MINERAL RESOURCES OF ALASKA, 1920.

By ALFRED H. BROOKS and others.

PREFACE.

By ALFRED H. BROOKS.

This volume is the seventeenth of a series of annual bulletins[1] summarizing the results achieved during the year in the investigation of the mineral resources of Alaska and treating of the mining industry of the Territory, especially of the statistics of mineral production, with the collection of which the Geological Survey is charged by law.

The reports included in this volume are primarily intended to give prompt publication of the more important economic results of the work of the year. The time available for their preparation does not permit full office study of the field notes and specimens, and some of the statements made here may require modification when the study has been completed. Those who are interested in any particular district should therefore procure a copy of the complete report on that district as soon as it is available.

Again, as for many years in the past, the Geological Survey is under great obligation to residents of the Territory for valuable data. Those who have thus aided include the many mine operators who have made reports on production as well as developments. There are still some Alaskan mineral producers who fail to respond to requests for information. Many prospectors, Federal officials, engineers, and officers of banks and transportation and commercial companies have contributed valuable data. It is impracticable to mention by name all who have aided in this work, but it should be stated that without the assistance of these public-spirited citizens the preparation of this report would have been impossible. Special acknowledgments should be made to the Director and other officers of the Mint; the

[1] The preceding volumes in this series are U. S. Geol. Survey Bulls. 259, 284, 314, 345, 379, 442, 480, 520, 542, 592, 622, 642, 662, 692, 712, and 714.

Director and other officers of the United States Bureau of Mines; B. D. Stewart, Territorial mining inspector; the officers of the Alaska customs service; the officers of the Alaskan Engineering Commission; the American Railway Express Co.; Stephen Birch, Kennecott Copper Corporation; Sumner S. Smith, resident engineer of the Alaskan Naval Coal Commission; George Parks, General Land Office; Asa C. Baldwin, of Seattle, Wash.; C. W. Dietzel, of Juneau; Philip Bradley, of Treadwell; George C. Hazelet, of Cordova; J. M. Finnegan, of Kodiak; Paul Buckley, of Unalaska; J. M. Elmer, of Chistochina; F. E. Youngs, of Seward; Sidney Anderson and Milo Kelley, of Anchorage; H. W. Nagley and Edward McConnell, of Talkeetna; Luther C. Hess, the First National Bank, T. H. Deal (postmaster), J. A. Fairborn, and Henry Cook, of Fairbanks; B. J. Everman, of Fox; N. P. Nelson, of Chisana; Charles E. M. Cole and F. E. Phillips, of Jack Wade; Charles Zielke, of Nenana; John B. Mathews, of Hot Springs; George W. Ledger, of Rampart; Oscar Morell, of Deadwood; Alexander Mitchell, of Kantishna; Thomas G. Carter and F. P. Sturrock, of Beaver; H. S. Wanamaker, of Nolan; T. A. Parsons, of Ruby; B. B. Smith and G. W. C. Glass, of Ophir; Harry Madison, of Tolstoi; F. E. Wiseman and R. C. Butler, of Iditarod; D. E. Stubbs and L. Huber, of Aniak; John Haroldson and A. Stecker, of Quinhagak; R. W. J. Reed, of Nome; George P. Stanley, of Kiana; and Louis Lloyd, of Shungnak.

THE ALASKA MINING INDUSTRY IN 1920.

By ALFRED H. BROOKS.

GENERAL FEATURES.

Though the mining industry of Alaska as a whole suffered a serious depression in 1920, yet the value of the total mineral output was greater than in 1919, chiefly because of the great increase in the production of copper, to be credited largely to the four leading copper mines in the Territory. The value of the total mineral product of Alaska was $19,620,913 in 1919 and $23,303,757 in 1920. The output of the gold placers has decreased, but that of the gold lode mines has been maintained.

During 41 years of mining Alaska has produced minerals to the value of more than $460,000,000, over half of which was produced in the last decade. About 75 per cent of this output has come from small but rich deposits termed "bonanzas." Such deposits can be exploited profitably, even under the most adverse conditions of isolation and transportation, because they yield very large returns on the capital and labor employed.

Bonanza mining, always the first to be developed in a new land, is a most powerful agency in attracting population, in forming communities, and in establishing transportation systems. This mining will continue, for the known bonanza deposits in Alaska have been by no means exhausted, and there is good prospect of finding others. A stable and permanent mining industry can not, however, be founded on the exploitation of only the very rich ore bodies. Permanency must be based on the development of the larger deposits of less unit value. This development depends for its profits not so much on the richness of the ore as on economies made possible by the magnitude of the operations. Large mining operations require regular and cheap transportation; they can not be successful at places served only by the haphazard and expensive means of transportation that are generally available on the frontier. The passage from bonanza mining to a stable and permanent industry takes place in all mineral-bearing regions and has long been under way in the accessible coastal region of Alaska, but the mineral wealth of the interior remains practically untouched except by the bonanza miner.

It will be well to emphasize again the fact that the product of large mining operations on low-grade deposits has for many years formed

a considerable part of the mineral output of the Territory. This kind of mining began with the exploitation of the Treadwell auriferous lode in 1887. During the last two decades low-grade deposits of copper, placer gold, etc., have been profitably worked in other parts of the seaboard region of Alaska. The minerals recovered from these large operations have a total value of about $105,000,000, of which nearly $76,000,000 is to be credited to the mines of the Juneau district. This total includes the value of the mineral output from (1) auriferous lodes that yield ores whose gold and silver content is valued at less than $2.50 a ton, (2) copper deposits containing an average of not more than 3 per cent of copper, (3) placers having a gold content of less than 75 cents to the cubic yard, and (4) marble and gypsum of southeastern Alaska. All the low-grade deposits thus far developed are at or near tidewater and therefore have not had to bear the high cost of land transportation, which can be borne only by bonanza deposits. Many mineral deposits of low grade are known in Alaska, and the prospect of finding others is good. The exploitation of large mineral deposits of this kind yields only a small profit per ton, but under normal industrial conditions this disadvantage is offset by the large tonnage handled. Under the present high operating costs and the relatively low market value of mineral products the profits on certain operations are entirely swept away, so that during the last two years there has been no incentive to this form of mining in Alaska, and no large mining ventures have been undertaken.

As about 96 per cent of the mineral output of Alaska, measured in value, has been taken from her gold and copper mines, the world-wide depression in the mining of these two metals, which continued through 1920, has been a staggering blow to the prosperity of the Territory. About 60 per cent of the population of Alaska has heretofore been directly or indirectly supported by gold mining, and with the relative decrease in the value of gold the population has decreased, for the miner or prospector has been forced to leave the Territory. This decrease, however, must not be regarded as an indication of the early exhaustion of the gold resources, for Alaska contains enormous potential reserves of gold and other minerals.[1] The depression of the mining industry is only temporary; a change for the better will come when general economic conditions become more nearly normal and water and land transportation are cheaper and better. A lowering of freight rates, the completion of the Government railroad, and the building of a large mileage of wagon roads are needed to quicken the now stagnant mining industry. Such changes will, however, take time, so that an immediate general improvement can not be expected.

[1] Brooks, A. H., The future of Alaska mining: U. S. Geol. Survey Bull. 714, pp. 5-57, 1921.

The prospects of successfully exploiting the mineral fuels have been improved somewhat by the coal-land leasing act of 1913, but unfortunately this act became effective during the period when industrial conditions were made unstable by the World War and by the readjustments that followed peace. In 1920 further help was given by the passage of an oil-land leasing act, but this act has not been in force long enough to affect the Alaska mining industry.

The interdict which long existed on the use of the mineral fuels of Alaska greatly retarded all forms of mining in the Territory. It not only enhanced the cost of mining by prohibiting the use of local fuels, but it made the industry lose the benefit of the improvement in industrial conditions that would certainly have followed the development of coal and oil. In spite of these conditions gold and copper mining in Alaska has been very prosperous, principally because there has been no direct interference to prevent their normal development. Had metal mining been subject to restrictions similar to those imposed on the development of mineral fuels the Alaska mining industry would to-day be still in its infancy.

The number of men engaged each year in productive mining gives a rough measure of the prosperity of the industry, but unfortunately complete statistics of the number of men employed in mining are not available. A careful study of all the facts at hand appears to justify the following estimates,[2] which include only the men employed at mines that made some mineral output during the year.

Estimates of number of men employed at productive mines of Alaska, 1911–1920.

Year.	Placer mines.		Lode mines and reduction plants.	All other mining and quarrying.	Total men engaged in mining, not including winter placer mines.
	Summer.	Winter (omitted from total).			
1911	4,900	670	2,360	150	7,410
1912	4,500	900	2,560	150	7,210
1913	4,500	800	3,450	140	8,090
1914	4,400	800	3,500	140	8,040
1915	4,400	700	3,850	160	8,410
1916	4,050	880	4,570	340	8,960
1917	3,550	950	3,220	270	7,040
1918	3,000	610	2,000	400	5,400
1919	2,180	320	1,900	310	4,390
1920	1,990	340	1,880	360	4,230

[2] The reports of the Geological Survey contain estimates of the number of men engaged in placer mining for each year since 1910, and miscellaneous notes on the number of men employed in other branches of the mining industry. The following publications also give much valuable information about the number of men employed, especially in lode mining:

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, 1912, Washington, 1913. Same for the fiscal year ended June 30, 1913, Washington, 1914. Same for the fiscal year ended June 30, 1914, Washington, 1914.

Maloney, William, Report of the Territorial mine inspector to the governor of Alaska, for the year 1915 [Juneau, Alaska, 1916]. Same for the year 1916 [Juneau, Alaska, 1917]. Same for the year 1917 [Juneau, Alaska, 1918].

Stewart, B. D., Annual report of the Territorial mine inspector to the governor of Alaska, 1920, Juneau, Alaska, 1921.

In considering the above table it should be remembered that the summer placer mines are operated for an average period of less than 100 days in a year. A comparison of the first two columns shows that only a small percentage of the men engaged in summer placer mining can find similar employment in the winter. As the winter placer mining is all done through shafts and drifts it is closely related to lode mining. Some of the deep placer mines are operated for nearly the entire year and hence are included in the total summer mines also. The lode mines include copper and gold and a few other metal mines. The fourth column shows the number of men engaged in all other forms of mining and quarrying, including the exploitation of coal, petroleum, marble, tin, gypsum, etc.

Mineral output of Alaska, 1919 and 1920.

	1919		1920		Decrease or increase in 1920.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	455,984	$9,426,032	404,683	$8,365,560	− 51,301	−$1,060,472
Copper.....pounds..	47,220,771	8,783,063	70,435,363	12,960,106	+23,214,592	+ 4,177,043
Silver....fine ounces..	629,708	705,273	953,546	1,039,364	+ 323,838	+ 334,091
Coal.....short tons..	60,674	343,547	61,111	355,668	+ 437	+ 12,121
Tin, metallic....do....	56	73,400	16	16,112	− 40	− 57,288
Lead.....do....	687	72,822	875	140,000	+ 188	+ 67,178
Platinum minerals, fine ounces.	569.52	73,663	1,478.97	160,117	+ 909.45	+ 86,454
Miscellaneous nonmetallic products, including petroleum, marble, and gypsum.	.....	143,113	.....	266,830	.....	+ 123,717
	.....	19,620,913	.....	23,303,757	.....	+ 3,682,844

Value of total mineral production of Alaska, 1880–1920.

By years.				By substances.	
1880–1890	$4,686,714	1907	$20,850,235	Gold	$320,030,553
1891	916,920	1908	20,145,632	Copper	127,486,202
1892	1,098,400	1909	21,146,953	Silver	7,342,892
1893	1,051,610	1910	16,887,244	Coal	1,796,128
1894	1,312,567	1911	20,691,241	Tin	934,264
1895	2,388,042	1912	22,536,849	Lead	662,258
1896	2,981,877	1913	19,476,356	Antimony	237,500
1897	2,540,401	1914	19,065,666	Marble, gypsum, petroleum, platinum, etc	2,984,992
1898	2,587,815	1915	32,854,229		461,474,789
1899	5,706,226	1916	48,632,212		
1900	8,241,734	1917	40,710,205		
1901	7,010,838	1918	28,253,961		
1902	8,403,153	1919	19,620,913		
1903	8,944,134	1920	23,303,757		
1904	9,569,715		461,474,789		
1905	16,480,762				
1906	23,378,428				

NEW DEVELOPMENTS.

One of the most encouraging features of the year's mining was the systematic development of a large auriferous lode in the Nixon Fork (McKinley) district, in the upper Kuskokwim Valley. This ore body gives promise of being valuable, and if the promise is fulfilled the

beginning of a lode-mining industry in this remote region will be assured. Auriferous mineralization appears to have taken place rather widely in the Kuskokwim basin, a region which has been relatively little prospected. The gold of this region is associated with granitic rocks, which are intruded into limestone and other little-altered sedimentary rocks. In general the strong mineralization appears to be more localized than that in the schist areas of the upper Yukon, and the conditions are therefore favorable to the occurrence of commercial ore bodies.

The discovery of this lode and the continued success of the Candle Creek dredge near McGrath have attracted attention to the Kuskokwim basin, and more prospecting has consequently been done in this region than in any other part of inland Alaska. Especially noteworthy has been the considerable search and the numerous tests for dredging ground here and in the region immediately adjacent during the last two years.

