

MINERAL RESOURCES OF ALASKA, 1914.

By ALFRED H. BROOKS and others.

PREFACE.

By ALFRED H. BROOKS.

This volume contains a condensed summary both of the results of the investigations of Alaskan mineral resources during 1914 and of the status of the mining industry in the Territory. It is the eleventh of a series of annual bulletins¹ devoted to this subject. The chief purpose of this volume is to give prompt publication to the most important economic results of the year's investigations. This necessitates to a certain extent the curtailment of office studies, and hence some of the statements here presented may be subject to modification when the researches have been completed. Those interested in any particular district are therefore urged to procure a copy of the complete report on that district as soon as it is available.

Attempt has been made in this report to present more complete data on mineral production than in those previously issued. Unfortunately the accuracy of the statistical data is impaired by the fact that some of the mine operators, notably the placer miners, fail to report their production. Were it not for the public spirit shown by many residents of the Territory it would not be possible to prepare figures on the mineral production of many of the districts or to summarize the mining development. There are now nearly 450 operators who furnish information on mineral production and mining development. To these the writer desires to express his obligations. In addition to these operators many residents of the Territory have furnished valuable data of a general character relative to statistics of mineral production and mining development. Those who have thus rendered aid include many mine operators, engineers, prospectors,

¹ Report on progress of investigations of the mineral resources of Alaska, 1904 [to 1914]: U. S. Geol. Survey Bull. 259 [284, 314, 345, 379, 442, 480, 520, 542, and 592].

Federal officials, and officers of banks and of transportation and commercial companies. It is impossible to enumerate all who have contributed information, but special acknowledgment should be made to the Director of the Mint; Thomas Riggs, jr., of the Alaskan Engineering Commission; Wells Fargo & Co.; the Alaskan Mexican Gold Mining Co.; Alaska United Gold Mining Co.; and Alaska Treadwell Gold Mining Co., of Treadwell; Stephen Birch, of Kennecott; Melvin Dempsey, of Chistochina; the late Thomas L. Hammore, of Iliamna; E. R. Stivers, of Fortymile; T. E. Phillips, of Jack Wade; John R. Kemp, of Steel Creek; J. J. Hillard, of Eagle; N. B. Nelson, of Chisana; William J. Reynolds, of Deadwood; Frank A. Reynolds, of Circle; American Bank, First National Bank, A. Bruning, and J. A. Fairborn, of Fairbanks; George W. Ledger and W. B. Ballou, of Rampart; John Hackanson, of Bonnifield; Northern Commercial Co. and O. R. Williams, of Nolan; Alexander Cameron, of Poorman Creek; A. S. Kinzer, of Ruby; Harry Fathergill, of Innoko; C. P. Wood and E. A. Austin, of Iditarod; E. R. Stivers, of St. Michael; R. W. J. Reed, of Nome; G. A. Adams, of Council City; F. A. Thomas, of Shelton; George Jamme, of Lost River; and E. E. Patterson, of Kotzebue.

The arrangement and manner of treatment in this volume are the same as in those previously issued. First, papers of a general character are presented, followed by those treating of special districts, arranged geographically from south to north. This bulletin contains eighteen papers by eight authors. One of these papers deals with administrative matters, one is a general summary of the mining industry, one treats of the future of the placer-mining industry, and the remainder deal more specifically with the mineral resources of certain districts. In the geologic papers emphasis is laid on the conclusions having immediate interest to the miner. These conclusions are discussed here briefly, but will be more fully treated in reports now in preparation. The need of prompt publication requires that the illustrations in this volume be of the simplest kind.

ADMINISTRATIVE REPORT.

By ALFRED H. BROOKS.

INTRODUCTION.

Under date of April 6, 1914, \$100,000 was appropriated for the continuation of the investigation of the mineral resources of Alaska. The availability of the funds at this early date made it possible to start the field work promptly and to carry it on economically, these conditions being in strong contrast to those of the two previous years, when the delay in the appropriations greatly hampered the field work and made it very expensive.

Ten parties in all were engaged in surveys and investigations in 1914 from June until October. These parties included 11 geologists, 4 topographers, and 25 packers, cooks, and other assistants. Six parties were engaged in geologic work, two in topographic surveys, and two combined both classes. The results are summarized below.

The area covered by exploratory geologic surveys, on a scale of 1:500,000 (8 miles to the inch), was 1,200 square miles; by reconnaissance geologic surveys, on a scale of 1:250,000 (4 miles to the inch), 7,700 square miles; by detailed geologic surveys, on a scale of 1:62,500 (1 mile to the inch), 325 square miles. Much of the time of the geologists was devoted to the investigation of special field problems in the important mining districts, the results of which can not be presented in terms of area. About 600 square miles was covered by exploratory topographic surveys, on a scale of 1:500,000 (8 miles to the inch); 10,900 square miles by reconnaissance topographic surveys on a scale of 1:250,000 (4 miles to the inch); and 10 square miles by surveys on a scale of 1:24,000 (2.64 inches to 1 mile).

To state the work geographically, one topographic party was in southeastern Alaska, one geologic party in the Chitina basin, one topographic-geologic party in the Nelchina-Susitna region, one geologic party in the Prince William Sound region, one topographic-geologic party in the Lake Clark-Iditarod region, one geologic party in the lower Kuskokwim region, and one topographic and one geologic party in the Chisana-White River district. One party investigated the tin deposits of York and the mining developments near Nome, Fairbanks, and Juneau. Another party was engaged in geologic studies in southeastern Alaska, in the Chitina Valley, and along the Yukon.

Among the important results of the year were the tying together of the reconnaissance surveys of the Copper and Susitna basins and the carrying of a geologic and topographic survey from Lake Clark to the Iditarod. The latter work coordinates the previous surveys of the Iliamna region and on Cook Inlet with the work in the interior and the Iditarod district. A detailed study of the geology and mineral resources of the Kotsina district, in the Chitina region, was also completed. Important results were also obtained bearing on the general geology of the Mesozoic terranes of Alaska.

The following table shows the allotment, including both field and office expenses, of the total appropriation of \$100,000 to the districts investigated. In addition to this, a balance of about \$6,000 left from last year's appropriation was expended in equipping the parties for the season's field work. In preparing this table the general office expenses were divided among the districts in proportions determined by the cost of the surveys in each district, allowance being made for variations in the character of the work. The results are expressed in round numbers. The "general investigations" include the cost of special studies of geology and mineral resources which were not of an areal character. The unallotted balance will be used for equipment of field parties and expenses up to the close of the fiscal year 1915.

Approximate geographic distribution of appropriation for Alaska investigations, 1914.

Southeastern Alaska.....	\$6, 000
Copper and Susitna basins.....	25, 000
Prince William Sound.....	6, 500
Kuskokwim and Mulchatna river basins.....	22, 000
White and Chisana river basins.....	14, 000
Yukon basin.....	2, 000
Seward Peninsula.....	1, 500
General field and office investigations.....	12, 000
Unallotted.....	11, 000
	<hr/> 100, 000

In the following table the approximate amount of money devoted to each class of investigations and surveys is indicated. It is not possible to give the exact figures, as the same party or even the same man may have carried on two different kinds of work, but this statement will help to elucidate a later table, which will summarize the complete areal surveys.

Approximate allotments to different kinds of surveys and investigations, 1914.

Geologic and topographic exploration.....	\$4, 400
Geologic reconnaissance surveys.....	13, 000
Detailed geologic surveys.....	15, 600
Special geologic investigations.....	13, 000

Reconnaissance topographic surveys.....	\$22,500
Detailed topographic surveys.....	4,300
Collection of statistics.....	1,400
Miscellaneous, including administration, inspection, clerical salaries, office supplies and equipment, and map compilation.....	14,800
Unallotted.....	11,000
	<u>100,000</u>

Allotment for salaries and field expenses, 1914.

Scientific and technical salaries.....	\$36,530
Field expenses.....	36,715
Clerical and other office and miscellaneous expenses.....	15,755
Unallotted.....	11,000
	<u>100,000</u>

The following table exhibits the progress of investigations in Alaska and the annual grant of funds since systematic surveys were begun in 1898. It should be noted that a varying amount is spent each year on special investigations, yielding results which can not be expressed in terms of area.

Progress of surveys in Alaska, 1898-1914.

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys. ^a						Investigations of water resources.	
		Exploratory (scale 1: 625,000 or 1: 1,000,000).	Reconnaissance (scale 1: 250,000).	Detailed (scale 1: 62,500).	Exploratory (scale 1: 625,000 or 1: 1,000,000).	Reconnaissance (scale 1: 250,000; 200-foot contours).	Detailed (scale 1: 62,500 and larger; 25, 50, or 100 foot contours).	Lines of levels.	Bench marks set.	Gaging stations maintained part of year.	Stream volume measurements.	
		Sq. mi.	Sq. mi.	Sq. mi.	Sq. mi.	Sq. mi.	Sq. mi.	Miles.				
1898.....	\$46,189	9,500			12,840	2,070						
1899.....	25,000	6,000			8,600							
1900.....	60,000	3,300	6,700		630	11,150						
1901.....	60,000	6,200	5,800		10,200	5,450						
1902.....	60,000	6,950	10,050		8,330	11,970	96					
1903.....	60,000	5,000	8,000	96		15,000						
1904.....	60,000	4,050	3,500		800	6,480	480	86	19			
1905.....	80,000	4,000	4,100	536		4,880	787	202	28			
1906.....	80,000	5,000	4,000	421		13,500	40			14	286	
1907.....	80,000	2,600	1,400	442		6,120	501	95	16	48	457	
1908.....	80,000	2,000	2,850	604		3,980	427	76	9	53	556	
1909.....	90,000	6,100	5,500	450	6,190	5,170	444			81	703	
1910.....	90,000		8,635	321		13,815	36			69	429	
1911.....	100,000	8,000	10,550	496		14,460	246			68	309	
1912.....	90,000		2,000	525			298			69	381	
1913.....	100,000	3,500	2,950	180	3,400	2,535	287			24	185	
1914.....	100,000	1,000	7,700	325	600	10,300	10					
Percent- age of total area of Alaska.....	1,261,189	73,200	83,735	4,396	51,680	126,880	3,652	450	72			
		12.48	14.28	0.75	8.81	21.64	0.62					

^a The Coast and Geodetic and International Boundary surveys and the General Land Office have also made topographic surveys in Alaska. The areas covered by these surveys are, of course, not included in these totals.

GEOGRAPHIC DISTRIBUTION OF INVESTIGATIONS.

GENERAL WORK.

The writer was engaged in office work until July 6, when he started for Alaska. A conference was held with Mr. Witherspoon at Juneau, and B. L. Johnson's camp at Valdez was reached on July 22. A week was devoted to a study of local geology with Mr. Johnson and Mr. Harrington. The journey was then continued to Mr. Moffit's camp on the Kotsina, and here a week was spent with him and Mr. Mertie on the local geology. It had been planned to proceed direct to Fairbanks by private automobile from Chitina, but as this plan failed a delay was occasioned by waiting for transportation. Through the courtesy of Col. W. P. Richardson the journey from Chitina to McCarthy was made with him in the Alaska Road Commission's autotruck. No difficulties were encountered in the use of the machine, as the wagon road was in excellent condition. The heavy rains had washed out two bridges between McCarthy and Fairbanks, making the use of the truck impractical on this stretch of the road. Therefore the journey was continued on the Quartermaster Department steamer *General Jacobs*, and Fairbanks was reached on August 30. Some 12 days were then devoted to a study of some features of the local geology, partly in company with H. H. Bennett, of the Bureau of Soils. The return trip to Seattle was made by way of Dawson, and Washington was reached on October 7.

During the calendar year 1914 the geologist in charge devoted 31 days of his time in the office to geologic studies, 27 days to reading and revising manuscripts, 26 days to preparation of progress report, 19 days to mineral statistics, 14 days to matters relating to railways in Alaska and Alaska coal leasing, 8 days to field plans, 8 days to Panama-Pacific Exposition work, 7 days to preparation of the annual press bulletin on mining in Alaska, and the rest to routine matters.

George C. Martin was engaged during the summer in investigating the Mesozoic stratigraphy of Alaska. His results will be of great importance in correlating Mesozoic terranes and in the deciphering of the geologic history of Alaska. Mr. Martin, accompanied by R. M. Overbeck as assistant, left Washington on June 6 and returned on October 9, having visited localities in southeastern Alaska and in the Chitina and Yukon valleys.

R. H. Sargent continued the general supervision of the topographic surveys and map compilation, in addition to carrying on his own field work. E. M. Aten continued as office assistant to the geologist in charge and supervised the office work during the writer's absence in the field. He also continued to assist in collecting statistics of production of precious metals in Alaska.

SOUTHEASTERN ALASKA.

The very extensive mining developments in the Juneau district led to a demand for a revision of the surveys in this area. The base map of Juneau and its environment was completed in 1902 and the geologic survey of the same area in the following year, but the recent developments have made available much additional information about the geology and occurrence of the metalliferous deposits. For these reasons a resurvey was justified, and in view of the fact that Juneau promises to be one of the most important gold-producing camps on the continent it was decided to make a large-scale base map.

The scale adopted, 1:24,000 (about 2.64 inches to the mile), is the same as that used in the important mining camps of the Western States. The making of a detailed map of this kind under the best of conditions is very laborious, and the difficulties were much increased by the ruggedness of the topography, the heavy underbrush, and the large number of rainy days. D. C. Witherspoon was detailed for this work and spent the time from May 27 to October 12 in the Juneau district. Of this time it rained 45 days to the extent of totally prohibiting surveys, but in spite of the adverse conditions Mr. Witherspoon did the necessary triangulation and mapped 9.75 square miles.

In 1913 the systematic geologic survey of the Ketchikan district was undertaken, but owing to other demands this work was not continued in 1914. It is to be again taken up in 1915. C. W. Wright's detailed report on the "Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska" (Professional Paper 87) was issued in May, 1915.

COPPER RIVER AND SUSITNA BASIN.

The detailed geologic mapping of the west end of the Kotsina-Chitina copper belt began in 1912 but, being interrupted in 1913, was not completed until 1914. F. H. Moffit, assisted by J. B. Mertie, began work in this district June 10 and continued until September 30. During this time they mapped the geology and studied the mineral resources of an area of 185 square miles. A preliminary statement of results is contained in this volume, and the complete report is in preparation.

A topographic reconnaissance survey was carried by J. W. Bagley from Copper Center to the head of Klutina River and thence northwest to the Susitna. Work was begun on June 25 and concluded on October 11, and in this time an area of 4,000 square miles was surveyed by phototopographic methods on a scale of 1:250,000, with 200-foot contours. Theodore Chapin, who accompanied the party as

geologist, mapped an area of about 3,600 square miles. He also examined the gold placers of the Nelchina basin. This survey forms an important connecting link between previous surveys in the Copper, Susitna, and Matanuska valleys. The principal economic results are summarized in this volume, and a complete report is in preparation.

PRINCE WILLIAM SOUND.

A detailed geologic survey and study of mineral resources of Port Valdez district was begun in 1914, and it is hoped will be completed in 1915. B. L. Johnson, assisted by G. L. Harrington, was assigned to this project, began work on June 19, continued until October 6, and covered an area of 140 square miles. He also spent a few days in the Port Wells district. The economic results are presented in this volume.

LAKE CLARK-IDITAROD REGION.

As there was a large, almost unknown region lying between Lake Clark and the Iditarod district, an exploration of this field was undertaken in 1914. The party, under the leadership of R. H. Sargent, topographic engineer, and P. S. Smith, geologist, also included five camp men and was equipped with 20 horses. Work was begun on June 20 at Lake Clark, and a survey was carried through to Iditarod, which was reached September 10. The topographic surveys covered an area of 4,800 square miles and the geologic surveys 3,500 square miles. Some of the quicksilver deposits of the Kuskokwim were examined. The economic results are summarized in this volume and a complete report is in preparation.

LOWER KUSKOKWIM BASIN.

There are several placer-gold districts in the lower Kuskokwim basin where mining has been carried on for several years. Plans were made for investigating these districts in 1913 but could not be carried out because of the lateness of the appropriation. In 1914 these plans were put into execution. A. G. Maddren, assisted by Burt Kennedy, arrived at Iditarod on July 6 and then went overland to Kuskokwim River. The route then lay down that river and up several tributary streams. The Aniak and Tuluksak placer districts were examined. The field work closed at Bethel on September 23, and from that point the party returned to Seattle by gasoline schooner. During the season exploratory topographic surveys were made of about 600 square miles and geologic surveys of about 1,000 square miles. Besides the gold placers, some copper and quicksilver deposits were also examined. Preliminary statements of results are included in this volume, and a more complete report is in preparation.

SEWARD PENINSULA.

In view of important developments in the York tin district, a supplementary examination of this field was undertaken by H. M. Eakin, who devoted about 15 days to this work and to the investigation of the mining developments near Nome, including a brief study of the iron deposits in the Sinrock basin, about 40 miles from Nome. The results are presented elsewhere in this volume.

YUKON BASIN.

The development of gold placers in the Chisana district, in the upper Tanana region, made an examination of this field desirable. C. E. Giffin was detailed to extend the topographic surveys in this region. Field work began on June 12 and was continued until August 23. A survey was made of Skolai Pass, and the previous mapping in the Tanana and White River basins was extended eastward to the boundary. A reconnaissance was thus carried over an area of about 1,500 square miles for publication on a scale of 1:250,000. In addition to this, about 1,500 square miles of the old mapping was revised. The wagon road from Willow Creek to Chitina, a distance of 40 miles, together with the adjacent country, was also surveyed in the fall, making an additional area of revision of about 150 square miles. S. R. Capps at the same time made a geologic study of the Chisana placer district and mapped the geology of an area of about 600 square miles. His field work began June 10 and closed September 5. A summary of results is presented in this volume.

The writer's own field work near Fairbanks has already been referred to. H. M. Eakin devoted about three weeks to the investigation of the mining developments at Hot Springs and Fairbanks.

COLLECTION OF STATISTICS.

The collection of statistics of the production of precious metals was continued as in previous years. Mine operators have shown a willingness to cooperate in this work by furnishing promptly a statement of mineral production. There are still a number who fail to make returns, thereby decreasing the accuracy of the figures on production for the different districts. In the absence of complete information, the statistics are still in part based on estimates made on the basis of information procured from various sources. Practically all the gold and copper lode operators furnish statements of production, but the returns from placer mines are still far from being complete.

PUBLICATIONS.

During 1914 the Survey published two bulletins relating to Alaska. One professional paper, two bulletins, and one water-supply paper were in press at the end of the year. In addition the authors' work on three bulletins and one water-supply paper is completed, and these will soon be sent to press. Four reports are in progress. One map to be issued separately is in press, and the compilation of a new general map is nearly completed.

REPORTS ISSUED.

BULLETIN 578. The Iditarod-Ruby region, Alaska, by H. M. Eakin; including geologic and topographic reconnaissance maps. (Issued in September, 1914.)

BULLETIN 592. Mineral resources of Alaska: Report on progress of investigations in 1913, by Alfred H. Brooks and others. (Issued in October, 1914.)

REPORTS IN PRESS.

PROFESSIONAL PAPER 87. Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska, by C. W. Wright; including detailed geologic and topographic maps. (Issued in May, 1915.)

BULLETIN 576. Geology of the Hanagita-Bremner region, Alaska, by F. H. Moffit; including topographic and geologic reconnaissance maps. (Issued in January, 1915.)

BULLETIN 587. Geology and mineral resources of Kenai Peninsula, Alaska, by G. C. Martin, B. L. Johnson, and U. S. Grant; including geologic and topographic reconnaissance maps. (Issued in July, 1915.)

WATER-SUPPLY PAPER 342. Surface water supply of the Yukon-Tanana region, Alaska, by C. E. Ellsworth and R. W. Davenport; illustrated by topographic reconnaissance maps. (Issued in May, 1915.)

REPORTS FOR WHICH ILLUSTRATIONS ARE BEING PREPARED.

BULLETIN 605. The Ellamar district, Alaska, by S. R. Capps and B. L. Johnson.

BULLETIN 607. The Willow Creek district, Alaska, by S. R. Capps.

BULLETIN 608. The Broad Pass region, Alaska, by F. H. Moffit, with sections on Quaternary deposits, igneous rocks, and glaciation by J. E. Pogue.

WATER-SUPPLY PAPER 372. A water-power reconnaissance in south-central Alaska, by C. E. Ellsworth and R. W. Davenport.

REPORTS IN PREPARATION.

Geology of the Glacier Bay and Lituya region, Alaska, by F. E. Wright and C. W. Wright, including geologic reconnaissance map.

Geology of the region along the international boundary from Porcupine River to the Arctic Ocean, by A. G. Maddren, including detailed geologic map.

The Yukon-Koyukuk region, by H. M. Eakin.

The upper Matanuska basin, by G. C. Martin.

MAPS PUBLISHED SEPARATELY.

Port Valdez district, by J. W. Bagley and C. E. Giffin; scale, 1:62,500; contour interval 50 feet. (Published in April, 1915.)

General map of Alaska; scale, 1:1,500,000. (Published in May, 1915.)

THE ALASKAN MINING INDUSTRY IN 1914.

By ALFRED H. BROOKS.

GENERAL CONDITIONS.

The certainty of railroad connection with the Yukon basin and the probability of an early development of the coal fields greatly stimulated the search for mineral deposits in Alaska during 1914. This advance was offset in a measure by the low price of copper and the financial depression resulting from the European war. The mining industry of the Territory can, as a whole, be said to have had a prosperous year, though the value of the total mineral output is somewhat less than that of 1913. This was due largely to the decrease in the price of copper, for the gold output was a little larger than that of the previous year.

