

THE MINING INDUSTRY IN 1910.

By ALFRED H. BROOKS.

INTRODUCTION.

The gold and copper lode-mining industry of Alaska made considerable progress in 1910, not so much in output as in the amount of dead work accomplished. On the other hand, there was a falling off in the production of the placer mines and an absolute stagnation in all enterprises depending on the opening of the coal fields.

As in previous years, the lack of cheap fuel is the one great hindrance to the advancement of the mining industry in Alaska. So long as the Pacific seaboard of Alaska and the adjacent portions of the inland region have to depend on expensive coal brought from British Columbia, Japan, and Washington, so long will the industries of the Territory suffer. With coal at \$8 to \$20 a ton along the Pacific seaboard of Alaska, even mines located at tidewater are at great economic disadvantage. Under such conditions only the richest and largest ore bodies can be mined at a profit. Moreover, railway construction will be active only when there is an assured tonnage from the coal fields and when cheap fuel for operating is available.

The inadequacy of the mineral-land laws which apply to placer claims continues to hamper the mining industry by discouraging the bona fide miner and prospector. This condition, while ever present, is emphasized when a new district is discovered and a few men, often mere speculators and not miners, can preempt large tracts of land and hold them for a year and sometimes nearly two years without doing any development work.

In spite of the decreased gold production and the handicap because of the delay in opening the coal fields, considerable advance was made in the mining industry. Copper mining was prosperous and much development work was done on the copper deposits. More has been accomplished than in any previous year in the development of auriferous lodes. Much work was also done toward installing large mining plants for working low-grade placer deposits. The decrease

in the value of the gold production is entirely chargeable to the falling off in the output from the placer mines of Fairbanks, Seward Peninsula, and some of the smaller placer districts. Except in these camps and the coal fields, the output from all the mining districts increased.

The value of the total mineral production in 1910 is estimated at \$16,925,178; in 1909 it was \$21,141,019. In the following table the sources of this wealth, as well as a comparison with the previous year, are presented. The statistics for gold and silver output are not yet completed and may be subject to change, but the figures for the other mineral products are presented with more confidence as to their accuracy.

It should be noted that the apparent increase in silver production in 1910 as compared with 1909 is due largely to the fact that in the past the silver content of the placer gold has been estimated too low. This is due to the fact that the placer-gold producers make no returns of the silver content of their gold output. The placer silver, which occurs as an impurity in the gold, can be arrived at only by a computation based on the purity of the gold. The accumulation of data on the composition of the placer gold from the several districts during the last six years has made it possible to compute the silver percentage more accurately and has shown that in the statistics published in the past the estimate for placer silver is too low.

In the table the outputs of marble, tin, gypsum, etc., are combined because a separate listing might reveal the production of individual properties.

Mineral production of Alaska, 1909-10.

	1909		1910 ^a		Increase (+) or decrease (-).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....ounces..	987,416.76	\$20,411,716	781,836.75	\$16,162,000	-205,580.01	-\$4,249,716
Silver.....do.....	147,950.00	76,934	169,418.00	91,485	+ 21,486.00	+ 14,551
Copper.....pounds..	4,124,705.00	536,211	4,241,689.00	538,695	+116,984.00	+ 2,484
Coal.....short tons..	2,800.00	12,300	1,400.00	13,600	- 1,400.00	+ 1,300
Marble, gypsum, tin, mineral water, and lead.....		103,858		119,398		+ 15,540
		21,141,019		16,925,178		- 4,215,841

^a Preliminary estimates.

NOTE.—In the above table copper is valued at 13 cents a pound for 1909 and 12.7 cents for 1910; silver at 52 cents an ounce for 1909 and 54 cents for 1910.

Mining began in Alaska in 1880, but for many years no very accurate records of mineral output were kept. Since 1905, however, fairly reliable statistics of mineral production are available. These data are summarized in the following table, both by years and by substances:

Value of total mineral production of Alaska, 1880-1910.

By years.			By substances.		
1880-1890.....	\$4,686,714	1901.....	\$7,007,398	Gold.....	\$178,797,171
1891.....	916,920	1902.....	8,400,693	Silver (commercial value).....	1,286,687
1892.....	1,096,000	1903.....	8,941,614	Copper.....	5,338,709
1893.....	1,048,570	1904.....	9,567,535	Coal.....	336,789
1894.....	1,305,257	1905.....	16,478,142	Marble, gypsum, tin, etc.....	552,014
1895.....	2,386,722	1906.....	23,375,008		
1896.....	2,980,087	1907.....	20,847,055		186,311,370
1897.....	2,538,241	1908.....	20,142,272		
1898.....	2,585,575	1909.....	21,141,019		
1899.....	5,703,076	1910.....	a 16,925,178		
1900.....	8,238,294				
			186,311,370		

a Preliminary estimate.

TRANSPORTATION.

The nondevelopment of the coal fields has put the railways at a double disadvantage. In the first place, those of the Pacific slope region are paying \$11 to \$12 a ton for coal used in operating, when high-grade coal should cost them only from \$2.50 to \$3.50. Moreover, the imported coal is of an inferior quality compared with the native fuels. In the second place, the coal tonnage needed to help support the railways is nonexistent. In spite of these handicaps, the backers of some of the railway projects have shown commendable enterprise in either continuing construction work or preparing for it.

The most important event of the year in the development of transportation routes was the extension of the Copper River & Northwestern Railway to about mile 150. As this report goes to press telegraphic dispatches announce that this railway has been completed to Kennicott, a distance of 195 miles from the coast at Cordova. This affords an outlet for the copper ores of the Kotsina-Chitina district and renders the Nizina placer district readily accessible. It also both shortens the winter sled route to Fairbanks and does away with the necessity of crossing the high coastal barrier. It will also decrease the cost of transportation to the Valdez Creek and Chistochina placer districts and render the copper belt of upper Nabesna and White rivers more accessible. With the changing of the trail from Chitina to Fairbanks into a wagon road, which is now being accomplished by the Alaska Road Commission as fast as funds available permit, an overland summer route to the Tanana camps will be opened. Take it all in all, this is the most important advance made in the history of Alaska transportation since steamboat service was established on the Yukon about half a century ago.