Though lode mining in southeastern Alaska is still chiefly confined to the low-grade ores of Juneau, whose development is seriously handicapped by the existing conditions, yet there was in 1920 a marked increase in prospecting for auriferous lodes in this field, notably in the Sitka district. Promising discoveries of auriferous quartz were made on Chichagof Island. Important also were the activities in the Willow Creek district, in the Susitna basin, tributary to the Government railroad, which were directed to the consolidation of some auriferous lode properties and their development on a large scale.

One of the most important events of the year was the beginning of systematic underground exploration of the Matanuska coal field under the auspices of the Navy Department. This exploration has for its purpose the development of high-grade coal for the use of the Navy, but incidentally it should afford a thorough test of the commercial possibilities of the field.

The enactment of the oil-land leasing law in February, 1920, together with the world-wide search for petroleum, have again attracted public attention to the oil in Alaska. There has not yet been sufficient time to drill under the new régime, but more than 700,000 acres of land has been staked on the assumption that it is oil bearing. The evidence in hand indicates that though a part of this land is well worth drilling many of the places staked now, as during all oil booms, will be found worthless. There is, however, a very good prospect of developing producing wells in Alaska.

GOLD AND SILVER.

TOTAL PRODUCTION.

The total production of gold and silver since the beginning of mining in 1880 is given in the following table. For the earlier years the figures, especially those for silver, are probably far from correct, but they are based on the best information now available.

Gold and silver produced in Alaska, 1880–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.
1880	967	$20,000		
1881	1,935	40,000		
1882	7,256	150,000		
1883	14,561	301,000		
1884	9,724	201,000	10,320	$11,146
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
1902	400,709	8,283,400	92,000	48,590
1903	420,069	8,683,600	143,600	77,843
1904	443,115	9,160,000	198,700	114,934
1905	756,101	15,630,000	132,174	80,165
1906	1,066,030	22,036,794	203,500	136,345
1907	936,043	19,349,743	149,784	98,857
1908	933,290	19,292,818	135,672	71,906
1909	987,417	20,411,716	147,950	76,934
1910	780,131	16,126,749	157,850	85,239
1911	815,276	16,853,256	460,231	243,923
1912	829,436	17,145,951	515,186	316,839
1913	755,947	15,626,813	362,563	218,988
1914	762,596	15,764,259	394,805	218,327
1915	807,966	16,702,144	1,071,782	543,393
1916	834,068	17,241,713	1,379,171	907,495
1917	709,049	14,657,353	1,239,150	1,021,060
1918	458,641	9,480,952	847,789	847,789
1919	455,984	9,426,032	629,708	705,273
1920	404,683	8,365,560	953,546	1,039,364
	15,481,476	320,030,553	9,972,562	7,342,892

The subjoined table gives an estimate, based on the best available data, of the gold and silver produced in Alaska from different sources since mining began in 1880. About $65,900,000 worth of gold, or about one-fifth of the total estimated output, was produced before 1905, and there is but scant information about its source. For the period since that time fairly complete statistics are available, and the figures presented in the following table are probably sufficiently accurate to be valuable. The figures given 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 derived from this industry therefore represent approximately the actual output.

Gold and silver produced in Alaska from different sources, 1880–1920.

	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Siliceous ores [a]	4,662,942	$96,391,594	1,674,872	$1,321,588
Copper ores	84,799	1,752,967	6,497,919	4,956,834
Placers	10,733,735	221,885,992	1,799,771	1,064,470
	15,481,476	320,030,553	9,972,562	7,342,892

[a] Including small amounts of galena ore.

The above table shows that 30 per cent of all the gold produced in Alaska since 1880 has been obtained from siliceous ores. During the last decade there has been a gradual increase in the percentage of the annual gold output from the auriferous lodes. In 1911 the proportion was 25 per cent; in 1915, 37 per cent; in 1919, 46.6 per cent, and in 1920, 53 per cent.

Gold and silver produced in Alaska, 1920, by sources.

	Ore.	Gold.		Silver.	
		Quantity. (fine ounces).	Value.	Quantity. (fine ounces).	Value.
Siliceous ores	tons.. 3,413,021	216,414	$4,473,687	246,292	$268,458
Copper ores	do.... 765,025	913	18,873	682,033	743,416
Placers	cubic yards of gravel.. 3,439,974	187,356	3,873,000	25,221	27,490
	.....	404,683	8,365,560	953,546	1,039,364

LODE MINING.

Seventeen gold-lode mines and five prospects were operated in 1920 and produced gold worth $4,473,687. Twenty-three gold-lode mines and two prospects were operated in 1919 and produced gold worth $4,392,237. This increase came entirely from the gold mines of southeastern Alaska, as the output from all the other districts declined. It is not likely that the output from the low-grade mines of the Juneau district will be maintained, and unless there is an increase elsewhere the gold-lode output of Alaska probably will be less in 1921 than it was in 1920. There is most hope for an increase from the Willow Creek district, where a large consolidation of mines was made in 1920, and operations on a larger scale than heretofore are to be expected.

Gold and silver produced from gold-lode mines in Alaska, 1920, by districts.

District.	Mines operated.	Ore mined (short tons).	Gold.		Silver.		Average value per ton of ore in gold and silver.
			Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.	
Southeastern Alaska	8	3,409,197	210,536	$4,352,165	114,621	$124,936	$1.31
Willow Creek	3	2,850	3,067	63,400	146	158	22.30
Fairbanks district	[a] 2	504	967	20,000	164	178	40.03
Other districts	[b] 4	1,165	1,844	38,122	131,361	143,186	155.63
	17	3,413,716	216,414	4,473,687	246,292	268,458	1.39

[a] In addition a small tonnage of ore was produced from 5 prospects.
[b] Includes 1 small mine in Kantishna district, 1 in McKinley district, and 2 in Kenai Peninsula.

Of the eight mines in southeastern Alaska only four made a large output, that of the other four being only incidental to development work. The reduction in the number of producing mines in the Willow Creek district, from five in 1919 to three in 1920, was due to a combination of three properties which are to be worked as a unit, and there was an actual output from only one of these properties. In 1920, as in 1919, little work was done on the gold lodes in the Fairbanks district, for the owners of the mines in this district are awaiting cheaper operating costs before continuing developments. The great increase in the silver ouput of the lode mines, as indicated by the above table, is to be credited to the small mine in the Kantishna district, whose principal ore is galena carrying a high percentage of silver. For many years the average value per ton of ore of the gold and silver recovered from Alaska siliceous ores was about $2.80. This high value was due to the preponderance of the metals in the ore produced from the mines of the Treadwell group. When, in 1915 and 1916, the output of the lower-grade ores of the Perseverance and Alaska Juneau mines began to be larger, the value of the average recovery fell below $2 per ton, and the value was still further reduced when two of the Treadwell mines closed in 1917. The average value per ton of ore of the gold and silver mined in Alaska in 1919 was $1.38, and the average value in 1920 was $1.39.

One of the most encouraging features of lode mining in southeastern Alaska is the work being done on Chichagof and Admiralty islands, where promising auriferous lodes are being developed. The advances in lode mining made in the Willow Creek district have already been referred to. The Cliff and possibly the Granite lode mine of Prince William Sound may again be productive in 1921.

PLACER MINING.

During 41 years of mining Alaska has produced gold to the value of $320,000,000, and $217,885,000 of this amount is to be credited to her placer mines. For reasons already discussed less placer

mining was done in 1920 than in 1919, and the profits on actual operations were also less. Though the general fall of prices will eventually benefit the Alaska placer mines, yet it is not likely to prevent a further decline of the industry in 1921. Except the installation of some dredges no new large placer-mining projects are definitely under way. Investigations of large bodies of gold-bearing gravel are, however, being made in several districts, and if these result in mining operations a revival of the industry is assured. Meanwhile any lowering of operating costs by cheaper freight rates and cheaper supplies will quicken the mining activities of the smaller operators. It can not be too strongly emphasized that the enormous alluvial gold reserves of Alaska [3] give every assurance of the eventual revival of placer mining. In the following table a comparison is made between the condition of the placer-mining industry in 1920 and its condition in 1919:

Alaska placer mining, 1919 and 1920.

Region.	Number of mines.				Number of miners.				Value of gold produced.		Decrease or increase, 1920.
	Summer.		Winter.		Summer.		Winter.		1919	1920	
	1919	1920	1919	1920	1919	1920	1919	1920			
Southeastern and southwestern Alaska	14	18	.....	.....	39	18	.....	.....	$30,000	$10,000	−$20,000
Copper River region	18	19	.....	.....	115	94	.....	.....	185,000	200,000	+ 15,000
Cook Inlet and Susitna region	21	27	.....	.....	81	70	.....	.....	110,000	55,000	− 55,000
Yukon basin	274	273	76	69	1,246	1,130	255	271	2,910,000	1,995,000	−915,000
Kuskokwim region	20	32	2	.....	101	125	3	.....	350,000	305,000	− 45,000
Seward Peninsula	103	112	10	8	555	540	60	61	1,360,000	1,300,000	− 60,000
Kobuk region	16	7	.....	5	40	10	.....	9	25,000	8,000	− 17,000
	466	488	88	82	2,177	1,987	318	341	4,970,000	3,873,000	1,097,000

The above table shows that there was a decrease of about 22 per cent in the value of the output of placer gold in 1920 as compared with 1919, and also that the chief loss was in the Yukon camps, where the decrease was 31 per cent. It also indicates that, measured by production, the districts on Seward Peninsula were the most prosperous. A still greater decrease in the output of placer gold from Alaska is to be expected in 1921. The record of 488 placer mines operated in the summer of 1920 and 82 in the previous winter somewhat exaggerates the activity of the industry. These totals, like those given in all previous reports, include every placer-mine operation of the year, no matter how small, and among them are many whose output for the year amounted to only a few hundred dollars. About 150 mines were operated in the summer of 1920 and 20 mines

[3] Brooks, A. H., The future of Alaska mining: U. S. Geol. Survey Bull. 714, pp. 7–11, 1921.

in the previous winter that produced less than $1,200 worth of gold per mine. The total value of the gold produced by these mines was $95,000, and they employed about 230 men. Sufficiently complete returns have been received from 100 of these mines to permit the analysis of their operations presented in the following table:

Operations of small gold-placer mines in Alaska in 1920.

[Includes only mines whose gold output for the year was $1,200 or less.]

Region.	Number of mines considered.	Number of men employed.	Average number of days' work per man.	Average number of cubic yards of gravel mined per man per day.	Value of gold recovered—		
					Per cubic yard.	Per man per day.	Per man for the year.
Southeastern Alaska, Copper River, and Susitna River districts	15	23	45	7.4	$1.03	$7.63	$343
Yukon and Kuskokwim districts	67	86	76	4.8	1.10	5.28	401
Seward Peninsula and Kobuk districts	18	27	50	5.8	1.37	7.92	396
	100	136	67	5.3	1.13	4.94	398

About 70 per cent of these operations consisted of development work on placer deposits, which are expected to yield satisfactory returns at some future time, when the economic conditions are more favorable or better equipment can be obtained. Some placer gold was recovered during this work. The other 30 per cent of these operations consisted of mining small and rich pockets of gold-bearing gravel exploited by "snipers" or "pocket hunters" solely to obtain an immediate livelihood. Many millions of dollars' worth of gold has been won by this kind of mining. The richest field of the sniper was the beach placers of Nome in 1899 and 1900. The bars of Fortymile River have been yielding returns to the sniper since their discovery in 1886. In recent years, however, no new fields for the sniper have been found, and, as the above table shows, his returns have been very meager. Unless new bonanzas are found mining of this kind must therefore inevitably cease, except in so far as it may be done by men who obtain their principal support from some other work.

As shown above, the average return to the small miner in 1920 was only $398. A careful estimate, based on retail prices at Fairbanks, shows that the cost of a year's provisions for one man in 1920 was $420. Supplies are considerably cheaper in the districts nearer the coast but are much higher in the isolated camps than at Fairbanks. A year's provisions for a man, including only necessities, will probably cost from $300 to $500, and will average above $398. The returns in gold from these small mines are therefore not paying the cost of the provisions consumed.

This loss is in part offset by the fact that the miner works on the average only 67 days a year; living in a cabin built by himself he pays no rent, and his fuel, which is wood, he obtains for the labor of cutting it. In most places his provisions are helped out by fish and game, and he may be able to raise his potatoes and other vegetables. Furthermore, many small miners get a much larger return from fur hunting in winter than from mining in summer. In estimating the number of days' work it should be noted that the small miner must spend a certain number of days each year in transporting his supplies from the nearest trading post, in cutting his fuel, in building cabins, in making sluice boxes, and in doing other work, none of which is included in the average 67 days of mining. Taking together the time devoted to mining and to the work just mentioned, the average small miner will probably not be employed more than half the year. If, therefore, he can find remunerative occupation, such as trapping or cutting wood during the rest of the year he may still make a fair income, and if he is developing a mineral deposit that will give good profits in the future he may be bettering himself economically.

The increased cost of supplies is a serious hardship to the small operator. It not only reduces the net returns on mining his own claim, but by reducing the larger operations it prevents his finding employment with the mining companies. It is probably safe to estimate that the cost of clothing, traveling, tools, etc., added to that of provisions, will bring the average annual expense of the Alaska miner up to $700 or $800. It will therefore be necessary for him to earn an additional sum of money at least equal to the return from his mine, taken as the average return of 1920. The returns for 1920 (see table above) show that he is mining placers whose value is only $1.13 a cubic yard, and he is mining an average of 5.3 cubic yards a day, which gives him an average daily wage of $5.94. If he is to obtain his actual living expenses from mining alone he must confine his efforts to deposits which carry at least $2 worth of gold to the cubic yard, which will give him a daily wage of $10 and, with an average of 67 working days, an annual return of $670.