A noteworthy feature of the mining industry in 1914 was the great number of investigations that were made on behalf of capitalists looking for properties that would warrant development on a large scale. This was true in nearly all the mining districts, but, as was to be expected, it was more pronounced in the south-central region, which will be directly benefited by the building of the Government railroad. With the consequent opening of the coal fields we can now look forward with confidence to the early establishing of copper smelters in the coastal districts, and possibly at no distant day to the utilization of some of the iron ores. The choice of the Seward-Fairbanks route, with a branch to the Matanuska coal field, having been announced, the regions thus served will probably receive the earliest development, but that the trans-Alaska line is expected to benefit other parts of the Territory is indicated by important developments undertaken in southeastern Alaska, in Seward Peninsula, and other districts remote from any railroad route under consideration. The new railroad will undoubtedly, directly or indirectly, benefit all parts of the Territory. The regions tributary to the proposed line will receive the direct benefit, but other regions will obtain cheaper fuel. Moreover, the project will attract population and capital to other parts of the Territory, especially to those parts that are already served by the existing railways or water transportation.

Outside of the Government railroad project there was little change during the year in the transportation system of Alaska. Some of the existing lines were operated, including the White Pass, Copper River & Northwestern, and Tanana Valley railroads and part of the line of the Alaska Northern Railway. The Alaska Northern line has now been purchased by the Government. The Alaska Road Commission continued its important work of constructing wagon roads and trails.

The installation of dredges has continued chiefly on Seward Peninsula, but to a lesser extent in the Yukon basin. The high price of fuel has in a large measure discouraged the utilization of dredges on the extensive deposits of auriferous gravels in the Fairbanks and other inland districts that can not be profitably mined by the methods now in use. Quartz mining at Fairbanks is almost at a standstill for the same reason. On the other hand, the auriferous lode mines on or near the coast made notable advances during the year, especially in the Juneau, Port Wells, and Willow Creek districts. In southeastern Alaska the utilization of the water powers, both for mining and other industries, made notable advance in 1914.

Although the actual production of copper was less than in 1913, the copper-mining industry made greater advances in 1914 than in any previous year. Large copper developments were under way during the year in the Ketchikan, Prince William Sound, and Chitina districts, though these were in a measure curtailed when the copper market became demoralized after hostilities began in Europe. There is good reason to believe that the copper output of 1915 will be larger than that of any previous year.

The development of both lode and placer tin deposits in the York district of Seward Peninsula was continued. There was also an increase in the amount of placer tin recovered from the Hot Springs gold placers.

There was no change in the coal-mining situation during the year, though the passage of the leasing law stimulated interest in Alaskan coal fields. The Katalla field produced some oil in 1913, but in the absence of any hope of obtaining title or lease of oil lands there was no prospecting except on patented claims. Marble and gypsum deposits were worked in southeastern Alaska, as in previous years, and some beginning was made in the opening up of barite deposits.

PRODUCTION.

The value of the total mineral production of 1914 is estimated at \$19,118,080; in 1913 it was \$19,476,356. The statistics for 1914 are

not yet complete, and the figures given in the subjoined table may be subject to slight change. The output of marble, gypsum, petroleum, and other minor products is given under a single item because separate listing might reveal the production of individual properties.

Mineral production of Alaska, 1913 and 1914.

	1913		1914		Increase (+) or decrease (-).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	755,947	\$15,626,813	762,596.03	\$15,764,259	+ 6,649.03	+\$137,446
Silver.....do.....	362,563	218,988	394,805	218,327	+ 32,242	— 661
Copper.....pounds..	21,659,958	3,357,293	21,450,628	2,852,934	-209,330	— 504,359
Tin.....tons of metallic tin..	69	44,103	104	66,560	+ 35	+ 22,457
Coal.....short tons..	2,300	13,800	.....	.....	- 2,300	— 13,800
Marble, gypsum, lead, petroleum, etc.....	.....	215,359	.....	216,000	.....	+ 641
	.....	19,476,356	.....	19,118,080	.....	- 358,276

Productive mining began in Alaska in 1880, when the Juneau gold placers were first exploited. It is estimated that since that time mineral wealth has been produced to the value of \$268,151,936. This output by years and by substances is summarized in the following table:

Value of total mineral production of Alaska, 1880-1914.^a

By years.	By years.	By substances.
1880-1890.....\$4,686,714	1904.....\$9,569,715	Gold.....\$244,156,799
1891.....916,920	1905.....16,480,762	Silver.....2,278,518
1892.....1,098,400	1906.....23,378,428	Copper.....19,780,452
1893.....1,051,610	1907.....20,850,235	Tin.....380,006
1894.....1,312,567	1908.....20,145,632	Lead.....67,142
1895.....2,388,042	1909.....21,146,953	Coal.....361,189
1896.....2,981,887	1910.....16,887,244	Marble, gypsum, petroleum, etc.....1,127,830
1897.....2,540,401	1911.....20,691,241	
1898.....2,587,815	1912.....22,536,849	
1899.....5,706,226	1913.....19,476,356	
1900.....8,241,734	1914.....19,118,080	
1901.....7,010,838		
1902.....8,403,153		
1903.....8,944,134	268,151,936	268,151,936

^a Some slight changes from those previously published have been made in this table.

^b Preliminary estimate.

The following table is an estimate of the total production of gold, silver, and copper since the beginning of auriferous mining in 1880. For the earlier years, and this is especially true of the silver, the figures are probably far from being correct, but they are based on the best information now available.

Production of gold, silver, and copper in Alaska, 1880-1914.

Year.	Gold.		Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commer- cial value.	Quantity (pounds).	Value.
1880.....	967	\$20,000				
1881.....	1,935	40,000				
1882.....	7,256	150,000				
1883.....	14,561	301,000	10,320	\$11,146	3,933	\$826
1884.....	9,728	201,000				
1885.....	14,512	300,000				
1886.....	21,575	446,000				
1887.....	32,653	675,000				
1888.....	41,119	850,000	2,320	2,181		
1889.....	43,538	900,000	8,000	7,490		
1890.....	36,862	762,000	7,500	6,071		
1891.....	43,538	900,000	8,000	7,920		
1892.....	52,245	1,080,000	8,000	7,000		
1893.....	50,213	1,038,000	8,400	6,570		
1894.....	62,017	1,282,000	22,261	14,257		
1895.....	112,642	2,328,500	67,200	44,222		
1896.....	138,401	2,861,000	145,300	99,087		
1897.....	118,011	2,439,500	116,400	70,741		
1898.....	121,760	2,517,000	92,400	54,575		
1899.....	270,997	5,602,000	140,100	84,276		
1900.....	395,030	8,166,000	73,300	45,494		
1901.....	335,369	6,932,700	47,900	28,598	250,000	40,000
1902.....	400,709	8,283,400	92,000	48,590	360,000	41,400
1903.....	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904.....	443,115	9,160,000	198,700	114,934	2,043,586	275,676
1905.....	756,101	15,630,000	132,174	80,165	4,805,236	749,617
1906.....	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907.....	936,043	19,349,743	149,784	98,857	6,308,786	1,261,757
1908.....	933,290	19,292,818	135,672	71,906	4,585,362	605,267
1909.....	987,417	20,411,716	147,950	76,934	4,124,705	536,211
1910.....	780,131	16,126,749	157,850	85,239	4,241,689	538,695
1911.....	815,276	16,853,256	460,231	243,923	27,267,878	3,408,485
1912.....	829,435	17,145,951	515,186	316,839	29,230,491	4,823,031
1913.....	755,947	15,626,813	362,563	218,988	21,659,958	3,357,293
1914.....	762,596	15,764,259	394,805	218,327	21,450,628	2,852,934
	11,811,084	244,156,799	3,851,406	2,278,518	133,404,063	19,780,452

In the following table the total production of gold is distributed according to districts so far as the information at hand will permit. The error in the distribution of total production previous to the year 1905, when systematic collection of Alaska's mineral output was begun, is believed to be less than 15 per cent. Complete statistical returns from all producers are not even now available, so that there is probably still some error in the distribution of the totals to the various districts. This error is, however, believed to be less than 3 per cent, and it is hoped that in future it may be eliminated altogether.

The production from the Pacific coast belt is derived principally from the lode mines of southeastern Alaska, but includes also the output of the lode mines of Prince William Sound and southwestern Alaska, as well as a small output from gold placers. Previous to 1885 the placers of the Juneau district yielded considerable gold, and since 1899 the Porcupine district of southeastern Alaska has been a small producer. The beach placers along the Pacific seaboard have been worked spasmodically since about 1890.

Up to 1909 all the gold from the Copper River and Cook Inlet region was derived from gold placers; since then there has been an output from the auriferous lodes of Willow Creek and Kenai Peninsula. The gold output of Seward Peninsula is practically all derived from placers, and although there has been a little lode mining on the peninsula, none was done in 1914. Since 1910 there has been a small lode production from the Fairbanks district, which in 1914 amounted to about 6 per cent of the total.

Since 1909 some gold has been recovered each year from placers in the lower Kuskokwim basin. In the table which follows this is included in the output of the Yukon basin. It should be noted that the figures for the Yukon gold output include only the Alaska camps and not the Klondike and other Canadian districts.

Value of gold production of Alaska, with approximate distribution, 1880-1914.

Year.	Pacific coast belt.	Copper River and Cook Inlet region.	Yukon basin.	Seward Peninsula and north-western Alaska.	Total.
1880.....	\$20,000	.....	.....	.....	\$20,000
1881.....	40,000	.....	.....	.....	40,000
1882.....	150,000	.....	.....	.....	150,000
1883.....	300,000	.....	\$1,000	.....	301,000
1884.....	200,000	.....	1,000	.....	201,000
1885.....	275,000	.....	25,000	.....	300,000
1886.....	416,000	.....	30,000	.....	446,000
1887.....	645,000	.....	30,000	.....	675,000
1888.....	815,000	.....	35,000	.....	850,000
1889.....	860,000	.....	40,000	.....	900,000
1890.....	712,000	.....	50,000	.....	762,000
1891.....	800,000	.....	100,000	.....	900,000
1892.....	970,000	.....	110,000	.....	1,080,000
1893.....	838,000	.....	200,000	.....	1,038,000
1894.....	882,000	.....	400,000	.....	1,282,000
1895.....	1,569,500	\$50,000	709,000	.....	2,328,500
1896.....	1,941,000	120,000	800,000	.....	2,861,000
1897.....	1,799,500	175,000	450,000	\$15,000	2,439,500
1898.....	1,892,000	150,000	400,000	75,000	2,517,000
1899.....	2,152,000	150,000	500,000	2,800,000	5,602,000
1900.....	2,606,000	160,000	650,000	4,750,000	8,166,000
1901.....	2,072,000	180,000	550,000	4,130,700	6,932,700
1902.....	2,546,600	375,000	800,000	4,561,800	8,283,400
1903.....	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904.....	3,195,400	500,000	1,300,000	4,164,600	9,160,000
1905.....	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906.....	3,454,794	332,000	10,750,000	7,500,000	22,036,794
1907.....	2,891,743	275,000	9,183,000	7,000,000	19,349,743
1908.....	3,448,318	401,500	10,323,000	5,120,000	19,292,818
1909.....	4,264,716	265,000	11,580,000	4,302,000	20,411,716
1910.....	4,182,730	351,630	8,062,389	3,530,000	16,126,749
1911.....	4,265,573	313,538	9,139,145	3,135,000	16,853,256
1912.....	4,904,753	358,401	8,857,797	3,025,000	17,145,951
1913.....	4,529,529	378,643	8,183,641	2,535,000	15,626,813
1914.....	4,538,157	597,681	7,895,421	2,735,000	15,764,259
	70,450,313	6,008,393	99,055,393	68,642,700	244,156,799

• Includes a small proportion from the Kuskokwim basin.

The subjoined table is an estimate, based on the best available data, of the source of the gold, silver, and copper produced in Alaska since mining began in 1880. About \$65,100,000 worth of gold, or nearly a third of the total output, was produced previous to 1905,

and there is but scant information about its source. Since that time fairly complete statistics of production are available, and it is believed that the figures here presented are near enough to the truth to have value. The figures given in this table for the silver recovered from placer gold and from siliceous ores are probably less accurate than those for the gold. Copper mining did not begin in Alaska until 1901, and the figures for gold and silver from this source should therefore be a close approximation to the actual output:

Estimate of sources of gold and silver in Alaska, 1880-1914, by kinds of ore.

	Gold.		Silver.	
	Quantity.	Value.	Quantity.	Value.
Siliceous ores.....	<i>Fine ounces.</i> 3,264,787	\$67,489,141	<i>Fine ounces.</i> 894,847	\$612,533
Copper ores.....	46,181	954,666	1,462,348	840,029
Placers.....	8,500,116	175,712,992	1,494,311	825,956
	11,811,084	244,156,799	3,851,506	2,278,518

Tin mining began in Alaska in 1902, since when about 526 tons of metallic tin has been recovered, valued at \$380,006. (See pp. 81-94.) Most of this has been taken from the placers of the York district, of Seward Peninsula, but there has been a little tin lode mining in the same district. Some stream tin has also been recovered from the gold placers of Hot Springs district, in the lower Tanana region.

There has been relatively little mining of galena ores as such, but some lead has been recovered in the treatment of ores mined chiefly for other metals. The first treatment of such galena-bearing ores was in 1892, and since that time 796 tons of lead, valued at \$67,142, has been recovered. It is worthy of record here that galena deposits were among the first lodes to be developed in Alaska. Galena was found in the Fish River basin, in the eastern part of Seward Peninsula, in 1881,¹ about the time of the discovery of the Treadwell lode at Juneau. Here some developments were made at what was called the Omalik mine as early as 1882. Some ore has been shipped from this property, but the mine has never been on a regular productive basis.

The only other galena ores mined in Alaska are located in southeastern Alaska. These operations, which have been on only a small scale, were on deposits² located on Cholmondeley Sound, an indentation of the eastern shore of Prince of Wales Island, and on Coronation Island, which lies in the lower end of Lynn Canal.

¹ Smith, P. S., and Eakin, H. M., A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska: U. S. Geol. Survey Bull. 449, p. 130, 1911.

² Wright, F. E. and C. W., The Ketchikan and Wrangell mining districts, Alaska: U. S. Geol. Survey Bull. 347, 1908.

There has been a little mining of cinnabar on the lower Kuskokwim since 1908. The cinnabar has been treated at the mine in a small retort, and the total recovery from this industry has been about 700 pounds of quicksilver.

Besides that listed above, there has been no production of other metals from Alaska on a commercial scale, though some test shipments of iron and antimony ores have been made.

The first coal mining in Alaska was done on Kachemak Bay,¹ Cook Inlet, in 1888. Since that time 47,969 short tons of coal has been produced, valued at \$362,029. This is practically all lignite, except for a few thousand tons of bituminous coal mined on Bering Lake in 1906-7. During the epoch of railway building at Katalla in 1908 some petroleum was pumped from the oil wells near by for local use as fuel. Since 1912 an oil company has operated in the Katalla field and made an annual production.

Marble has been produced in southeastern Alaska since 1901 to a total value of about \$650,000. A gypsum deposit on Chichagof Island, in southeastern Alaska, has been operated on a productive basis since 1905. There has been some mining of garnet in southeastern Alaska, near Wrangell. Several years ago some shipments of mineral water were made from a spring near Wrangell. A little graphite has been produced on Seward Peninsula. Some volcanic ash has been shipped from Kodiak during the last three years for use as an abrasive.

METAL MINING.

GENERAL FEATURES.

In 1914 about 32 per cent of the total gold production came from lode mines, the balance from placer mines. In 1913 31.6 per cent of the total gold output was credited to lode mines; in 1912 the amount so credited was 29 per cent of the total. In the following table the production of precious metals has been distributed as to sources:

Sources of gold, silver, and copper in Alaska, 1914, by kinds of ore.

	Total quantity.	Gold.		Silver.		Copper.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>	<i>Fine ounces.</i>		<i>Fine ounces.</i>		<i>Pounds.</i>	
Siliceous ores.....	1,738,127	235,248.98	\$4,863,028	28,254	\$15,624		
Copper ores.....	153,605	8,283.30	171,231	283,355	156,695	21,450,628	\$2,852,934
Placers.....		519,063.75	10,730,000	83,196	46,008		
	1,891,732	762,596.03	15,764,259	394,805	218,327	21,450,628	2,852,934

¹ Martin, G. C., Johnson, B. L., and Grant, U. S., *Geology and mineral resources of Kenai Peninsula, Alaska*: U. S. Geol. Survey Bull. 587, pp. 107-110, 1915.

Alaska's auriferous lode mines produced during the year 235,249 fine ounces of gold, valued at \$4,863,028, compared with 232,916 fine ounces, valued at \$4,814,813, in 1913. These mines made an output of 28,254 fine ounces of silver, valued at \$15,624, in 1914, and 30,897 ounces, valued at \$18,662, in 1913.

Twenty-eight gold-lode mines, including several properties which made only small outputs, were operated the whole or a part of the year 1914 in Alaska—two less than in 1913. Work was also done on many gold prospects, some of which produced a little gold. Of the producing mines nine were in southeastern Alaska, eight on Prince William Sound, four in Kenai Peninsula, three in the Willow Creek district, and four in the Fairbanks district. It is estimated that these mines had an output of 1,738,127 tons of ore, compared with 1,614,506 tons in 1913. In 1913 the average value of the gold and silver contents for all the ores mined was \$2.99 a ton; the average for 1914 was \$2.79.

Six copper mines were operated in Alaska for a whole or a part of the year 1914, compared with seven in 1913. Of these two were in the Ketchikan district, two on Prince William Sound, and two in the Kotsina-Chitina district. The total production of copper in 1914 is estimated to have been 21,450,628 pounds, valued at \$2,852,934, compared with 21,659,958 pounds, valued at \$3,357,293, in 1913. About \$171,231 worth of gold and \$156,695 worth of silver were recovered from the copper ores. It is estimated that in 1914 about 153,605 tons of copper ore was mined, compared with 135,730 tons in 1913. The average copper content of the ore was about 6.98 per cent and the value of the gold and silver recovered about \$2.04 to the ton.

It is estimated by the mine inspector for the Territory of Alaska that during the fiscal year ending June 30, 1914, 4,500 men were engaged in lode mining.¹ Though this is the fiscal and not the calendar year, it serves to indicate approximately the number of men employed in 1914.

The value of the placer gold produced in 1914 is estimated at \$10,730,000; that of 1913 was \$10,680,000. As compared with the previous year there was a decrease in the placer-gold output from the Fairbanks, Koyukuk, and Fortymile districts and an increase from the Ruby and Seward Peninsula districts, as well as from some of the smaller camps. It is estimated that about 730 placer mines were operated in 1914, but many for only a part of the season; the number was 700 in 1913. About 4,740 men were engaged in productive placer mining, most of them for only a small part of the

¹ Smith, S. S., Report of the mine inspector for the Territory of Alaska to the Secretary of the Interior for the fiscal year ended June 30, 1914, p. 10.

year. In addition there were probably 500 to 1,000 men engaged in prospecting and other nonproductive work relating to the placer-mining industry.

Two new localities where placer gold occurs were reported in 1914, both in the Tanana basin. One is on a stream tributary to the lower Healy River and, so far as now known, includes only a small area of auriferous gravels. The other is in the upper Tolovana basin, and here, according to reports of prospectors, the outlook for placer mining is rather encouraging.

In accordance with past practice, a table is given here to show approximately the total bulk of gravel mined annually in Alaska for several years and the value of the gold recovered per cubic yard. This table is based on certain assumptions which do not now admit of proof but which are supported by a large number of facts. Therefore, although the table is only approximately correct, it indicates the magnitude of the true figures.

Estimated total amount of gravel sluiced in Alaska placer mines and value per cubic yard of gold recovered, 1908-1914.

	Total quantity of gravel.	Value of gold recovered per cubic yard.		Total quantity gravel.	Value of gold recovered per cubic yard.
	<i>Cubic yards.</i>			<i>Cubic yards.</i>	
1908.....	4,275,000	\$3.74	1912.....	7,050,000	\$1.70
1909.....	4,418,000	3.66	1913.....	6,800,000	1.57
1910.....	4,036,000	2.97	1914.....	8,500,000	1.26
1911.....	5,790,000	2.17			

Forty-two gold dredges were operated for a whole or a part of the mining season in 1914. Of these, 39 were located on Seward Peninsula, 2 in the Iditarod district, and 1 in the Fairbanks district. It is estimated that these dredges handled 4,450,000 cubic yards and made a gold recovery of \$2,350,000. The average gold content of the gravels mined is 50 cents to the cubic yard. In 1913, 35 gold dredges were operated and handled about 4,100,000 cubic yards, having a value of \$2,200,000. Two of the gold dredges operating on Seward Peninsula in 1914 are on Anikovik River, in the York district, and were used to recover stream tin as well as gold. In addition to these, the dredge on Buck Creek was operated on a tin placer, as in previous years.

Some attempts at gold dredging were made in Alaska as early as 1900. This form of mining did not, however, reach a profitable stage until about 1903, when two small dredges were successfully operated on Seward Peninsula. In 1907 a dredge was installed in the Fortymile district, the first in the Alaska part of the Yukon basin. Up to the close of 1914 gold to the value of \$10,100,894 had

been mined in Alaska by dredges. The growth of the gold-dredging industry is indicated by the following table:

Estimate of gold production from dredge mining in Alaska, 1903-1914.

Year.	Number of dredges operated.	Value of gold output.	Year.	Number of dredges operated.	Value of gold output.
1903.....	2	\$20,000	1910.....	18	\$800,000
1904.....	3	25,000	1911.....	27	1,500,000
1905.....	3	40,000	1912.....	38	2,200,000
1906.....	3	120,000	1913.....	36	2,200,000
1907.....	4	250,000	1914.....	42	2,350,000
1908.....	4	170,901			
1909.....	14	424,993			10,100,894

MINERAL FUELS.

In 1913 only one coal mine was operated in Alaska. This, the Wharf mine, located at Port Graham, on Cook Inlet, produced lignitic coal, which found a local market. In 1914 this mine was closed and not a single commercial coal mine was operated in the Territory. There was, however, a little mining of lignitic coal at several localities for individual use. The following table shows the coal consumption of Alaska from 1899 to 1914:

Coal consumption of Alaska, by sources, 1899 to 1914, in short tons.