The Alaska Northern Railway did no new construction work because of the coal-land situation, but it maintained communication over its 71 miles of track which connects Seward, the coastal terminal, with the head of Turnagain Arm. By the use of small launches a route

of communication with Knik and points on Susitna River was thus established, which is competitive with the older route from Cook Inlet. Some location surveys were also made beyond the end of the road. This railway, when completed, will lead to the development of the Matanuska coal field and the Willow Creek lode district, as well as other mining districts of the Susitna basin, besides making accessible extensive areas of arable land.

Most of the other railway projects appear to have lain dormant awaiting the settlement of the coal-land question. The completed railways, such as the White Pass, Tanana Valley, and Seward Peninsula, were operated but need no special mention. At the close of 1910 the aggregate length of all Alaska railways was about 420 miles, compared with 371.4 miles at the close of 1909. This mileage is distributed among nine different railways, from 5 to 196 miles in length.

Among the important work accomplished by the Alaska Road Commission, in addition to the continuation of work on the Valdez-Fairbanks wagon road, already referred to, was the preparation for the establishment of a winter trail from the inland terminus of the Alaska Northern Railway to the Innoko-Iditarod region. This will serve the placer miners of the Susitna basin, the Kuskokwim, and the Innoko-Iditarod and will shorten the winter mail route from the Pacific seaboard to Nome by about 300 miles. The commission also built or improved many other roads and trails in different parts of the Territory.

METAL MINING.

INTRODUCTION.

In 1910 about one-quarter of the gold production came from lode mines and three-quarters from placers. It is a significant fact that in 1909 only one-fifth of the gold came from lode mines. The ratio of lode production to placer production has varied considerably during the 30 years that mining has been carried on. In the first two or three years the gold output was almost all from placers. With the opening of the lode mines of the Juneau belt the lode production became larger than the placer, the ratio in 1894 being about 2 to 1. Five years later, when the Nome placers were developed, the ratio of lode to placer output decreased to about 1 to 3. After this the percentage of lode production gradually decreased until 1910, when it began to rise. A further increase in the ratio of gold lode to placer output is to be expected. In the following table, which is based on the preliminary estimates, the metal production has been distributed as to source:

Sources of gold, silver, and copper in Alaska, 1910.

	Tonnage.	Gold.		Silver.		Copper.	
		Ounces.	Value.	Ounces.	Value.	Pounds.	Value.
Siliceous ores.....	1,400,000	199,595.25	\$4,126,000	31,450	\$16,983		
Copper ores.....	39,000	1,741.50	36,000	26,300	14,202	4,241,689	\$538,695
Placers.....		580,500.00	12,000,000	111,668	60,300		
		781,836.75	16,162,000	169,418	91,485	4,241,689	538,695

In the following table the production of gold, silver, and copper is given by years. The fluctuations in the gold output are chargeable to the discovery of bonanza placer deposits, which at different times in the past have yielded large quantities of gold. This form of mining, while still continuing, will probably in the future contribute a decreasing percentage of the gold production, and as a result there will be less marked fluctuations in the annual output.

Production of gold, silver, and copper in Alaska, 1880-1910.

Year.	Gold.		Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.	Quantity (pounds).	Value.
1880.....	968	\$20,000			3,933	\$826
1881.....	1,935	40,000				
1882.....	7,256	150,000				
1883.....	14,566	301,000	10,320	\$11,146		
1884.....	9,728	201,000				
1885.....	14,513	300,000				
1886.....	21,575	446,000				
1887.....	32,653	675,000				
1888.....	41,119	850,000	2,320	2,181		
1889.....	49,538	900,000	8,000	7,490		
1890.....	36,862	762,000	7,500	6,071		
1891.....	43,538	900,000	8,000	7,320		
1892.....	52,245	1,080,000	8,000	7,000		
1893.....	50,213	1,033,000	8,400	6,570		
1894.....	61,927	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	48,500	360,000	41,400
1903.....	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904.....	443,115	9,160,400	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 ^a	781,837	16,162,000	169,418	91,485	4,241,689	538,695
	8,411,467	178,789,171	2,130,199	1,286,678	33,795,108	5,338,709

^a Preliminary estimate.

In the following table the total gold production is distributed according to districts, so far as the information at hand will permit. The error in distribution is believed to be less than 15 per cent;

and it is hoped in future statements to eliminate it altogether. The production from the Pacific coast belt is for the most part from the lode mines of southeastern Alaska but includes also a small placer output, as well as the production from a lode mine on Unga Island. The gold credited to the Cook Inlet and Copper River region is, aside from the output of some small quartz mines in the Susitna basin and on Kenai Peninsula, all from placers and includes the yield of the Nizina, Chistochina, Sunrise, Yentna, and Valdez Creek districts.

The gold output of Seward Peninsula and the Yukon basin¹ is nearly all from placers, though there was a small output from the lode prospects of the Fairbanks districts, at least one of which can be classed as a mine.

Value of gold production of Alaska, with approximate distribution, 1880-1910.

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.....	560,000		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.....	833,000		200,000		1,033,000
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.....	3,195,800	500,000	1,300,000	4,164,600	9,160,400
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.....	4,237,000	350,000	13,045,000	3,530,000	16,162,000
	52,261,971	4,358,500	64,962,000	57,214,700	178,797,171

^a Includes a small production from the Kuskokwim.

LODES.

DEVELOPMENT AND PRODUCTION.

The total gold production from the auriferous lode mines of Alaska which have been productive since 1882 is estimated to be 2,346,635 fine ounces, valued at \$48,602,775. These mines have also produced 1,001,241 fine ounces of silver, with a commercial value of \$611,808.

¹ This refers, of course, only to the Alaskan parts of the Yukon basin and does not include the production of the Klondike and other Canadian camps.