If the small mines as defined above and the gold dredges are excluded the summer placer mines operated in 1920 numbered 317, employing 1,832 men, and the winter placer mines numbered 62, employing 278 men. In these winter placers the gold-bearing gravel is thawed in winter and is sluiced after the summer thawing. The total value of the gold recovered by placer mining was $1,478,068. The gold and silver output of placer mines by regions is shown in the following table:

Gold and silver produced from placer mines in Alaska, 1920, by regions.

Region.	Gold.		Silver.		Gravel mined (cubic yards).	Recovery per cubic yard.
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.		
Southeastern and southwestern Alaska	483.75	$10,000	83.27	$91	2,750	$3.64
Copper River region	9,674.99	200,000	1,014.78	1,105	160,000	1.25
Cook Inlet and Susitna region	2,660.62	55,000	397.02	432	78,000	.70
Yukon basin	96,508.08	1,995,000	12,905.46	14,068	1,272,924	1.57
Kuskokwim region	14,754.36	305,000	3,962.98	4,320	131,900	2.31
Seward Peninsula	62,887.49	1,300,000	6,813.06	7,426	1,792,100	.73
Kobuk region	387.00	8,000	44.47	48	2,300	3.47
	187,356.29	3,873,000	25,221.04	27,490	3,439,974	1.13

The following table shows approximately the total bulk of gravel mined annually since 1907 and the value of the gold recovered per cubic yard. This table is based in part on returns made by operators of placer mines and in part on known facts or assumptions concerning the richness of the gravels in the several districts. Although the table is thus in part an estimate it is probably nearly correct.

Gravel sluiced in Alaskan placer mines and value of gold recovered, 1908–1920.

Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.	Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1908	4,275,000	$3.74	1915	8,100,000	$1.29
1909	4,418,000	3.66	1916	7,100,000	1.57
1910	4,036,000	2.97	1917	7,000,000	1.40
1911	5,790,000	2.17	1918	4,931,000	1.20
1912	7,050,000	1.70	1919	4,548,000	1.10
1913	6,800,000	1.57	1920	3,439,974	1.13
1914	8,500,000	1.26			

The table shows that from 1908 to 1914 there was a decline in the average gold content of the gravels mined. This decline reflects the improved methods of placer mining that have been introduced, more especially the increase in the use of dredges, which is brought out in the following table:

Relation of recovery of placer gold per cubic yard to proportion produced by dredges.

	Percentage of placer gold produced by dredges.	Recovery per cubic yard.		
		Dredges.	Mines.	All placers.
1911	12	$0.60	$3.36	$2.17
1912	18	.65	2.68	1.70
1913	21	.54	3.11	1.57
1914	22	.53	2.07	1.26
1915	22	.51	2.33	1.29
1916	24	.69	2.64	1.57
1917	26	.68	2.21	1.40
1918	24	.57	1.84	1.20
1919	27	.77	1.31	1.10
1920	29	.69	1.53	1.13

The 22 dredges operated in 1920 employed crews numbering 145 men. Two of these dredges were in the Fairbanks district, 2 in the Iditarod, 1 in the Mount McKinley (McGrath) district, and 17 in Seward Peninsula. The average gold recovery of the 5 Yukon and Kuskokwim dredges was 94 cents per cubic yard, and that of the Seward Peninsula dredges was 48 cents per cubic yard. The inland dredges were operated for an average of 170 days, and the longest season was that in the Iditarod, which ran for 196 days. The Seward Peninsula dredges were operated for an average of 66 days, and the longest season for any one dredge was 96 days.

Gold produced by dredge mining in Alaska, 1903–1920.

Year.	Number of dredges operated.	Value of gold output.	Gravel handled (cubic yards).	Value of gold recovered per cubic yard.
1903	2	$20,000	.....	.....
1904	3	25,000	.....	.....
1905	3	40,000	.....	.....
1906	3	120,000	.....	.....
1907	4	250,000	.....	.....
1908	4	171,000	.....	.....
1909	14	425,000	.....	.....
1910	18	800,000	.....	.....
1911	27	1,500,000	2,500,000	$0.60
1912	38	2,200,000	3,400,000	.65
1913	35	2,200,000	4,100,000	.54
1914	42	2,350,000	4,450,000	.53
1915	35	2,330,000	4,600,000	.51
1916	34	2,679,000	3,900,000	.69
1917	36	2,500,000	3,700,000	.68
1918	28	1,425,000	2,490,000	.57
1919	28	1,360,000	1,760,000	.77
1920	22	1,129,932	1,633,861	.69
	.....	21,524,932	.....	.....

COPPER.

The copper output of Alaska was 70,435,363 pounds, valued at $12,960,106, in 1920, and 47,220,771 pounds, valued at $8,783,063, in 1919. This increase is to be credited almost entirely to 3 mines of the Kennecott group, in the Chitina basin, and the Beatson mine, on Prince William Sound. Eight copper mines were operated productively in 1920 as compared with 11 in 1919. Of the productive mines, 2 on Prince William Sound were under development and recovered only small amounts of ore incidentally. The total copper output shown in the following table includes, in addition to that of the copper mines, some copper won from ores mined chiefly for other metal.

Output of Alaska copper mines in 1920, by districts.

District.	Mines operated.	Ore (tons).	Copper.		Gold.		Silver.	
			Quantity (pounds).	Value.	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Ketchikan [a]	2	16,088	670,155	$123,308	912.72	$18,868	5,313	$5,791
Chitina [b]	2	[c] 295,473	55,997,660	10,303,569	.....	.....	557,553	607,733
Prince William Sound	4	454,534	13,767,548	2,533,229	.....	.....	119,167	129,892
	8	766,095	70,435,363	12,960,106	912.72	18,868	682,033	743,416

[a] Includes some copper shipments from other parts of Alaska.
[b] Kennecott Copper Corporation Annual Report for 1920.
[c] Includes a small amount of placer copper.

The average copper content of the ore mined in 1920 was 4.6 per cent. The ores yielded an average of $0.025 in gold and $0.97 in silver to the ton. The average yield for 1919 was 4.8 per cent copper, $0.129 in gold, and $1.11 in silver. The large reduction in the average gold content of the ores mined in 1920 as compared with those mined in previous years is due to the closing of the Ellamar mine, whose ores carried much gold.

Of the total copper ore mined in Alaska in 1920, 96 per cent, or 732,549 tons, was treated by oil flotation, yielding 80,342 tons of concentrates, which averaged 32 per cent of copper. Most of the copper ore mined in 1920 was shipped to the Tacoma smelter, but a part of that mined in southeastern Alaska was treated at the Anyox smelter, in British Columbia.

Copper produced in Alaska, 1880–1920.

Year.	Ore mined (tons).	Copper produced.	
		Quantity (pounds).	Value.
1880		3,933	$826
1901		250,000	40,000
1902	[a] 40,000	360,000	41,400
1903		1,200,000	156,000
1904		2,043,586	275,676
1905	52,199	4,805,236	749,617
1906	105,729	5,871,811	1,133,260
1907	98,927	6,308,786	1,261,757
1908	51,509	4,585,362	605,267
1909	34,669	4,124,705	536,211
1910	39,365	4,241,689	538,695
1911	68,975	27,267,878	3,408,485
1912	93,452	29,230,491	4,823,031
1913	135,756	21,659,958	3,357,293
1914	153,605	21,450,628	2,852,934
1915	369,600	86,509,312	15,139,129
1916	617,264	119,854,839	29,484,291
1917	659,957	88,793,400	24,240,598
1918	722,047	69,224,951	17,098,563
1919	492,644	47,220,771	8,783,063
1920	766,095	70,435,363	12,960,106
	4,501,793	615,442,699	127,486,202

[a] Estimated.

In 1920, as in previous years, the Rush & Brown copper mine was the largest copper producer in southeastern Alaska. Copper was produced also at the Salt Chuck mine, better known for its production of palladium. Relatively little prospecting and no considerable development work was done on the copper deposits of southeastern Alaska. The three large mines, the Bonanza, Jumbo, and Mother Lode, were the only producing mines of the Chitina district in 1920, and no considerable developments were made at other mines. Some alluvial copper was produced incidentally to gold-placer mining in the Nizina district. On Prince William Sound the Beaton mine was the only property operated systematically throughout the year. The most notable advances were made at the Girdwood mine, where systematic underground and surface work was continued during much of the year. Small developments were continued at the Schlosser and McIntosh mines through a part of the year.

The above review shows that the Alaska copper-mining industry is in a rather discouraging situation in spite of the relatively large output of the metal in 1920. Except possibly in Prince William Sound, no large amount of work was done during the year in opening new ore bodies. The falling copper market and certain local conditions have discouraged the launching of any new enterprises. Not only will the copper output of 1921 be far less than that of 1920, but probably several years will pass before any new large copper-mining ventures will be under way.

LEAD.

The lead produced in Alaska in 1920 amounted to 875 tons, valued at $140,000, as compared with 687 tons, valued at $72,822, in 1919. In 1920, as in other years, most of the lead output was a by-product derived from the gold ores of the Juneau district. The increase in 1920 over 1919 was derived largely from galena ore mined in the Kantishna district.

The recent development of rich silver-lead ores in the Mayo district[4] of the Yukon Territory, about 100 miles east of Dawson, has started a search for similar deposits on the Alaska side of the boundary, not because of the lead content of the ore but because of the recent high price of silver. Galena ores are rather widely distributed in Alaska, but no large deposits have been found. Though some work was done on a number of Alaska galena deposits in 1920, which will be referred to in the review by districts, to follow (pp. 43–54), only one mine, in the Kantishna district, shipped any ore.

[4] Cockfield, W. E., The Mayo area, Yukon: Canada Geol. Survey Summary Rept., 1918, pp. 1B–22B, Ottawa, 1919.

Lead produced in Alaska, 1892–1920.

Year.	Quantity (tons).	Value.	Year.	Quantity (tons).	Value.
1892	30	$2,400	1908	40	$3,360
1893	40	3,040	1909	69	5,934
1894	35	2,310	1910	75	6,600
1895	20	1,320	1911	51	4,590
1896	30	1,800	1912	45	4,050
1897	30	2,160	1913	6	528
1898	30	2,240	1914	28	1,344
1899	35	3,150	1915	437	41,118
1900	40	3,440	1916	820	113,160
1901	40	3,440	1917	852	146,584
1902	30	2,460	1918	564	80,088
1903	30	2,520	1919	687	72,822
1904	30	2,580	1920	875	140,000
1905	30	2,620			
1906	30	3,420		5,059	662,258
1907	30	3,180			

TIN.

The tin mines of Alaska produced 26 tons of ore, containing 32,000 pounds of tin, valued at $16,112, in 1920, as compared with 86 tons of ore, containing 112,000 pounds of tin, valued at $73,400, in 1919. This decrease of output was due largely to the fact that in 1920 only one tin dredge instead of two, as in 1919, was operated in the York district of Seward Peninsula, which is the only important tin-producing area in Alaska. None of the tin mined in 1920 was marketed before the end of the year. In the York district the American Tin Mining Co. operated its dredge on Buck Creek from July to October. Some open-cut mining was done with pick and shovel on Goodwin Creek. During the winter of 1919-20 about 20 men were employed in developing the Lost River tin mine, on Cassiterite Creek. A 250-foot incline was sunk on the tin-bearing dikes from a station on the lower tunnel. Work was suspended in May, 1920.

It is reported that the tin placers of Grouse Creek have been worked out and that at the present rate of mining the placers of Buck Creek may be exhausted in about five years. Meanwhile sufficient prospecting has been done on other creeks to give reasonable assurance that the tin production will be maintained. Tin-bearing gravels have been prospected on Potato Creek and on Goodwin Creek and its tributary, Percy Gulch, flowing northward to the Arctic Ocean, as well as on Cape Creek, flowing southward to Bering Sea. Tin has been found on other creeks in the district, but on these creeks the prospecting is said to have developed some good dredging ground, and plans to install dredges on them are under consideration.

Though the only mines exploited solely for tin were the two in the York district, 7 of the Yukon gold-placer mines reported the recovery of some tin. Of these 6 were in the Hot Springs district and 1 in the Ruby district.

Tin produced in Alaska, 1902–1920.

Year.	Quantity (tons).		Value.	Year.	Quantity (tons).		Value.
	Ore.	Metal.			Ore.	Metal.	
1902	25	15	$8,000	1913	98	50	$44,103
1903	41	25	14,000	1914	157.5	104	66,560
1904	23	14	8,000	1915	167	102	78,846
1905	10	6	4,000	1916	232	139	121,000
1906	57	34	38,640	1917	171	100	123,300
1907	37.5	22	16,752	1918	104.5	68	118,000
1908	42.5	25	15,180	1919	86	56	73,400
1909	19	11	7,638	1920	26	16	16,112
1910	16.5	10	8,335				
1911	92.5	61	52,798		1,600.0	988	934,264
1912	194	130	119,600				

PLATINUM METALS.

