35, 620	34, 254	157, 174
1927.....	104, 300	548, 000	35, 212	27, 225	166, 737
1928.....	126, 100	662, 000	39, 184	32, 521	197, 805
1929.....	100, 600	528, 000	32, 762	24, 172	157, 534
1930.....	120, 100	631, 000	37, 128	23, 892	181, 120
1931.....	105, 900	556, 000	30, 772	17, 796	154, 468
1932.....	102, 700	513, 500	28, 422	13, 959	145, 081
1933.....	96, 200	481, 000	21, 524	14, 009	131, 733
1934.....	107, 500	451, 500	28, 317	14, 675	150, 492
1935.....	119, 425	501, 600	26, 554	15, 707	161, 686
1936.....	136, 600	573, 700	27, 643	11, 806	176, 049
Total.....	2, 001, 579	10, 450, 800	1, 437, 148	1, 762, 412	5, 201, 139

<sup>1</sup> Compiled from reports from Bureau of Foreign and Domestic Commerce. No figures on imports before 1899 are available.

Practically all the Alaska coal mined in 1936 came from two mines—one in the Matanuska field and one in the Nenana or Healy River field. The principal mine in the Matanuska field was that of the Evan Jones Coal Co., at Jonesville, but a small amount of coal was produced from the Wishbone Hill coal mine, operated by the New Black Diamond Coal Co., in the valley of Moose Creek, and

from the Alaska Railroad's own mine near Eska. Both of these small mines are in the Matanuska field. The mine in the Healy River field is owned and operated by the Healy River Coal Corporation.

The mine supplying practically all of the locomotive and power fuel for the Alaska Railroad was that of the Evan Jones Coal Co. That company's coal was also shipped rather extensively through central and western coastal portions of Alaska for use in many of the schools under the direction of the Office of Indian Affairs and for use at some of the canneries. A little difficulty was met in the underground work because of a fault that dislocated the coal measures. Fortunately, the amount of this displacement proved small, and the continuation of the beds was picked up on the other side of the fault plane without having to resort to much dead work. The mine maintained a better than normal output throughout the year, though during June and July mining was carried on only at a much reduced rate. During the periods while productive mining was in progress a crew of 30 or more was employed in surface and underground work on the property.

At the Wishbone Hill mine of the New Black Diamond Coal Co., which was formerly known as the Rawson mine, the main work has been of a prospecting or developing type, in the course of which a small amount of coal has been mined and delivered under contract to the Alaska Railroad. Only a small crew has been employed on this property, and most of the time the greater number of these men have been used on surface work. The mine is connected with the standard-gage branch of the Alaska Railroad at Premier by a narrow-gage track, on which the coal cars are handled by a small engine leased to the operators of the mine. At the Premier terminus of this narrow-gage line an elevated siding was built so that the cars could dump directly into the standard-gage cars without rehandling the coal, as had been necessary in the past.

The Alaska Railroad's mine near Eska does not enter into consideration as a source of commercial coal, as it is maintained only as a source of railroad fuel in the event that the commercial mines are unable to supply the coal needed for the operation of the railroad. As has been stated, there is only one commercial mine now operating that is able to supply enough coal of the quality required to meet the needs of the railroad, so that the holding of its own mine in a stand-by condition is only prudent, in view of the dangers inherent in coal mining and the uncertainties of geologic conditions that may be encountered in a relatively undeveloped field of complex structure like the Matanuska area. The season's work at this mine consisted mainly in turning off short entries on the coal beds en-

countered in a long crosscut adit and raising a suitable air shaft to the surface to provide adequate ventilation. This work has been carried on under the direction of the railroad's geologist, Ralph Tuck. A full description of the geology of the area near Eska and the correlation of the coal croppings, accompanied by a detailed map and sections, has been prepared by Dr. Tuck and is in course of publication as a separate chapter of the preceding volume of this series.<sup>14</sup> It is hoped that this valuable investigation of the surface exposures and the old workings may be extended as time permits, so as to furnish an interpretation of the structure and relations of the coal beds from Eska westward to the limits of the Moose Creek area.