The total copper production up to the close of 1910 was 33,775,108 pounds, valued at \$5,338,709. Tin mining began in the York region in 1902, since which time it has been carried on spasmodically. The value of the total tin product, which has come chiefly from the placers, up to the close of 1910 is \$139,639. There has also been some recovery of lead from ores valuable chiefly for other metals.

While the output of the auriferous lodes in 1910 was about the same as that of 1909, marked advances were made in installing mining plants and in prospecting. As a result it is most probable that the lode-gold output in 1911 will be greater than that of 1910 and that the production will increase very much in the next two or three years.

Alaska's auriferous lodes are estimated to have produced during the year 199,595 fine ounces of gold, valued at \$4,126,000, as compared with an output of 199,181 fine ounces, valued at \$4,117,440, in 1909. The output of the Juneau district was somewhat less than in the previous year, but this is only a temporary setback, for the large amount of development accomplished assures a larger output in 1911. The increased output must be credited to the Sitka, Port Valdez, and other smaller districts. Noteworthy advances in prospecting auriferous lodes were made in the Prince William Sound region, Kenai Peninsula, at Willow Creek, and in the Fairbanks district.

There were 14 productive gold-lode mines in operation in Alaska in 1910, two more than in 1909. Work was also done on more than 50 gold prospects, a few of which produced some gold as an incident to the development work. Of the producing mines six were in the Juneau district.

It is estimated that these mines had an output of 1,400,000 tons of ore, as compared with 1,496,361 tons, the total output for 1909. The decrease in tonnage with an increase in value of gold output indicates the relatively larger percentage of the total made by mines exploiting high-grade ores. In 1909 the average value of gold-silver contents for all the ores mined was \$2.72; the average in 1910 is estimated to have been \$2.85.

There were six productive copper mines in 1910, as compared with seven in 1909. In addition to these there were several properties which produced some copper incidental to development work. The certainty that the Kennicott-Bonanza mine will be shipping ore in 1911 assures a very large increase in the copper production. Furthermore, other Alaska copper mines are making preparations to increase their output, and several properties which have not yet been productive will probably begin shipping some ore in 1911. All of this assures a rapid expansion of Alaska's copper-mining industry.

The total copper production in 1910 was 4,241,689 pounds, valued at \$538,695, compared with 4,124,705 pounds, valued at \$536,211, in 1909. About \$36,000 worth of gold and \$14,202 worth of silver was

recovered from the copper ores. It is estimated that in 1910 about 39,000 short tons of copper ore was hoisted, as compared with 34,669 tons in 1909. The average copper content of the ore was about 5.4 per cent and the gold-silver values about \$1.29 to the ton.

SUMMARY OF LODE MINING BY LOCALITIES.

PACIFIC COAST REGION.

Except for a small production at Fairbanks, all of the auriferous-lode gold came from mines situated on the Pacific seaboard or in the drainage basins tributary to it. Lode mining, especially that of the Treadwell group of mines, in the Juneau district, continues to overshadow all other enterprises of this kind. Mr. Knöpf on pages 94-111 summarizes the mining developments of the year in southeastern Alaska.

Kotsina-Chitina district.—The most important event of the year in the Kotsina-Chitina copper district was the extension of the Copper River & Northwestern Railway, already referred to on page 23. As this report goes to press (April, 1911) a telegraphic dispatch from Cordova announces that the first train load of copper ore has been shipped to the coast from the Kennicott-Bonanza mine. This is one of the most important events in the history of Alaska's mining industry, as it assures the opening of a region which promises to become an important producer of copper.

The Kennicott-Bonanza is now fully equipped to ship ore, of which a large quantity of extraordinary richness has been blocked out. The deepest workings are from 150 to 160 feet below the surface. During 1910 the most important development was the construction of ore bins and a concentrator at the railway terminal, which is connected with the mine by an aerial tram 15,000 feet in length.

The assurance of a railway has led to much prospecting of other claims in the Kotsina-Chitina district, detailed information in regard to which is, however, lacking at this writing. It is reported that the development work done on the Mother Lode group of claims, which lie on the McCarty Creek side of the Bonanza divide, has opened some very promising ore bodies. The work accomplished in the Kotsina region, at the west end of the copper belt, is also reported to have developed some good ore bodies. Up to the present time the aggregate amount of rock work accomplished, outside of the Kennicott-Bonanza, has been very little, but now that quick and comparatively cheap transportation is assured, more systematic development will undoubtedly be undertaken.

Lower Copper River basin.—The Bremner and Tiekell regions of the lower Copper River basin have long been known to carry auriferous gravels, some of which have been mined in a small way. In 1910

some auriferous quartz veins were found in this district. So far as known, their geologic occurrence is similar to that of the veins of Port Valdez. Interest in gold-bearing lodes was revived in the McKinley Lake region in 1910 by some new discoveries. These discoveries are a few miles north of Algonik, a station on the Copper River & Northwestern Railway about 22 miles from Cordova.

Prince William Sound.—The most important event of the year in the Prince William Sound region was the development of an auriferous lode mining district on Port Valdez. Though some of the gravels of this region have long been known to be auriferous, little search was made for lode deposits until 1909 and no commercial ore bodies were developed until 1910. The most important prospects thus far discovered lie in an area bounded on the east by Valdez Glaciers, on the south by Port Valdez, on the west by Shoup Bay and Shoup Glacier, and on the north by a less well defined line lying 2 to 5 miles from tidewater. Some prospects have also been located on the south side of Port Valdez. Within this area more than 200 lode claims have been staked, most of them during 1910. As during all other periods of mining excitement, only a small fraction of these claims can be expected to contain commercial ore bodies. The facts that one mine has been opened, that several other prospects have been sufficiently developed to give promise of carrying commercial ores, and that auriferous mineralization is widely distributed augur well for the future of the district.

The Cliff mine, the only property which has been put on a productive basis, is located near the eastern entrance to Shoup Bay, about 8 miles west of the town of Valdez. The claim was staked in 1909 (?), development work began in July, 1909, and a 3-stamp mill, said to have a capacity of 30 tons a day, was installed in April, 1910. As, however, up to the time of the writer's visit (August, 1910) only one concentrating table was in use, the mill had been run only two shifts (16 hours) each day. The mine was operated until December, when it was temporarily closed, but work was resumed in January, 1911.