The output of platinum, palladium, and other metals of the platinum group in Alaska in 1920 is estimated at 1,476.97 ounces, valued at $160,117, as compared with 569.25 ounces, valued at $73,663, in 1919. In 1920, as in previous years, the larger part of the output was from the copper-palladium ore of the Salt Chuck mine, in the Ketchikan district. An output of platinum minerals was reported by 7 gold placer mines in 1920. Four of these were in the Koyuk district and one in the Fairhaven district of Seward Peninsula. Two placer mines in the Chistochina district of the Copper River basin produced platinum in 1920. The largest output of placer platinum was made on Dime Creek, in the Koyuk district, and on Slate Creek, in the Chistochina district. The bedrock source of the alluvial platinum has not yet been definitely determined. The total production of platinum metals in Alaska since they were first saved, in 1916, is given in the following table:

Platinum metals produced in Alaska, 1916–1920.

Year.	Quantity.		Value.
	Crude ounces.	Fine ounces.	
1916	12.0	8.33	$700
1917	81.2	53.40	5,500
1918	301.0	284.00	36,600
1919	579.3	569.52	73,663
1920	1,493.4	1,478.97	160,117
	2,466.9	2,394.22	276,580

QUICKSILVER.

Productive mining was continued in a small way at the Parks cinnabar mine, the only one in Alaska that has yet made an output. This mine is on the north bank of Kuskokwim River about 16 miles above Georgetown.

In 1919 a cinnabar-bearing lode was discovered in the headwater region of Iditarod River, a tributary of the Yukon. This deposit is said to be on Montana Creek, formerly called Moose Creek, 35 miles south of the town of Iditarod. Though it is on the Yukon side of the watershed, the place appears to be only about 10 miles in a direct line from the Kuskokwim. A trail about 15 miles long has been built from the Kuskokwim at the mouth of Crooked River to the deposit. Claims are under development by the Fidelity-Kuskokwim Quicksilver Co., which is said to have shipped about 60 tons of supplies, including retorts, during the summer of 1920. The underground development consists of a 50-foot shaft, said to reveal an ore body of considerable size. The deposit has not been examined by any member of the Geological Survey, but it is probably of the same general type as that found in the Iditarod district,[5] to the north, though it is reported to be much larger.

This newly discovered lode and the cinnabar deposits previously found are distributed over a considerable area, and cinnabar is not uncommon in the gold placers of this general region. This rather wide distribution of quicksilver ore augurs well for future discoveries, especially as but little prospecting has been done for cinnabar. Though most of the cinnabar-bearing lodes found thus far are too small to be of value yet there is good hope of finding commercially valuable bodies such as that on Montana Creek is reported to be.

MISCELLANEOUS METALS.

Antimony ore (stibnite) was mined at several places in Alaska during the World War, when the price of the metal was high. A total of 2,492 tons of stibnite ore, valued at $237,500, was mined in Alaska during 1916, 1917, and 1918. No antimony was mined in the Territory in 1920. The only developments reported were on the Norvill property, in Chicken Creek valley, in the Fortymile district. No tungsten has been mined in Alaska since 1918. It is reported that a deposit of chromite has been developed on the Whitney & Lass property, at Red Mountain, near the southern end of Kenai Peninsula, and that in the course of the work some ore was produced

The development of the molybdenite deposits near Shakan, on Prince of Wales Island, which has been going on for several years, was suspended in 1920. Oscar Yehring, of Juneau, discovered a molybdenite deposit near Glacier Bay in 1920. The deposit is near Wood Glacier, about 1½ miles from the beach and 200 feet above tidewater.

COAL.

The output of coal in Alaska in 1920 was 61,111 tons, valued at $355,668; the output in 1919 was 60,674 tons, valued at $343,547. Of the output in 1920, 35,044 tons was taken from the two Government

[5] Brooks, A. H., The antimony deposits of Alaska: U. S. Geol. Survey Bull. 649, pp. 47-49, 1916.

mines in the Matanuska field. Besides these two mines there were only three others whose output for the year exceeded 1,000 tons—two in the Nenana field and one in the Kachemak Bay field. Lignitic coal for near-by use was produced at five other mines. The largest output from the small mines was made at the Kugruk mine, in the Fairhaven district, which supplied coal for some placer operations in its vicinity. The Alaska school service mined about 200 tons of coal for its use on Wainwright Inlet, north of Cape Lisburne. Ten mines, large and small, were operated during the year, employing 207 men for an average of 240 days.

Work at the Eska mine, in the Matanuska field, was continued on about the same scale as in previous years, to obtain coal for the Government railroad and for some of the near-by communities. The mine was operated 239 days, employing an average of 43 men underground and 50 men on the surface, which gave a total of 8,835 man-shifts underground and 15,609 man-shifts on the surface. There were 195 days lost owing to sickness, and the mine was closed 73 days on account of a strike. A total of 3,633 feet of gangways, etc., were driven in 1920, making 5,337 feet in all.[6] The resident engineer, S. S. Smith, reports that the cost of mining coal was about $6 a ton in 1920, compared with $5 in 1919 and $4.66 in 1918, and that the increase in cost was due to an increase of 32 per cent in the wages of miners,[7] the reduced output on account of the strike, a longer haul underground, and the greater cost of timber. The underground work consisted chiefly of mining coal beds, and but little advance work was done. The developed coal reserves are reported to be about 70,000 tons, which at the present rate of mining is about two years' supply. A washery having a capacity of 1,000 tons is being built and will be completed in 1921. It will be used for the Eska coal and for any other coal mined by the Government along the railroad.

In the summer of 1920 the Navy Department began systematic prospecting in the Matanuska field to find coal for use by the Navy. This work is directed by the Alaskan Naval Coal Commission, of which Commander O. C. Dowling is chairman. Sumner S. Smith, resident engineer, has the immediate technical direction of all the field work and has associated with him as geologists Prof. T. E. Savage, of the University of Illinois, and Lieut. W. P. T. Hill, of the Marine Corps. Prospecting and underground exploration have been actively pushed in the Chickaloon and Coal Creek areas, and some examinations have been made in other parts of the field. The results are reported to be encouraging, notably in the Coal Creek area, but details are not yet available for publication. The only other mining done in the Mata-

[6] Information on mining developments in the Matanuska field is taken from "Report of the mining department, Alaskan Engineering Commission, for 1920," by Sumner S. Smith, resident engineer, to whom the writer is indebted for an advance copy.

[7] Wages in 1920, per day of 8 hours, for skilled labor underground were $8.60; for unskilled labor, $7.90.

nuska field was on the leasehold of the Evans Jones Coal Co., near Eska. Underground work was started in October, 1920, to produce coal to be sledded to the railroad, about 1½ miles distant, during the winter. About five men were employed at the mine.

The Bering River Coal Co. continued the underground exploration and surface improvement of its leasehold in the western part of the Bering River field throughout the year. An average of 20 men were employed underground and 20 on the surface. No coal has been mined except that incidental to the development work, which supplied the wants of the mine. In all about 3,500 feet of crosscuts and gangways have been driven. In 1920 a plank automobile road 4 miles long was constructed, which gives connection with scow navigation at tidewater on Bering Lake. The company reports a total expenditure of nearly $400,000 up to the end of 1920.[8]

Some developments were continued by the Alaska Coal & Petroleum Co. on its patented coal claim in the eastern part of the field. The mine is connected with tidewater on Bering River by a small railroad.

The McNally mine, on Kachemak Bay, previously operated under a permit, is now operated under a leasehold, and larger developments are promised. It finds its principal market for its lignite product in the Cook Inlet region.

The Healy River Coal Corporation is operating a small lignite mine under leasehold on the west bank of Nenana River, opposite the mouth of Healy Fork. An adit[9] driven into the bank of Nenana River a few feet above water level reaches the coal about 200 feet in. An entry has been driven on the coal for about 300 feet. The coal is from 5 to 7 feet thick, and the floor and roof are of shale. The mine was worked throughout the year and employed about 12 men.

The Broad Pass Coal & Development Co. is operating under a permit a small lignite mine on Lignite Creek, a tributary of Nenana River from the east. It is worked only in winter, and the coal mined is carried across the Nenana on the ice. The coal bed is about 25 feet thick and lies nearly horizontal. In 1920 the mine was operated 80 days and employed 12 men underground and 9 on the surface, including those who sledded coal to the railroad.

The coal produced in the Nenana field was sold to the railroad and in the near-by settlements. Some coal was shipped to Fairbanks, where it was sold in carload lots at $7 a ton, but it has not yet there superseded wood as the general fuel.

The above review shows that the development of the high-grade Alaska coal has not yet gone beyond the prospecting stage. Indeed, the coal actually blocked out does not exceed a few hundred thousand

[8] Kennecott Copper Corporation Ann. Rept. for 1920, p. 15, New York, 1921.

[9] Information received from B. W. Dyer, of the U. S. Bureau of Mines, and from George Parks, of the General Land Office.

tons, which, of course, is not an adequate base for a productive industry. This is the state of affairs after the coal fields have been open to leasehold for seven years, during which only one coal tract has been systematically explored by private capital. There is certainly a strong contrast between the present actual conditions and those foretold in the prophecies so freely made in the conservation propaganda a decade ago. Exaggerated statements of the value of the Alaska coals and of the profits sure to be realized by their development were then widely published and were generally accepted as true by those who had no technical knowledge of the subject and who failed to inform themselves by reading the official publications then extant. At the height of this propaganda every Alaska coal claimant was regarded by many as a prospective millionaire. After the actual facts were recognized the pendulum of popular opinion swung toward the other extreme, and some persons probably now believe that any interest in Alaska coal lands is a liability rather than an asset. The truth lies between these two extreme views.

The coal fields were opened for leasing about at the outbreak of the World War, and the industrial and financial revolution attendant on the war has no doubt delayed their development. Some men who attempted to develop leased tracts had neither the experience nor the capital to carry on the projects properly and were soon discouraged. The best hope for profitable exploitation of the Alaska high-grade coals is in operation on a large scale, calling for heavy investments. A great deal of preliminary underground exploration must be done to block out sufficient coal to justify the costly installation of large mining plants and, in the Bering River field, the construction of railroads. The conditions are in strong contrast to those affecting the eastern coals, which lie horizontal and are undisturbed, so that only a comparatively few openings are required to afford a reliable estimate of the quantity of coal available.

In view of the general importance of the fuel problem on our Pacific coast it will be well to summarize briefly the essential facts relating to the occurrence of the Bering River and Matanuska coals, even though they may be largely a repetition of what has long been published.[10] The underground work of the last few years has revealed

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

Martin, G. C., and Mertie, J. B., jr., Mineral resources of the upper Matanuska and Nelchina valleys: U. S. Geol. Survey Bull. 592, pp. 273–300, 1914.

Martin, G. C., Geologic problems at the Matanuska coal mines: U. S. Geol. Survey Bull. 692, pp. 269–282, 1919.

Chapin, Theodore, Mining developments in the Matanuska coal field: U. S. Geol. Survey Bull. 712, pp. 131–167, 1920; Mining developments in the Matanuska coal fields: U. S. Geol. Survey Bull. 714, pp. 197–199, 1921.

Brooks, A. H., The future of Alaska mining: U. S. Geol. Survey Bull. 714, pp. 43–51, 1921.

Martin, G. C., Geology and mineral resources of Controller Bay region, Alaska: U. S. Geol. Survey Bull. 335, 1908. (This publication contains a detailed description of the Bering River coal field.)

details concerning the occurrence of the coal that were not available when the earlier reports were published. Those reports were necessarily based solely on examinations of the outcrops and of the shallow pits of their day. In general, however, the conclusions then reached have been confirmed by the underground developments of recent years. For example, Martin [11] in his report on the Bering River field, published 13 years ago, says:

> The possible overturned folds and faults introduce problems the scope of which can perhaps be determined only by exploration of the seams in depth. It seems probable that there are areas within the field which can not be successfully mined. These must be determined by careful surface prospecting, followed by either boring or tunneling at critical points.

It has been known that the fuel value of the Alaska coals leaves little to be desired, though like many others of similar grade they will require washing. The friability of the coal favors cleaning by washing, as has been demonstrated by numerous tests. In general the quality of the coals appears to bear a more or less direct relation to the intensity of their deformation. For example, the coal of the Eska mine is both of a lower fuel value and much less disturbed than that of the Chickaloon mine. It also appears that the anthracite coals of the eastern part of the Bering River field are more intricately folded and faulted than the bituminous coals in the southwestern part of that field.

The most discouraging fact that has been brought out by the underground work is the lack of continuity of the coal beds. Most of those opened up thicken and thin very irregularly, and many pass into beds in which the carbonaceous material forms only a part and in some only a small part of the whole bed. These irregularities of occurrence are probably due largely to disturbances caused by folding and faulting, but they are also in part original features of deposition.

The evidence tends to show that the vegetable matter from which the coals were formed accumulated in small basins along valley bottoms and in river deltas rather than in extensive swampy lowlands. In coal beds formed from deposits that accumulated under the conditions stated there would naturally be recurring transition from clean coal well within the basins to dirty coal or even to clay sediments toward the rims of the basins. The mode of origin of the coal will therefore in part account for the lack of continuity of good coal beds. There is, however, no measure of the size of the basins in which the vegetable matter accumulated, and it probably varied greatly from place to place. These differences in original deposition are probably of less consequence to the miner than the folding and faulting of the beds, but a careful study of the conditions under which the coal was

[11] Op. cit. (Bull. 335), p. 93.

deposited will reveal facts which will aid in the identification and correlation of coal beds found in different mine openings. Furthermore, it may be possible that the most persistent coal beds as originally deposited may be found in the unprospected parts of both the Bering River and the Matanuska fields.