Year.	Imported from States, chiefly from Washington.		Produced in Alaska, chiefly subbituminous and lignite. ^a	Total domestic, chiefly from Washington. ^a	Total foreign coal, chiefly bituminous, from British Columbia. ^b	Total coal consumed.
	Bituminous.	Anthracite.				
1899.....	c 10,000		c 1,200	11,200	50,120	61,320
1900.....	15,048		c 1,200	16,248	56,623	72,871
1901.....	c 24,000		c 1,300	25,300	77,674	102,974
1902.....	c 40,000		2,212	42,212	68,363	110,575
1903.....	64,625	1	1,447	66,073	60,605	126,678
1904.....	36,689		1,694	38,383	76,815	115,198
1905.....	67,707	6	3,774	71,487	72,567	144,054
1906.....	68,960	533	5,541	75,034	47,590	122,624
1907.....	45,130	1,116	10,139	56,385	88,596	144,981
1908.....	23,402	491	3,107	27,000	72,831	99,831
1909.....	33,112		2,800	35,912	74,316	110,228
1910.....	32,138		1,000	33,138	73,904	107,042
1911.....	32,255		900	33,155	88,573	121,728
1912.....	27,767		355	28,122	59,804	87,926
1913.....	61,666		c 2,300	63,966	60,600	124,566
1914.....	37,062			37,062	21,882	58,944
	619,561	2,147	38,969	660,677	1,050,863	1,711,540

^a By calendar years.

^b By fiscal years ending June 30.

^c Estimated.

The decline in coal consumption is more than made up by the increase in consumption of crude petroleum and gasoline. (See p. 39.) Most of the coal shipped to Alaska is used along the Pacific seaboard. In 1914 a total of 2,087 tons of domestic coal and 446 tons of foreign

coal was received at Nome.¹ This represents the total coal consumption of Seward Peninsula, except for a little lignite mined at Chicago Creek, in the Fairhaven district. Fifty tons of coal were received at the port of St. Michael,² largely for local use, but including a little blacksmith coal shipped up the Yukon to the mining camps. Practically all the rest of the coal, amounting to some 36,807 tons, was used in southeastern Alaska, on Prince William Sound, in the lower Copper River region, and at other points along the Pacific seaboard. Some is shipped to canneries on Bristol Bay, to the Pribilof Islands, and for the use of local steamers to Unalaska. This tonnage does not include the consumption by steamers plying between Alaska and Puget Sound ports. It should be noted, however, that many of these steamers are oil burners.

Steaming tests have now been made by the Navy Department of coal from one or two beds in each of the high-grade fields—the Bering River and Matanuska. The results of the tests of Bering River coal have been published in complete form, and as the report may not be available to all who receive this volume the following data are extracted from it:³

The test was made on about 855 tons of coal mined under the direction of R. Y. Williams, a mining engineer detailed from the United States Bureau of Mines. The coal was taken from the Tenino claim of the so-called Cunningham group. Of the total coal mined, 674 tons was taken from one opening, and most of the coal appears to have been taken from a single bed. Mr. Williams estimates the cost of mining this coal at \$3.05 a ton, including all overhead charges.

General conclusions in regard to the occurrence of the coal are summarized as follows:⁴

As the actual detailed examination of this region proceeded in connection with the extraction of the large sample of coal for subsequent ship test it was found that all of these beds upon which excavations were made proved to be lenticular or otherwise irregular in shape, and the coal proved to vary from high-grade and fairly lumpy coal at certain places to a crushed coal, which at some points was high-grade and at other points a decidedly low-grade material.

The conclusions of the Navy Department in regard to the steaming tests made on this coal are summarized as follows:⁵

It is with regret, then, that the department reports that the recent tests show conclusively that Bering River coal, mined from selected veins in one of the most promising portions of the field, is entirely unsuitable for naval use. Formerly the defect that gave the greatest concern was the general crushed condition of the coal, from which a large percentage of slack might be expected.

¹ Data received through courtesy of deputy collector of customs at Nome.

² Data received through courtesy of deputy collector of customs at St. Michael.

³ Report on coal in Alaska for use in United States Navy: 63d Cong., 2d sess., H. Doc. 876, 1914.

⁴ *Idem*, p. 7.

⁵ *Idem*, pp. 122-123.

An adequate percentage of lump was found, however, although it developed that much if not all of the slack must be washed, for it appears impossible for the miner to avoid knocking down the black shale bands with the coal, and the separation of these impurities from the coal is not practicable in any other way than by washing, which increases the cost of mining while not overcoming the inherent objections to slack coal.

The coal, however, failed on account of its property of forming large, tenacious clinker—probably the most serious defect that can be developed by a coal for marine use. Whether or not a nonclinking coal of good chemical and physical qualities exists in the field is an unsolved problem. The Bering River sample tried by the *Nebraska* in 1908 did not clinker at the low rate of combustion and consequent low furnace temperatures pertaining during that inconclusive trial. However, neither did the Bering River coal recently tested clinker under natural draft. Coal from that part of the field from which the *Nebraska* sample was mined is generally slack and apparently not in this respect equal in physical qualities to the all-round satisfactory grade which it is hoped may be found.

It thus appears that in a field like the Bering River, where in a comparatively small area anthracite, semianthracite, and semibituminous coals are found, and moreover, where the measures have been so extensively disturbed, lack of uniformity in grade may be expected. It seems, therefore, that if coal suitable for naval use exists, it can not be spotted by chemical or physical excellence, but must be searched out by the laborious and expensive but conclusive methods of trial under service conditions.

The clinking of coal is a subject on which but little of value is known from analysis. It varies with the type of grate, rate of combustion, depth of fire, and draft, so that the only positive guide as to its existence, nonexistence, or extent is a trial under the actual conditions under which the coal will be used. For this reason the department would not regard a field test for clinking—analyzing, taking temperatures of ash fusibility, tests in small grates or boilers—as information of any positive value. This procedure would be expensive and the results probably misleading. Now that the Alaskan railroads will be built, and a line extended into the Bering River fields, and the coal fields probably opened to leasing, the further test of coal from these fields for naval use should be resumed as soon as possible after the completion of the road, and after general development has set in in the coal fields, by the trial of large samples (cargoes) from various seams. In this manner only, in the department's opinion, can the existence of a satisfactory coal for naval use be ascertained.

In conclusion, the failure on test of the excellent Bering River sample at the engineering experiment station from severe and unusual clinking—a sample better in all respects than the Pocahontas used in comparative test—obliges the department to regard and so report the Bering River field to be unavailable as a source of coal for the Navy until extensive development definitely locates coal not possessing the serious objection found in the sample tested by the department.

This must not be regarded as a conclusive test of the quality of coal in the entire Bering River field. Martin,¹ who surveyed the field in detail in the seasons of 1904 to 1906, has shown that there

¹ Martin, G. C., *Geology and mineral resources of the Controller Bay region, Alaska*: U. S. Geol. Survey Bull. 335, 1908.

are many beds in the field and much variation in the quality of the coal in different parts of the coal-bearing area. Therefore, while the test recorded above shows that the beds mined do not carry the high-grade coal demanded for naval use, yet this by no means condemns the entire field. There can be no doubt that the Bering River field includes a large amount of steaming coal in beds that can be mined.

In 1913 about 1,100 tons of coal was mined at Chickaloon, in the Matanuska field, under the direction of the United States Bureau of Mines. This was presumably taken from one or two beds. This coal was sledged to the coast during the winter and subjected to a steaming test by the Navy Department. The complete report on this examination and test has not been published, so that no data are available on the cost of mining, underground conditions, etc. The coal field has, however, been reported upon in detail by Martin and Katz.¹

The test of the coal showed it to be satisfactory for naval use, as shown by the following report:²

NAVY DEPARTMENT, SUMMARY REPORT ON TEST OF MATANUSKA COAL.

Port test, seven days.—All coal, ash, and clinker were weighed, one boiler was used, forced draft was necessary on two days. Run of mine coal was used for five days, slack for one day, and lump coal for one day. There were no casualties. Coal burned very freely. Firing was very good, the analyses of flue gases giving rarely below 9 per cent of CO₂. There was little clinker, but the ash was several per cent higher than with the Pocahontas coal. Draft was good and coal burned with bright-yellowish flame. Coal coked very nicely; the coke was friable and very easily worked by the firemen. Fires 6 inches to 8 inches thick were carried most of the time, although occasionally they were heavier. The ash fused into clinker on the grate bars, generally about 2 inches thick, medium weight, porous, a little tough and hard while hot but friable when cold. The clinker had a little ash mixed throughout the mass. It stuck a little to the bridge wall, but not seriously. The soot deposit was about 25 per cent more than the Pocahontas coal. The soot was a little different from that of the Pocahontas, as the granules appeared as minute fused grains. The load during this week of test would ordinarily have required two boilers burning Pocahontas coal.

Four-hour forced draft.—Fires thin; dampers partly closed. Fires burned brightly; work of firing very easy on account of ease of breaking up the coke. Furnaces one mass of yellowish flame. Not an excessive amount of ash formed. The men, on being questioned, all said it was the easiest 20-knot run they had ever made.

Twenty-four hour 15-knot test.—Started with 12 boilers, but necessary to cut out four boilers to get the highest efficiency. Coal burned with greatest ease, forming a very easily worked coke, not an excessive amount of ash or clinker,

¹ Martin, G. C., and Katz, F. J., *Geology and coal fields of the lower Matanuska Valley, Alaska*: U. S. Geol. Survey Bull. 500, 1912.

² Alaska railroads, statement of Hon. Franklin K. Lane, Secretary of Interior. Monday, February 1, 1915: Sundry civil bill, 1916, supplement to hearings before subcommittee of House Committee on Appropriations, pp. 15-17.

and in general appeared easier to handle than Pocahontas coal. CO₂ analysis generally high, over 9 per cent. Fires, carried 6 inches to 8 inches thick, were always glowing, ash pans bright, and the furnaces a mass of yellowish incandescent flame. Coal burned like pine knots. The amount of clinker was not excessive, was more or less easy to work, and very friable when cold. Fires were noticeably hot. Amount of soot made was a little higher than is usually made by good Pocahontas coal, about 10 per cent more.

Ten-knot test.—Started with six boilers, but it was found necessary to cut out two boilers to give greatest efficiency. This power was more than ample, as at times there were four evaporators in use. Fires were very easily worked; the coke broke up easily; clinker was not very hard; bright, level fires from 6 inches to 8 inches thick and sometimes thicker were carried, and CO₂ was generally high.

General remarks.—There was very little foreign matter. The slack appeared to burn better than the lump. No evidences of gases being given off from the coal during the test. The noticeable characteristic of this coal is friability. Lumps pulverize very easily.

Port test of seven days.

Coal.	Total tons.	Water evaporated.	Coal per gallon.	Ash.	Efficiency.
		<i>Gallons.</i>	<i>Pounds.</i>	<i>Per cent.</i>	<i>Per cent.</i>
Pocahontas.....	94.291	248,610	1.168	11.04	100
Bering River.....	136.391	247,783	.811	36.6	69.4
Matanuska.....	116.185	305,446	1.177	15.8	100.3

Four-hour forced draft, speed 20 knots.

Coal.	Total tons.	Ash.	Smoke by scale.	Knots per ton.	Indicated horsepower.	Pounds per indicated horsepower.	Steaming radius.	Average efficiency.
		<i>Per cent.</i>						<i>Per cent.</i>
Pocahontas.....	79.1	8.8	2.4	1.02	20,820.3	2.09	2,367.8	100
Bering River.....	127.3	38.8	1.5	.60	13,992.3	5.32	.....	.....
Matanuska.....	85.484	18.67	2.8	.93	19,929.15	2.32	2,002.2	91

15 knots, 24-hour test.

Coal.	Total tons.	Ash.	Smoke by scale.	Knots per ton.	Indicated horsepower.	Pounds per indicated horsepower.	Steaming radius.	Average efficiency.
Pocahontas.....	153.155	7.6	1.25	2.38	7,083	2.01	4,781	100
Bering River.....	160.3	35.0	.60	1.09	7,600	4.98	2,372	43
Matanuska.....	157.212	14.59	1.99	2.29	6,142.37	2.15	4,796.3	96

10 knots, 48-hour test.

Coal.	Total tons.	Ash.	Smoke by scale.	Knots per ton.	Indicated horsepower.	Pounds per indicated horsepower.	Steaming radius.	Average efficiency.
Pocahontas.....	137.325	10.5	1.18	3.515	2,134	3.08	7,077	100
Matanuska.....	118.582	15.67	1.86	3.37	2,686.527	3.09	7,160.6	98

The board found that this sample of Matanuska coal tested is suitable in every respect for use in the naval service.

DEPARTMENT OF THE INTERIOR,
BUREAU OF MINES,*Experiment Station, Pittsburgh, Pa., December 17, 1914.*Subject: Report on tests of Matanuska coal on U. S. S. *Maryland*.The Director: The following is Mr. Flagg's report upon the tests of Matanuska coal aboard the U. S. S. *Maryland*:*Inspection and loading.*

Upon the *Maryland's* arrival at Bremerton a visit was made to the coal dock, where some 7,700 sacks of the coal were stored under cover. On account of the receipt of a letter from the Bureau of Steam Engineering stating that preliminary tests at Annapolis indicated high ash content and instructing that the necessary preparation be given the coal, a preliminary inspection was made to gain some idea as to the quality of the coal. Rough determinations of the ash contents of the different-sized parts of a sample taken from six bags at random failed to show any excessive percentages of ash, so the coal was loaded onto the lighters and placed in the ship's bunkers.

During the loading of the lighters a shovelful of coal was taken from every fifth bag and retained for a sample. This sample (of about 3 tons) was worked over and one can retained. From the same sample a portion (about 800 pounds) was taken for a sizing test. The percentages of the different sizes, the analyses of the samples of the several sizes, and the analysis of the general sample are given in attached sheets.

Seven-day port test.

The port test was begun as soon as one lighter of coal had been taken on. The load during part of the test period was heavy but was carried throughout the test on one boiler. Fires were cleaned every 12 hours, by which time about 2 inches of clinker had formed. The clinker was medium weight, rather porous, and dark colored, with small pieces of light-gray ash mixed in with the fused portion. The clinker stuck some to the bridge wall, but not enough to cause serious trouble, and did not stick to the grates at all. In the furnace the clinker could be broken fairly easily; when cold it was brittle and easily broken.

During the port test the gas analyses showed 10 to 12 per cent CO₂ with probably 0.3 to 0.4 per cent CO. The effort was to carry fires 7 to 8 inches thick, but they were heavier much of the time, thus accounting in one way for the presence of CO.

The soot formed was comparatively free from tarry matter and hence did not adhere to the tubes as much as does that from Pocahontas coal, although the amount of soot formed by the Matanuska coal was more than with Pocahontas.

The figures for the evaporation, on account of the difficulties incident to the measurement of the feed water, can only be considered approximate at best. The figures obtained during the port test showed an evaporation equal to or a little better than was obtained during the test with Pocahontas coal made by the *Maryland* in 1913.

On the last two days of the port test the use of screened coal was tried. The coal for this purpose was screened on the lighter alongside the dock. One day all of the coal remaining on a 4-mesh screen was used; and on the other that which passed through the screen. The only trouble experienced with the finer coal was that the natural draft was not quite strong enough to maintain the required rate of combustion at all times.

20-knot test.

The excellent steaming properties of this coal were plainly shown in this test. For a time it looked as if it would be possible to make the turns for 20 knots without putting on the blowers, but it was not done. With about three-fourths inch pressure of air in the firerooms, however, there was an abundance of steam, and steam could be raised to the popping-off pressure at any minute. This condition obtained throughout the 4-hour test, and at its close the fires were still in excellent steaming condition.

15-knot test.

For the 15-knot test twelve boilers were lit up, but soon after the test was started two of these were put out and later a third. During the remainder of the test the turns were kept up most of the time with eight boilers working and the ninth banked. Difficulty in maintaining the desired steam pressure with the eight boilers was experienced only at times of cleaning the fires, and then only when the fires were cleaned too soon after each other. For cruising at this speed it has been the practice to use ten boilers with eastern coal.

10-knot test.

Six boilers were lit for this run, but one was banked almost at the start of the test, and later it was cut out. About 2½ hours after the test started a second boiler was banked, and this was cut out when the test had been in progress 9 hours. During the remainder of the test four boilers only were used, these furnishing plenty of steam to make the proper number of turns and keep the regular auxiliaries going. For this speed the practice has been to use six boilers with Pocahontas coal. So far as is known the *Maryland* has never before made turns for 10 knots with only four boilers in use.

General.

The coal as stored on the dock was dry, but was wet on the lighters after they were placed alongside the ship. Neither on the dock nor in the bunkers was any tendency to heating noticed. The coal was almost entirely free from lumps, but for the most part was not objectionably fine.

It is a fairly friable coal, has moderate coking tendency, and is excellent for steaming purposes. The volatile matter appears to be fairly easily driven off, but is not difficult to burn.

From the standpoint of smokelessness the coal is also very desirable. Under natural draft the stack observations ranged between No. 0 and No. 3 (Rengelmann chart), averaging somewhat above No. 2. Under forced draft during the 4-hour run the smoke averaged about the same, but showed less of the heavier smoke. The smoke is somewhat less in density than that from Pocahontas and it is not as black.

Both officers and men cooperated heartily with the Bureau's engineer throughout the test, and this cooperation was one factor contributing to the success of the tests.

Very truly, yours,

(Signed) O. P. Hoob,
Chief Mechanical Engineer.

No new discoveries of coal in Alaska were reported in 1914, with the exception of some lignite in the Ruby district. The extent of

these deposits and their availability as fuel have not been determined. By far the most important event of the year with reference to the Alaska coal fields was the passage of a coal-leasing law. This act is as follows:

[PUBLIC—No. 216—63D CONGRESS.]

[H. R. 14233.]

An Act To provide for the leasing of coal lands in the Territory of Alaska, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Interior be, and hereby is, authorized and directed to survey the lands of the United States in the Territory of Alaska known to be valuable for their deposits of coal, preference to be given first in favor of surveying lands within those areas commonly known as the Bering River, Matanuska, and Nenana coal fields, and thereafter to such areas or coal fields as lie tributary to established settlements or existing or proposed rail or water transportation lines: *Provided*, That such surveys shall be executed in accordance with existing laws and rules and regulations governing the survey of public lands. There is hereby appropriated, out of any money in the Treasury not otherwise appropriated, the sum of \$100,000 for the purpose of making the surveys herein provided for, to continue available until expended: *Provided*, That any surveys heretofore made under the authority or by the approval of the Department of the Interior may be adopted and used for the purposes of this Act.

SEC. 2. That the President of the United States shall designate and reserve from use, location, sale, lease, or disposition not exceeding five thousand one hundred and twenty acres of coal-bearing land in the Bering River field and not exceeding seven thousand six hundred and eighty acres of coal-bearing land in the Matanuska field, and not to exceed one-half of the other coal lands in Alaska: *Provided*, That the coal deposits in such reserved areas may be mined under the direction of the President when, in his opinion, the mining of such coal in such reserved areas, under the direction of the President, becomes necessary, by reason of an insufficient supply of coal at a reasonable price for the requirements of Government works, construction and operation of Government railroads, for the Navy, for national protection, or for relief from monopoly or oppressive conditions.

SEC. 3. That the unreserved coal lands and coal deposits shall be divided by the Secretary of the Interior into leasing blocks or tracts of forty acres each, or multiples thereof, and in such form as in the opinion of the Secretary will permit the most economical mining of the coal in such blocks, but in no case exceeding two thousand five hundred and sixty acres in any one leasing block or tract; and thereafter, the Secretary shall offer such blocks or tracts and the coal, lignite, and associated minerals therein for leasing, and may award leases thereof through advertisement, competitive bidding, or such other methods as he may by general regulations adopt, to any person above the age of twenty-one years who is a citizen of the United States, or to any association of such persons, or to any corporation or municipality organized under the laws of the United States or of any State or Territory thereof: *Provided*, That a majority of the stock of such corporation shall at all times be owned and held by citizens of the United States: *And provided further*, That no railroad or common carrier shall be permitted to take or acquire through lease or permit under this Act

any coal or coal lands in excess of such area or quantity as may be required and used solely for its own use, and such limitation of use shall be expressed in all leases or permits issued to railroads or common carriers hereunder: *And provided further*, That any person, association, or corporation qualified to become a lessee under this Act and owning any pending claim under the public-lands laws to any coal lands in Alaska may, within one year from the passage of this Act, enter into an arrangement with the Secretary of the Interior by which such claim shall be fully relinquished to the United States; and if in the judgment of the Secretary of the Interior, the circumstances connected with such claim justify so doing, the moneys paid by the claimant or claimants to the United States on account of such claim shall, by direction of the Secretary of the Interior, be returned and paid over to such person, association, or corporation as a consideration for such relinquishment.

All claims of existing rights to any of such lands in which final proof has been submitted and which are now pending before the Commissioner of the General Land Office or the Secretary of the Interior for decision shall be adjudicated within one year from the passage of this Act.

SEC. 4. That a person, association, or corporation holding a lease of coal lands under this Act may, with the approval of the Secretary of the Interior and through the same procedure and upon the same terms and conditions as in the case of an original lease under this Act, secure a further or new lease covering additional lands contiguous to those embraced in the original lease, but in no event shall the total area embraced in such original and new leases exceed in the aggregate two thousand five hundred and sixty acres.

That upon satisfactory showing by any lessee to the Secretary of the Interior that all of the workable deposits of coal within a tract covered by his or its lease will be exhausted, worked out, or removed within three years thereafter, the Secretary of the Interior may, within his discretion, lease to such lessee an additional tract of land or coal deposits, which, including the coal area remaining in the original lease, shall not exceed two thousand five hundred and sixty acres, through the same procedure and under the same competitive conditions as in case of an original lease.

SEC. 5. That, subject to the approval of the Secretary of the Interior, lessees holding under leases small blocks or areas may consolidate their said leases or holdings so as to include in a single holding not to exceed two thousand five hundred and sixty acres of contiguous lands.