In the Nenana coal field the only producing property was the Suntrana mine of the Healy River Coal Corporation, on the Healy River, about 4 miles east of the junction of that stream and the Nenana River. The plant of this mine has been well laid out and is now equipped with the necessary modern machinery to handle readily 200 tons or more of coal a day, as well as excellent quarters for the comfort and convenience of the personnel and adequate protection against the hazards of fire or floods. The management is constantly alert to adopt anything that will improve the operation of the property and the living conditions there. Among the many things done in 1936 to improve the equipment was the installation of an automatic stoker, boiler, and new high stack at its power house. The largest single user of coal from this property is the United States Smelting, Refining & Mining Co., Fairbanks Exploration Department, for furnishing power to its dredges and in its large placer-mining operations in the vicinity of Fairbanks, and constantly growing demands by that company for more power are calling for an increasing quantity of coal. The Healy River coal is also extensively used for power and domestic fuel at many other points in Alaska, including Cordova and points along the Alaska Peninsula, and a growing market is being built up through reliable quality and service. The coal has a somewhat lower heating value than that from the Matanuska and nearby fields and as a consequence is not used in the railroad locomotives, but the shorter haul makes its use more economical in many parts of the interior. This mine was in continuous operation throughout 1936 and yielded considerably more than half of all the coal mined in Alaska during that year.

Small amounts of coal are reported to have been mined during the year at the old Chicago Creek mine, in the valley of the Kugruk River, in northern Seward Peninsula; and at two or three points:

<sup>14</sup> Tuck, Ralph, Eska Creek coal deposits, Matanuska Valley, Alaska: Geol. Survey Bull. 880-D, 1937.

along Kuk Lagoon, south of Wainwright, in northern Alaska. The coal from these different properties was used only locally and had no significant effect on the general Alaska coal situation, except to confirm the statement, often made before, that throughout the Territory there are many areas containing coal adequate for local use. So far as the Geological Survey is informed, no production was made during the year from the known coal deposits on Admiralty Island, in the Juneau district, where some activity had lately been shown. In the Bering River field, where extensive deposits ranging in composition from bituminous coal to anthracite have long been known; prospecting or other development work relating to the coal resources continued apparently to be at a standstill in 1936. Rumors of renewed activity in this field were heard from time to time, and extensions of some of the Government permits for coal prospecting there have been asked for, as the old permits neared their expiration. It is evident that this field has much potential value, but it is also evident that the present coal consumption of Alaska is not such as to stimulate large companies to undertake extensive projects and that until there is a greater demand for their product or until they are prepared to invade a more distant market, where competition will be more severe, they will not enter this field. Furthermore, the development work already done in this field indicates that some complex geologic conditions will be encountered, so that desultory prospecting by small, poorly financed, or technically unskilled operators holds little promise of success, and full development must await a company that is able to go into the matter in a large way and to bear the necessarily uncertain expense of exploring a new field.

The whole problem of the development of Alaska's coal resources is exceedingly complex, for while there are in the Territory large areas occupied by coal-bearing rocks, the local demands are fairly well supplied by existing mines, and to attempt to enter a larger field would require large outlays for developing mines and the market. Obviously, many consumers are unwilling to commit themselves to any specific agreements to purchase until they are sure that the coal offered them is available at a satisfactory price, and the mining operator, of course, in the initial stages can offer little definite assurance as to costs and availability of his product until he has some certainty as to his market. Certainly many of the steps that must be taken, if any extensive use of Alaska coal is to be made, require that the enterprise be undertaken on such a scale as will justify the outlay for the essential facilities. This means that a considerable tonnage must be marketed, but the attempt to dispose of a large tonnage of Alaska coal will bring it into competition with coals from other areas

and in places where the competitive conditions appear to be almost insuperable for the Alaska product. Many of the competitive conditions are changing, however, so that the situation must be subjected to constant review. Of course, as Alaska develops and becomes more settled, its people and industries will call for more and more coal, and in meeting this demand Alaska coals will have great competitive advantage over those from outside sources. That growth, however, probably will be relatively slow but none the less sure.