Though some of the variations in the thickness and composition of individual coal beds may be due to their mode of accumulation, there is no question that much of their extreme irregularity is certainly due to the profound disturbance of all the coal measures. This disturbance is general throughout both coal fields, but it varies in intensity, apparently increasing from the southwest to the northeast, yet there are no doubt local variations from the general conditions, so that both fields should be carefully prospected to discover the coal beds that are least disturbed. Such prospecting has been begun by the Navy Department for the Matanuska field and should be done in the Bering River field.

As a result of this great disturbance nearly all the coal beds are tilted, many at high angles, and some are folded and overturned. Although the folding is far more complex than that of the Pennsylvania anthracite, it is no greater than that of some of the coal beds mined in Europe.

In addition to the folding there is much faulting, which is far more serious to the miner. Faults are of two general types—cross faults, which cut across the beds, and bedding or parallel faults, which follow the bedding of the strata and of many of the coal beds themselves. These two types merge into each other so that by change of direction a cross fault may become a bedding fault and vice versa.

The best-known example of cross faulting is in the Eska mine, where the displacement in at least one locality amounts to several hundred feet. If the cross faults are clean breaks they do not seriously interfere with the mining of coal, though they do greatly increase the cost of mining because of the large amount of deadwork required to pick up the coal bed beyond the fault.

Far more serious are the bedding faults, which, so far as present developments show, are characteristic structural features of much of the areas of best coal. Evidence is abundant to show that the bedding faults are usually developed from cross faults, which enter the coal bed, follow it as bedding faults for a certain distance, and leave it as cross faults. Where a fault follows a coal bed the bed thickens and thins very irregularly and may be practically squeezed out. Moreover, many of the bedding faults are not the results of movements along a single plane, but include a complex of fault planes. This type of fault is marked by a zone of crushing, which may include not only the entire coal bed but a part of the wall rock, so that the position of the coal bed is marked by a complex mixture of coal and wall rock. These

bedding faults appear at irregular intervals and differ in extent. As a result of such faulting a bed of good coal that has been followed by a gallery for several hundred feet may suddenly be lost or may pass into a zone made up of intermingled coal, shale, and bone that can not be separated in mining. In the mining thus far done no coal bed has been traced unbroken for more than 500 feet.

In places the difficulties of mining are further enhanced by the presence of intrusive dikes or stocks of igneous rocks. In the Bering River field there are no stocks and so far as determined the dikes are not sufficiently abundant to interfere seriously with mining. In the Matanuska field dikes are far more numerous and large dioritic stocks cut the coal measures. The gaseous character of these coals, the local differences in the firmness of the wall rock, and other physical conditions also influence the cost of mining, but these will not be considered here.

The discouragement found in the facts presented above is offset by the encouragement afforded by certain other facts: (1) The coal is of better grade than any other found on the Pacific seaboard; (2) outcrops of such coal are distributed over an area of about 70 square miles in the two fields; (3) it is quite possible that the parts of the fields in which the structural conditions are most favorable to mining have not been revealed; (4) underground work has thus far been limited to a total of about 21,500 feet of gangways and crosscuts and to tracts aggregating only a few square miles, and even these tracts have not been exhaustively explored.

The above outline indicates the principal difficulties, as well as the advantages and favorable possibilities, in mining Alaska coal. The difficulties are inherent in the mode of occurrence of the coal, and added to them are the difficulties inherent in all operations in remote regions, such as that of obtaining transportation and labor. It should be noted also that though there will undoubtedly be a great demand for the coal no actual market has yet been definitely established. The Government railroad gives ready access to the Matanuska field, but a large investment will be required for railroad construction into the Bering River field. Moreover, to reach a market in the States will require proper ocean carriers, which do not now form a part of the Alaska merchant marine. It is therefore evident that large investments will be necessary and that much time must pass before any expectation of a large coal-mining industry in Alaska can be realized; also that private capital will not undertake the development of the industry unless there is hope for very large returns. The greatest liberality must therefore be shown to coal lessees unless the Government itself is to undertake the underground exploration.

Coal produced in Alaska, 1888 to 1920.

Year.	Quantity (short tons).	Value.	Year.	Quantity (short tons).	Value.
1888–1896	6,000	$84,000	1910	1,000	$15,000
1897	2,000	28,000	1911	900	9,300
1898	1,000	14,000	1912	355	2,840
1899	1,200	16,800	1913	2,300	13,800
1900	1,200	16,800	1914	.....	.....
1901	1,300	15,600	1915	1,400	3,300
1902	2,212	19,048	1916	13,073	52,317
1903	1,447	9,782	1917	53,955	265,317
1904	1,694	7,225	1918	75,606	411,850
1905	3,774	13,250	1919	60,674	343,547
1906	5,541	17,974	1920	61,111	355,668
1907	10,139	53,600		313,788	1,796,128
1908	3,107	14,810			
1909	2,800	12,300			

Coal consumed in Alaska, 1899–1920, in short tons.

Year.	Produced in Alaska, chiefly subbituminous and lignite.	Imported from States, chiefly bituminous from Washington.	Total foreign coal, chiefly bituminous from British Columbia.	Total coal consumed.
1899	1,200	10,000	a 50,120	61,320
1900	1,200	15,048	a 56,623	72,871
1901	1,300	24,000	a 77,674	102,974
1902	2,212	40,000	a 68,363	110,575
1903	1,447	64,626	a 60,605	126,678
1904	1,694	36,689	a 76,815	115,198
1905	3,774	67,713	a 72,612	144,099
1906	5,541	69,493	a 47,590	122,624
1907	10,139	46,246	a 93,262	149,647
1908	3,107	23,893	a 86,404	113,404
1909	2,800	33,112	69,046	104,958
1910	1,000	32,098	58,420	91,518
1911	900	32,255	61,845	95,000
1912	355	27,767	68,316	96,438
1913	2,300	69,066	56,430	127,796
1914	.....	41,509	46,153	87,662
1915	1,400	46,329	29,457	77,186
1916	13,073	44,934	53,672	111,679
1917	53,955	58,116	56,589	168,660
1918	75,606	51,520	37,986	165,112
1919	60,674	57,166	48,708	166,548
1920	61,111	37,043	45,264	143,418
	304,788	928,623	1,321,954	2,555,365

a By fiscal year ending June 30.

PETROLEUM.

The petroleum produced in Alaska in 1920, as in previous years, was derived from the single patented claim in the Katalla oil field. This property is owned by the Chilkat Oil Co., which refines the entire product in its own refinery. The output in 1920 was pumped from 7 or 8 small wells. Two new wells in which oil was found were drilled on this property in 1920. The high-grade gasoline made from this oil finds a ready sale in the local market, chiefly on Prince William Sound. At present the residue from the refinery is not utilized

No drilling was done in undeveloped fields in 1920, but some geologic examinations were made by private corporations. In 1920–21

a hole was sunk near Anchorage to a depth of about 200 feet, but did not reach bedrock. Later (July, 1921) a small petroleum seepage was found near Anchorage in the gravel and clay which here mark the bedrock. The alluvial cover prevents the determination of the bedrock source of the oil.

The enactment of the oil-land leasing act of February, 1920, together with the world-wide search for petroleum, has again attracted public attention to the oil lands in Alaska, which had been withdrawn from entry since 1910. The enactment of the new law started a rush into all the accessible prospective oil fields, and many claims were staked. Later the enthusiasm of this rush carried many of the locators into areas that had little to recommend them as possible fields for petroleum. Up to the end of the year 335 applications for oil-prospecting permits, covering 762,553 acres, had been received at the Juneau land office. These applications, according to Mr. Stewart,[12] are distributed geographically as follows:

Applications for oil permits received at Juneau land office, 1920.

Location.	Number.	Area (acres).
Cold Bay	168	431,040
Katalla	63	98,053
Yakataga	36	75,520
Iliamna (Iniskin Bay)	30	69,400
Kootznahoo (Admiralty Island, southeastern Alaska)	15	33,280
Cape Spencer (Icy Strait, southeastern Alaska)	3	7,680
Chinitna, (north of Iliamna Bay, Cook Inlet)	3	7,680
Seward (Kenai Peninsula)	2	5,320
Wasilla (Matanuska Valley)	2	5,120
Anchorage (Knik Arm)	9	19,200
Aniakchak (Alaska Peninsula, southwest of Cold Bay)	4	10,240

Of the above list, only the Cold Bay, Katalla, Yakataga, Iliamna, and possibly the Chinitna and Aniakchak areas are classed by the Geological Survey as prospective oil territory on the geologic information now at hand.[13] Curiously enough, no claims appear to have been filed on any land in the Douglas River region, tributary to the southwest end of Cook Inlet, where an oil seepage has long been known.

The large areas staked in the prospective oil fields above listed no doubt include much land that is worthless, but until the structure has been worked out this can not be helped. It will be well to note also that until actual drilling has been done there is no certainty of the existence of important oil pools in any of these areas. Some drilling will probably be done in 1921, but these prospective fields can probably not be systematically tested for several years.

[12] Stewart, B. D., Annual report of the Territorial mine inspector to the governor of Alaska, 1920, p. 11, Juneau, 1921.

[13] Martin, G. C., Preliminary report on petroleum in Alaska: U. S. Geol. Survey Bull. 719, 1921.

Petroleum products shipped to Alaska from other parts of the United States, 1905–1920, in gallons.[a]

Year.	Heavy oils, including crude oil, gas oil, residuum, etc.	Gasoline, including all lighter products of distillation.	Illuminating oil.	Lubricating oil.
1905	2,715,974	713,496	627,391	83,319
1906	2,688,940	580,978	568,033	83,992
1907	9,104,300	636,881	510,145	100,145
1908	11,891,375	939,424	566,598	94,542
1909	14,119,102	746,930	531,727	85,687
1910	19,143,091	788,154	620,972	104,512
1911	20,878,843	1,238,865	423,750	100,141
1912	15,523,555	2,736,739	672,176	154,565
1913	15,682,412	1,735,658	661,656	150,918
1914	18,601,384	2,878,723	731,146	191,876
1915	16,910,012	2,413,962	513,075	271,981
1916	23,555,811	2,844,801	732,369	373,046
1917	23,971,114	3,256,870	750,238	465,693
1918	24,379,566	1,086,852	382,186	362,413
1919	18,784,013	1,007,073	3,515,746	977,703
1920	21,981,569	1,764,302	887,942	412,107
	259,931,061	25,369,708	12,695,150	4,012,640

[a] Compiled from Monthly Summary of Foreign Commerce of the United States, 1905 to 1920, Bureau of Foreign and Domestic Commerce.

STRUCTURAL MATERIALS, ETC.

Marble is widely distributed in southeastern Alaska[14] but has been developed on an extensive scale only at the quarries of the Vermont Marble Co. at Tokeen, near the north end of Prince of Wales Island. In 1920, as in the past, only one gypsum mine was operated in Alaska. The mine was flooded during the first four months of the year, but operations were resumed later on the same scale as before.

The equipment for mining and reducing sulphur on Akun Island, at the east end of the Aleutian chain, was completed about the end of the year, but no sulphur has yet been produced there.

A trial shipment of about 20 tons of garnet sand, taken from the beach of Imuruk Basin, 20 miles east of Port Clarence, to be used as an abrasive, was made from Nome in the summer of 1920.

REVIEW BY DISTRICTS.

The following review summarizes briefly the principal developments in all the districts. Many of the districts were not visited by members of the Geological Survey in 1920, and for this reason and because some operators fail to make reports the information at hand is not complete, especially concerning the placers of the lower Kuskokwim basin and of the Koyukuk district. The space devoted to any district is therefore not necessarily a measure of its relative importance. The general arrangement of the presentation is geographic, from south to north.

[14] Burchard, E. F., Marble resources of southeastern Alaska: U. S. Geol. Survey Bull. 682, 1920.

SOUTHEASTERN ALASKA.

The mineral output of southeastern Alaska in 1920 was derived from eight gold-lode mines, gold placers (a very small production), two copper mines, one of which yields ore carrying a high content of platinum minerals, one gypsum mine, and one large marble-quarry property. The total value of the minerals produced increased from $4,679,632 in 1919 to $5,120,163 in 1920. Only four of the gold mines were large producers—three at Juneau and one on Chichagof Island; the others were under development and made a small incidental output of gold. All the copper produced came from the Rush & Brown and Salt Chuck mines, in the Ketchikan district. Placer mining was limited to very small operations in the Porcupine district and on the beach placers of Yakataga and Lituya Bay.

Mineral production of southeastern Alaska, 1920.

	Ore mined (tons).	Gold.		Silver.	
		Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
Gold-lode mines	3,409,197	210,535	$4,352,145	114,621	$124,937
Copper mines	15,018	913	18,873	5,313	5,791
Placer mines		193	3,990	33	36
	3,424,215	211,641	4,375,008	119,967	130,764

	Copper.		Lead.		Palladium, marble, gypsum, etc. (value).
	Quantity (pounds).	Value.	Quantity (pounds).	Value.	
Gold-lode mines			1,518,454	$121,477	
Copper mines	[a] 670,155	$123,308			
Placer mines					
	670,155	123,308	1,518,454	121,477	$369,606

[a] Includes some copper shipped from other parts of Alaska.

KETCHIKAN DISTRICT.