The following notes are based on a hasty visit:

The country rock at the mine appears to be chiefly dark siliceous slate, in places graphitic and usually blocky. At the beach the strike is about east and west and the dip 20° to 30° N. The slate carries mica and is in places heavily charged with finely divided pyrite, which occurs in veinlets cutting the foliation and is also disseminated especially along the cleavage planes. There has been movement later than the pyrite, as is shown by slickensided surfaces about parallel to the cleavage.

The vein cuts across the foliation of phyllites with a strike of about N. 30° to 45° W., averaging about N. 35° W. It dips southwest at

an angle of about 50° to 70° but has some rolls in it. The footwall is smooth and along it there is from half an inch to 3 inches of gouge which carries values. There seems to have been no movement along the hanging wall, but it is well defined. The vein varies in width from, say, an inch, where quartz may be entirely lacking, to 34 inches. The managers report that small swellings occur where the vein widens out to 3 and $4\frac{1}{2}$ feet. The vein matter is in places entirely lacking, but the fissure is everywhere well defined. In one place in the upper tunnel a roll was encountered where a bulge in the footwall gave a reverse dip to the vein. On the whole, the strike of the vein is fairly uniform in direction, though the workings show minor swings of 5° to 10° . At the upper prospect tunnel, about 150 to 200 feet above the beach, what appears to be the same vein has a thickness of about a foot. So far as determined by the exposures, the vein is definitely recognizable for about 300 to 400 feet, but the managers stated that it has been traced by float throughout the length of the claim, and it is reported that the same vein has been found on the north side of the ridge, a distance of probably 3,000 feet from the mine.

The typical vein filling is a blue quartz carrying considerable finely disseminated pyrite and also apparently minute quantities of arsenopyrite and galena, but no detailed study of ore has been made. Visible free gold is found, especially in the upper workings, where there has been considerable oxidation. Free gold occurs, however, in the fresh, unaltered vein material, where it is clearly not the product of alteration. In places the ore shows a rough banding, and this type is reported to carry the highest values. Some of the vein material is crushed and some shows a suggestion of brecciation and re cementation.

Much of the ore is very rich, and the average recovery of free gold is currently reported to be about \$50 to the ton. The manager reports no noteworthy change in values between the upper and the lower workings. The concentrates are said to run about 7 per cent and to have a value of about \$100 a ton in gold.

Oxidation of vein matter is very marked on the upper level and was observed on the lower level to a distance of about 100 feet from the entrance of the adit. Beyond 100 feet on the lower adit there was no evidence of oxidation. The superintendent, Ray Millard, stated to the writer that there was no diminution in free-gold values at depth. At the same time the richest specimens of free gold seem to have been taken from the upper part of the mine. Values of \$1.50 to \$6 are reported in the hanging-wall rock, in which many quartz stringers were observed extending a distance of a foot or more from the vein. In the upper adit the vein matter is absent from the last 50 feet, but the fissure is traceable. It is in this part of the mine that the roll occurs.

There are two adit tunnels (which are connected by raises) 54 feet apart and one intermediate drift. Plans are made for sinking on the vein in the lower tunnel. There is also a prospecting tunnel which is 150 to 200 feet above the beach. The lower adit is about 200 feet long. According to the manager, a winze has been sunk to a depth of 50 feet below the lower adit since the writer's visit. At this depth the ore body seems to maintain itself and there are reported to be no notable changes in gold tenor.

No exact information is available regarding the many other properties which have been more or less prospected. Along the shores of Port Valdez, near the Cliff mine, are a number of veins, some of which have been developed by adit tunnels, but these were not examined by the writer. At the Imperial an adit has been driven along the vein for a hundred feet, and since the writer's visit an air compressor has been installed. A 3-stamp mill has also been erected near this point and probably on this property. In the fall of 1910 prospecting was being pushed on six or seven properties located on Mineral Creek. Of these the Williams-Gentzler property, about $4\frac{1}{2}$ miles from the beach, is said to be one of the most promising. Here a well-defined 18-inch quartz vein carrying high gold values is reported. A wagon road has been completed from Valdez to Mineral Creek and up that stream about 4 miles.

There has also been considerable gold-lode prospecting in other parts of Prince William Sound. Encouraging results are reported from Jackpot Bay and from McClure Bay, both on the west side of the sound.

In the aggregate there was considerable work done on the copper lodes of Prince William Sound, though the low price of copper rather discouraged any except the strong companies from putting their properties on a shipping basis. Work was continued on the properties on Landlocked and Galena bays, though so far as known they made no shipments.

The Glacial Island Copper Co. is said to have opened a body of high-grade chalcopyrite ore by a tunnel 170 feet in length. The vein is said to be 4 feet wide and to be exposed 150 feet above the tunnel. A small bunker has been built and the managers report that some shipments will be made in 1911.

At the Beatson-Bonanza mine, on Latouche Island, ore bunkers having a capacity of 1,500 tons were built and a small water-power plant installed. A diamond drill is being used for prospecting. Ore shipments have continued throughout the year. A compressor plant with air drills has been installed on the property of the Seattle Alaska Copper Co. near Big Bay. The managers report that a 10-stamp mill and concentrating table are to be installed to concentrate the lower-grade ores. At Ellamar a horseshoe-shaped coffer-

dam 400 feet in length and 20 feet above low tide is being completed. A steam pumping plant has been installed and shipments of ore were made in 1910.

Kenai Peninsula.—There was great activity in quartz prospecting on Kenai Peninsula in 1910, but this district was not studied by the Geological Survey. The following notes are gleaned from numerous sources. Of the many properties which were developed to some extent, those of Watson & Snow, now incorporated under the name Wanowski Gold Mining Co., near Moose Pass, showed the greatest results. On this property several hundred feet of underground work has been accomplished, work having been done on one large quartz vein and another small one, which are parallel. The larger vein is well defined, having been traced for about a mile. Plans have been formulated for erecting a stamp mill in 1911.