#### PETROLEUM

No petroleum was produced from any Alaska deposits in 1936. For a number of years there has been a small but significant production of petroleum from wells of the Chilkat Oil Co. in the Katalla district, on the coast east of the mouth of the Copper River. According to the published report of this company the boiler house and contents at the refinery were destroyed by fire late in December 1933, and it has not yet been considered desirable to replace the building and equipment, because the outlook was not encouraging for the profitable operation of the property. Until such time as this refinery equipment is replaced there will be no production from the property. The wells from which the company obtained its oil were relatively shallow, few of them being more than 1,000 feet deep and none of them more than 2,000 feet. The bedrock near the surface at the wells is of Tertiary age, but there is considerable uncertainty as to whether these rocks are the source of the oil or whether it may not come from older beds lower in the stratigraphic column. In the past the products of the refinery operated by this company—gasoline and distillate, which are of especially high quality—found a ready market near at hand, especially for use by the fishing fleet near Cordova.

Even when the Chilkat Oil Co.'s property is in operation the small domestic production of petroleum from the Katalla field is not adequate to supply local needs, and the demand for large quantities of petroleum products throughout the Territory is met principally by imports from the States. The most notable feature shown by the subjoined table is that from the end of the war through 1928 there was a constant increase in the amount of gasoline and related lighter products of distillation imported. This increase was called for by the growing use of power in fishing boats and other water craft, in the canneries, in many mining developments, and in the operation of means of transportation, such as automobiles and airplanes or of gas cars on practically all the railroads. Beginning with 1930, however, there was a decided drop in the quantity of petroleum products shipped into Alaska. But in 1933 there was an upturn in the consumption of most of these petroleum products, and in 1936 the im-

ports of heavy oils were almost three times as much as in 1933 and the imports of gasoline increased about 40 percent. The decrease in the period from 1930 to 1933 is interpreted as only a temporary drop in the consumption, brought about by the general decline in all business activities, and the increased consumption later is regarded as due to the improvement in general business conditions and the greatly increased use of petroleum and its products in mining, the road-construction program, and the various developments that are taking place which utilize power-driven machines.

*Petroleum products shipped to Alaska from other parts of the United States, 1905-36, in gallons<sup>1</sup>*

Year	Heavy oils, including crude oil, gas oil, etc.	Gasoline, including lighter products of distillation	Illuminating oil	Lubricating oil
1905.....	2,715,974	713,496	627,391	83,319
1906.....	2,688,940	580,978	568,033	83,992
1907.....	9,104,300	636,881	510,145	100,145
1908.....	11,891,375	939,424	566,598	94,542
1909.....	14,119,102	746,930	531,727	85,687
1910.....	19,143,091	788,154	620,972	104,512
1911.....	20,878,843	1,238,865	423,750	100,141
1912.....	15,523,555	2,736,739	672,176	154,565
1913.....	15,682,412	1,735,658	661,656	150,918
1914.....	18,601,384	2,878,723	731,146	191,876
1915.....	16,910,012	2,413,962	513,075	271,981
1916.....	23,555,811	2,844,801	732,369	373,046
1917.....	23,971,114	3,256,870	750,238	465,693
1918.....	24,379,566	1,086,852	382,186	362,413
1919.....	18,784,013	1,007,073	3,515,746	977,703
1920.....	21,981,569	1,764,302	887,942	412,107
1921.....	9,209,102	1,403,683	2,021,033	232,784
1922.....	15,441,542	1,436,050	2,095,675	345,400
1923.....	12,285,808	4,882,015	473,826	454,090
1924.....	14,412,120	5,554,859	566,431	506,364
1925.....	16,270,746	6,993,560	562,844	580,321
1926.....	14,000,664	5,069,584	328,615	730,924
1927.....	17,628,744	8,141,574	516,306	620,450
1928.....	13,000,176	8,025,402	463,134	715,082
1929.....	17,347,344	6,847,050	589,340	878,094
1930.....	13,801,746	6,317,934	401,646	701,946
1931.....	12,282,480	5,532,912	338,310	450,870
1932.....	14,167,104	4,755,660	297,780	338,310
1933.....	15,340,962	5,077,644	412,230	337,806
1934.....	16,174,662	6,791,232	421,218	515,508
1935.....	29,254,008	7,890,750	375,810	549,696
1936.....	43,840,062	7,786,548	297,444	731,419
Total.....	534,388,331	118,476,165	22,856,798	12,701,704

<sup>1</sup> Compiled from reports of Bureau of Foreign and Domestic Commerce.