Productive development work was continued at the Rush & Brown mine on about the same scale as in previous years. This is the oldest productive copper mine in southeastern Alaska, having been operated almost continuously since 1904. In 1920, as in previous years, the work was directed principally to the development of the smaller of the two ore bodies that have been explored underground. This ore body lies in a shear zone bounded by two well-defined walls of graywacke. It consists of rich chalcopyrite ore shoots in a mineralized gangue of crushed graywacke, which is in part merchantable ore, for in addition to the rich shoots the gangue contains veins and veinlets of sulphides. The ore body contains also some pyrite and pyrrho-

tite. The lower-grade copper-bearing magnetite ores on the property, of which a considerable tonnage has been developed, will not be utilized until a market for their iron content can be found. The Ketchikan district as a whole has large reserves [15] of this type of ore, which will form an important asset when use can be found for its iron content. The principal work on the Rush & Brown mine in 1920 was the extension of the incline to the 500-foot level, drifting on the 450-foot level, and explorations at higher levels. All the ore produced was sent to the Anyox smelter, in British Columbia. Mining was done at the Salt Chuck mine on a larger scale in 1920 than in the previous year. The ore on this property has a high content of palladium and platinum and carries copper also. This occurrence was fully described in the report of last year.[16]

The Dunton gold mine, near Hollis, on Prince of Wales Island, has been taken over by the Kasaan Gold Mining Co., and the name of the property has been changed to Harris Creek mine. The ore body has been described in a recent publication.[17] In 1920 the work has consisted chiefly of a reconstruction of the mill and mining plant, which was completed in the fall of 1920. Some gold ore was milled in the course of the year. Considerable prospecting was done by the Helm Bay Mining Co. on a group of claims on Helm Bay, on the south shore of Cleveland Peninsula, north of Ketchikan. The group includes the old Gold Standard mine, which has not been worked for many years. The work performed in 1920 includes a series of shallow open cuts and pits, which crosscut a rather ill-defined shear zone traversing greenstone schists. Within this shear zone there are many small quartz veins and stringers which carry gold and some pyrite. The zone has been traced with some interruptions for several thousand feet. The several open cuts show from 10 to 50 feet of mineralized rock, but no well-defined walls were seen. It is reported that results of sampling seven or eight of these cuts yielded an average of about $6 worth of gold to the ton. A crosscut is being driven, which should reach the shear zone at a depth of 80 feet. The work on this property when it was hastily examined in September, 1920, was only well begun, as the bedrock was exposed only in the open cuts. No adequate conception of the character of the ore body could be obtained. The value of the property will depend on the quantity of ore, which, according to the surface indications, may be large. Another important fact that awaits determination is the continuance in depth of the gold content thus far reported. The cuts examined showed some oxidation, which indicates that there may be some surface enrichment. The evidence at other mines in the district supports the

[15] Brooks, A. H., The future of Alaska mining: U. S. Geol. Survey Bull. 714, pp. 15–19, 1921.
[16] Mertie, J. B., jr., Lode mining in the Juneau and Ketchikan districts: U. S. Geol. Survey Bull. 714, pp. 121–217, 1921.
[17] Idem, pp. 127–128.

belief that a crosscut run on the ore body at a depth of 80 feet should give a reliable indication of the depth of surface enrichment.

JUNEAU DISTRICT.

The Perseverance, Alaska-Juneau, and Ready Bullion mines and mills, all near Juneau, were operated throughout the year. In 1920 the value of the average recovery of metal from the ore of these three mines was 85 cents a ton. Developments were continued throughout the year on the Alaska Ebner property, adjacent to the Alaska-Juneau. This mine is developed by an adit 4,000 feet long, and during 1920 about 1,000 feet of drifting and crosscutting was done.

Developments at the Jualin mine, at Berners Bay, were suspended in February, 1920, but the company reports that work will be resumed when financial conditions improve. The 10-stamp mill at this mine was burned during the year, but the extensions projected include a 200-stamp mill. A little work was done at the Peterson mine, north of Juneau. Some work was done at the Daisy Bell mine, near Snettisham, and a little ore was treated in its 5-stamp mill.

The following notes on the most important recent developments at Windham and Sumdum bays are taken from Stewart's report.[18] In 1919 the Alaska Peerless Mining Co. drove about 50 feet of adits and crosscuts on the Basin Queen lode, at Windham Bay. This property, formerly known as the Yellow Jacket group, has been described by Spencer.[19] This work exposed an extensive belt of highly mineralized talcose schist approximately 70 feet in width, constituting a showing which appears to be well worth further exploration. The main tunnel is now 400 feet in length, and from it four crosscuts have been driven aggregating 300 feet. It was planned by the Alaska Peerless Mining Co. to drive a crosscut adit 630 feet vertically below the present drift adit and 5,000 feet in length, to cut the above-described zone at this horizon. This work was started and 50 feet of open-cut work and 30 feet of tunneling work completed. Work on the property was discontinued in the fall of 1919 and only assessment work done during 1920.

According to the mine inspector's report, the Independent Gold Mining Corporation completed in 1920 about 150 feet of underground work on a property at the head of Windham Bay. The ore body exposed is a belt of silicified schists, having an average width of about 10 feet and containing gold, galena, and iron sulphides. This mineralized belt has been traced on the surface for a long distance to the southeast of the adit and it crops out on the opposite shore of the bay, where claims have been located upon it.

The most extensive developments on Admiralty Island were those made on the property of the Admiralty Alaska Gold Mining Co.,

[18] Stewart, B. D., Annual report of Territorial mine inspector to the governor of Alaska, 1920, p. 20, Juneau, 1921.

[19] Spencer, A. C., The Juneau gold belt: U. S. Geol. Survey Bull. 287, p. 41, 1906.

which has been described in a recent report.[20] Here operations were carried on from May to the end of the year. The main adit was extended for about 650 feet. Many open cuts were made, and a new working shaft was started. Work was continued in a small way on the Nowell-Otterson group of claims,[21] which are adjacent to the Admiralty-Alaska property.

Underground work has been continued at the Alaska Endicott property on William Henry Bay, north of Juneau. Preparations are being made to erect a mill and compressor plant.

SITKA DISTRICT.

The Sitka district was the scene of the first lode-gold mining venture in Alaska, which began as early as 1871. This proved unprofitable, and when gold was discovered at Juneau and on the Yukon the district was almost abandoned. It was not until 1905, when the Chichagoff lode, now developed into one of the largest mines in Alaska, was discovered, that prospectors began to return to the district. In 1920 lode prospecting was more active here than in any other part of the Territory, and some promising discoveries were made. It is astonishing that a region which is so readily accessible and in which the physical conditions permit low operating costs should have been almost ignored for nearly half a century.

In 1920, as in the past, the Chichagoff mine was the only productive property in the district except the gypsum mine already referred to (p. 33). The mine and 30-stamp mill were operated throughout the year, and the new underground work included 112 feet of shaft and 1,310 feet of drifts.

The following quotation from the Territorial mine inspector's report summarizes the recent prospecting in the Sitka district:[22]

> Active development was continued on the Hirst-Chichagoff property, at Hirst Cove, on the opposite side of Doolth Mountain from the Chichagoff mine.
>
> During the winter of 1919 and the spring of 1920 a stamp mill which had been installed at Windham Bay was dismantled and moved to the Hirst-Chichagoff property. A mill building was constructed, but the mill has not yet been installed.
>
> A wharf has been built and a comfortable bunk house and boarding house completed at the property. Difficulty was had with the compressor formerly in use, and a new machine has been installed. Following this improvement work was resumed on the crosscut tunnel at the mill level, and about 300 feet driven, making a total of about 1,100 feet. It is understood this tunnel has reached the vein and exploration of the ore zone at the mill tunnel level has begun. This vein is very similar in type to the Chichagoff vein, and the results of development work upon it are being looked forward to with interest.
>
> The Chichagoff Mining Co. has acquired control of the Apex group of claims, lying across the divide, between the head of Cann Creek on the west shore of Lisianski Inlet and Stag Bay, an arm of Lisianski Strait.

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[20] Mertie, J. B., jr., Mining in Juneau and Ketchikan districts: U. S. Geol. Survey Bull. 714, pp. 115–116, 1921.

[21] Idem, pp. 116–118.

[22] Op. cit., pp. 22–23.

The discovery of the Apex vein was made in October, 1919, and development work was commenced upon it as soon as the snow had left in the early summer of 1920. The vein on the surface averages about 20 inches in width, and its outcrop has been traced for a considerable distance. Patches of exceedingly high grade gold ore appear on the outcrop at several places.

A camp was built on the beach at the mouth of Cann Creek and a pack trail about 2 miles in length constructed, leading to an upper camp and the lowest showings on the outcrop. The upper camp is at an altitude of 800 or 900 feet and the discovery about 1,300 feet. It is understood that a tunnel 50 feet in length has been driven on the vein, commencing at the discovery, since July, 1920. A lower tunnel, commencing at a point near the upper camp, is understood to be under construction at the present time.

The Apex vein is practically solid quartz in unaltered hornblende diorite. A very fine grained porphyritic acidic dike a few inches in thickness lies along the walls on either side of the vein. This dike closely resembles quartzite in appearance and weathers brown on the surface.

Adjoining the Apex group on the east is the El Nido group of claims, controlled by Mr. J. H. Cann, who was also one of the discoverers of the Apex lode. The El Nido lode was discovered in June, 1920, and some development work, consisting of open cuts and trenching, had, at the time of visit (July, 1920), exposed the outcrop for a length of about 200 feet. Some exceedingly high grade samples were secured from this crop, hand specimens being said to run as high as $5 per pound. The El Nido lode at the outcrop is from 3 to 3½ feet in width, consisting of alternating pure white quartz and dike material, similar to that referred to above in connection with the Apex lode. No report has been had on developments made on this lode since July, 1920.

COPPER RIVER BASIN.

The continuous operation of the three large copper mines of the Kennecott group and the summer placer mining in the Nizina and Chistochina districts constitute all the productive work done in the Copper River basin in 1920. A little underground work was done on the Midas gold mine [23] in the early part of the summer, but the mill was not operated. The only other lode operations were assessment work on copper claims.

The following statements on mining and milling at the Kennecott group of mines during 1920 are taken from the annual report of the company:[24]

Kennecott ores milled totaled 199,656 tons, assaying 6.82 per cent. From this tonnage there resulted 21,696 tons concentrates assaying 51.06 per cent copper, this giving a recovery of 82.29 per cent, as against 85.9 per cent in 1919 and 84.19 per cent in 1918. The percentage of total copper occurring in carbonate form was 41.8, compared with 37.4 in 1919 and 37.8 in 1918, which accounts for the lower recovery obtained during the last year. The cost per ton of milling was 76 cents, as against 73 cents in 1919 and 80 cents in 1918.

In addition to the Kennecott ores the Kennecott mill also treated 67,567 tons of ore during the year for the account of the Mother Lode Coalition Mines Co.

The leaching plant at Kennecott treated 190,327 tons mill tailings assaying 1.14 per cent carbonate copper, with a recovery of 3,332,500 pounds of copper in the form of

[23] For a brief description of the ore body see Moffit, F. H., Mining in the Chitina Valley: U. S. Geol. Survey Bull. 714, pp. 191–192, 1921.

[24] Kennecott Copper Corporation Sixth Ann. Rept., for year ending December 31, 1920, pp. 6–7, New York, 1921.

precipitates assaying 74.75 per cent copper, the percentage of recovery being 74.5 per cent, as against 74 per cent in 1919. Leaching costs were $1.33, as against $1.18 in 1919 and $1.12 in 1918.

The total recovery of copper in all ores treated, milling and leaching combined, was 90.10 per cent, as against 92.96 per cent in 1919 and 89.38 per cent in 1918.

Thirteen thousand six hundred and thirty feet of development work was driven for the purpose of developing new ore bodies and opening known deposits on other levels preparatory to stoping. In addition to this 14,936 feet of diamond drilling was done. The most important items were the development of the Birch vein, on the 150-foot level, and the Bonanza-Mother Lode vein, on the 900-foot level in the Bonanza mine; and in the Jumbo mine, the development of the ore in the 518 vein at and below the fifth level.

The work of building the Glacier mine tramway was completed in time to transport 4,722 tons that were mined before the season closed. At the same time an intermediate station at the halfway station of the Jumbo line was built, making it possible to handle a greater tonnage over this line.

A high-tension power line was strung to the Erie mine, making it possible to use compressed air in carrying on the development of this mine.

In 1920, as in previous years, practically all the placer gold produced in the Nizina district was obtained from three hydraulic mines on Dan, Chititu, and Rex creeks. A little mining was also done on the bench placers of Dan Creek.

Nine placer mines were operated in the Chistochina district during the summer of 1920, employing 35 men and producing gold to the value of about $75,000. The largest output was made by a hydraulic plant on Slate Creek. An average of $1.53 worth of gold per cubic yard was recovered from the placer-mining operations of the district. Some platinum was won from the Slate Creek placers.

Some placer mining was done in the Nelchina and Valdez Creek districts, and plans are under way for again operating the large hydraulic plant on Valdez Creek, which has been idle for several years.

PRINCE WILLIAM SOUND.

Mining was at a low ebb in the Prince William Sound region[25] during 1920, except for the large copper output of the Beatson mine, on Latouche Island. Other mines, however, incidentally produced some copper. The only gold mine on Prince William Sound that reported any production in 1920 was the Valdez Gold, which produced only a few tons of ore.

The following extracts from the annual report of the Kennecott company summarize the principal operations at the Beatson mine during the year. Much work was done at the Girdwood mine, which is north of and adjacent to the Beatson. The mine is developed by a 1,600-foot adit and is equipped with a 150-ton flotation mill.

Ore milled totaled 451,863 tons, assaying 1.77 per cent copper. From this tonnage 44,268 tons of concentrates were produced, assaying 15 per cent copper, as against

[25] The ore deposits of Prince William Sound are described in the Geological Survey reports listed on pages v and vi.