On False Creek the California-Alaska Mining Co. continued work on a gold-bearing quartz prospect, where an air compressor has been erected. Work was also continued on the Stevenson property, in the same neighborhood. Auriferous quartz veins have been staked at many other places in the Sunrise placer district, but these have been for the most part little developed, except for the annual assessment work. What appears to be a promising auriferous quartz vein was found north of Turnagain Arm, at the head of Crows Creek. This vein is reported to be 2 to $4\frac{1}{2}$ feet in width, of which 12 to 14 inches carries very high gold values. It is said to have been traced for several hundred feet. The specimens from this lode seen by the writer showed free gold and iron and arsenopyrite, with a gangue of well-developed interlocking crystals of quartz.

It appears from the information at hand that the quartz veins of Kenai Peninsula are similar in their geologic relations to those of Prince William Sound. There is, however, more than one type of vein filling. One of the lodes in the Moose Pass district appears to be a mineralized dike and hence of a different type from the other deposits which have been opened. At the Cliff mine, in the Port Valdez district, the values are largely in free gold, while in the Kenai Peninsula veins more of the gold is combined with the pyrite. Further study of these deposits will have to be made before more definite comparisons can be made.

Willow Creek.—The lode-mining developments of the Willow Creek region, north of Cook Inlet, are described by Mr. Katz on pages 139–150. These occur along the marginal contact of the great mass of granite which forms the Talkeetna Mountains. Prospectors report the occurrence of metal-bearing lodes in other parts of this contact zone, but little is known about them and they are practically undeveloped. Such lodes are said to occur on the upper part of Granite Creek and on Little Willow Creek. On Iron Creek, a tributary of the

Susitna, a lode has been found which carries chalcopyrite and pyrite, with copper and gold values. This is reported to occur at the contact of slate and greenstone, not far from the outer margin of the granite mass.

Southwestern Alaska.—There are but few mining developments in southwestern Alaska. Prospecting continued on the copper deposits of the Iliamna region and some steps were taken to open an auriferous lode on Popof Island. About 15 men were employed at the Apollo mine, chiefly in development work, but some ore was taken out. Some prospecting of auriferous lodes was also done on Kodiak, Dry, and Afognak islands.

YUKON BASIN.

Although many lode claims have been staked in the Yukon basin, there was little actual prospecting in 1910 and no developments of importance except in the Fairbanks and Chandalar districts. The completion of a 10-stamp customs mill with full equipment at Chena in November, 1910, has stimulated auriferous-lode development. Most of the actual lode-gold production came from the smaller mill at Fairbanks, which was operated at intervals during the year. One arrastre was also operated a part of the summer season. At this writing complete returns are not available from all the lode-mining operations, but it is estimated that probably about 200 tons was milled, yielding about \$20,000 in gold, besides the concentrates and some values in silver. Detailed notes in regard to all the properties are lacking. The following data are based in part on information collected by G. L. Parker, incidental to his investigations of the water supply of the Fairbanks district.

The most important developments were on the Free Gold mine of Rhodes & Hall, located near the head of Cleary Creek. A part of this property was worked under lease and a part by the owners. The main adit tunnel, which follows the ledge, is reported at the close of the year to have been driven over 630 feet, and a shaft has been sunk about 50 feet, together with a 90-foot crosscut. In this distance the ledge has been lost once or twice through pinching or faulting but has been picked up again. The ledge varies from a few inches up to 4 feet in width and has been traced on the surface for a distance of about 1,000 feet. The greatest depth of the workings below the outcrop of the lode is about 250 feet, and to this depth there is apparently no change in the character of the ore.

An adit tunnel has been driven for about 300 feet on the property of the Tanana Quartz & Hydraulic Co., whose ledge (so far as known about 10 inches wide) parallels that of the Free Gold and lies close to it. On the "Carlisle fraction," which is also close at hand, a shaft has been sunk about 50 feet and some crosscuts have been driven.

Some rich ore was milled from this property, which was chiefly picked up on the surface.

Work has been continued by the Tolovana Mining Co. on its claims, where an 85-foot adit tunnel was driven, and some rich ore was mined and milled at Fairbanks. No data are at hand regarding the thickness of the ledge. This company is preparing to erect a stamp mill. Work has been continued on the Jupiter-Mars property, in the same neighborhood, where a 70-foot adit tunnel and 50-foot crosscut have been completed. Some work was also done on another group of claims on Willow Creek by Hershberger, Beall & Phipps, in the course of which some rich ore was taken out. No data are at hand regarding the thickness of the veins.

No work was done on the property of the Rex Mining Co. (Butler & Petree) on Chatham Creek, because of litigation. The total development to date includes a 160-foot inclined shaft with several prospecting levels. The vein is reported to be 4 to 8 feet in width. The property of the Pioneer Co. has been leased and some prospecting was done. On the Soo claim (W. L. Spalding) a 125-foot adit tunnel has been driven and a shaft sunk to a depth of 30 feet. The vein is about 15 inches wide. Some ore milled from this property gave good returns. On the adjacent Waterbury claim a 55-foot shaft has been sunk to develop a 3-foot vein, which yields good values in gold. The ore taken from this property in the course of development was sent to the mill and a 200-foot crosscut was driven. Some rich ore was taken out of a claim on Wolf Creek by Horton & Solomon.

Some open cuts were made on a lode located on the divide between Wolf and Fairbanks creeks, which was discovered in 1909. This property is owned by Lawrence McCarty and Frank Lawson. Some rich ore was taken out and milled at Fairbanks. The thickness of the lode had not been determined at the time of Mr. Parker's visit in August. In July and August five ledges were discovered on Fairbanks Creek. These seem to follow two systems of fissuring, one paralleling the creek and one about at right angles to this direction. They carry gold, galena, and stibnite. On the Excelsior claim a 7-foot vein is reported, according to the mining press, carrying \$10 to \$20 in gold and \$15 to \$30 in silver to the ton. Another vein is chiefly galena, with reported gold values of \$5. Some ore was shipped to Fairbanks from these properties. The development work seems to have consisted chiefly of open cuts.