Search for new oil fields in Alaska, which had been active a few years before, had practically been discontinued by 1936, and in that year, so far as reported to the Geological Survey, only one company was drilling in the entire Territory. This was the Iniskin Drilling Co., which was testing its holdings in the Iniskin-Chinitna district, on the west coast of Cook Inlet, in the Alaska Peninsula region. This was a new project, so that much of the early part of the season was spent in preparatory work, but before the work was suspended for the winter the company had put down a hole to a depth of

2,550 feet. Drilling will be resumed as early in 1937 as practicable, and there should be no difficulty in completing the test hole before the end of that season. Although no signs of oil are reported to have been found in the distance drilled, this was in accord with expectation, as the geologic evidence had not indicated that any significant showings would be found at so shallow a depth. The work is being done by an adequately financed and competently conducted organization, so that the results should afford convincing information as to the possibilities of there being significant deposits of oil in that area. Discovery of commercial oil pools in this portion of Alaska would have an almost incalculable effect in accelerating the development of the whole Territory.

In connection with the general development of oil claims both in Alaska and the States there is a widespread misunderstanding as to the real significance of Government permits for exploration for oil. Hundreds of such permits have been issued by the Government and cover tracts in all parts of Alaska and are outstanding in the hands of individuals or companies, but most of them were evidently taken up solely for speculative purposes and will lapse if no active work is done under them. As prospecting permits for oil are issued on application, without regard to the merits of the land involved as a favorable place in which to search for oil, the investing public should be warned that a permit from the Government is only what it purports to be—permission to search for oil—and in no way implies that the search has even a remote chance of being successful. Furthermore, the public should realize that prospecting permits, if within the law, are readily granted by the Government at a nominal charge and so should be warned against unscrupulous individuals who offer their services in obtaining permits for their clients at a charge far in excess of any reasonable fee for any service they render and of any payment required by the Government.

#### 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 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 1936 in the broadest sense of that

word, but few of them were reported to have been produced and sold in quantities that represent a value of more than a few hundred dollars, and so far as could be determined the total value of the production in 1936 of all the mineral products not described in the earlier pages of this report, was \$51,900. However, it should be noted that in the following table, as well as in certain of the other tables in this report, all the minerals that were produced only by a single operator or 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 included in this table that have also been described elsewhere in this report are the platinum metals. The inclusion of platinum metals is a relic of the period when practically the entire production of platinum metals in Alaska came from one mine and so could not be disclosed. Now that there are a number of producers it is appropriate to state their combined production, and this has been done, but in order that there may be a fair comparison of the production of the minerals grouped together as miscellaneous products in earlier years with those same products in 1936, it has been considered desirable to include the value of the platinum metals in this table.

*Value of output of miscellaneous mineral products of Alaska, including platinum, petroleum, quicksilver, stone, antimony, gypsum, marble, and other products, 1901-36<sup>1</sup>*

Year	Value	Year	Value	Year	Value
1901.....	\$500	1914.....	\$199,767	1927.....	\$162,000
1902.....	255	1915.....	205,061	1928.....	164,000
1903.....	389	1916.....	326,737	1929.....	194,000
1904.....	2,710	1917.....	203,971	1930.....	157,300
1905.....	710	1918.....	171,452	1931.....	108,000
1906.....	19,965	1919.....	214,040	1932.....	223,400
1907.....	54,512	1920.....	372,599	1933.....	39,200
1908.....	81,305	1921.....	235,438	1934.....	86,400
1909.....	86,027	1922.....	266,296	1935.....	299,700
1910.....	96,408	1923.....	229,486	1936.....	293,800
1911.....	141,739	1924.....	348,728		
1912.....	165,342	1925.....	454,207	Total.....	6,690,900
1913.....	286,277	1926.....	444,500		

<sup>1</sup>\$117,000 of placer platinum metals mined prior to 1926 and \$238,000 of antimony mined prior to 1927 not distributed by years but carried in total.