264,265 tons milled, 28,204 tons concentrates produced, assaying 14.78 per cent, in 1919. The average recovery was 82.85 per cent, as against 80.8 per cent in 1919; however, the recovery of copper existing as the sulphide in the ore was 85.2 per cent.

Two thousand nine hundred and fourteen feet of raising and 5,738 feet of drifting, making a total of 8,652 feet, augmented by 4,846 feet of diamond drilling, was done during the year. This work, with the exception of 1,499 feet of raising and drifting and 991 feet of diamond drilling done on the upper levels, was for the purpose of preparing the ore above the 200 level for stoping.

A small sawmill was added to the surface equipment. A compressor of 500 cubic feet capacity was added to furnish air for the mill. A mechanical shoveler was purchased to be used underground.

The Schlosser mine of the Alaska Mines Corporation was operated from January 1 to November 15. The hand-sorted crude ore is shipped to the Tacoma smelter. In 1920 the principal advance work done was that of driving 1,450 feet of the main adit.

The work done at the Fidalgo (McIntosh) mine on Fidalgo Bay included the driving of a 104-foot raise and a 150-foot drift, in course of which some ore was recovered, but none was shipped.

Copper prospecting on Knight Island is practically at a standstill. The only development was the continuation of the main crosscut on the Rua Cove property by W. A. Dickey.

The Valdez Mining Co. continued to develop its property [27] on the west side of Valdez Glacier from June until December, 1920. The main adit was driven 400 feet during the year and is now 800 feet long. Some ore that was recovered incidentally to the development work was milled. Late in the summer of 1920 the Cliff mine, near Valdez, was unwatered, and about 119 feet of underground work was done. The ore body has been described by Johnson.[28]

KENAI PENINSULA.

There was no improvement in gold mining on Kenai Peninsula during the year. The value of the total mineral output in 1920 was $35,000, and that in 1919 was $37,500. Of the total amount for 1920 $14,675 is to be credited to the gold output of two small lode mines and six placer mines, the latter employing about 15 men. Most of the placer gold came from Resurrection, Canyon, and Six-mile creeks.

The Lucky Strike mine, on Palmer Creek, was operated from June to October, and its mill for 15 days, one shift a day. The principal underground work done consists of a 150-foot adit. Some ore was milled at the Virginia mine, but no developments were made. There was considerable prospecting of auriferous quartz veins during the year. Plans were made for doing work on a group of quartz claims at the head of Crow Creek, on the north side of Turnagain Arm.

[27] For a brief description of the ore body see Johnson, B. L., The gold and copper deposits of the Port Valdez district: U. S. Geol. Survey Bull. 622, p. 162, 1915.

[28] Idem, pp. 170-172.

These claims, so far as identified, belong to what was formerly known as the "Barnes property," which has been described in a former report.[29]

The operation of the lignite mine at Bluff Point, on Kachemak Bay, and the developments on chrome deposits at Red Mountain have already been referred to (pp. 26, 24).

SUSITNA AND MATANUSKA REGION.

Productive mining in the Susitna-Matanuska region included gold-placer mining in the Yentna district and at a few scatterred places in the Susitna basin, gold-lode mining in the Willow Creek district, and coal mining in the Matanuska field and at one or two other places in the Susitna basin. The value of the total mineral output from this region was $532,562 in 1919 and $324,810 in 1920. Most of the decrease in 1920 was due to the decline in the output of gold. The consolidation of some of the Willow Creek gold properties and the systematic exploration of the Matanuska coal field constitute the most important advances of the year. The developments in coal mining have already been summarized (pp. 25, 26).

WILLOW CREEK DISTRICT.

Productive mining was done on three properties in the Willow Creek district in 1920. These were the Mabel mine, the Gold Bullion mine, and the Independent, Brooklyn, and Free Gold mines, consolidated into one holding by the Kelly Mines Co. Lode mining in this district has heretofore been done in a small way on properties worked only during the open season, and the several small mills were built at altitudes so high that they could obtain water only during the summer. Since mining began, in 1908, the district has produced 66,053 tons of ore, from which the average value of gold recovered has been $27.70 per ton and the silver recovery 0.1 ounce per ton. These figures do not, however, represent the whole value of the ores, for the gold is largely free gold, recovered by rather crude milling practice. Thus far little of the concentrates has been utilized. Larger operations have now been planned and an increase in the output of gold can be confidently expected.[30]

The following table shows the progress and results of lode mining in the Willow Creek district. In addition to the production of lode

[29] Johnson, B. L., The central and northern part of Kenai Peninsula: U. S. Geol. Survey Bull. 587, pp. 173–176, 1915.

[30] The ore bodies of the Willow Creek district are described in the folowing publications:

Capps, S. R., The Willow Creek district: U. S. Geol. Survey Bull. 607, 1915; Gold mining in the Willow Creek district [1915]: U. S. Geol. Survey Bull. 642, pp. 195–200, 1916; Gold-lode mining in the Willow Creek district [1917]: U. S. Geol. Survey Bull. 692, pp. 177–186, 1919.

Chapin, Theodore, Lode developments in the the Willow Creek district [1918]: U. S. Geol. Survey Bull. 712, pp. 169–176, 1920; Lode developments in the Willow Creek district [1919]: U. S. Geol. Survey Bull. 714, pp. 201–206, 1921.

gold about $30,000 worth of placer gold has been taken from the gravels of Willow Creek. A little placer mining was done in this field as early as 1897, but no output has been made from these placers during the last 10 years.

Gold and silver produced at lode mines in the Willow Creek district, 1908–1920.

Year.	Mines operated.	Ore mined (short tons).	Gold.		Silver.	
			Quantity (ounces).	Value.	Quantity (ounces).	Value.
1908	1	12	87.08	$1,800	6.88	$3.64
1909	1	140	1,015.87	21,000	80.25	41.73
1910	1	144	1,320.15	21,290	104.29	56.31
1911	2	812	2,505.82	51,800	197.95	109.91
1912	3	3,000	4,673.02	96,600	369.07	226.97
1913	3	3,028	4,883.94	100,960	385.83	233.42
1914	3	10,110	14,376.28	297,184	1,330.00	735.00
1915	3	6,117	11,961.55	247,267	811.00	421.00
1916	3	12,182	14,473.46	299,193	1,468.00	967.00
1917	5	7,885	9,466.17	195,662	713.00	586.00
1918	5	13,043	13,043.05	269,624	724.00	724.00
1919	5	6,730	7,882.00	162,944	508.00	509.00
1920	3	2,850	3,067.00	63,400	148.00	158.00
		66,053	88,755.39	1,828,724	6,846.27	4,771.98

YENTNA DISTRICT.

Only about half the placer-mining operators in the Yentna district made complete returns in 1920, but it is estimated that 21 placer mines, employing 55 men, were operated in this district during the year, and that they produced gold having a value of $45,000. The value of the output of gold in 1919 was $95,000. The length of the mining season in 1920 was about 150 days, but the mines were operated for an average of only 92 days. The returns from 7 mines, of which 5 were hydraulic, showed that the value of the gold recovery per cubic yard ranged from 40 cents to $2 and averaged 70 cents.

Several hydraulic plants are being installed in the district, and a hydroelectric plant is being built to furnish power for the Cache Creek dredge, which has not been operated in two years. The completion of the Talkeetna-Cache Creek wagon road, now under construction by the Alaska Road Commission, will do much to revive mining in the Yentna district.

UPPER SUSITNA VALLEY AND BROAD PASS REGION.

No productive mining was done in the upper Susitna Valley nor in the Broad Pass region in 1920 except the digging of a little lignitic coal for local use at Sullivan Road House and possibly a little placer mining at widely scattered localities. Interest in the gold and copper lodes of this region has continued, and in the aggregate considerable development work was done, but the details are lacking at this writing.

SOUTHWESTERN ALASKA.

No productive mining was done in southwestern Alaska in 1920 except small beach-placer operations on Kodiak Island. The development of the sulphur on Akun Island has already been recorded (p. 33), as well as the staking of petroleum claims in the Cold Bay and other regions of the Alaska Peninsula (pp. 131–132).

YUKON BASIN.

The value of the total mineral output of the Alaska Yukon region in 1920 was $2,329,286; the value in 1919 was $3,049,061. No encouraging advances were made during the year except some development of gold and silver lodes in the Kantishna district and the systematic mining of coal in the Nenana field. The sources of the product in 1920 and the total mineral production since mining began, in 1886, are presented in the following tables:

Mineral production of the Yukon basin, Alaska, in 1920.

	Placer mines.		Lode mines.		Total.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	96,508	$1,995,000	2,585	$53,447	99,093	$2,048,447
Silver.....do....	12,905	14,068	131,276	143,090	144,181	157,158
Tin, metal.....pounds..	11,057	3,454	.....	.....	11,057	3,454
Coal.....tons..	.....	.....	.....	.....	21,252	107,418
Lead and copper.....	.....	.....	.....	12,809	.....	12,809
	.....	2,012,532	.....	209,346	.....	2,329,286

Mineral production of the Yukon basin, Alaska, 1886-1920.

	Placer mines.		Lode mines.		All mines.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	6,305,858	$130,352,000	62,364	$1,288,677	6,368,222	$131,640,677
Silver.....do....	1,083,447	656,390	150,030	152,012	1,233,477	808,402
Tin, metal.....pounds..	327,467	162,194	.....	.....	327,467	162,194
Coal.....tons..	.....	.....	.....	.....	42,851	253,621
Lead and copper...pounds..	.....	.....	275,321	14,481	275,321	14,481
Antimony, tungsten, and platinum.....	.....	3,100	.....	325,500	.....	328,600
	.....	131,173,684	.....	1,780,670	.....	133,207,975

In 1920 the Alaska Yukon region produced about $1,995,000 and in 1919 $2,910,000 worth of placer gold. The decrease in output was rather evenly distributed among all the districts except the Ruby district, which practically maintained its output of 1919. The Tolovana district showed the greatest percentage of loss as compared with previous years. About 273 placer mines, giving employment to about 1,130 men, were operated during the summer of 1920, and 69, giving employment to 270 men, were operated during the previous

winter. A very large number of these mines were worked for only a part of the season. In 1919 274 mines, employing 1,246 men, were worked in the summer and 76, employing 255 men, in the winter.

Estimated value of gold produced from principal placers of Yukon basin, 1920.

Fairbanks	$580,000	Marshall	$90,000
Iditarod	505,000	Circle	55,000
Tolovana	200,000	Hot Springs	50,000
Ruby	170,000	All others	152,000
Innoko and Tolstoi	103,000		
Koyukuk	90,000		1,995,000

FAIRBANKS DISTRICT.

The value of the total mineral production of the Fairbanks district in 1920 was $605,998, represented entirely by gold and silver, for no other metals were mined. The total mineral output of the district to date is $72,650,767. The output for 1920 was practically all obtained from placer mines (see subjoined table), about 45 of which, employing 345 men, were operated in the summer of 1920 and 9, employing 54 men, in the previous winter. During the summer of 1919 there were in operation 53 mines, employing 350 men, and during the previous winter 24 mines, employing 86 men.

Placer gold and silver produced in the Fairbanks district, 1903–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (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
1915	118,518.75	2,450,000	28,444	14,421
1916	87,075.00	1,800,000	11,058	7,276
1917	63,371.25	1,310,000	8,379	6,904
1918	38,700.00	800,000	5,708	5,708
1919	35,313.75	730,000	5,197	5,820
1920	28,057.50	580,000	3,870	4,218
	3,420,596.25	70,710,000	635,278	358,329

The placer mines can be classed as follows: One dredging company, operating 2 dredges; 22 open-cut mines, using steam scrapers; 2 hydraulic mines; 7 open-cut mines, worked by pick and shovel; and 13 deep mines, worked by thawing and drifting. The two dredges on Fairbanks Creek carried on the largest single operation. The largest

of the open-cut mines were on Goldstream Creek and its tributaries. The 13 deep mines produced gold to the value of about $150,000.

An attempt has been made in the following table to distribute the total placer-gold production of the Fairbanks district by the creeks on which the mines are located, although the information available as to the source of the gold may not be very accurate.

Approximate distribution of gold produced in the Fairbanks district, 1903–1920.

Cleary Creek and tributaries	$23,098,000
Goldstream Creek and tributaries	14,625,000
Ester Creek and tributaries	11,359,000
Dome Creek and tributaries	8,149,000
Fairbanks Creek and tributaries	7,857,000
Vault Creek and tributaries	2,665,000
Little Eldorado Creek	2,269,000
All other creeks	688,000
	70,710,000

About 386,000 cubic yards of gravel, having an average gold content of $1.50 to the cubic yard, was sluiced in the Fairbanks district in 1920. The returns made by seven of the thirteen deep mines were nearly enough complete to permit the following analysis. These mines were operated for an average of 240 days, two of them throughout the year. They employed an average of 6.5 men each. They hoisted in all 32,600 cubic yards of gravel, from which $134,000 worth of gold was sluiced. The value of the gold content of the gravel per cubic yard ranged from $2.46 to $8.27 and averaged $4.11. The gravel mined per man per day, including surface and underground employees, ranged from 0.73 to 3.25 cubic yards and averaged 2.59 cubic yards.

The large open-cut mines in the Fairbanks district were operated on an average for 130 days. The returns from these mines are not nearly enough complete to permit a determination of the average gold recovery, but if the hydraulic mines are included and not the dredges, it ranged from 54 cents to $1.78 a cubic yard.