SEC. 6. That each lease shall be for such leasing block or tract of land as may be offered or applied for, not exceeding in area two thousand five hundred and sixty acres of land, to be described by the subdivisions of the survey, and no person, association, or corporation, except as hereinafter provided, shall be permitted to take or hold any interest as a stockholder or otherwise in more than one such lease under this Act, and any interest held in violation of this proviso shall be forfeited to the United States by appropriate proceedings instituted by the Attorney General for that purpose in any court of competent jurisdiction, except that any such ownership and interest hereby forbidden which may be acquired by descent, will, judgment, or decree may be held for two years, and not longer, after its acquisition.

SEC. 7. That any person who shall purchase, acquire, or hold any interest in two or more such leases, except as herein provided, or who shall knowingly purchase, acquire, or hold any stock in a corporation having an interest in two or more such leases, or who shall knowingly sell or transfer to one disqualified to purchase, or except as in this Act specifically provided, disqualified to acquire, any such interest, shall be deemed guilty of a felony, and upon conviction shall be punished by imprisonment for not more than three years and

by a fine not exceeding \$1,000: *Provided*, That any such ownership and interest hereby forbidden which may be acquired by descent, will, judgment, or decree may be held two years after its acquisition and not longer, and in case of minority or other disability such time as the court may decree.

Sec. 8. That any director, trustee, officer, or agent, of any corporation holding any interest in such a lease who shall, on behalf of such corporation, act in the purchase of any interest in another lease, or who shall knowingly act on behalf of such corporation in the sale or transfer of any such interest in any lease held by such corporation to any corporation or individual holding any interest in any such a lease, except as herein provided, shall be guilty of a felony and shall be subject to imprisonment for a term of not exceeding three years and a fine of not exceeding \$1,000.

Sec. 8a. If any of the lands or deposits leased under the provisions of this Act shall be subleased, trusted, possessed, or controlled by any device permanently, temporarily, directly, indirectly, tacitly, or in any manner whatsoever, so that they form part of or are in anywise controlled by any combination in the form of an unlawful trust, with consent of lessee, or form the subject of any contract or conspiracy in restraint of trade in the mining or selling of coal, entered into by the lessee, or of any holding of such lands by any individual, partnership, association, corporation, or control, in excess of two thousand five hundred and sixty acres in the Territory of Alaska, the lease thereof shall be forfeited by appropriate court proceedings.

Sec. 9. That for the privilege of mining and extracting and disposing of the coal in the lands covered by his lease the lessee shall pay to the United States such royalties as may be specified in the lease, which shall not be less than two cents per ton, due and payable at the end of each month succeeding that of the shipment of the coal from the mine, and an annual rental, payable at the beginning of each year, on the lands covered by such lease, at the rate of twenty-five cents per acre for the first year thereafter, fifty cents per acre for the second, third, fourth, and fifth years, and \$1 per acre for each and every year thereafter during the continuance of the lease, except that such rental for any year shall be credited against the royalties as they accrue for that year. Leases may be for periods of not more than fifty years each, subject to renewal, on such terms and conditions as may be authorized by law at the time of such renewal. All net profits from operation of Government mines, and all royalties and rentals under leases as herein provided, shall be deposited in the Treasury of the United States in a separate and distinct fund to be applied to the reimbursement of the Government of the United States on account of any expenditures made in the construction of railroads in Alaska, and the excess shall be deposited in the fund known as The Alaska Fund, established by the Act of Congress of January twenty-seventh, nineteen hundred and five, to be expended as provided in said last-mentioned Act.

Sec. 10. That in order to provide for the supply of strictly local and domestic needs for fuel the Secretary of the Interior may, under such rules and regulations as he may prescribe in advance, issue to any applicant qualified under section three of this Act a limited license or permit granting the right to prospect for, mine, and dispose of coal belonging to the United States on specified tracts not to exceed ten acres to any one person or association of persons in any one coal field for a period of not exceeding ten years, on such conditions not inconsistent with this Act as in his opinion will safeguard the public interest, without payment of royalty for the coal mined or for the land occupied: *Provided*, That the acquisition of holding of a lease under the preceding sections of this Act shall be no bar to the acquisition, holding, or operating under the

limited license in this section permitted. And the holding of such a license shall be no bar to the acquisition or holding of such a lease or interest therein.

SEC. 11. That any lease, entry, location, occupation, or use permitted under this Act shall reserve to the Government of the United States the right to grant or use such easements in, over, through, or upon the land leased, entered, located, occupied, or used as may be necessary or appropriate to the working of the same or other coal lands by or under authority of the Government and for other purposes: *Provided*, That said Secretary, in his discretion, in making any lease under this Act, may reserve to the United States the right to lease, sell, or otherwise dispose of the surface of the lands embraced within such lease under existing law or laws hereafter enacted in so far as said surface is not necessary for use by the lessee in extracting and removing the deposits of coal therein. If such reservation is made, it shall be so determined before the offering of such lease.

That the said Secretary during the life of the lease is authorized to issue such permits for easements herein provided to be reserved, and to permit the use of such other public lands in the Territory of Alaska as may be necessary for the construction and maintenance of coal washeries or other works incident to the mining or treatment of coal, which lands may be occupied and used jointly or severally by lessees or permittees, as may be determined by said Secretary.

SEC. 12. That no lease issued under authority of this Act shall be assigned or sublet except with the consent of the Secretary of the Interior. Each lease shall contain provisions for the purpose of insuring the exercise of reasonable diligence, skill, and care in the operation of said property, and for the safety and welfare of the miners and for the prevention of undue waste, including a restriction of the workday to not exceeding eight hours in any one day for underground workers except in cases of emergency; provisions securing the workers complete freedom of purchase, requiring the payment of wages at least twice a month in lawful money of the United States, and providing proper rules and regulations to secure fair and just weighing or measurement of the coal mined by each miner, and such other provisions as are needed for the protection of the interests of the United States, for the prevention of monopoly, and for the safeguarding of the public welfare.

SEC. 13. That the possession of any lessee of the land or coal deposits leased under this act for all purposes involving adverse claims to the leased property shall be deemed the possession of the United States, and for such purpose the lessee shall occupy the same relation to the property leased as if operated directly by the United States.

SEC. 14. That any such lease may be forfeited and canceled by appropriate proceeding in a court of competent jurisdiction whenever the lessee fails to comply with any provision of the lease or of general regulations promulgated under this Act; and the lease may provide for the enforcement of other appropriate remedies for breach of specified conditions thereof.

SEC. 15. That on and after the approval of this Act no lands in Alaska containing deposits of coal withdrawn from entry or sale shall be disposed of or acquired in any manner except as provided in this Act: *Provided*, That the passage of this Act shall not affect any proceeding now pending in the Department of the Interior, and any such proceeding may be carried to a final determination in said department notwithstanding the passage hereof: *Provided further*, That no lease shall be made, under the provisions hereof, of any land, a claim for which is pending in the Department of the Interior at the date of the passage of this Act, until and unless such claim is finally disposed of by the department adversely to the claimant.

SEC. 16. That all statements, representations, or reports required, unless otherwise specified, by the Secretary of the Interior under this Act shall be upon oath and in such form and upon such blanks as the Secretary of the Interior may require, and any person making false oath, representation, or report shall be subject to punishment as for perjury.

SEC. 17. That the Secretary of the Interior is authorized to prescribe the necessary and proper rules and regulations and to do any and all things necessary to carry out and accomplish the purposes of this Act.

SEC. 18. That all Acts and parts of Acts in conflict herewith are hereby repealed.

Approved, October 20, 1914.

The form of lease and the regulations under the general provisions of this act have not yet been announced. The following form and regulations, however, have been issued by the Commissioner of the General Land Office to meet the clause providing for short-term permits to mine coal for local use on tracts not exceeding 10 acres:

Application for permit to mine coal in Alaska under section 10 of the act of October 20, 1914 (Public 216).

-----, 191--

The Commissioner of the General Land Office, Washington, D. C.

SIR: The undersigned, -----
(Name of applicant.)

of -----, hereby appl ----- for a permit to prospect for, mine, and
(Post-office address.)

remove coal from the following-described land: -----
(Describe the land by legal subdivi-

vision if surveyed and by metes and bounds with reference to some permanent natural
landmark if unsurveyed.)

containing approximately ----- acres, situated within the ----- land district,
----- miles ----- of -----, Alaska, and in support
(Direction.)

of this application make the following representation as to qualifications to
receive a permit: -----

(Citizenship of applicant or applicants must here be shown. If the
applicant is a municipality or corporation, it must be shown under what laws it is
organized; and if the latter, it must also be shown whether a majority of its stock is
owned and held by citizens of the United States.)

The applicant further represent that _____ ha not, within two
(He, they, or it.)

years last past, applied for or received a permit to mine coal under the provisions of section 10 of the act of October 20, 1914, in the coal field in which the land described in this application is situated, _____
(State exceptions here, if any.)

and that the coal herein applied for is to be mined for the purpose of supplying the following demands, for which approximately _____ tons are required annually: _____

(Here itemize the various uses to which the coal is to be applied,

stating the number of tons necessary for each use.)

It is further represented that the boundaries of the tract described in this application have been plainly marked by substantial monuments and that a proper notice describing the land and showing the intention of the applicant to apply for a free permit to mine coal therefrom has been posted in a conspicuous place upon the land.

On consideration that a permit be granted, the applicant hereby agree :

1. To exercise reasonable diligence, precaution, and skill in the operation of the mine, with a view to the prevention of injury to workmen, waste of coal, damage to Government property, and to comply substantially with the instructions and the rules and regulations printed on the back of this application.

2. To charge only such prices for coal sold to others as represent a fair return for the labor expended and reasonable earning value to which the investment in the enterprise is entitled, without including any charge for the coal itself.

3. Not to mine or dispose of, either directly or indirectly, any coal from the area covered by said permit for export or any purpose other than "strictly local and domestic needs for fuel."

4. To leave the premises in good condition upon the termination of the permit, with all mine props and timbers in the mine intact and with the underground workings free from refuse and in condition for continued mining operations.

Signature of applicant _____

The foregoing application was signed by _____

of _____, the applicant therein, in the presence of the undersigned, who, at _____ request and in _____ presence
(His or their.) (His or their.)

and in the presence of each other, have subscribed our names as witnesses to the execution thereof.

Dated this ____ day of _____, 19 __, at _____, Territory of Alaska.

Name _____ Residence _____

Name _____ Residence _____

Circular No. 370.—Regulations governing the issuance of permits for the free use of coal in the unreserved public lands in Alaska.

DEPARTMENT OF THE INTERIOR,
GENERAL LAND OFFICE,
Washington, December 30, 1914.

Registers and receivers of the United States land offices at Fairbanks, Juneau, and Nome, Alaska:

Section 10 of the act of October 20, 1914 (Public 216), provides:

"That in order to provide for the supply of strictly local and domestic needs for fuel the Secretary of the Interior may, under such rules and regulations as he may prescribe in advance, issue to any applicant qualified under section three of this act a limited license or permit granting the right to prospect for, mine, and dispose of, coal belonging to the United States on specified tracts not to exceed ten acres to any one person or association of persons in any one coal field for a period not exceeding ten years, on such conditions not inconsistent with this act as in his opinion will safeguard the public interest without payment of royalty for the coal mined or for the land occupied: *Provided*, That the acquisition of holding of a lease under the preceding sections of this act shall be no bar to the acquisition, holding, or operating under the limited license in this section permitted. And the holding of such license shall be no bar to the acquisition or holding of such a lease or interest therein."

Owing to the legal embarrassment occasioned by existing claims and there being no settlements or local industries in or adjacent to the Bering River or Matanuska coal fields, these regulations and the permits provided for shall not at present apply to coal deposits in those fields.

Qualifications.—Under the terms of the act, expressed in section 3 thereof, only citizens of the United States above the age of 21 years, associations of such citizens, corporations, and municipalities organized under the laws of the United States or of any State or Territory thereof, provided the majority of the stock of such corporations shall at all times be owned and held by citizens of the United States, are eligible to receive a permit to prospect for and mine coal from the unreserved public lands in Alaska.

Who may mine coal for sale.—All permittees may mine coal for sale except railroads and common carriers, who by the terms of section 3 of the act are restricted to the acquirement of only such an amount of coal as may be required and used for their own consumption.

Duration of permits.—Permits will be granted for two years, beginning at date of filing if filed in person or by attorney, or date of mailing if sent by registered letter, subject to the approval of the Commissioner of the General Land Office, and upon application and satisfactory showing as to the necessity therefor may be extended by the commissioner for a longer period, subject to such conditions necessary for the protection of the public interest as may be imposed prior to or at the time of the extension. Misrepresentation, carelessness, waste, injury to property, the charge of unreasonable prices for coal, or material violation of such rules and regulations governing operation as shall have been prescribed in advance of the issuance of a permit will be deemed sufficient cause for revocation.

Limitation of area.—The act limits the area to be covered in any one permit to 10 acres. It is not to be inferred from this, however, that the permits granted thereunder shall necessarily cover that area. The ground covered by a permit must be square in form and should be limited to an area reasonably sufficient to supply the quantity of coal needed.

Scope of permit.—Permits issued under section 10 of the act of October 20, 1914, grant only a license to prospect for, mine, and remove coal free of charge from the unreserved public coal lands in Alaska, and do not authorize the mining of any other form of mineral deposit nor the cutting or removal of timber.

How to proceed to obtain a permit.—The application should be duly executed on Form 4—020, and the same should either be transmitted by registered mail to or filed in person with the register and receiver of the United States land office of the district in which the land is situated. Prior to the execution of the application the applicant must have gone upon the land, plainly marked the boundaries thereof by substantial monuments, and posted a notice setting forth his intention of mining coal therefrom. The application must contain the statement that these requirements have been complied with, and the description of the land as given in the application must correspond with the description as marked on the ground. The permit, if granted, should be recorded with the local mining district recorder if the land is situated within an organized mining district.

When coal may be mined before issuance of a permit.—In view of the fact that by reason of long distances and limited means of transportation many applicants may be unable to appear in person at the United States land office to file their applications, it has been deemed advisable to allow such applicants the privilege of mining coal as soon as their applications have been duly executed and sent by registered mail to the proper United States land office. Should an application be rejected, upon receipt of notice thereof all privileges under this paragraph terminate, and the applicant must cease mining the coal.

Action by register.—The register will keep a proper record of all applications received and all actions taken thereon in a book provided for that purpose. If there appear no reason why the application should not be allowed, the register will issue a permit on the form provided for that purpose. Should any objection appear either as to the qualifications of the applicant or applicants, or in the substance or sufficiency of the application, the register may reject the application or suspend it for correction or supplemental showing under the usual rules of procedure, subject to appeal to the Commissioner of the General Land Office. Upon the issuance of a permit the register will promptly forward to the Commissioner of the General Land Office, by special letter, the original application and a copy of the permit, and transmit copies thereof to the chief of the Alaskan field division and to the local representative of the United States Bureau of Mines, for their information and use in the event that it should be found necessary or advisable to make investigations or inspections.

Note.—These regulations are intended merely as a temporary arrangement to meet immediate necessities, as authorized by section 10 of the act of October 20, 1914, and are not to be construed as applying to the leasing of public coal lands in Alaska provided in other sections of the act. Full regulations governing the matter of leasing will be issued as soon as practicable.

Very respectfully,

CLAY TALLMAN,
Commissioner.

Approved:

FRANKLIN K. LANE,
Secretary.

The Alaska oil lands were withdrawn from entry in 1906, and only claims located previous to that date are subject to entry. Patents

have been granted to a few claims near Katalla, where some oil has been produced for several years. A small refinery located near Katalla supplies gasoline to a local market. Except for this, there was no development of Alaska oil fields. Assessment work has, however, been continued on some unpatented oil claims.

As already noted, the shipment of petroleum products to Alaska has steadily increased for a number of years. Petroleum has rapidly supplanted coal as a source of power in the Pacific coast region of Alaska and on Seward Peninsula. The shipments of petroleum to Alaska during the past decade are shown in the following table:

Shipments of petroleum products to Alaska from other parts of the United States, 1905-1914.

Year.	Oil used for fuel, including crude oil, gas oil, residuum, etc.	Gasoline, including all lighter products of distillation.	Illuminating oil.	Lubricating oil.
	Gallons.	Gallons.	Gallons.	Gallons.
1905.....	2, 715, 974	713, 496	627, 391	83, 319
1906.....	2, 688, 940	580, 978	558, 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	626, 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
	130, 348, 976	12, 995, 848	5, 919, 594	1, 149, 697

No complete data as to the distribution in Alaska of these petroleum shipments are available. In 1914 about 40,000 barrels of crude oil was shipped to Nome, where most of it was used as fuel for operating dredges. About 24,000 barrels was shipped to St. Michael and practically all of this was used as fuel by Yukon River boats.

The opening of the lignitic coal at Chicago Creek, on Seward Peninsula, would give a source of power for some of the mining operations. In the Fairhaven district, at least, it should be cheaper to use this coal than the California petroleum. If a plant were located at the coal mine it is possible that other parts of the peninsula could be supplied with electric power cheaper than that derived from imported petroleum. The development of the Nenana coal field south of the Tanana should also make it possible to furnish fuel to the Yukon River boats at lower cost than the petroleum now used. By making available the high-grade coals of the Matanuska and Bering River fields the use of California petroleum as a source of fuel would decline along the Pacific seaboard and in the basins of the tributary rivers.

It appears, therefore, that with the opening of the Alaska coal the use of California petroleum will decline relatively, if not abso-

lutely. The transition from oil to coal burners will, however, be gradual on account of the cost of new equipment, unless there should be a decided increase in the price of California petroleum.

REVIEW BY DISTRICTS.

The subjoined review is intended to summarize briefly the principal developments in all the districts. Some of the districts, including several of the most productive camps, are treated at greater length in later sections of this volume, and, therefore, the space devoted to any district here is not necessarily an indication of its relative importance. Reports on the geology of some of the districts are cited in footnotes under the respective headings.

SOUTHEASTERN ALASKA.

Nine lode-gold mines, about four placer mines, and two copper mines were operated on a productive basis in southeastern Alaska for the whole or a part of the year 1914. These mines produced 204,749 ounces of gold, valued at \$4,232,538; and 34,376 ounces of silver, valued at \$19,009. The copper production can not be published, as it might reveal the output of individual operators. A total of 1,712,530 tons of gold ore was hoisted in 1914.

For comparative purposes the following statistics are given for the previous year: Seven lode-gold mines, about four placer-gold mines, and three copper mines were operated on a productive basis in southeastern Alaska during 1913. These mines produced 201,360 ounces of gold, valued at \$4,229,648; 29,211 ounces of silver, valued at \$17,643; and 599,903 pounds of copper, valued at \$92,985. A total of 1,589,746 tons of gold ore and 7,276 tons of copper ore was hoisted in 1913.

As in the previous year the most important developments were those of auriferous lodes in the Juneau district and to a lesser extent in the Berners Bay district. Important copper-mine developments started in the Ketchikan district were curtailed in the middle of the year on account of the fall in the price of copper and the unsettled financial condition. The commercial depression also affected adversely some of the auriferous lode-mine developments.

The increase of lode mining in southeastern Alaska has led to a growing interest in the development of water power. Near Juneau there have been some large installations, and in other parts of the province smaller power plants are in use. Plans are under way for other large developments, among which that of the Alaska Hydroelectric Co. has assumed definite form. This company has taken preliminary steps to construct a large hydroelectric plant at Speel River, about 40 miles southeast of Juneau.

JUNEAU AND BERNERS BAY DISTRICTS.¹

Auriferous lode mining continued in 1914 on a large scale in the Juneau and Berners Bay districts and is described elsewhere in this report. Seven gold mines were operated, but the large developments under way have, for the most part, not yet reached a productive stage. Most of the gold output from the Juneau district came from the four mines of the Treadwell group, on Douglas Island. The first section of the mill at the Alaska-Juneau was in operation before the close of the year. The stamp mill at the Eagle River mine was operated the last three months of the year. Some gold was also won at the Jualin, incidentally to tests of the ore. No other properties were productive, but the large developments at the Alaska-Gastineau and Alaska-Juneau that have been under way for several years were continued, and these mines promise to add very considerably to the gold output in 1915. Among other developments of a considerable scale were those at the Ebner, Salmon Creek, and Kensington properties. Smaller operations were carried on at many other prospects.

KETCHIKAN DISTRICT.²

One gold mine, two copper mines, and one marble quarry were productive in the Ketchikan district during 1914. There was, however, much greater mining activity in the district than is indicated by the number of producing mines, notably in the development of copper ores. Incidentally some gold and copper were taken from property not here classed as productive mines.

The Rush & Brown mine, near Karta Bay, on Prince of Wales Island, was the only mine in the district which was operated throughout the year. It is reported that the sinking on the ore body was continued during the year to a depth of about 60 feet below the second level, making a total depth of 244 feet below the outcrop. The mine workings now include about 1,350 feet of drifts, 130 feet of raises, 184 feet of shaft, and a 60-foot winze.

The Jumbo mine, on Hetta Inlet, on the west side of Prince of Wales Island, was operated at its usual capacity until August 31, when it was closed because of the uncertainty of the copper market. The Alaska Consolidated Copper Co. did considerable work on five claims at Copper Mountain, on Hetta Inlet. Some work was also done on the near-by Red Wing and Bruce properties. Developments were continued at the Big Harbor mine, on the west side of Prince of Wales Island. Here the shaft was sunk to a depth of 117 feet, and

¹ Spencer, A. C., The Juneau gold belt: U. S. Geol. Survey Bull. 287, 1908. Knopf, Adolph, Geology of the Berners Bay region, Alaska: U. S. Geol. Survey Bull. 446, 1911; The Eagle River region, southeastern Alaska: U. S. Geol. Survey Bull. 502, 1912.

² Wright, F. E. and C. W., The Ketchikan and Wrangell mining districts, Alaska; U. S. Geol. Survey Bull. 347, 1908. Wright, C. W., Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska: U. S. Geol. Survey Prof. Paper 87, 1915.

this shaft, 200 feet of drifts, and 150 feet of adit are reported as the total underground work up to the close of 1914.