Two lodes about 300 feet apart have been located by Louis Friederich on the divide between Vault and Dome creeks. The westerly one has a granite-dike hanging wall and varies, so far as the small amount of surface work admits of determination, from 20 inches to 3½ feet in width. The easterly vein, which has been traced for about 800 feet, is from 3½ to 8 feet wide. It has been crosscut by an adit tunnel.

Both veins carry gold values and several tons of ore have been milled. These veins contain considerable stibnite. Since Mr. Parker's visit these prospects have been further developed and others have been opened in the vicinity.

Among other prospects reported is a 3-foot vein called the Hidden Treasure, near the head of Little Eldorado Creek, developed by a 140-foot tunnel and carrying high gold values, and another in the same vicinity on which a 38-foot shaft has been sunk and which is said to be 5 feet wide. Some ore has been milled from these properties.

Some developments were made on the claims of Whitman & Murray at the junction of Skoogy and Twin creeks. Here there are two shafts, 40 to 50 feet deep, and about 400 feet of drifts and crosscuts. An arrastre was built in 1910, with which considerable ore was milled.

The above notes indicate that considerable advance was made in lode mining during the year. Most of the veins opened are small and carry high values. The developments on the Free Gold property indicate that some of the veins, at least, have a persistence which is encouraging. There is good reason to think that the geologic conditions are the same throughout that part of the Fairbanks district where lodes have been found. All this, together with the presence of the rich gold placers, favors the belief that workable lode deposits will be developed.

The development of auriferous quartz veins continued in the Chandalar district in 1910. Conditions of transportation were somewhat improved in this district by the completion of 90-odd miles of trail from Beaver, on the Yukon, to Old Caro. In spite of the immense cost of transportation, a small 3-stamp mill was erected on the Gold King claims, owned by T. S. Haynes and E. W. Griffin, on Big Creek. This mill was erected with only a very insecure foundation, because of the high cost of timber, the nearest being 18 miles distant. Some ore was put through this mill. The Alaska-Chandalar Mining Co. continued development work on its property on Squaw Creek, on which the lode is reported to be from 4½ to 8 feet wide and to carry high gold values. A 4-stamp mill has been delivered at Beaver, on the Yukon, for this company and will be sledded in during the winter of 1911-12. The men who are developing this remote district in the face of such serious obstacles, including difficulty of transportation and lack of timber and fuel, merit the highest praise and support.

GOLD PLACERS.

INTRODUCTION.

The value of the placer-gold production of Alaska for 1910 is estimated at \$12,000,000, as compared with \$16,212,000 in 1909. The difference between these two amounts is almost exactly the

sum of the decreased production of the Seward Peninsula and Fairbanks placers in 1910 as compared with 1909. This, however, does not tell the whole story, for in 1910 the output of the Fortymile, Rampart, and Koyukuk was less than in the previous years, but this loss was more than made up by the increased output of the Innoko-Iditarod region, whose production was more than double that of 1909. There were also small increases in the output of the placer camps of the Pacific slope as compared with previous years.

Among the most encouraging features of the year's placer mining are the large increase in the gold production of the Innoko-Iditarod region, the discovery of a new auriferous district in the Squirrel River basin of northwestern Alaska (see pp. 306-319), and the continuation of activity in the installation of dredges in Seward Peninsula. On the other hand, the delay in installing plants to exploit the extensive deposits of auriferous gravels in the Fairbanks district, whose gold values are too low to permit profitable exploitation by present mining methods, has not been encouraging. A large annual production has been maintained in the Fairbanks district up to the present time by the output from bonanza placer deposits, but deposits of this character are being rapidly depleted, and unless steps are taken to mine the gravels of lower grade, the output of the camp must continue to decline. Some advance, however, was made in the Fairbanks district, where a small dredge was built and preparations were made to install several large dredges in 1911.

In the following table the approximate yardage of the total bulk of gravels mined in Alaska during the last three years is presented, together with the value of the gold recovered per cubic yard. While these estimates are little more than scientific guesses, they are certainly near enough to the truth to indicate the order of magnitude to which the true figures belong. The estimated quantity of gravel mined is intended to include only that which is passed through the sluice boxes. Obviously, in open-cut mining any overburden which may be removed by shoveling, mechanical means, or ground sluicing will not be included in these totals.

Estimate of total amount of gravel sluiced in Alaska placer mines and value per cubic yard of gold recovered, 1908-1910.

	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1908.....	3,500,000	\$4.45
1909.....	4,020,000	4.00
1910.....	3,800,000	3.20

These figures clearly indicate the improvement in mining methods which each year permits the exploitation of gravels of lower gold

tenor than in the preceding year. If figures for the earlier years of placer-mining operations were available, the decrease in average gold content would be still more striking. For example, it has been estimated that the average gold content of the gravels mined on Seward Peninsula during the nine years ending in 1906 was about \$5.95 a cubic yard,¹ while gravels mined on the peninsula in 1908-1910 yielded an average of \$2.85.

There is probably no better evidence of the future of the Alaska placer-mining industry than the above figures. Every reduction in cost of mining means the making available for profitable exploitation of more auriferous gravels. These gold values in the gravels mined are still more striking when compared with the average gold content of the gravels mined in the States. According to Waldemar Lindgren, the average gold recovery from all the placer mines in the States for the year 1909 was about 12 cents a cubic yard.

SUMMARY OF PLACER MINING BY LOCALITIES.

PACIFIC COAST REGION.

For the purposes of this discussion the Pacific coast region will be made to include not only the seaboard but all the drainage basins tributary to it, including the Copper and Susitna. The placers of this province are estimated to have had in 1910 an output valued at \$425,000, as compared with \$330,000 in 1909. This increase is to be credited to the small districts of the region, of which the Yentna is the largest producer.