It is evident that if the value of the platinum produced in 1936 is deducted from the foregoing total value of these miscellaneous products for the year the remainder becomes only \$51,900—an almost negligible amount when contrasted with the value of these other products in some of the earlier years. This condition, however, is regarded as marking merely a temporary situation that will speedily change, because there are many mineral resources that not only await development but have been the base of extremely profitable enter-

prises in recent past and have by no means been exhausted. For example, one of the hitherto large mining enterprises is the quarrying of marble by the Vermont Marble Co. from its properties near Tokeen and Calder, in southeastern Alaska. No productive mining was done there during 1936, though the property was kept in condition so that work could be resumed promptly when required. The general practice of this company has been to operate these quarries actively at intervals and supply all the stone it needed for the ensuing 2 or 3 years, during which time the quarries are kept only in a stand-by condition. The stone from these quarries is used in most of the larger and better buildings in the whole Pacific coast region, being especially in demand for interior trim and decoration. Ordinarily the company ships its rough stone from Alaska to finishing plants it maintains in Tacoma, Wash., and San Francisco, Calif. There is, of course, no basis for believing that the cessation of quarrying during the year means the permanent closing of the property. It only marks a halt in production until sales of the product now on hand deplete the stock so that replacements are needed, and there is every indication that this will occur shortly so that the quarries will again be running. Limestone and marble are widely distributed throughout southeastern Alaska, and, according to Burchard,<sup>15</sup> many different grades, some even approaching statuary quality, are found in the region. It therefore seems certain that some of these limestone and marble deposits, many of which are favorably situated with respect to deep-water transportation, will ultimately be profitably developed.

The quarrying of limestone as an ingredient of cement afforded much the larger part of the amount credited here to miscellaneous minerals in 1936. This enterprise is conducted by the Superior Portland Cement, Inc., of Seattle, operating under lease from the Pacific Coast Cement Co. The quarries at which this high-grade limestone is mined are on Dall Island, in the Ketchikan district of southeastern Alaska. From the quarries at this locality the rough stone is shipped in barges to Seattle, where it is treated and mixed with the other constituents of the cement. This property has been productive for several years, but ordinarily it has been found possible to supply all of the limerock needed by the company by keeping the quarries in operation only during the summer. In accordance with this practice, the quarries in 1936 were in operation during the 4 months from June to September, inclusive.

Cinnabar, the principal ore of quicksilver, has been recognized in the placer concentrates from streams in many parts of the Terri-

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<sup>15</sup> Burchard, E. F., Marble resources of southeastern Alaska: Geol. Survey Bull. 682, pp. 29-39, 1920.

tory, but in most of these places the lodes from which it came were apparently small stringers that appear little likely to afford ore that can be mined under present conditions. In the central and western parts of the Kuskokwim Valley there are, however, extensive areas of cinnabar mineralization which have long been known and which appear to hold promise of containing quicksilver deposits that may be profitably developed, though much further exploration will be required to determine their real value. The place in this region where the greatest amount of development work has been done is on the property of E. W. Parks, about 10 miles in an air line downstream from the junction of the Holitna with the Kuskokwim. This property was visited during 1936 by S. R. Capps, of the Geological Survey, and the following statements are taken from his notes resulting from that study.

At this property, which is on the north bank of the Kuskokwim River, five men were employed in prospecting on the Alice and Bessie claims. Most of the development work was done by numerous open cuts and pits, and one adit had been driven 600 feet into the hill and a drift 110 feet long had been turned off some 75 feet south of its inner face. The country rock consists of shale and sandstone, presumably of Upper Cretaceous age, cut by dikes and sills of varying thickness. These intrusive rocks have undergone strong hydrothermal alteration, so that in places they are now soft clayey material. Stibnite, a sulphide of antimony; cinnabar, a sulphide of mercury; pyrite, a sulphide of iron; and chalcopyrite, a sulphide of copper, occur both in the dikes and in the associated sediments. Some rich bunches of ore have been found in lenses and vugs in which coarse needlelike stibnite crystals are intergrown with crystals of cinnabar. These lenses, which lie parallel with the bedding of the sandy shale, are almost free of gangue or other sulphides. The exploration so far carried on has not yet demonstrated the presence of ore in sufficient amounts or richness to insure profitable mining, though apparently it would require only a slight improvement in either of these factors to alter this condition materially. Three-quarters of a mile east, or upstream, from the Parks property and on the south side of the river, a small amount of prospecting by means of short drifts and open cuts was in progress, and a little ore had been taken out and saved. Some exceedingly rich pieces of mercury ore had been found in the course of that work, but so far as learned no extensive deposit that appeared rich enough to mine on a commercial scale had been uncovered.