The Granby Consolidated Mining, Smelting & Power Co. in 1913 took over the Mamie copper mine near Hadley, on Prince of Wales Island, and in April, 1914, began large-scale operations which were continued until September. Besides the surface improvements some 750 feet of underground work was done.

Some developments were made during the first half of the year on It, Dean, and Mount Andrew properties, all on the southwest side of Kasaan Peninsula. The underground work at the Cymru mine, which has not been operated for several years, was extended in the first half of 1914, 100 feet of drifting and stoping being reported. This makes the total mine workings 100 feet of shaft and 500 feet of drifts.

The Jackson group of copper claims is on Lake Bay, an indentation of the northeast shore of Prince of Wales Island, about 60 miles northwest of Ketchikan and 40 miles southwest of Wrangell. Here a tram has been built to the beach and considerable underground work completed. Some test shipments of ore were made in 1914. In addition to those above listed, there are probably other copper developments in the Ketchikan district which have not been reported.

The Dunton gold mine (also known as the Julia or Rodgers mine), near Hollis, on Prince of Wales Island, is equipped with a 5-stamp mill and was productive in 1914. The total underground workings include an incline 200 feet deep and about 200 feet of drifts. Some developments were also made at the Crackerjack and Ready Bullion mines, near the Dunton mine. The Cascade claims, also in this district, were developed in a small way during 1914, ore being treated in an arrastre and in a small stamp mill.

The mill at the Valparaiso gold mine, near Dolomi, Prince of Wales Island, was not operated in 1914. Underground work, however, was continued, and the completion of 450 feet of drifting during the year is reported. Only assessment work is reported on other claims in the vicinity of Dolomi.

Until the European war broke out the Alaska Venture Syndicate, an English company, continued work on the Old Glory claims, near Smuggler Cove, on the mainland 30 miles northwest of Ketchikan. An air compressor, operated by water power, has been installed, and a total of 900 feet of underground work was done in 1914. Some work was also done at the Gold Standard property, which has long been idle, on the King & Elliot claims, both in the same region. The Gold Mountain group, also in this part of the district, is reported to have been developed by 300 feet of adit, and several test shipments of ore are said to have been made from this property. The Old Sealevel mine, on Revillagigedo Island south of Ketchikan, which

has long been idle, is reported to have been pumped out in 1914 for the purpose of examination.

The large marble quarries¹ near Tokeen, on Davidson Inlet, in the northwestern part of the Ketchikan district, were operated on about the same scale as in previous years. There was also some prospecting of marble deposits in other parts of the district, but of this work there is no definite report at hand. Some work was done in 1914 by Charles Sulzer on a barite deposit near Hetta Inlet, on the west side of Prince of Wales Island.

YAKATAGA DISTRICT.²

In 1914 the hydraulic placer mine on White River, in the Yakataga district, was operated throughout the season, which extended from about May 1 to October 25. In addition to this there was some mining of beach placers at Yakataga, but the value of the entire output from beach mining did not exceed \$3,000 or \$4,000. There were no other developments in the Yakataga district.

KATALLA AND BERING RIVER DISTRICTS.³

The only productive mining in the region tributary to Katalla consisted in the operations of the Alaska Oil & Refining Co. This company has five wells, from which oil has been produced by pumping and one of which was drilled in 1914. The oil is used chiefly at a small refinery owned by the same company, and the products are disposed of in a local market.

Patent has been granted to one coal claim in the Bering River field. In other respects there has been absolutely no development, as has been the case for many years.

OTHER DISTRICTS.

The Chichagof gold mine, in the Sitka district,⁴ was operated throughout the year. The mine development in 1914 included about 1,800 feet of drifts and cuts. Five stamps and a 12-foot tube mill were added to the equipment, making 25 stamps in all. At the Hurst property, which is in the same region, a 300-foot adit was driven in 1914. A new gold-bearing vein on which some work was done is said to have been discovered in the same district by Richard Hofstad and Ole Johnson. The gypsum mine, on the east side of Chichagof Island, is said to have been worked on about the same scale as in previous years.

¹ Burchard, E. F., Marble resources of the Ketchikan and Wrangell districts: U. S. Geol. Survey Bull. 542, pp. 52-77, 1913.

² Madden, A. G., Mineral deposits of the Yakataga district: U. S. Geol. Survey Bull. 592, pp. 119-153, 1914.

³ Martin, G. C., Geology and mineral resources of the Controller Bay region, Alaska: U. S. Geol. Survey Bull. 335, 1908.

⁴ Knopf, Adolph, The Sitka mining district, Alaska: U. S. Geol. Survey Bull. 504, 1912.

In 1914 three hydraulic plants were operated or in process of construction in the Porcupine district, which is tributary to Haines, on Lynn Canal. Another is in course of construction on Salmon River, in the same region. Some excitement was caused in this district by the discovery in June, 1914, of a rich placer near Pleasant Camp, close to the international boundary. It appears that this deposit is not very extensive.

Though copper ores, galena, marble, and other mineral deposits are found in the Wrangell district, there is as yet but little mining. In 1914 there was some development of galena deposits in the Groundhog, and some test shipments of ore were made. E. E. Harvey is developing a copper property on the west side of Wrangell Narrows, and is said to have done some 200 feet of underground work. Developments continued on some marble deposits in this district. Some garnets were shipped from the garnet mine near Wrangell.¹

COPPER RIVER REGION.

Mining in the Copper River region includes the development of copper mines in the Kotsina-Chitina copper belt and placer mining in the Nizina and Chistochina districts. There is also a little placer mining in the Bremner River region and in the Nelchina district and some lode prospecting in different parts of the Copper River basin.

The mining developments in the Chitina basin are described at length elsewhere in this volume. In this district two copper mines, the Kennecott-Bonanza and the Mother Lode, were productive in 1914, and some copper was also shipped from the Kennecott-Jumbo property. Among the developments in the district are those by the Great Northern Development Co., Hubbard & Elliot Co., and Alaska Consolidated Copper Co., and those on the Westover and Rarus claims. None of these properties are in a productive stage, and they will require railroad construction before they can ship ore.

Three large hydraulic plants were operated in the Nizina district in 1914, and there were also some smaller operations in the same field. A little placer mining was also done in the Bremner River basin and in other parts of the lower Copper River region. The placers discovered in the basin of Nelchina River, tributary to Tazlina River, in 1913 have not proved either rich or extensive. Auriferous gravels were found on several creeks, but only those on Albert Creek have proved rich enough to exploit, and the output of gold so far has been insignificant. This district is described elsewhere in this report.

About 10 placer mines were operated in the Chistochina district in 1914. It is estimated that about 100 men were engaged in mining and

¹ Brooks, A. H., The mining industry in 1912: U. S. Geol. Survey Bull. 542, p. 51, 1913.

prospecting in this field. Two hydraulic plants were operated on Slate Creek; the other placers were worked by pick and shovel. Some work was done in preparation for the installation of a hydraulic plant on Hidden Treasure Creek. Plans were made for prospecting some dredging ground on the Chisna. Operators report that the sluicing season was exceptionally short. One flood early in the summer seriously interfered with some of the work.

PRINCE WILLIAM SOUND.

Two copper mines and eight gold-lode mines were operated in the Prince William Sound region in 1914. The value of the total mineral production of the region in 1914 was \$1,198,742, compared with \$1,327,950 in 1913. This decrease is due to the fall in price of copper. The mining industry on Prince William Sound is fully treated elsewhere in this volume; therefore only its principal features will here be referred to.

The Beatson Bonanza and Ellamar copper mines continued throughout the year on their normal shipping basis. An aerial tram was nearly completed, and considerable underground work was done on the Midas copper mine, near Valdez, by the Granby Co. before the decline in value of copper led to the closing of the plant. Some copper developments were also made on half a dozen other properties on the sound.

The Cliff gold mine, near Valdez, was operated until early in the summer. A mill was installed during the summer on the Ramsay & Rutherford property, in the same district, and some gold was produced on this as well as on the Cameron & Johnson, Gold King, Mountain King, and several other properties. The mill at the Granite mine, in the Port Wells district, was operated for practically the entire year. A smaller plant was installed in the fall on the Gold Eagle property, in the same district. There was also considerable prospecting of other auriferous lodes in the Port Wells region.

KENAI PENINSULA.¹

The value of the total gold production of Kenai Peninsula in 1914 is estimated to be \$70,000, compared with about \$50,000 in 1913. Though there was much prospecting and initial development work looking toward lode and placer mine development in the peninsula, no important advances were made. Lode mining continued during the year on only a very small scale, but there was some improvement in the placer-mining industry. It seems probable that attempts are

¹ Martin, G. C., Johnson, B. L., and Grant, U. S., *Geology and mineral resources of Kenai Peninsula, Alaska*: U. S. Geol. Survey Bull. 587, 1915.

soon to be made to develop some of the larger bodies of auriferous gravels whose low tenor has not permitted profitable exploitation under present methods of operation. Now that the northeastern part of the peninsula is to be served by a government railroad greater prosperity in the mining industry seems assured. About 20 placer mines and four lode mines were operated during the summer on Kenai Peninsula. As the total value of the output of the lode mines, including also four prospects, was less than \$26,000, it can be seen that they were all small operations.

The Skeen-Lechner mine was operated during the first six months of 1914. Most of the underground work was done on the 200-foot level. The equipment consists of a 4-stamp and a 10-foot Chilean mill. Some rich ore was mined on the Grant Lake property and treated in a small customs mill at Seward. The underground work at this mine is reported as including a 20-foot shaft, 75 feet of adit, and 50 feet of drifts. At the Lucky Strike mine, near Hope, a 1-stamp prospecting mill was used to treat some ore, which was taken out of a 35-foot adit. A similar equipment was used on the Ophir and Columbia claims to treat gold ore taken from the property. Work was continued at the Primrose mine, on Porcupine Creek, where considerable underground work has been done.

In the Moose Pass region J. C. Gilpatrick continued work on his property. The ore was treated in an arrastre. The Moose Pass Mining Co. has opened its property in the same district by an adit and crosscuts. Its equipment includes a 1-stamp prospecting mill. An arrastre was also operated on a claim on Colorado Creek. Work was continued on the property of the Gold Stamp Mining Co., on Bear Creek; over 900 feet of underground work has been done at this mine. Other quartz-mining developments took place, but there are no data at hand relating to them.

Placer mining was carried on in 1914 on Crow, Resurrection, Bear, Canyon, Sixmile, Winner, Gulch, Mills, Quartz, and Cooper creeks. Of these the first four were the largest producers. About 10 hydraulic plants were operated on Kenai Peninsula in 1914. The largest of these are those of Nutter & Dawson on Crow Creek,¹ the Matthieson Mining Co. on Resurrection Creek, and the Kenai Mining & Milling Co. on Cooper Creek. A number of other hydraulic plants are in process of installation.

The two dredges on Kenai River were not operated in 1914. There was, however, some extensive prospecting with churn drill on the lower parts of Sixmile and Resurrection creeks. This work was done with a view of installing dredges.

¹ Crow Creek is north of Turnagain Arm but is usually included with the Kenai Peninsula placers.

SOUTHWESTERN ALASKA.

Work was continued at the Amok gold-lode mine, on the west side of Kodiak Island, but so far as known this property was not productive. Some work was also done by F. R. Brennan on an auriferous quartz vein on the north side of Viekoda Bay (locally known as Little Uganik Bay). An adit tunnel some 56 feet in length has been driven on this vein. The only other mining on Kodiak Island consisted in some small operations on beach placers. Some volcanic ash was shipped from Kodiak to be used as an abrasive.

It is reported that some low-grade placers have been found on Raspberry Island, adjacent to the northwest end of Kodiak Island. Some beach mining also continued at Popof Island, near Unga. The total gold produced in 1914 from beach mines of Kodiak and other places in southwestern Alaska is estimated to have a value of about \$4,000. Plans are being made to construct a cyanide plant to work over the tailings of the Apollo mine, on Unga Island. In the Iliamna¹ and Mulchatna regions there was no production except a small output from placers. Two hand drills were used to test placer ground on Bonanza Creek, a tributary of Mulchatna River. Developments were continued on the Duryea & McNeil and Cook & Bornland properties in the Iliamna region. Mining engineers visited the Iliamna district in 1914 to examine some of the copper and gold lodes.

SUSITNA-MATANUSKA REGION.

The developed mineral resources of the Susitna-Matanuska region include the Willow Creek gold-lode district, the Yentna and Valdez Creek placer districts, and the Matanuska coal field. A little placer mining has also been done on Willow Creek and on tributaries of the upper Chickaloon. Some copper ore has been found on Sheep Mountain,² in the upper Matanuska basin, and on Iron Creek,³ in the Talkeetna River basin. There have also been reported discoveries of large low-grade lode deposits in the Broad Pass region, of the upper Susitna, but authentic information in regard to these deposits is lacking. It should be added, however, that what is known of the geology of the Broad Pass region⁴ seems favorable to the occurrence of metalliferous deposits. The Susitna and Broad Pass route has been selected for the Government railroad from Seward to Fair-

¹ The writer is indebted to the late Mr. Thomas W. Hanmore, U. S. Commissioner at Iliamna, for information about the Iliamna and Mulchatna regions.

² Martin, G. C., and Mertie, J. B., jr., Mineral resources of the upper Matanuska and Nelchina valleys: U. S. Geol. Survey Bull. 592, pp. 281-282, 1914.

³ Brooks, A. H., The mining industry in 1910: U. S. Geol. Survey Bull. 480, pp. 32-33, 1911.

⁴ Moffit, F. H., Preliminary report on the Broad Pass region: U. S. Geol. Survey Bull. 592, pp. 301-305, 1914. Complete report to be issued as Bulletin 608, now in press.

banks. The assurance of railroad communication will give a strong impetus to prospecting in this field, a condition which has to some extent been anticipated by the developments made in 1914.

In 1914 three auriferous lode mines and about 24 placer mines were operated in the Susitna-Matanuska region, and the value of their total gold output was \$357,184. In 1913 the same region produced gold to the value of \$155,000. This increase is to be credited to the Willow Creek lode district.

WILLOW CREEK DISTRICT.¹

Three lode mines operated in the Willow Creek district in 1914 milled 10,110 tons of ore, yielding \$297,184 worth of gold. One hydraulic placer mine was also operated at the mouth of Grubstake Gulch, in this district, from June 22 to September 15. Some placer ground on Willow Creek was prospected by another company, and incidentally some gold was recovered.

The Gold Bullion mine was operated from June 19 to September 8, and about 500 feet of underground work was done. A cyanide plant having a daily capacity of 45 tons was added to the surface equipment. The underground work at the Alaska Free Gold Mining Co.'s plant aggregates 300 feet, and the mine was operated from June 1 to November 1. A second Lane mill and a cyanide plant were added to the equipment but were not operated in 1914. The Alaska Gold Quartz property was taken over by the Independence Gold Mining Co. in 1914. The operations at that time were conducted on about the same scale as in previous years, but work has been started on the enlargement of the reduction plant, a 4-stamp mill. About 500 or 600 feet of underground work has been done on this property. Considerable development work was done on the Rosenthal and other prospects in the Willow Creek district, but detailed information about it is lacking.

The developments in the Willow Creek district thus far have been on a relatively small scale. With the assurance of railroad connection with Seward at an early date, undoubtedly the feasibility of larger operations will receive careful investigation. There seems to be justification for the opinion that the quantity of ore available will permit larger installations. The three mills thus far erected are all at high altitudes, where water is to be had only from about June to October. If reduction plants were built in some of the larger valleys there is no reason why the mills should not be operated throughout the year. When the Matanuska coal field is opened cheap fuel will be assured. There are in the region, moreover,

¹ Capps, S. R., The Willow Creek district, Alaska: U. S. Geol. Survey Bull. 607 (in press). See also abstract in Bull. 592, pp. 255-272.

some good water powers¹ which are available during at least seven months of the year.

YENTNA DISTRICT.²

The season of 1914 was not favorable to placer mining in the Yentna district on account of the low water in July. It is estimated that about 25 plants were operated during the summer, employing some 60 to 100 men. Unfortunately, many of the operators did not report their gold output, so that reliable figures on gold production are not available. It is estimated, however, that the total output in 1914 had a value of about \$50,000. Plans were made for larger operations in this field, and it is probable that a dredge will be installed on Cache Creek in 1915, while other dredging ground is being prospected.

Though there has been no lode development in the Yentna district, some auriferous veins have been prospected. A rich vein is reported to have been discovered on Nugget Creek in 1914.

VALDEZ CREEK DISTRICT.

Developments continued on Valdez Creek,³ a tributary of the headwaters of the Susitna, which carries valuable gold placers. Up to a few years ago placer mining in this field was confined to small operations. In the fall of 1914 the installation of a large hydraulic plant on this creek was completed and some sluicing was done. There were also a few other small operations in this district.

MATANUSKA BASIN.⁴

As in previous years there were no developments in the Matanuska coal field in 1914. The coal mined for a navy test was brought to the coast in the winter of 1913-14, and the preliminary statement of the results of this test is presented elsewhere in this volume (pp. 27-30). A little placer mining was done on some of the upper tributaries of Chickaloon Creek.

YUKON BASIN.

PRODUCTION.

The value of the gold output of the Alaska Yukon district in 1914 is estimated to have been \$7,795,421, compared with \$8,130,000 in 1913. It is estimated that about 500 placer mines were operated in

¹ Ellsworth, C. E., and Davenport, R. W., Preliminary report on a water-power reconnaissance in south-central Alaska: U. S. Geol. Survey Bull. 592, pp. 189-192, 1914.

² Capps, S. R., The Yentna district, Alaska: U. S. Geol. Survey Bull. 534, 1913.

³ Moffit, F. H., Headwater regions of Gulkana and Susitna rivers, Alaska: U. S. Geol. Survey Bull. 498, 1912.

⁴ Martin, G. C., and Katz, F. J., Geology and coal fields of the lower Matanuska Valley: U. S. Geol. Survey Bull. 500, 1912.

the Yukon camps in 1914, giving employment to about 3,500 men. Only four lode mines were productive in the Yukon basin in 1914, and these were all in the Fairbanks district. A number of other properties produced some gold incidental to development.

The important placer camps of the Yukon basin, together with their gold output in 1914, are listed in the following table:

Estimated value of gold produced from placers in the Yukon basin, by districts, 1914.

District.	Value.	District.	Value.
Fairbanks.....	\$2,500,000	Circle.....	\$215,000
Iditarod.....	2,060,000	Innoko.....	200,000
Ruby.....	1,000,000	All others.....	335,000
Hot Springs.....	750,000		
Koyukuk.....	260,000		
Chisana.....	250,000		7,570,000

The Yukon placer mines also produced \$35,602 worth of silver. These figures do not include the output of lode mines, which in 1914 produced gold to the value of \$225,421 and silver to the value of \$2,209. There was no other productive form of mining in the Yukon basin except the recovery of stream tin incidental to gold placer mining in the Hot Springs district.

PLACER DISCOVERIES.

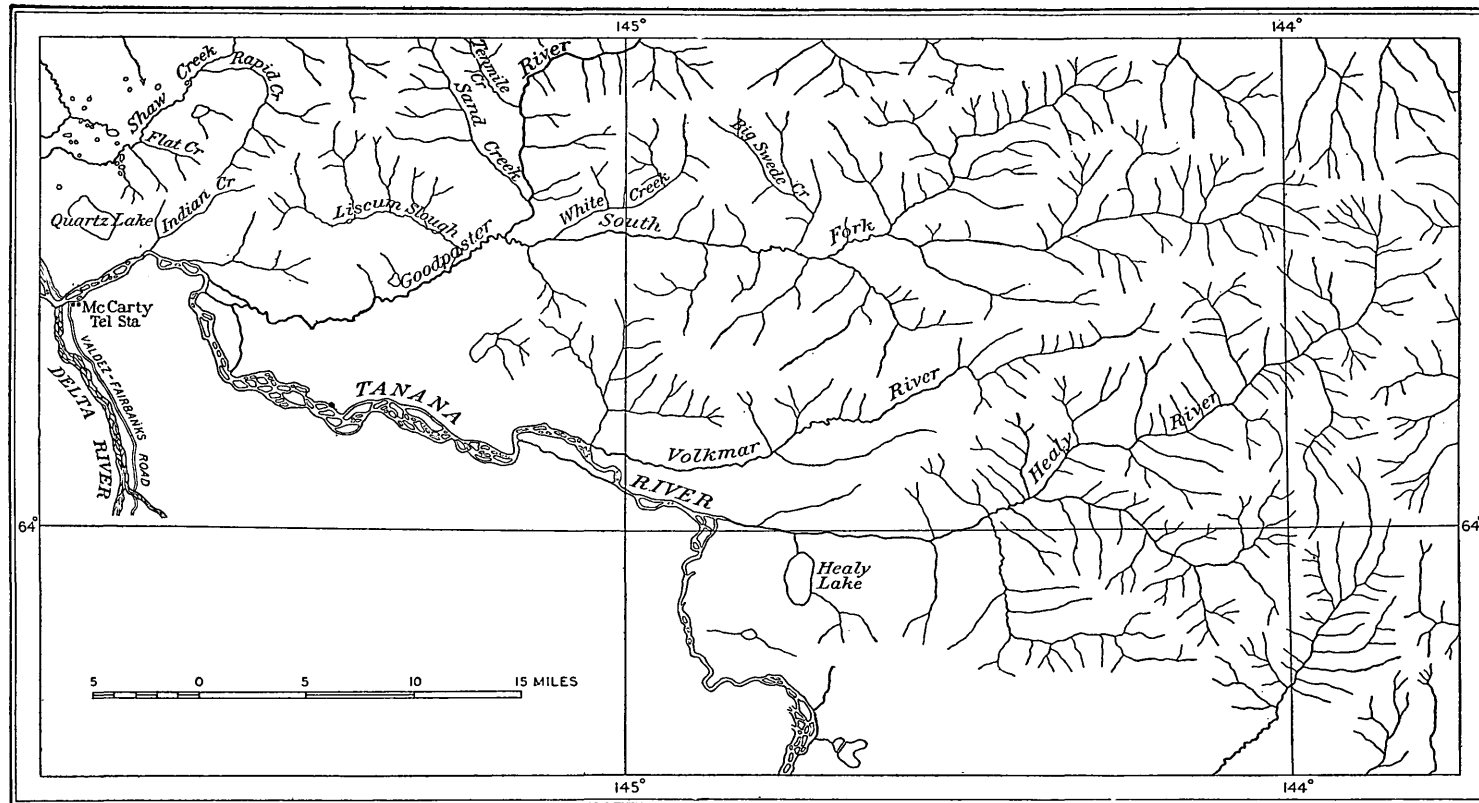
The only new localities where placer gold was discovered in the Yukon region during 1914 were in the Healy River and upper Tolovana River basins. Both these rivers are tributary to the Tanana. Neither of these camps has been visited by Survey geologists since the discoveries were made, and information regarding the reported finds is meager.