Southeastern Alaska.—A little placer gold was mined during 1910 on Gold Creek, near Juneau, but the only important mining ventures in this part of Alaska are those of the Porcupine district, lying about 40 miles from tidewater, on Lynn Canal. The largest operations in this field were those of the Porcupine Gold Mining Co., which operated its hydraulic plant for a good part of the season. A high-line flume was completed and a bedrock drain was extended 2,000 feet in 1910. The Cahoon Creek Placer Mining Co., in the same district, accomplished much dead work, including the building of flumes. Its plant was completed in time to do considerable hydraulicking. In addition to these, there were some smaller operations in the district.

Beach mining.—Beach mining was continued at a number of localities scattered along the Pacific seaboard from Lituya Bay to Unga Island. A large part of the gold recovered in this way comes from the Yakataga beach placers. In the past the relatively small bulk of auriferous gravels contained in the beaches has discouraged all but individual operators, who, for the most part, use the rocker. During 1910, however, steps were taken to organize a company to mine some of these beach placers on a larger scale.

¹ Collier, A. J., and others, Gold placers of parts of Seward Peninsula: Bull. U. S. Geol. Survey No. 328 1908, p. 136.

Copper River region.—The placers of the Chistochina district are described by Mr. Moffit on pages 112–137. Two hydraulic plants were operated in the Nizina district, besides a number of smaller plants. The output, which can not be published, because it might serve to indicate the production of individual operators, was nearly twice as large as that of 1909. With the completion of the Copper River & Northwestern Railway this district will become readily accessible and an increased gold production is to be expected.

Sunrise district.—The placer-mining industry of the Sunrise district, including the northern part of Kenai Peninsula, had a prosperous season. This is shown not so much in the actual gold production, which is still small, as in the fact that initial steps were taken on several of the creeks to undertake mining on a large scale. These enterprises include plans for installing dredges and also for systematically exploiting groups of creek or bench claims by hydraulic methods. It is well known that there are extensive deposits of auriferous gravels whose values are too low to permit profitable exploitation by open-cut and manual methods.

During 1910 there were some half a dozen hydraulic plants, large and small, in operation in this district. One of the largest of these is on Crow Creek, where the operations of the year consisted largely in removing the heavy overburden, which covers the gold-bearing gravels, by hydraulic methods. In addition to the hydraulic mines, 15 or 20 smaller operators made some gold output.

Susitna basin.—There are in the Susitna basin three productive placer districts—Willow Creek, described by Mr. Katz on pages 150–152; Valdez Creek, described by Mr. Moffit on pages 119–124; and the Yentna district. The Yentna had the most profitable season in its history. Here placer gold has been found in three distinct areas in a belt some 20 miles long, which embraces the foothills of the Alaska Range. The most southwesterly of these includes the placers which have been found on Nakochna River, near the mouth of Kellar Creek, and on Eagle and Independence creeks, which join Yentna River. Here only a small amount of mining has been done so far. A second gold-bearing area includes the placers of some of the tributaries of Lake Creek, which have been mined only on a small scale. The third and up to the present time the most important gold-bearing area in this district is that drained by Cache and Peters creeks. The Cache Creek Mining Co. completed the installation of a hydraulic plant in 1910 and did considerable mining. Another company carried on large operations on Nugget Creek. The success of these larger plants has encouraged the investigation of other properties with a view to introducing improved methods. It is estimated that about 200 men were engaged in mining and prospecting in the entire district.

MULCHATNA REGION.

Mulchatna River heads in an unsurveyed area northwest of Lake Clark and flows into Bristol Bay. Gold has long been known to occur in its drainage basin, and some promising prospects are reported to have been discovered in 1910. The region is rather difficult of access, involving either a canoe trip from Cook Inlet via Iliamna and Clark lakes, with numerous portages, or a long upstream boat trip from Bristol Bay. In 1910 a steamboat was built at Bristol Bay for use on the Mulchatna. There are said to have been between 25 and 50 prospectors in this district in 1910.

YUKON BASIN.

The value of the placer production of the Yukon basin, including the Innoko-Iditarod region, in 1910 is estimated at \$8,020,000, as compared with \$11,580,000 in 1909. This falling off is due largely to the decreased production of the Fairbanks district, the value of whose output was \$6,100,000¹ in 1910 and \$9,650,000 in 1909. The mining industry of the placer camps of the Yukon-Tanana region, including Fairbanks,² is described by Messrs. Ellsworth and Parker on pages 153-172 of this volume. Mr. Maddren describes the Innoko-Iditarod region on pages 236-270. It will therefore only be necessary here to refer to the remaining districts, which include those of the lower Yukon, the Chandalar, and the Koyukuk.

Mining continued in 1910 in a small way in the Gold Hill district, which is near the mouth of the Tanana. Nothing of importance was accomplished, except preparations for mining on a larger scale than had hitherto been attempted. In the Chandalar district only three placer claims were worked in 1910. Interest centered on lode prospecting, which is referred to on page 35. Accurate figures of the gold output of the Koyukuk in 1910 are lacking at this writing, but it certainly was much less than that of 1909. This was due to the fact that the output of 1909 was far above the normal, because of the output of one or two rich spots on Nolan Creek, which were quickly mined out. According to current reports, some rich gravels were found during the year on Sheep Creek. Of perhaps greater significance is the reported occurrence of gold placers on Old Man Creek, a southerly tributary of the middle Koyukuk. It is estimated that about 300 men were engaged in mining and prospecting on the Koyukuk in 1910.

KUSKOKWIM REGION.

The influx of population to the Innoko-Iditarod region has led to considerable prospecting in the adjacent parts of the Kuskokwim

¹ This does not include gold to the amount of over half a million dollars from other districts which passed through the town of Fairbanks.

² Lode mining is described on pp. 33-35.

basin. A trading post and settlement named Georgetown has been established on the Kuskokwim, about 325 miles above the Lelenaw anchorage, the highest point on the river reached by ocean-going vessels of any considerable size, and about 450 miles from Goodnews Bay, the nearest good harbor on Kuskokwim Bay. Georgetown affords a supply point for the Kuskokwim, and as a result there has been considerable prospecting in this general region.