One of the important developments of the year affecting a kind of ore that has not lately been produced in significant quantities in Alaska was that at the Stampede antimony property, in the Kantishna district, in the northern foothills of the Alaska Range. This work was started late in the season under the direction of Earl Pilgrim. Considerable time was necessarily devoted to the preliminary work required in getting an outfit in to the property and installed, so that only a little ore was produced during the remainder of the year. The work will be continued during the winter and the ore

hauled over the snow to the railroad for shipment to smelters in the States. The occurrence of a large mass of stibnite ore at this place has long been known,<sup>16</sup> but no extensive attempt has previously been made to undertake mining it, so that the progress of this work will be watched with keen interest, as the success of the venture would mean much, not only in itself, but also in the general development of the whole Kantishna district. Antimony ores are known to have a wide distribution throughout Alaska, and in the past, especially in some years of the World War, shipments to the extent of nearly \$100,000 were made. The revival of this industry, not only from lodes in the Kantishna district, but also from other Alaska districts, is likely to follow improved conditions of transportation and increase in the demand for the ore.

A little prospecting is said to have been continued and a revival of interest shown in the search for workable deposits of nickel-bearing ore in southeastern Alaska. The occurrence of nickel minerals has long been known,<sup>16</sup> but no extensive attempt has previously been made, especially in a belt that passes through Baranof and Chichagof Islands and in a more or less parallel belt farther east on Admiralty Island. During 1936 foreign engineers are said to have made extensive examinations of the deposits at Snipe Bay, on Baranof Island, during which the showings of nickel-bearing rocks were carefully and thoroughly sampled. There has been no public announcement as to the findings that resulted from these tests, and consequently nothing is known as to whether or not they will be followed by further developments. The desirability from both a commercial and a national standpoint of developing a domestic source of nickel is obvious, and encouragement should be given to determine more fully the resources of any areas in Alaska that are known to contain nickel-bearing minerals.

Outside of a small amount of prospecting and assessment work, no productive mining is reported to have been in progress at any of the chrome-ore deposits in the southern part of Kenai Peninsula, where ores of this sort have long been known and at times have been marketed. In the vicinity of Red Mountain especially large bodies of chrome ore have been known for some time, but what average chrome content can be maintained under commercial conditions, what will be the cost of mining it and transporting it to the market, and what profit will be left after it is sold are matters that still require investigation. According to newspaper accounts some prospecting for chrome-bearing ores has been continued in the vicinity of Red Bluff Bay, Baranof Island, in southeastern Alaska. No details as to the developments at this place have been received by the Geological Survey, and it seems certain that it is not to be credited with commercial

<sup>16</sup> Moffit, F. H., The Kantishna district: Geol. Survey Bull. 836, pp. 311-313, 1933.

production of ore in 1936. Chrome is one of the mineral products of which the United States has no adequate developed domestic supply. The thorough examination of the known Alaska deposits to determine whether or not they could supply the deficiency is therefore a matter of concern to many more than the individual who may be fortunate enough to own a deposit of chrome minerals that can be profitably developed.

Little new development is reported to have taken place in 1936 in mining the many kinds of nonmetallic mineral products that occur at various places in Alaska. Extensive use was made of the widespread gravel and rock deposits for railroad ballast and road construction, and with sand they entered largely into the concrete mixtures required in the more permanent structures that are beginning to be built in many parts of the Territory. In estimating the value of Alaska's mineral output in 1936 no value has been set on these materials, though if a price of only a few cents a ton had been placed on them, the output of mineral products would have been worth many thousand dollars more than the value stated.

Although the various mineral commodities other than platinum metals here grouped under the heading "miscellaneous mineral products" yielded negligible monetary returns in 1936, yet their diversity, their wide distribution, and the interest that is being displayed in the search for them indicate that they already play an important part in the mineral economics of the Territory and are destined to become even more significant as the development of Alaska proceeds.



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