Healy River flows into the Tanana from the north about 170 miles above Fairbanks. The lower part of its valley has not been surveyed, but the accompanying map (Pl. I) shows its general location and the details of drainage in the upper basin.

The bedrock of the region¹ so far as known is mica schist with gneissoid and massive granites. The mineralization is probably connected with the intrusion of granites, as it is in other parts of the Yukon-Tanana region.

Several years ago some auriferous gravels were found on Ruby Creek in this district. Ruby Creek is tributary to Healy Lake, which is in the flood plain of Healy River about 4 miles from the Tanana. In the midsummer of 1914 some excitement was caused at Fairbanks by the reported discovery of valuable placers in the Healy

¹ Brooks, A. H., A reconnaissance in the White and Tanana River basins, Alaska, in 1898: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, pp. 425-494, 1900.



MAP SHOWING LOCATION OF HEALY RIVER.

River region, and probably more than a hundred men went to the scene. It was found that the discovery was of no great promise and but few remained to prospect. So far as can be learned the actual find consisted of some auriferous gravels on Kenyon Creek, a tributary to Healy Lake, about 4 miles from its mouth. The gravels are reported to be 125 feet deep and the pay streak about 60 feet wide. Many garnets are found in concentrates, and as the bedrock is reported to be schist it is probably a garnetiferous mica schist. The gold is medium grained with but few nuggets, angular and bright colored. Its value is probably about \$14 to \$16 an ounce. In spite of the discouraging reports of this find a number of prospectors undertook to test the gravels of Kenyon and other creeks of the district. What is known of the geology of the region justifies the hope of finding gold placers.

Healy River may be reached from Fairbanks by small launches ascending the Tanana, though navigation is difficult on account of shoals, driftwood, and swift water. There is a good wagon road as far as McCarty, at the mouth of Delta River, about 90 miles from Fairbanks. McCarty is about 60 miles by river route from the mouth of Healy River. This district lies in the Tanana recording precinct, and the recording office is at Richardson.

In September, 1914, it was reported at Fairbanks that rich placers had been found in the headwater region of Tolovana River (see fig. 1), a tributary of the lower Tanana. The Tolovana drains the southern slope of an upland forming the watershed between it and Hess Creek on the west and northwest and Beaver and Victoria creeks on the east and northeast. To judge by what is known of adjacent regions,¹ the country rock of the new district is probably limestone and slate with some greenstone and, probably, intrusive granites. The geology is probably more like that of the Hot Springs district than that of the Fairbanks district.

According to the newspaper accounts, the first claims recorded in this district were in the names of C. W. and N. R. Hudson, Jay Livengood, and C. W. Koegly, and these men were presumably the discoverers. The first claims staked were on what was called Livengood Creek, which is tributary to the upper Tolovana. Placer gold is reported to have been found at the same time on Olive Creek, a tributary to the Tolovana just above Livengood Creek. Later other creeks were staked, including some tributaries to Hess Creek. There appears to be no question that auriferous gravels are distributed over a considerable area in this new district, but there is still a question as to how much of this offers workable placers. The alluvium on many of the creeks is said to be from 20 to over 100 feet in depth,

¹ Prindle, L. M., and others, A geologic reconnaissance of the Fairbanks quadrangle, Alaska: U. S. Geol. Survey Bull. 525, 1913.

and hence the work of prospecting is necessarily slow. During the winter of 1914-15 several steam plants were taken into the district, and the results of the winter's work should yield some definite evi-

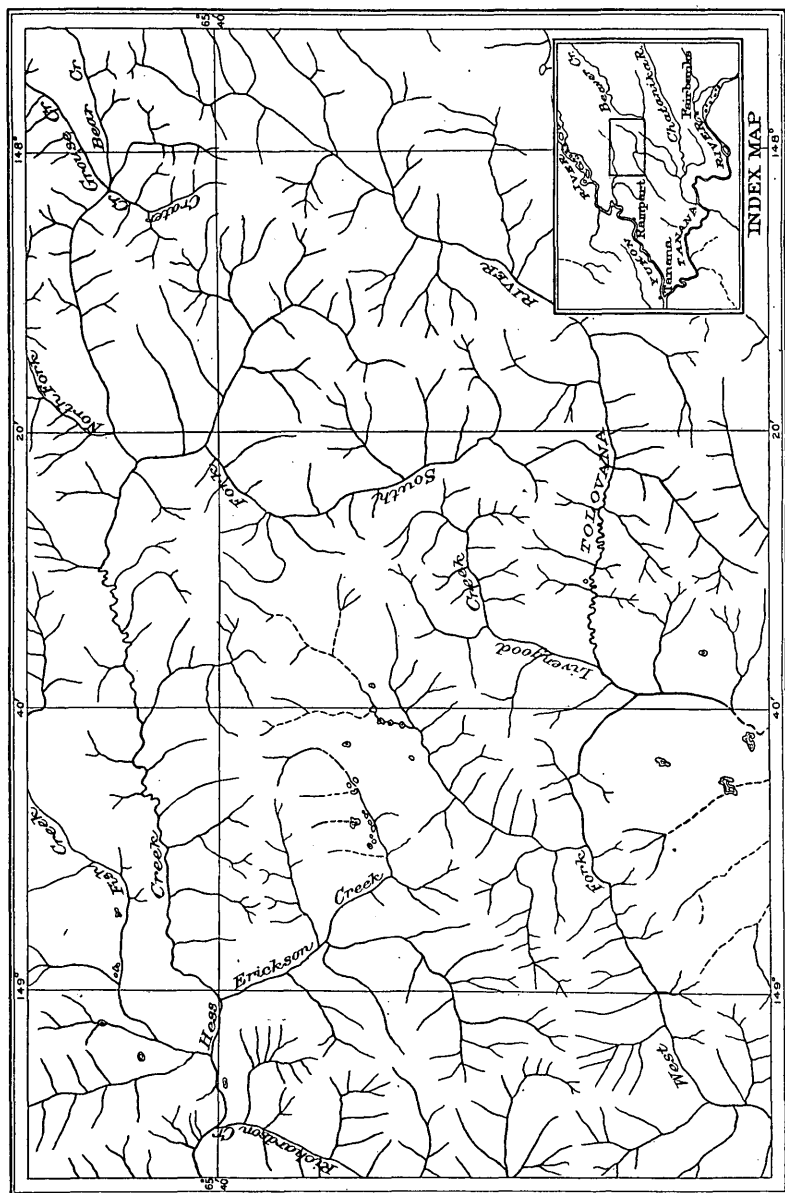


FIGURE 1.—Map showing location of Livengood Creek, Tolovana district.

dence of the value of the placer ground. Meanwhile, what is known of the district certainly justifies careful prospecting.

The Tolovana district lies near the northwestern boundary of the Fairbanks precinct. Therefore, claims are recorded at Fairbanks,

which in an air line is 50 miles from Livengood Creek. The trail thus far used to the new camp leaves Olnes, a station on Tanana Valley Railroad, and takes a northwesterly course. It is probably 50 or 60 miles in length. This trail has been used only in winter, but there will be no serious difficulty about establishing a summer trail, though the flats of the larger rivers are likely to prove swampy.

Another route of approach is by launch or small steamer up Tolvana River. This watercourse is a deep, winding, sluggish stream, but log jams are likely to present difficulties to navigation. It is reported that small steamers can be taken within 10 or 20 miles of the new camp. Livengood Creek is about 40 miles due east of the Yukon at the mouth of Hess Creek, which can be ascended in small boats to points within 10 or 15 miles of the new camp. Though the district is not very difficult of access, it will be rather expensive to reach with heavy machinery. Several hundred persons are said to have wintered in the new camp.

FAIRBANKS DISTRICT.¹

The first placer mining in the Fairbanks district consisted of some small operations in 1903. Up to 1908 the gold output steadily increased, but since then it has been on the decline. In these 12 years of operations gold to the value of \$63,040,000 has been won from the auriferous gravels. The placer gold and silver output by years is shown in the following table. Silver occurs as an impurity in the placer gold, and the production of this metal as stated in the table is based on an estimate of its percentage.

Placer gold and silver produced in the Fairbanks district, 1903 to 1914, inclusive.

Year.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Value.
1903.....	1,935.00	\$40,000	348	\$188
1904.....	29,025.00	600,000	5,225	2,821
1905.....	290,250.00	6,000,000	52,245	28,212
1906.....	435,375.00	9,000,000	78,367	42,318
1907.....	387,000.00	8,000,000	69,660	37,616
1908.....	445,050.00	9,200,000	79,909	43,151
1909.....	466,818.75	9,650,000	84,027	45,375
1910.....	295,087.50	6,100,000	53,116	28,683
1911.....	217,687.50	4,500,000	52,245	27,690
1912.....	200,756.25	4,150,000	48,182	29,632
1913.....	159,637.50	3,300,000	20,274	12,245
1914.....	120,937.50	2,500,000	29,024	16,050
	3,049,560.00	63,040,000	572,622	313,981

The data relating to the source of the gold by creeks are not very accurate. Attempt has been made in the following table, however,

¹ Prindle, L. M., and others, A geologic reconnaissance of the Fairbanks quadrangle, Alaska: U. S. Geol. Survey Bull. 525, 1913.

to distribute the total Fairbanks placer-gold production up to and including 1914 by the creeks on which the mines are located.

Approximate distribution by creeks of value of placer gold produced in Fairbanks district, 1903 to 1914, inclusive.

Cleary Creek and tributaries.....	\$21,600,000
Goldstream Creek and tributaries.....	12,400,000
Ester Creek and tributaries.....	10,300,000
Dome Creek and tributaries.....	7,300,000
Fairbanks Creek and tributaries.....	6,700,000
Vault Creek and tributaries.....	2,400,000
Little Eldorado Creek	1,800,000
Other creeks.....	540,000
	<hr/> 63,040,000

The above tables show only the placer output of the district immediately tributary to Fairbanks. They do not include the output of Bonnifield, Tenderfoot, Salchaket, and other smaller camps which are supplied from Fairbanks and whose gold is sent to Fairbanks. Several other districts, such as Hot Springs and Ruby, send a part of their gold output to Fairbanks. All these districts have added from \$500,000 to \$1,500,000 of gold to the total which annually passes through Fairbanks.

Lode mining began at Fairbanks in 1910, and since that time gold to the value of \$851,069 has been produced by this industry. The lode output by years is shown in the following table, which is based on more accurate data than those used for the placer production:

Lode gold and silver produced in the Fairbanks district, 1910 to 1914, inclusive.

Year.	Gold.		Silver.	
	Fine ounces.	Value.	Fine ounces.	Value.
1910.....	841.19	\$17,389	106	\$57
1911.....	3,103.02	64,145	582	308
1912.....	9,416.54	194,657	1,578	971
1913.....	16,904.98	349,457	4,124	2,491
1914.....	10,904.75	225,421	2,209	1,222
	<hr/> 41,170.48	<hr/> 851,069	<hr/> 8,599	<hr/> 5,049

The very marked decline in the gold-mining industry of the Fairbanks district is chargeable to the economic conditions and not to the exhaustion of the gold deposits. While it is true that the exploitation of bonanza placers in this field will soon be a thing of the past unless discoveries not now anticipated are made, yet large bodies of auriferous gravels remain, but only a small part of them can be profitably exploited under present operating costs. With the rapid exhaustion of the easily accessible timber wood is increasing in cost.

The operator who now works on placers of lesser gold tenor than those handled by his predecessor of a few years ago (see pp. 78, 79) is forced to pay two or three times as much for fuel. Operators also report that during the last two years the cost of supplies has increased somewhat at Fairbanks. Therefore the average cost of everything necessary to gold mining except labor is greater now than in the past. Under these conditions there is not much incentive to embark on new mining ventures.

There is need, therefore, of cheaper fuel and cheaper transportation, and these needs will be met by the proposed Government railroad to Fairbanks. This railroad will lower the cost of freight, will make communication possible throughout the year, and will furnish cheaper fuel by bringing in the coal from the Nenana field. Under such conditions large placer-mining operations will surely be undertaken and Fairbanks will maintain its position as an important placer camp.

The conditions that have brought about a decline of placer mining have had a still more depressing effect on the lode mines. The enthusiasm aroused by the first lode developments led many to embark on ventures without counting the cost of operation. It is now certain that there can be little hope of substantial profit until mining and milling costs are reduced, chiefly by obtaining cheaper power. Many owners of quartz mines are now awaiting the construction of the railroad, which will give them cheaper fuel and supplies, before proceeding with any development. While these conditions brought about the general decline in lode mining, it is also true that many veins have not shown the persistency in depth and value that their owners had hoped for. Such unrealized hopes are to be expected in all new lode camps.

It is estimated that 125 placer mines were operated in the Fairbanks district in the summer of 1914, employing about 1,200 men. During the previous winter probably less than 50 mines were operated. One dredge was operated during the entire summer on Fairbanks Creek, but this is the only attempt that has been made to exploit the extensive gold dredging ground. About half of the gold mined during the year was taken from the placers of Goldstream and Cleary creeks. Details regarding mining operations at Fairbanks are presented elsewhere in this volume.

IDITAROD DISTRICT.¹

The value of the gold produced in the Iditarod district in 1914 is estimated to be \$2,060,000, compared with \$1,860,000 in 1913. Much the greater part of the Iditarod output is taken out by a few large

¹ Eakin, H. M., The Iditarod-Ruby region, Alaska: U. S. Geol. Survey Bull. 578, 1914.

plants. Both the high cost of mining and the character of the deposits make the Iditarod the field of large operations. This is shown by the fact that only about 15 mines were worked in 1914, employing probably about 500 men. The most important operations are those of the two dredges, one on Flat Creek and the other, which began work this season, on Otter Creek. A new electric plant was being constructed in 1914 on the Iditarod about 10 miles above Otter to furnish power to the Flat Creek dredge. As in previous years most of the gold output was derived from Flat and Otter creeks. The following notes were collected by A. G. Maddren during a brief visit to Iditarod in July:

The principal new development in the mining industry of the Iditarod district during 1914 is the installation of a gasoline dredge on Otter Creek by Riley & Marston. This is of the small-flume washing type that has been used in the Nome district during the last few years. Its capacity in favorable gravels is from 2,000 to 2,500 cubic yards in 24 hours on a fuel consumption of 250 to 300 gallons. In July, 1914, this machine was operated along the right limit of Discovery claim, on the present bed of Otter Creek and its immediate banks. Many of the water-front buildings of the settlement of Discovery were removed in consequence of its operation.

The gravels in the immediate channel of Otter Creek are thawed, but the right bank, on which the town stands, is mostly frozen, especially in its upper 5 to 10 feet, which is composed chiefly of muck. Steam thawing and blasting in advance of the dredge were necessary to remove this frozen overburden. A considerable number of bowlders too large for the dredge to lift occur in the stream bed and right bank, where they were dug out until July 15, and the delays caused by their removal hindered the dredge from working at full capacity. A double crew of about 12 men was employed.

On Flat Creek the large electrically driven dredge of the Yukon Gold Co. continued its successful operation of the last four years. In July this machine was digging downstream along the west boundary of the Wildcat Association claim near its lower limit and on the adjoining Chicago Bench claim. About 60 men were employed in this dredging operation.

During 1913 two placer mines were operated on a bench claim along the right limit of the Wildcat Association, beyond the dredgeable area, and it was planned to continue this work during 1914 as soon as the rains of August and September furnished sufficient water for sluicing. This bench is mined by open-cut scraping and hoisting methods such as were generally employed along Flat Creek before the more efficient dredge was installed. About 10 men were engaged on this bench in July, but it was intended to double the force as soon as water for sluicing was available.

Several open-cut scraping and hoisting plants were also in more or less continuous operation on Otter Creek on claims 1 above and 1 below Discovery claim. The largest of these plants used a bottomless scraper of $2\frac{1}{2}$ cubic yards capacity. About 30 men were employed on these plants.

At the mouth of Glen Gulch a small hydraulic plant of small capacity, supplemented by shovel work, was under operation by two men, and on the lower part of Black Creek a plant was employing six to eight men in July.

The open-cut pit mining of the residual placer deposits on the higher slopes of Flat Dome was continued in the Flat Creek, Happy Gulch, and Chicken Creek drainage basins. On the Up-Grade Association and Chicken Creek operations

team derricks have been installed to handle the large residual granitic bowlders that encumber the gold-bearing deposits. The mining of these properties had not reached full capacity early in July, owing to the lack of water for washing the loosely consolidated residual granitic sands that contain the placer gold. But double shifts of about 10 men were then employed on each of these operations and it was planned to increase the force as soon as the rains of August and September furnished more water for ground sluicing and concentrating the pay dirt. Work was also continued on the Hilltop Association group at the source of Happy Gulch. There were other operations on Otter and Flat creeks, as well as on Black, Willow, and some other creeks of the district. Winter deep mining was carried on by only a few small plants in the Iditarod district.

RUBY DISTRICT.

It is estimated that the Ruby district, including the tributaries to the north, produced about \$1,000,000 in 1914, compared with \$785,000 in 1913. About 55 different mines were operated during the summer, employing about 450 men. Probably about 20 mines were worked in the winter, employing about 200 men.

The Ruby district embraces an ill-defined area in which auriferous gravels are widely distributed stretching southward from the Yukon at the town of Ruby. The center of most extensive mining at present is the basin of Long Creek. There is also considerable mining on Glenn Gulch and other tributaries of Flint Creek. All these creeks drain into Solatna River, many of whose other tributaries carry gold placers. Since 1912 the mining field was extended by the finding of gold on Poorman Creek, which lies within the basin of the upper Innoko, about 50 miles south of the Yukon. Mining and prospecting were particularly active in this part of the field during 1914. As, unfortunately, not all the operators returned the schedule sent to them requesting data on mining operations, the following notes on mining are far from being complete, but they will serve to indicate the principal operations in the district.

The largest placer-mine operations during the summer of 1914 were on Long Creek and its tributaries. On Long Creek proper there were eight or ten large plants working on deep gravels and employing from 20 to 50 men each, besides some smaller mines. Some of these were operating during the previous winter. Three or four large plants were also working the shallower gravels of Bear Pup, a tributary of Long Creek. This work was done by open-cut methods. There was also considerable mining, though no large single operations, on Midnight, Greenstone, and Monument creeks, all tributary to the upper Solatna. Considerable ground was stripped on Greenstone Creek, besides some large open-cut operations, with the purpose of mining on a large scale next season, either by dredges or steam scraper. One deep mine was operated on Tamarack Creek,

tributary to the Solatna from the south, also on its tributary Willo Gulch.

Data from the eastern part of the district are especially scant. It is known that there was considerable deep mining on Glenn Gulch, and deep mining is also reported on Trail Creek. Undoubtedly there were many other small operations.

The writer is greatly indebted to Mr. Alexander Cameron for notes on mining developments in the Poorman Creek region. Freight to this camp from the Yukon cost 4 cents a pound in winter and 8 cents in summer. The summer freight is brought part way by boat up Solatna River. According to Mr. Cameron eight claims, employing 30 men, were operated in this part of the district during the winter and sixteen, employing 76 men, during the summer. These produced gold to a total value of about \$120,000. On Poorman Creek four claims were worked in winter and eight in summer. All these are underground mines. Seven of the mines are equipped with engines of about 20 horsepower each. The placer gold is reported to be irregularly distributed, and this makes operations expensive. One deep mine was operated on Little Pup, a tributary of Poorman Creek. The bedrock here is about 60 feet deep. Most of the material above bedrock is muck. It contains a pay streak 5 to 18 feet wide, which is reported to carry good values. One mine was operated on Duncan Creek, which is also tributary to Poorman Creek. Here the bedrock is 50 to 75 feet in depth, and the distribution of gold seems to be rather irregular, though the creek has been little prospected. Flat Creek joins with Poorman Creek to form Timber Creek. Here there were two mines operated in the winter and one in the summer. The bedrock is about 60 feet deep.

HOT SPRINGS DISTRICT.

The gold placers of the Hot Springs district produced gold to the value of about \$750,000, compared with \$400,000 in 1913. About 40 mines, large and small, were operated in this district in 1914, employing some 300 men. The largest operations of the district were in the Sullivan Creek basin. Some stream tin was recovered incidentally to gold placer mining. Details regarding mining in this district are presented elsewhere in this volume.

KOYUKUK DISTRICT.

It is estimated that the Koyukuk district produced in 1914 gold to the value of \$260,000; in 1913 the output was about \$400,000. The decrease was due in part to lack of water, but largely to the fact that in 1913 one or two deep mines on Hammond River worked on very rich ground and thereby abnormally increased the total

output. So far as can be learned, the value of the annual gold output from the Koyukuk district has for a number of years been from \$200,000 to \$300,000. It is estimated that during 1914 about 30 different mines were worked in the district, employing about 130 men. These were about equally divided during the winter and summer seasons, but about four-fifths of the gold was taken out during the winter, and most of this was won from the deep Hammond River placers. About six mines were operated on Hammond River during the winter and two in summer. A 137-ounce nugget of gold was found on Hammond River. Nolan Creek was the second largest producer, with five plants operating in winter and three in summer. Five mines were operated on Gold Creek in winter and four in summer. There was also productive mining on Myrtle, Emma, Vermont, Linda, Smith, Wild, and other creeks of the district.