The streams joining the Kuskokwim from the north near Georgetown head in the Innoko-Iditarod region and are known to carry auriferous gravels, though these have not yet been productive. (See pp. 267-269.) Some gold has also been found on the Holiknuk, a tributary of the Chulitna, which flows into the Kuskokwim from the south 15 or 20 miles below Georgetown. Some placer mining was done in 1910 on Bear Creek, in the basin of Toluksak River, tributary to the Kuskokwim from the east about 20 miles above Bethel. The extent of these operations is not now known. In 1900 the discovery of placer gold in the Goodnews Bay region attracted a number of prospectors, but interest soon flagged and prospecting was abandoned. This region has again attracted prospectors, and it is reported that in 1910 some claims made a gold output. All these discoveries lie in what would be the southwesterly extension of the Innoko-Iditarod region, and this fact alone would appear to justify further prospecting.

NORTHWESTERN ALASKA.

The region here termed northwestern Alaska includes the Kobuk region, where a little placer mining was carried on in 1910 (see pp. 271-319); the Norton Bay region, where there was little or no productive mining; and Seward Peninsula, which is, in spite of its decreased output, still second only to Fairbanks in the value of its annual gold output.

The value of the gold production of Seward Peninsula in 1910 is estimated to be \$3,500,000, as compared with \$4,260,000 in 1909. In spite of the decreased output the mining industry, in view of the large amount of dead work accomplished, can be said to have had a prosperous year. Ten new dredges were installed, of which nine were operated for a part of the season, in addition to seven dredges built in previous years, which were also operated. About \$1,400,000 worth of gold was mined during the winter season, and about \$1,000,000 of this in the region immediately tributary to Nome. Of the total output, some \$2,200,000 is to be credited to the Nome precinct, including the Solomon River region. The Fairhaven precinct probably made an output worth half a million dollars, and the Council precinct somewhat less. The rest of the gold is to be credited to the placer mines of the Kougarok and Port Clarence precincts.

As already stated, dredging was the important feature of the year's mining industry. Three dredges were installed in the region tributary to Nome, making five in all for this district, of which four were operated. Four dredges were operated in the Solomon basin, of which two were built in 1910. Two new dredges and three old ones were operated in the Council region, and one new one in the Casadepaga basin.

Details regarding the operations of all these dredges are not available at this writing. It appears, however, that the 16 dredges, including the nine new ones, some of which were only completed in time for a brief test, were operated from 10 to 130 days, each averaging 58 days. The daily capacity of these dredges varies from 1,000 to 5,000 cubic yards, and they are equipped with a total of about 2,500 horsepower. The buckets vary in capacity from $2\frac{1}{2}$ to 9 cubic feet, though all but five of the dredges have buckets of $3\frac{1}{2}$ cubic feet or less. Two are driven by electric power, generated at one plant; seven are equipped with steam power, of which four use coal, two crude oil, and one wood. The other dredges are equipped with gasoline engines. It is estimated that the 16 dredges operated handled between 1,200,000 and 1,500,000 cubic yards of gravel, and had they all been able to operate to their full capacity they should have handled at least twice as great a yardage. It is a significant fact that the estimated bulk of gravel handled by all other forms of placer mining on the peninsula in the year 1910 is roughly estimated to have totaled 600,000 to 800,000 cubic yards. Complete returns are not yet available regarding the gold output of the dredges, but it is estimated to have a value of about \$800,000. It seems probable that the average working season should be 110 to 130 days instead of 90, as has been the case in the past. If this is true, the dredge production can be largely increased even without any additional machines. Plans have already been formulated for the building of three or four dredges in 1911. If this is accomplished and the existing plants all prove efficient, it is not impossible that the output of the dredges alone in Seward Peninsula may soon reach \$2,000,000. There is hope, therefore, that the gold output of the peninsula in 1910 may be the minimum for some time to come. The profits on dredging could be increased if power were furnished from one or two central stations. A further reduction in costs would be made by centralizing the management and by building dredges of the same type with interchangeable parts.

There is no question that there is a large amount of gravel suitable for dredging on Seward Peninsula and that this form of mining is likely to increase very much. It is unfortunate that the legitimate and well-managed projects often have difficulty in procuring the necessary capital because of a number of conspicuous failures. A

certain class of promoters apparently believe that it is unnecessary to determine the presence of gold values, the thickness of the gravels, and the distribution of ground ice before installing a dredge. This point of view is probably sometimes forced on the local managers by the nonresident stockholders, who are so desirous of quick returns that they are willing to do the prospecting after the dredge is constructed. There is probably no phase of placer mining which requires such careful study of conditions and prospecting of gravel by competent engineers as does that of dredging.

While dredging was the most important industry of the peninsula during 1910, other phases of mining were not neglected. The Pioneer Co. purchased the Miocene ditch and used the water on several properties in the Nome region. Hydraulic plants were also operated on Bangor and Boulder creeks. The season's operations in the Kougarok precinct were especially successful because there was more water available than in any previous season for several years. The Taylor Creek Ditch Co., the largest operator in this district, was engaged in hydraulicking some bench gravels on Kougarok River. The Fairhaven Ditch Co. also had a successful season in the northeastern part of the peninsula.

COAL AND OIL.

Practically nothing was done in the coal fields except a few patent surveys. Most of the small mines which have in the past furnished lignitic coal for local use were in 1910 closed until the matter of granting patents should be finally decided. On the other hand, some new drilling was done in the Katalla oil field. Some oil properties were leased and preparations were made to render the field productive.

BUILDING MATERIAL, ETC.

Work continued on the only developed gypsum deposit in Alaska, located on the east side of Chichagof Island, in the Sitka district. The large marble quarry located at Shakun, at the north end of Prince of Wales Island, continued shipments throughout the year. Some small shipments of garnets were made from the Wrangell district, in southeastern Alaska, in 1910. An investigation was made of the sulphur deposits of Makushin Volcano, on Unalaska Island, at the east end of the Aleutian chain, to determine the feasibility of mining them.