Sluicing was somewhat hampered because of low water in mid-summer, and hence the gold output was somewhat smaller than was expected. The white population of the entire district is about 250. Mining costs are high. Wages are \$6 to \$10 a day, with board, which costs from \$3 to \$4. Supplies are brought from the Yukon up the Koyukuk to Bettles, a distance of about 500 miles, by a steamer which makes from three to five trips each summer. The cost of freight to this point is about \$90 a ton. From Bettles supplies are hauled to Nolan on horse scows at a cost of about \$140 a ton. The summer freight rate from Nolan to the mines on Nolan Creek is \$140 a ton and the winter rate \$90 a ton. From Nolan to Hammond River the summer freight rate is \$100 a ton and the winter rate \$40. The average operator probably pays more than \$300 a ton for the freight delivered at his mine. The facts in hand indicate that more than half of the gross value of the total gold output of the district is needed to pay the cost of transportation. These facts are reflected in the cost of some of the supplies. Hay and oats cost \$150 a ton, and as a consequence there are but few horses in the district, though some native hay is utilized. Wood costs \$12 to \$16 a cord delivered on the claim. As high as \$350 a ton is paid for the small amount of blacksmith coal used in the district. There is not a wagon road in the district except a few inferior ones built by private enterprise.

Under these conditions it is not a wonder that operators have not been encouraged to undertake any large mining ventures. It has, in fact, been possible to work only the richest ground, and much of that available under present conditions is approaching exhaustion. A few steam hoists and thawing outfits constitute about the only mine equipment, except pick and shovel, used in the entire district. No steam scrapers have been utilized and only one or two small

pumps. There are, however, a few small hydraulic plants used on bench gravels.

The Koyukuk contains much placer ground that could be profitably exploited if operating costs were reduced. There are on Nolan and Hammond creeks deep placers, that can not now be worked because of the underground circulation of water, which can only be handled with pumps. There are other deposits that could probably be mined with steam scrapers and some that could be hydraulicked. Low-grade deposits suitable for dredging are also reported.

Small operations were continued in the Indian River district, lying in the lower Koyukuk basin. It is estimated that six or eight mines were operated during the summer, employing about 25 men, with a gold output of about \$25,000.

CHISANA DISTRICT.

The greater number of the stampedeers who went to the Chisana district in 1913-14 returned without realizing their expectations in the new camp. Nevertheless, some rich placer ground has been found in this district, though the total bulk of auriferous gravels so far developed is not large. The total gold output from the district in 1914 had a value of about \$250,000. It came chiefly from Bonanza Creek, but there was also a considerable output from Little Eldorado and Skookum creeks. Twenty-two mines were operated in the district during the summer of 1914, employing about 325 men. A description of the mineral resources of Chisana district is contained elsewhere in this volume.

CIRCLE PRECINCT.¹

The Circle precinct includes the Birch Creek district as well as the placers of the Woodchopper Creek and Beaver Creek basins. It is estimated that gold to the value of \$225,000 was produced here in 1914, compared with \$175,000 in 1913. About 46 mines, employing 80 men, were operated in winter, and 53 plants, employing 140 men, in summer. Nearly three-quarters of the gold produced was taken out in the summer.

Mining in the precinct consisted of a few large operations, employing 15 to 20 men each, all of which were in the Birch Creek district, and many small operations, which averaged only two or three men to each mine. About half the gold produced was taken from the mines on Mammoth and Mastodon creeks. One placer mine was operated on Mastodon Creek in winter and eight in summer. On Mammoth Creek one claim was worked in winter and three in summer. The old dredge that was brought in from Dawson and installed on Mastodon Creek in 1911 was found unfit for further

¹ Prindle, L. M., A geologic reconnaissance of the Circle quadrangle, Alaska: U. S. Geol. Survey Bull. 538, 1913.

service and dismantled. The control of the dredging ground reverted to the owners, and the ground is being worked by two hydraulic plants. There are also two other plants operating on Mastodon Creek, one above and the other below the dredging ground.

On Mammoth Creek a hydraulic plant was operated. The same operators bought a dredge, which was landed at Circle during the summer of 1914. This will be carried over the Government road 40 miles to the mouth of Mammoth Creek. It is hoped that it will be installed in time to operate the full season of 1915. The dredge has buckets holding $3\frac{1}{2}$ cubic feet, close-connected bucket line, 170-horsepower steam engines, and an estimated daily capacity of 2,000 yards. Wood will be used as fuel. The ground on Mammoth Creek is 12 to 16 feet in depth. It is chiefly coarse gravel, not frozen, and is said to be well adapted for dredging. On Miller Creek, a tributary of Mammoth Creek, three plants operated during the summer. Five plants operated on Independence Creek, which joins with Mastodon to form Mammoth Creek. One of these used a 1-yard steam shovel to deliver the gravel to a movable grizzly over portable sluice boxes.

Deadwood Creek was worked by eight to ten small outfits by open-cut methods. Some drift mining also was done on lower Deadwood Creek during the winter. It is proposed to install a hydraulic plant on upper Deadwood Creek next season. Switch Creek, tributary to Deadwood Creek, supported the operation of two drift-mining outfits throughout the summer. A hydraulic plant, intended to work claims Nos. 3 to 6, inclusive, on Switch Creek, was landed at Circle during the summer and is to be installed for operation in 1915.

A single plant operated on Half Dollar Creek, a tributary of Harrison Creek, and another on Eagle Creek, which is tributary to Birch Creek. The Eagle Creek plant has hydraulic equipment and uses water from Independence Creek. This plant uses two to four nozzles, according to the water supply.

The Birch Creek district, one of the oldest on the Yukon, has up to recent years been mined only by very simple methods. A change has now come about in the adoption of dredging and hydraulicking. The construction of a good wagon road from Circle, on the Yukon, to the district has been an important element in bringing about this change and is a good illustration of the quickness with which the mining industry responds to the improvement of conditions of transportation.

In the Woodchopper Creek region about 10 mines were operated and 25 men were employed during the summer of 1914. Ten plants were operated in the winter. Most of these were on Coal Creek, a southerly tributary of the Yukon 60 miles above Circle. Preparations are under way for installing a hydraulic plant on Woodchopper

Creek, water to be conducted from Iron Creek to the mouth of Mineral Creek.

INNOKO DISTRICT.

The Innoko district is estimated to have produced gold to the value of \$200,000 in 1914 and \$280,000 in 1913. This was produced by 26 mines employing some 88 men. All of this work except a little winter drift mining on Ophir and Little creeks was open-cut work. The producing creeks are Ophir, Spruce, Little, Ganes, and Yankee. Eight plants were operated on Ophir, three on Spruce, eight on Little, three on Ganes, and four on Yankee. Operating costs are high because of the high price paid for supplies.

It is reported that considerable work was done on Cripple Creek, which is located about 30 miles northeast of Ophir. Cripple Creek flows into Colorado Creek, a tributary of the Innoko. The placers are deep and are worked by underground methods. It is reported that five mines were operated on this creek, with a total output of \$15,000.

FORTYMILE DISTRICT.

The Fortymile district was the first of the Alaska-Yukon gold fields to be developed. Here placers were discovered in 1886,¹ and since that time the district has produced gold to the value of about \$6,100,000. In spite of the inaccessibility of the region in the early days, a considerable number of prospectors reached the scene of the discovery, and the first year of mining yielded probably about \$60,000 worth of gold. The annual gold output rapidly increased, so that by 1894 it amounted to \$400,000. The output in 1896, the year of the Klondike discovery, was nearly half a million dollars. Since then the output has declined. As in other isolated camps, operating costs are high. Most of the supplies are sledged up Fortymile River at heavy expense.

A remarkable feature is that this placer-gold output has for 28 years practically all come from the same creeks that were discovered in the first few years of mining. The only marked exceptions are the placers of Wade Creek, which were found in 1899.

Most of the gold from the district has been won by the simplest of manual methods, there having been but few attempts at the installation of machinery. The only exceptions were the building of some small dredges in 1907. These were successfully operated until 1913, when for one reason or another they were abandoned or moved. It is difficult to understand why dredging has not been developed on a larger scale, as there are many placers which could be exploited in this way. It is probable, however, that the dredging operations

¹ Prindle, L. M., The Fortymile quadrangle, Yukon-Tanana region, Alaska: U. S. Geol. Survey Bull. 375, p. 34, 1909.

attempted were on too small a scale to assure profitable ventures. There are also extensive bench gravels in the Fortymile district, which give promise of yielding workable placers. The topographic position of some of these deposits and the available water supply¹ are more favorable to hydraulic mining than in most of the other Yukon camps. There is also some possibility of developing water power.² Plans have been under consideration for the use of electric power for operating dredges in the district, to be developed at a coal mine in the Canadian Yukon, located at Coal Creek. There is a power plant at this mine, which is 20 miles from the point where Fortymile River crosses the international boundary.

The possibilities of large mining developments are now under investigation, but meanwhile actual mining is on the decrease. In 1914 the value of the gold output from the Fortymile district was about \$60,000, compared with \$100,000 in 1913. One reason for this decline was that certain claims were under bond with a company which was investigating the possibilities of large developments. Until such developments take place a revival of mining is not to be expected. Nearly all the operations in 1914 were on a small scale, and probably about 25 claims were worked by 75 to 100 men during the summer. Some winter work was done on Wade, Lost Chicken, and Chicken creeks. The winter work on about 10 claims on Wade Creek yielded about \$9,000 and the summer work about \$7,000. Chicken Creek was one of the largest producers, with an output between \$15,000 and \$25,000. Some mining was also done on Franklin, Walkers Fork, Squaw, Buckskin, Ingle, and other creeks. About a dozen men were engaged in mining with rockers on the bars of Fortymile River during low stages of water.

Considerable prospecting was done on Mosquito Fork with the view of finding placers for large development. Some dredging ground on Fortymile River near the boundary was also investigated with a view of installation of dredges. Good prospects were found on Texas Creek, a tributary of Fish Creek, which flows into the North Fork of Fortymile River.

EAGLE PRECINCT.

The Eagle precinct includes the gold placers of American Creek and Seventymile River and some smaller streams tributary to the Yukon from the south. The value of the gold output from this region in 1914 is estimated to be \$50,000, or about the same as in 1913. About 20 mines were operated during the year, employing about 70 men. There was practically no winter work.

¹ Ellsworth, C. E., and Davenport, R. W., Surface-water supply of the Yukon-Tanana region, Alaska: U. S. Geol. Survey Water-Supply Paper 342, pp. 67-119, 1915.

² *Idem*, pp. 328-329.

Five mines were operated on American Creek in 1914. Three of these employed 6 to 10 men each. About nine plants were in operation on Seventymile River and its tributaries. Much dead work was accomplished in building dams and opening ground with a view to larger operations next year. All the mines are of the open-cut type, and the methods used include ground sluicing, automatic dams, and small hydraulic operations.

A single plant worked on the main Seventymile near the falls. A little "sniping" was done at other points along the river, but such work was of little importance. Systematic prospecting of the low-grade placers of the Seventymile Valley, with a view to installing a dredge, was under way. Single plants operated also on Flume, Crooked, and Nugget creeks. One of the outfits on Barney Creek installed a small hydraulic plant, the only one in the district.

A little prospecting and mining was done on Washington, Sonickson, Fox, Curtis, and Pleasant creeks, but with only small returns. Some prospecting was done on Flat Creek, a tributary of Charley River.

A quartz prospect known as the Caribou ledge, on Flume Creek, has been opened by a 100-foot tunnel, and an arrastre has been installed to test the ore. The ledge is said to have a maximum width of about 8 feet, but no report as to its value has been received.

RAMPART DISTRICT.

The usual small-scale operations were continued in the Rampart district in 1914. About 10 mines were operated during the summer, employing 25 men, and 6 in winter, employing about 10 men. The value of the total gold output was about \$30,000.

Hunter Creek led the others in scale of operations and output. Two hydraulic plants, employing four men each, worked on claims Nos. 1 and 19 about Discovery. A little sluicing was done on a group of claims including Nos. 6 to 10 above and also on No. 1 below Discovery. Two mines were worked on Little Minook, the second largest producer.

A few men worked on Slate and Quail creeks, and one man worked alone on Big Minook Creek near its head. The gold recovered on Big Minook consisted chiefly of nuggets weighing from 1 to 3 ounces each.

Considerable dead work was done in preparation for larger operations next year. Two automatic dams were put in on Hoosier Creek. A dredge is to be installed on Minook Creek.

SMALLER YUKON DISTRICTS.

Placer mining in the Chandalar district during 1914 was confined to some small operations on Big, St. Marys, and Squaw creeks.

Three mines were operated, employing 8 to 10 men. No important developments of the auriferous lodes have been reported.

Productive mining operations in the Bonnifield district were about on the same scale as in previous years. It is estimated that about 15 mines were operated and gold was recovered to the value of about \$30,000.

There was a little mining on some new placers on tributaries to Healy Creek from the north, mostly by plants employing not over three or four men each. One of these tributaries, Home Creek, is about $8\frac{1}{2}$ miles from Nenana, and another, Alaska Creek, about 5 miles from Nenana. Six men were working on Moon Creek, 6 miles from the mouth. Operations in other parts of the district were the same as in previous years.

No new productive developments took place in the Kantishna district. The gold output in 1914 was estimated to have a value of about \$20,000, taken from about ten mines. Both the Kantishna and Bonnifield districts showed the stimulating effects of the proposed railroad. The Government railroad will pass along the western margin of the Bonnifield district and about 60 miles from the Kantishna district. There was, therefore, far more prospecting in both these districts than in previous years. Some lode and placer properties in the Kantishna district were examined by engineers with a view to large developments.

In 1913 some placer gold was found on Wilson Creek, a northerly tributary of the lower Yukon. The district has not been visited by any member of the Survey, but the following notes have been compiled by H. M. Eakin from reliable sources of information:

The Wilson Creek gold-placer district embraces a small area on the north side of Yukon River about 250 miles above its mouth, or 65 miles above Andreafski. Wilson Creek, 10 miles in length, has a broad drainage basin and receives three tributaries from the east and two from the west, all of which are less than 3 miles in length. Named in order going upstream, the tributaries are Wahpoo Creek from the west, Surprise, Disappointment, and Elephant creeks from the east, and King Creek from the west. Wilson Creek enters the Yukon through Polti Slough, which has become navigable in recent years for the largest river steamboats. Six miles above Wilson Creek is Bear Creek, another small northern tributary of the Yukon. Willow Creek, a west tributary of Bear Creek, heads against Disappointment Creek. The area thus drained has a rolling topography of moderate relief. Its valleys are relatively narrow and steep at their heads but broader downstream, and near the Yukon there are extensive flats.

A fair growth of spruce timber covers the lowlands and reaches well up on the slopes and up the valleys to their heads. A small settlement, called Marshall, has been established on the north bank of the Yukon near the mouth of Wilson Creek and is the distributing point of the district.

The bedrock of the Wilson Creek district is reported to consist of schists, greenstones, and intrusive rhyolite dikes. In general the schists and green-

stones are similar to those of Paleozoic metamorphic rocks in other parts of Alaska. Interbedded igneous and sedimentary rocks of probable Mesozoic age crop out along the river both above and below the Wilson Creek locality. The belt of metamorphic rocks is said to extend northward from the Yukon for more than 50 miles.

In the headward parts of all the valleys the alluvial deposits are reported to be shallow. In the Wilson Creek valley at the mouth of Disappointment Creek it is 3 to 12 feet to bedrock. Below this point depths to bedrock increase rapidly, and on Wabpooh Creek, $2\frac{1}{2}$ miles from the Yukon, a 125-foot hole failed to reach bedrock. Where the alluvium is shallow it consists of coarse gravel and boulders and is unfrozen. The deeper ground is frozen and is composed chiefly of silt overlying a relatively thin stratum of gravel near bedrock.

Considerable mineralization is evident in the greenstone cropping out on the river bank at Marshall and in specimens taken from outcrops on the more inland ridges. The greenstone mentioned contains metallic sulphides, chiefly pyrite and chalcopyrite, and is heavily stained with secondary copper minerals. Specimens taken from an altered rhyolite porphyry dike near the head of Disappointment Creek carry galena and molybdenite and on assay are said to yield small quantities of gold.

The first discovery of placer gold in the district was made by A. C. Rhode and Andrew Edgar in July, 1913. They reported the find of rim prospects on Wilson Creek near the mouth of Disappointment Creek, going as high as 10 cents to the pan, and before the close of navigation 250 men, on the strength of this report, had gone to the district.

During the winter of 1913-14 prospecting was carried on by sinking shafts and by drilling. Six prospecting boilers and three 4-inch drills were in use. Placers have been reported on Discovery claim, Wilson Creek, and on claim No. 1, Disappointment Creek. Prospects were found also on claims No. 1, No. 1 Bench, and No. 9 above Discovery, Wilson Creek, and on Elephant, Willow, and Happy creeks. Happy Creek is a small north tributary of King Creek, the uppermost tributary of Wilson Creek from the west. The gold is said to be well concentrated on and near bedrock. It occurs for the most part as fine, well-worn shotty particles with only a scattering of small nuggets.

Three plants, employing a total of 14 men, were engaged in mining most of the open season of 1914. Two plants worked Discovery claim and one No. 1 Disappointment. The work is all of open-cut type. The waste is ground-slucied off, and the gold-bearing gravel is shoveled by hand into sluice boxes made of whipsawed lumber. The production of the entire season is estimated to have a value of \$12,000.

Considerable prospecting was done during the summer on a number of claims on several different creeks. About 25 men were so employed. Work of this type will be carried on more extensively during the winter of 1914-15, when it will be possible to investigate the shallow deposits that carry live water during the open season.

KUSKOKWIM BASIN.

The total gold output of the Kuskokwim basin in 1914 had a value of about \$110,000, while that of 1913 was probably about \$50,000. It is estimated that about 25 plants were operated in 1914, employing about 80 men. In addition to this a large number of men were engaged in prospecting.

The largest mining developments in the Kuskokwim basin are on Tatalina River near the settlement of McGrath, at the mouth of Takotna River. On Candle Creek, a headwater branch of the Tatalina, there is an open-cut mine, the gravels of which are 10 feet deep. A steam bucket hoist is used to elevate the gravels to the sluice box. A churn drill is being used to prospect the deeper placers on the same property, on the lower part of Candle Creek. In all, 22 men are employed here. Three smaller plants, employing 13 men, were operated on Moore Creek.

Mining was also done in the headwater region of Crooked Creek, tributary to the Kuskokwim near Georgetown, and on Bear Creek and some of its tributaries in the Tuluksak basin; on Canyon Creek, flowing into Kwethluk River; on Marvel Creek, of the Aniak River basin; on Rainy and Kapon creeks, confluent of Eek River; and on Butte Creek, a tributary of Aalalik River. All these operations except those in the Tuluksak basin are on a small scale. While auriferous gravels are widely distributed in this region, but few very rich placers have been found. The promise for the future of mining in most of this field seems to lie in exploitation of the placers on a large scale.

Lodes, including deposits carrying gold, copper, and cinnabar, have attracted some attention in the Kuskokwim basin, in spite of the present difficulties of transportation. There has been a small production of quicksilver from the Parks claims, a cinnabar prospect located on the north bank of the Kuskokwim about 21 miles above Georgetown. Other cinnabar deposits in this region have been more or less prospected. These deposits are described elsewhere in this report.

On a copper deposit in the Russian Mountains, about 18 miles northwest of Kolmakof, on the Kuskokwim, a 25-foot shaft has been sunk on a fissure vein, 30 to 60 inches in width, which has been traced some 4,000 feet. The ore contains chalcopyrite, mispickel, pyrite, and stibnite. It is reported by the owner that the ore contains gold, silver, copper, and a trace of nickel. The gold placers and the lodes of the lower Kuskokwim basin are described in some detail elsewhere in this volume.

SEWARD PENINSULA.

Placer mining began on Seward Peninsula in 1898, and the peninsula has produced gold to the total value of \$68,442,000, practically all won from the auriferous gravels, though a little lode mining has been done at various times. There has been considerable tin mining and a little coal mining. A little graphite has been produced from deposits located on Seward Peninsula. Iron, galena, tungsten,

copper, and antimony ores have also been found and more or less developed.

The value of the gold output in 1914 was about \$2,700,000; that of 1913 was \$2,500,000. During the year 39 gold dredges were operated in Seward Peninsula. Of these two were working in the York district on placer ground which carried both gold and tin. In addition to these there was a placer tin dredge in the York district. The 39 gold dredges, which employed about 320 men, were not all worked the full season, for some were not completed in time. It is estimated that dredges recovered gold to the value of \$1,450,000. The output was curtailed because the dredging season was unusually short.

It is estimated that 70 placer mines in addition to those worked by dredges were operated on the peninsula in 1914, employing about 500 men and producing gold to the value of \$1,250,000. Besides the men engaged in productive mining there were several hundred engaged in prospecting and development work. The total employed in the mining industry during the height of the season was about 1,200. Details in regard to placer mining are presented elsewhere in this volume.

Except for the development of the Lost River tin mine there was little attention paid to lode mining. Developments were continued on some deposits of iron ore 25 miles northwest of Nome, described elsewhere in this volume, and assessment work was done on other lode claims.

KOBUK REGION.

Placer mining in a small way was continued in the Kobuk region during 1914. In the Squirrel River district three claims were worked in the winter and five in the summer, employing 12 to 20 men. Some mining was also done in the Shungnak district. The total output of gold from the Kobuk region in 1914 is estimated to have had a value of about \$35,000.

THE FUTURE OF GOLD PLACER MINING IN ALASKA.

By ALFRED H. BROOKS.

INTRODUCTION.

Placer mining in Alaska began by some small operations at Juneau in 1880, although there is an unverified report that some placer mining was done at Sumdum Bay, southeastern Alaska, in 1870-71. It is estimated that during the 35 years since 1880 Alaska's placer mines have produced gold to the value of \$175,712,992.

Most of the placer mining in Alaska has been done on a comparatively small scale. During the last six years gold dredges have been extensively used, notably on Seward Peninsula, but the value of the total gold recovered by this method is only \$10,100,894, or about 6 per cent of the entire placer production. There has been some hydraulic mining, but the total gold output from this source is probably less than that of the dredges. Much of the deep mining, notably at Fairbanks, has been done on a considerable scale. While no accurate figures are available, it seems probable that over half the gold has been won by the small operations with only very simple equipment. An estimate of the annual placer-gold production is given in the following table:

Value of placer-gold production of Alaska, 1880-1914.

1880-1894....	\$3, 150, 000	1902.....	\$5, 890, 000	1910.....	\$11, 894, 806
1895.....	840, 000	1903.....	5, 946, 067	1911.....	12, 540, 000
1896.....	990, 000	1904.....	6, 109, 481	1912.....	11, 990, 000
1897.....	690, 000	1905.....	12, 124, 000	1913.....	10, 680, 000
1898.....	680, 000	1906.....	18, 007, 000	1914.....	10, 730, 000
1899.....	3, 510, 000	1907.....	16, 491, 000		
1900.....	5, 630, 000	1908.....	15, 888, 000		175, 712, 992
1901.....	4, 990, 000	1909.....	16, 252, 638		

The above table shows that the large annual production began in 1899, the year when the first output was made from the rich beach placers at Nome. The annual gold output from the Nome and other districts of Seward Peninsula reached a maximum in 1906 and since then has greatly decreased. The rich placers at Fairbanks were found in 1903, and by 1905 they yielded a large annual gold output,

which reached its maximum in 1909. Since that year there has been a notable decline in the yearly production. It was the combination of the gold output from the bonanzas at Nome with that from the bonanzas at Fairbanks that resulted in the maximum annual placer-gold production of the Territory in 1906. In more recent years the exploitation of the rich deposits of the Iditarod, Ruby, Koyukuk, Hot Springs, and other smaller districts has gone to swell the annual production of placer gold.

These conditions in the placer-mining industry cause the fluctuation in the value of the annual output. In general, however, the large annual production has been maintained by the mining of rich placers on a small scale rather than by large operations on deposits of lower gold tenor. The depletion of bonanzas in one field has in a measure been offset by the development of new ones in other fields.

The above table indicates a considerable fluctuation in the annual output from placer mining, yet it clearly shows that the industry has during the last decade been on the decline. For several years the output has indeed not varied greatly, but this by no means indicates that under existing economic conditions placer mining can maintain its present status. In some districts, to be sure, such as those of Seward Peninsula, the gold output has probably reached its minimum for many years to come; in others, such as Fairbanks, placer mining is far from being established on a sufficiently permanent basis to give assurance that the present production can long be maintained under present economic conditions. Lode mining, on the other hand, has been on the increase. In 1904 the gold output from lode mining was \$3,050,977, in 1914 it was \$4,863,028, and the developments now under way give assurance of a very much larger production within the next few years. The decrease in the output of placer gold and the increase in that of lode gold is also illustrated by their ratio to the total production of gold. In 1908 about 80 per cent of the total gold production of Alaska was won from the placers, but this ratio has decreased and in 1914 only 68 per cent of the gold is to be credited to placers.

Although there can be no question of a large increase of lode mining, this does not give assurance of prosperity in all parts of the Territory, for valuable lodes have as yet been developed in relatively few of the placer districts. If, therefore, gravel mining should decline there is no assurance that other profitable mining would develop in all the many placer districts.

Between 5,000 and 6,000 men are engaged in placer mining and prospecting for placers, and nearly a third of the white population of the Territory is directly or indirectly supported by the placer-mining industry. It therefore becomes pertinent to inquire what the future of this industry is to be. Will it continue to decline, or are the known

auriferous gravels sufficient to justify the belief that the industry will hold its own or will increase? There is, of course, always the hope of finding new bonanza deposits such as have in the last decade yielded large returns. Such discoveries, however, can not be forecast, and an estimate of the future of placer mining should take into account only what is now actually known about the extent of the auriferous gravels. In other words, the future of the industry must depend, so far as now can be determined, on the exploitation of auriferous gravels of lower gold tenor than those which in the past have yielded most of the gold.

No one can deny that there are very extensive deposits of auriferous gravels in the Territory. In much of Alaska the gravels of most of the larger streams will yield at least fine colors of gold, and this in itself is evidence of the wide distribution of auriferous alluvium. Because of the lack of systematic prospecting of the gravels carrying small amounts of gold it is difficult to arrive at any definite conclusions about the extent of deposits that can be profitably exploited when cheaper transportation and fuel have reduced the costs of mining. In view of the importance of the subject it has seemed desirable to summarize briefly the data relating to it.

DISTRIBUTION AND EXTENT OF AURIFEROUS GRAVELS.

As placer gold was derived from a bedrock source, the occurrence of auriferous mineralization is the first important element to be considered in determining the distribution of the auriferous gravels. Information in regard to this phase of the subject has been recently set forth¹ and need not here be considered in detail. Much of Alaska falls in the Cordilleran province of North America, a province characterized by geologic conditions favorable to the formation of metalliferous deposits. The areas within which more or less metalliferous mineralization has been found in Alaska are widely distributed. They include southeastern Alaska, a part of the seaward flank of the St. Elias Range, a part of the Copper River and Susitna basins, Prince William Sound, the eastern part of the Iliamna and Clark lakes region, some localities in southwestern Alaska, the two flanks of the Alaska Range, the Yukon-Tanana region, the upper Tanana and White River basins, a part of the Koyukuk basin, and a belt running southward from the Yukon through the Iditarod district into the lower Kuskokwim. Much of Seward Peninsula is gold bearing, and some mineralization has been found in the Kobuk and Noatak basins. Within these areas, which, roughly outlined, comprise between 100,000 and 150,000 square miles, the valuable deposits are, of course, only locally distributed, but they indicate in a general

¹ Brooks, A. H., *The mineral deposits of Alaska*: U. S. Geol. Survey Bull. 592, pp. 24-26, 1914.

way the zones in which metalliferous mining has taken place or prospects have been found. They thus also serve to indicate roughly the localities where auriferous gravels occur or are likely to be discovered.

It is evident, therefore, that the metalliferous provinces of Alaska are of wide extent and distribution, a fact which augurs well for the future of mining. The provinces thus defined do not, of course, delimit the distribution or extent of the auriferous gravels, though they indicate that there are large areas in which such deposits have been or probably will be found. It should be noted that the mere presence of auriferous mineralization does not necessarily indicate the presence of auriferous gravels, much less that of workable placers. The process of concentration of gold in the placers will not here be discussed, for it has recently been described.¹

More pertinent to the present inquiry are the known facts in regard to the distribution of placers and auriferous gravels. To discuss this matter adequately it would be necessary to describe all the many placer districts, which would be but to duplicate published data.² For present purposes it will suffice to consider briefly these data, presenting, so far as may be, the results in quantitative form.

The maps and reports relating to Alaskan gold fields show the distribution of the known placers and to some extent, where the data are available, also that of the auriferous gravels. This information has been interpreted as indicating that the watercourses in Alaska placer districts where mining is now going on include over 1,000 linear miles of virgin ground which there is good reason to believe contains placer deposits. There are not sufficient facts at hand to justify any estimate of the width or yardage of this supposed pay ground. It may be said, however, that only deposits of sufficient bulk to justify large installations are included in this mileage.

This 1,000 miles does not include the creeks which have in part been worked out, except in such districts as Fairbanks, where it is known that large bodies of virgin ground still remain on the productive creeks. Nor does this mileage include the gravels of any of the large rivers, though some of them are known to be auriferous.

Another possible source of placer gold is in the auriferous gravels that lie outside of the developed mining districts. There are known to be many such occurrences, but the knowledge about them is too scant to justify their inclusion in the gold reserves.

In the absence of tests on the gravels thus defined there are, of course, no accurate quantitative data on their gold content. However, only those deposits have been included whose position relative to

¹ Brooks, A. H., The mineral deposits of Alaska: U. S. Geol. Survey Bull. 592, pp. 28-32.

² See list of publications relating to geology and mineral resources of Alaska, at end of this volume.

workable placers gives reasonable assurance that they carry sufficient gold to be profitably exploited by methods now in use in the Territory.

GOLD CONTENTS OF AURIFEROUS GRAVELS.

A gold placer may be defined as a deposit of auriferous alluvium that can be profitably exploited. Whether the deposit is or is not capable of being worked at a profit is a function of mining costs, depending on many factors. It follows that a deposit which under present industrial conditions is simply an auriferous gravel may in the future, by the lowering of mining costs, through the improvement of mining methods or for other reasons, be classed as a gold placer. A good example of this evolution is found in the gold placers now mined by dredges. Before the introduction of this cheap method of exploitation these deposits could not rightly be called placers, though they were known to carry gold, whereas now they are valuable placers, inasmuch as they can be profitably exploited.

It follows, therefore, that the determination of whether or not any given body of auriferous gravels is a placer must take account of the cost of mining. It is generally true that a district in which rich placers occur always contains much larger deposits of auriferous gravels of lower gold tenor, though exceptions to this rule are found in some shallow placers representing local concentrations of gold from a near-by bedrock source. Conversely, the reduction of mining costs in any given district makes available for profitable exploitation the deposits that could not before be included in the gold reserves.

It is therefore of much practical importance to determine the gold contents of the ground which is profitably exploited. Using this information in the comparison of one district with another gives a basis, though only a crude one, to forecast the possible extension of the placer-mining industry in any given district. It need hardly be added that the results are applicable only in general terms and that an actual evaluation of the gold placer reserves can be arrived at only by careful prospecting.

In collecting the statistics of gold production for 1914 special effort was made to ascertain the amount of alluvium handled at each mine. With this purpose, operators were requested to furnish an estimate of yardage as well as gold recovery. Many responded to this request, and as a result it is now possible to determine with a fair degree of accuracy the average gold content of the gravels mined in the different districts and under the various mining methods. It should be noted that the crude methods of recovery in use by many of the small operators involve a considerable loss of gold in the tailings. These data do not, of course, give precise information regarding mining costs, because the results show the costs plus the

profit to the operator. Nevertheless the average of a large number of returns from one district, except in the newer fields, should present an approximation of the gold content that is necessary to profitable exploitation, which is the important thing to this discourse.

It will be well to note that there are several sources of error in these data. One is the fact that many operators do not make accurate record of the amount of gravel handled. Again, there are undoubtedly, as shown from the returns, some placer mines that are worked at a loss, though the operators may not know it, owing to the loose system of bookkeeping they practice.

It is also true that, especially in the newer camps, only the richest placers are being mined, and the average of such operations by no means indicates the lowest gold tenor that can be profitably exploited, even under present conditions. Examples of this are afforded by some of the Alaska dredges, which are working on placer ground carrying as high as \$1 or more to the cubic yard, a sum which is, of course, far above operating costs plus a reasonable profit. Attempt has been made to eliminate these sources of error in the data here to be presented.

It has been shown (p. 23) that the estimated average value per cubic yard of the gold-bearing gravels mined each year in Alaska has been gradually reduced from \$3.74 in 1908 to \$1.26 in 1914. If figures were available for the earlier years it would show a still greater reduction. For example, the average gold recovery per cubic yard in Seward Peninsula for the nine years of mining ending with 1906 was about \$5.95,¹ compared with an average recovery of 55 cents per cubic yard for the year 1914.

Though these figures are only approximations, they clearly indicate the fact that gold placers of a much lower tenor than formerly can now be profitably exploited. It is evident that, the mining of low-grade gravels having become economically possible, a much larger placer-gold reserve has become available. In fact, on Seward Peninsula, for example, if profitable mining were possible only on the placers of high-gold tenor, as was formerly the case, mining would now almost have ceased. This change has been brought about largely by improvement of mining methods, for in most of the placer districts the other factors have not greatly changed. At Fairbanks, for example, the unit cost for deep placer mining is probably greater now than it was some years ago. Though wages have remained about the same, supplies cost somewhat more than formerly, and, above all, the price of fuel, wood being used, has increased enormously. Costs can be reduced in two ways—by improvement of mining practice, involving the investment of capital and the employment

¹ Brooks, A. H., *The gold placers of parts of Seward Peninsula, Alaska*: U. S. Geol. Survey Bull. 328, p. 136, 1908.

of technical skill, and by reduction in the price of supplies and fuel through the construction of railroads and wagon roads.

Estimates of the average gold recovery per cubic yard of alluvium mined in some of the principal placer camps of Alaska during the year 1914 are given in the following table. It should be clearly understood that these figures do not represent mining costs, although the averages for the older districts, as will be shown, bear a close relation to these costs.

Estimated average gold recoveries per cubic yard in some of the Alaska gold placer districts in 1914.

Seward Peninsula :

Council, Fairhaven, Nome, Port Clarence, Solomon,
and Kougarok districts :

Average-----	\$0.54
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Yukon basin :

Chisana -----	5.55
Circle -----	.98
Fairbanks -----	3.13
Fortymile -----	2.00
Hot Springs-----	12.10
Iditarod -----	1.32
Innoko -----	4.00
Koyukuk -----	4.33
Rampart -----	2.00
Ruby Creek -----	3.85
Average-----	2.37

Copper River :

Nizina, Bremner, and Chistochina districts—

Average-----	1.26
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Cook Inlet and Susitna basin :

Kenai, Willow Creek, Valdez Creek, and Yentna
districts :

Average-----	1.24
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General average-----	1.26
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The above table emphasizes some significant facts. For example, the well-organized condition of placer mining in Seward Peninsula is shown by the fact that the average recovery there is only 55 cents to the cubic yard. This, of course, is a reflection of the condition that much of the gold is recovered by dredges. In 1914 the average recovery by these dredges was about 40 cents a cubic yard. This figure is in strong contrast with the recovery of \$12.10 a cubic yard for the Hot Springs district, where the operations are chiefly those of deep mining. Hot Springs is a relatively new camp, and at present the gold is mostly taken from bonanza deposits. The relatively small mining operations in the Chisana district, a new and very inaccessible camp, show the high recovery of \$5.55 to the cubic

yard. This is to be interpreted as indicating that only high-grade placers can now be mined.

In the older camps the highest recovery, \$4.33, is from the Koyukuk district, and this is because the high operating costs, due to the high price of transportation, have limited operations to the richest gravels. The same is true of the Innoko, where the average values are estimated to be about \$4, though the returns from the Innoko are rather incomplete, and this figure may be too high. In the Iditarod, on the other hand, dredging has much reduced the average recovery, which in 1914 is estimated to have been \$1.32. This is significant of what can be accomplished by the use of machinery, even in camps where operating expenses are high because of the cost of transportation.

The data at hand indicate that the average recovery in the Circle district during 1914 was only 98 cents. This low figure is due to improved methods, for several hydraulic plants were operated and made it possible to mine gravel of relatively low gold tenor. It should be noted that on account of the abundant precipitation during the summer of 1914 in the Circle district the conditions were exceptionally favorable for hydraulic mining and this has undoubtedly increased the average recovery of gold.

The recovery of \$2 to the cubic yard in the Fortymile district can probably be interpreted as indicating that in this field mining is at present on the wane and that operators have been forced to exploit the gravels of lesser gold tenor. This district includes large bodies of auriferous gravels, but no large plants have yet been installed. What has been said of the Fortymile district also applies to the Rampart district.

The average gold recovery in the Ruby district during 1914 was \$3.85, which is somewhat lower than would be expected in a new camp that is not very accessible. As a matter of fact, the average recovery of the deep mines of the Ruby district is about \$7.30 to the cubic yard, indicating that this form of operation is still confined largely to the richest deposits. On the other hand, some large operations in open-cut mining with an average recovery of \$2.22 have offset to a certain extent the high returns from deep mines.

Placer-mining operations in the Susitna and Copper River basins and on Kenai Peninsula are not extensive, though they include some large individual plants. In this field the conditions for hydraulic mining being more favorable than in the Yukon basin and on Seward Peninsula that form of mining is more extensively practiced. On the other hand, there has been no dredging in this province. Operating costs have, as a rule, been lower than in the other Alaskan placer districts, largely because the region has been made more accessible by railroads and wagon roads. These facts will account

for the lower recovery of \$1.26 to the cubic yard. In other words, they indicate that mining has been possible on gravels of much lower gold content than in the Yukon basin. The average recovery for the entire Yukon basin in 1914 was \$3.33.

The comparisons that have been made above of the average gold recovery of different placer districts serve to indicate in a general way the comparative conditions of operations in the different fields, in spite of the fact that most of the gold recoveries here set forth represent averages from more than one method of mining. There is usually sufficient variation in the occurrence of gold in each district to demand different methods of recovery, so that average recoveries may safely be used for comparison. It will be desirable, however, to consider also, so far as the data will permit, the average recoveries made in different districts by each method of mining.

It is natural to look for the lowest gold recoveries in hydraulic mining. Alaska as a whole is not a field for this form of exploitation. In the Yukon basin and on Seward Peninsula the small stream volumes and low gradients are unfavorable to hydraulic mining. There are, of course, exceptions, and the moving of gravel by water under head is practiced in many favorable localities; moreover, many opportunities for this form of mining have not yet been improved. In the Fortymile district there are, for example, bench gravels which should be hydraulicked, and similar deposits are known in other districts. Heavy gravels, which carry some fine gold, occur on both slopes of the Alaska Range. Here there are streams which will furnish water for hydraulic mining. Whether the values are high enough to warrant exploitation can be determined only by systematic prospecting under a competent engineer. These gravels are not included in the above estimates of gold reserves. In the coastal region, including Kenai Peninsula and the Copper and Susitna basins, the conditions are more favorable for hydraulic mining than in other parts of Alaska. Large plants have been installed in several districts and appear to be operated at a profit. There has, however, been no hydraulic mining in Alaska on the scale of that practiced in California.

The average recoveries for hydraulic operations are of little value to the present discussion. Most of the operations that can be classed as true hydraulic mining have worked on ground that carried values from 50 cents a cubic yard upward and furnish little clue as to minimum values which would assure a profit. Two plants report an average recovery as low as 10 to 12 cents a cubic yard, but it is not certain that these plants have been run at a profit. Hydraulic mining can perhaps be eliminated from the present discussion, as but little of the reserve of auriferous gravels here considered is so located as to be available for this method of exploitation.

Much of the gold from Alaska placers is mined by open-cut methods, in which water under head is used in combination with the shovel to bring the gravel to the sluice box. Steam scrapers, hydraulic elevators, and other adjuncts are used in this form of mining. This mixed form of mining is perhaps best exemplified in Seward Peninsula, where the recovered values are reported to be from 30 cents to \$1 or more to the cubic yard. Enough of these operations are reported to be mining gravel carrying 60 to 80 cents or less to make it probable that these plants are being operated at a profit.

The recoveries from the mixed form of mining in the Iditarod district average about \$1.46 a cubic yard. Four large plants in the Ruby district averaged a recovery of \$2.22 a cubic yard. It is unfortunate that the returns from this form of mining in the Fairbanks district are not complete enough to justify presenting an average. In the smaller Yukon camps the returns indicate an average recovery of about \$2.

In the districts lying nearer the coast, like Kenai Peninsula and Yentna, the average recovery for the mixed mining is \$1 or less to the cubic yard. All these facts go to prove that placers located in the inland regions must, to justify exploitation, carry about twice as much gold as those of Seward Peninsula and other accessible regions.

It has already been stated that the average recovery of the Seward Peninsula dredges is about 40 cents to the cubic yard, which undoubtedly gives a good profit under the average conditions. Only a few dredges have been operated in other parts of Alaska, so there is little basis of comparison. With fuel at a reasonable price, the abundant lignitic coal, and cheaper transportation by railroad, there seems to be no reason why dredging should be more expensive in the Yukon region than in Seward Peninsula. There is every reason to believe, therefore, that dredging will yet be an important industry in the Yukon placer camps.

Deep placer mining, or drift mining, as it is generally called in Alaska, is the most expensive mode of operation. It has been perfected at Fairbanks, where the average cost in 1908, according to Prindle and Katz,¹ was about \$3 a cubic yard, not including overhead charges. Since that time operators report that the costs have been increased because of the higher price of supplies and fuel. The average recovery from 25 mines, which sent in complete reports in 1914, was \$5.20. As the royalty is usually 20 or 25 per cent, it can be seen that the operations were carried on with no great margin of profit. It is therefore probable that deep gravels averaging less than \$5 a cubic yard can not now be mined at a profit in the Fairbanks district.

¹ Prindle, L. M., and Katz, F. J., A geologic reconnaissance of the Fairbanks quadrangle, Alaska: U. S. Geol. Survey Bull. 525, p. 131, 1913.

In the Ruby district during 1914 the average recovery from deep mining was about \$7.30 and in the Hot Springs district about \$15. Both of these are comparatively new camps, where the operators have not yet been forced to develop the placers of lesser value. Incomplete returns from the Koyukuk district indicate that the average recovery from deep mines is about \$7 to the cubic yard. This is one of the old camps in which the cost of operating continues to be high.

SUMMARY AND CONCLUSIONS.

The data set forth above indicate a wide variation in the average gold recovery in the different placer districts. This, with certain exceptions already explained, can be used as a measure of mining costs.

As in nearly every one of these placer districts there is a far larger quantity of auriferous gravels than that constituting the placer deposits workable under present economic conditions, it is safe to conclude that Alaska's reserves of placer gold are by no means approaching exhaustion. If by improvement of the economic conditions the cost of operating the Yukon camps can be reduced to that of the camps on Seward Peninsula, large deposits of auriferous gravels will be available for profitable exploitation. There is no exact measure of the extent or value of these deposits, but that they are present and only await improved conditions of transportation and fuel supply to be classed as workable placers there can be no doubt. The conclusion from this analysis is that given cheaper fuel and transportation there is no reason to believe that placer mining will continue to decline.