There was little development of the auriferous lodes in the district during 1920, nor were any discoveries reported. Work was continued in a small way at the Crites & Feldman and Billy Sunday (Smith & McGonnigle) properties, and incidentally some ore was mined and milled. Similar but smaller operations were carried on at half a dozen other quartz properties. These activities are exceptional, for the general practice of the owners of lode property in the district is to await lower operating costs before attempting lode developments.

Lode gold and silver produced in the Fairbanks district, 1910–1920.

Year.	Crude ore (short tons).	Gold.		Silver.	
		Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1910	148	841.19	$17,389	106	$57
1911	875	3,103.02	64,145	582	308
1912	4,708	9,416.54	194,657	1,578	971
1913	12,237	16,904.98	349,457	4,124	2,491
1914	6,526	10,904.75	225,421	2,209	1,222
1915	5,845	10,534.91	217,776	1,796	910
1916	1,111	1,904.81	39,376	140	92
1917	1,200	2,311.38	47,781	2,217	1,826
1918	1,035	1,294.04	26,750	616	616
1919	1,384	2,026.57	41,893	378	424
1920	504	967.48	20,000	164	178
	35,573	60,209.67	1,244,645	13,910	9,095

HOT SPRINGS DISTRICT.

As will be seen from the subjoined table, the gold output of the Hot Springs district was only about half as large in 1920 as in 1919. Eleven placer mines, employing 30 men, were operated in the summer of 1920, and 4, employing 15 men, in the previous winter. The value of the average gold recovery from deep mines was about $5.50 per cubic yard. Six of these mines produced a little stream tin, the total output being 7,057 pounds. The district has produced in all 265½ tons of concentrates, containing about 336,060 pounds of metallic tin, valued at $157,695.

Placer gold and silver produced in the Hot Springs district, 1902–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1902–3	12,717.79	$262,900	1,818	$964
1904	7,038.56	145,500	1,007	584
1905	5,805.00	120,000	831	507
1906	8,707.50	180,000	1,245	843
1907	8,465.63	175,000	1,210	798
1908	7,256.25	150,000	1,038	550
1909	15,721.88	325,000	2,248	1,169
1910	15,721.88	325,000	2,248	1,169
1911	37,974.37	785,000	5,430	2,932
1912	19,350.00	400,000	3,267	2,009
1913	19,350.00	400,000	3,267	1,973
1914	36,281.25	750,000	6,125	3,387
1915	29,508.75	610,000	4,982	2,526
1916	38,700.00	800,000	6,534	4,299
1917	21,768.75	450,000	3,675	3,028
1918	7,256.25	150,000	1,225	1,225
1919	4,837.50	100,000	817	915
1920	2,418.75	50,000	567	618
	298,880.11	6,178,400	47,534	29,496

TOLOVANA DISTRICT.

A shortage of water prevails in the Tolovana district in all but very wet seasons and has hampered mining for the last two years. About 13 mines, employing 106 men, were operated during the summer of 1920, and 6 mines, employing 60 men, during the preceding winter. In 1920, as in previous years, the mines making the largest production were those of Livengood Creek.

Placer gold and silver produced in the Tolovana district, 1915–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1915	3,870.00	$80,000	321	$163
1916	33,862.50	700,000	2,813	1,851
1917	55,631.25	1,150,000	8,430	6,946
1918	42,328.12	875,000	4,060	4,060
1919	25,396.88	525,000	2,141	2,454
1920	9,675.00	200,000	819	893
	170,763.75	3,530,000	18,634	16,367

RAMPART DISTRICT.

Only small placer mines are being operated in the Rampart district. In 1920 there were 10 summer mines, employing 20 men, and 4 winter mines, employing 6 men.

Placer gold and silver produced in the Rampart district, 1896–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1896–1903	29,799.00	$616,000	4,440	$2,664
1904	4,353.75	90,000	649	376
1905	3,870.00	80,000	576	351
1906	5,805.00	120,000	865	588
1907	6,046.87	125,000	901	595
1908	3,628.12	75,000	540	286
1909	4,837.50	100,000	721	375
1910	2,080.12	43,000	310	167
1911	1,548.00	32,000	231	125
1912	1,548.00	32,000	274	169
1913	1,548.00	32,000	274	165
1914	1,451.25	30,000	257	142
1915	1,693.13	35,000	300	152
1916	1,935.00	40,000	343	226
1917	1,596.37	33,000	280	231
1918	1,161.00	24,000	206	206
1919	1,451.25	30,000	90	101
1920	967.50	20,000	69	75
	75,319.86	1,557,000	11,326	6,994

CIRCLE DISTRICT.

The output of gold in the Circle district in 1920 was only about one-third of that in 1919. About 20 mines were operated, employing some 50 men in the summer of 1920, and about 9 mines, employing 15 men, in the previous winter. The small output of gold was due partly to the closing down of the dredge and partly to a dry season, which caused a shortage of water for sluicing.

Placer gold and silver produced in the Circle district, 1894–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1894	483.75	$10,000	123	$77
1895	7,256.25	150,000	1,886	1,226
1896	33,862.50	700,000	8,794	6,080
1897	24,187.50	500,000	6,289	3,773
1898	19,350.00	400,000	5,031	2,968
1899	12,093.75	250,000	3,144	1,886
1900	12,093.75	250,000	3,144	1,886
1901	9,675.00	200,000	2,512	1,507
1902	9,675.00	200,000	2,512	1,331
1903	9,675.00	200,000	3,144	1,698
1904	9,675.00	200,000	3,144	1,823
1905	9,675.00	200,000	3,144	1,918
1906	14,512.50	300,000	3,773	2,565
1907	9,675.00	200,000	3,144	2,075
1908	8,465.63	175,000	2,212	1,166
1909	10,884.37	225,000	2,830	1,472
1910	10,884.37	225,000	2,830	1,528
1911	16,931.25	350,000	4,402	2,333
1912	15,721.87	325,000	2,439	1,500
1913	8,465.63	175,000	1,314	794
1914	10,884.37	225,000	1,689	934
1915	11,126.25	230,000	1,727	875
1916	14,512.50	300,000	2,252	1,482
1917	9,675.00	200,000	1,561	1,285
1918	8,465.63	175,000	1,798	1,798
1919	6,530.63	135,000	1,260	1,411
1920	2,660.62	55,000	464	506
	317,098.12	6,555,000	76,562	47,897

RICHARDSON DISTRICT.

Auriferous gravels are rather widely distributed in the Richardson district, in the Tanana Valley. No very rich placers have been found, and the mining consists of relatively small operations at widely scattered localities. It is estimated that eight mines, employing 18 men, were operated in the summer of 1920, and one mine, employing 3 men, was operated in the previous winter.

Placer gold and silver produced in the Richardson district, 1905–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1905	(a)	(a)	(a)	(a)
1906	4,837.50	$100,000	989	$673
1907	18,140.62	375,000	3,707	2,447
1908	18,140.62	375,000	3,707	1,965
1909	7,256.25	150,000	1,483	771
1910	4,837.50	100,000	989	534
1911	4,837.50	100,000	989	524
1912	4,837.50	100,000	989	608
1913	4,837.50	100,000	989	597
1914	4,837.50	100,000	989	547
1915	4,595.62	95,000	939	476
1916	3,870.00	80,000	790	520
1917	1,289.37	25,000	245	202
1918	290.25	6,000	59	59
1919	483.75	10,000	99	111
1920	338.62	7,000	69	75
	83,430.10	1,723,000	17,032	10,109

a Prospects.

EAGLE DISTRICT.

In the Eagle district about 10 mines, employing 25 men, were operated in the summer of 1920. There was no winter mining. Most of the productive mining was done in the Seventymile basin.

Placer gold and silver produced in the Eagle and Seventymile districts, 1908–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1908	483.75	$10,000	76	$40
1909	1,209.37	25,000	191	99
1910	483.75	10,000	76	41
1911	580.50	12,000	92	49
1912	967.50	20,000	164	100
1913	2,418.75	50,000	382	231
1914	2,418.75	50,000	382	211
1915	1,935.00	40,000	305	155
1916	822.37	17,000	130	86
1917	628.88	13,000	96	75
1918	1,209.37	25,000	191	191
1919	969.50	20,000	152	170
1920	725.62	15,000	99	108
	14,853.11	307,000	3,336	1,556

FORTYMILE DISTRICT.

The miners of the Fortymile district suffered losses in 1920 because of a lack of water for sluicing, as the summer was exceptionally dry. For this reason and because of the general economic conditions the output of gold was smaller than it has been for 20 years. About 22 mines, employing 30 men, were operated in the summer of 1920, and

12 mines, employing 20 men, during the previous winter. These figures show that much the larger part of this mining was done by men working alone, who obtained their gold from the relatively rich pockets of auriferous gravels. These "snipers," though their operations augment the number of mines, do not add greatly to the production of gold. The value of the recovered gold per man per year in this type of mining does not average more than a few hundred dollars, not enough to pay for a year's provisions. (See pp. 15–17.) These small operations were forced upon many of the miners because the lack of water prevented the larger operations.

Though productive mining was at a low ebb in the Fortymile district during 1920, there was some systematic prospecting of larger bodies of auriferous gravels on both Dennison and North forks. A hydraulic plant was being installed on the upper end of Jack Wade Creek. The completion of the wagon road from Eagle, part of which is now only a sled road, would do much toward stimulating the mining industry of this isolated district.

Placer gold and silver produced in the Fortymile district, 1886–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1886–1903	193,500.00	$4,000,000	30,553	$22,915
1904	14,851.12	307,000	2,345	1,360
1905	12,384.00	256,000	1,955	1,193
1906	9,868.50	204,000	1,558	1,059
1907	6,772.50	140,000	1,069	706
1908	6,772.50	140,000	1,069	567
1909	10,884.37	225,000	1,719	894
1910	9,675.00	200,000	1,528	825
1911	9,575.00	200,000	1,528	810
1912	10,303.87	213,000	1,627	1,000
1913	4,837.50	100,000	764	461
1914	2,418.75	50,000	382	211
1915	2,418.75	50,000	382	194
1916	2,418.75	50,000	382	251
1917	3,870,00	80,000	624	513
1918	3,628.12	75,000	573	573
1919	1,983.37	41,000	313	350
1920	1,935.00	40,000	348	380
	308,197.10	6,371,000	48,791	34,262

CHISANA DISTRICT.

The Chisana district is in the headwater region of Tanana River and is difficult of access. Though it lies within the Yukon basin the district receives its supplies and obtains its transportation through the Copper River basin. About 8 mines, employing 18 men, were operated in the district during the summer of 1920; there was no winter mining. Though no large deposits of valuable auriferous gravels nor rich placers were found in 1920, the gravel mined ranged from 81 cents to $12.40 per cubic yard and averaged about $2.08.

The mines were operated for an average of about 120 days. The information in hand shows that the average earnings of the miners were about $10 a day, or $1,200 for the season, so that in spite of the high cost of supplies the few miners in the district were better off than the average small operators of Alaska. (See pp. 15–17.)

Placer gold and silver produced in the Chisana district, 1913-1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1913	1,935.00	$40,000	465	$280
1914	12,093.75	250,000	2,910	1,609
1915	7,740.00	160,000	1,862	944
1916	1,935.00	40,000	465	306
1917	1,935.00	40,000	420	346
1918	725.63	15,000	160	160
1919	1,306.12	27,000	314	352
1920	967.50	20,000	137	150
	28,638.00	592,000	6,733	4,147

BONNIFIELD DISTRICT.

Small-scale placer mining was done on Moose, Eva, and Daniel creeks, in the Bonnifield district, during 1920. It is estimated that 6 mines were operated during the summer, employing about 10 men. The coal mining in the Nenana field, lying within the Bonnifield district, has already been described (p. 126).

Placer gold and silver produced in the Bonnifield district, 1903–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1903–1906	1,451.25	$30,000	227	$136
1907	241.87	5,000	38	25
1908	241.87	5,000	38	20
1909	2,418.75	50,000	379	197
1910	483.75	10,000	76	41
1911	967.50	20,000	152	81
1912	967.50	20,000	152	93
1913	967.50	20,000	152	92
1914	1,451.25	30,000	227	126
1915	967.50	20,000	152	77
1916	483.75	10,000	76	50
1917	580.50	12,000	98	81
1918	580.50	12,000	91	91
1919	483.75	10,000	75	84
1920	241.87	5,000	38	41
	12,529.11	259,000	1,971	1,235

KANTISHNA DISTRICT.[31]

The mining of galena ores carrying much silver at the Quigley mine, in the Kantishna district, has greatly stimulated prospecting for both lodes and placers in the district. Mining was probably more active in the Kantishna than in any other district of the Yukon region. The production from placer mining was, however, about the same as in previous years. About 20 mines, employing about 55 men, were operated in the summer of 1920. The largest output of gold was made on Glenn Creek; the next creeks in order were Eureka, Moose, Little Moose, and Wickersham. The placers of the district are not rich, the value of the average gold recovery from them in 1920 being about $1 a cubic yard. This district, however, contains some considerable bodies of low-grade gravel, which should give profitable returns if worked on a large scale.

Placer gold and silver produced in the Kantishna district, 1903-1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1903-1906	8,465.62	$175,000	1,325	$795
1907	725.62	15,000	114	75
1908	725.62	15,000	114	60
1909	241.87	5,000	38	20
1910	483.75	10,000	76	41
1911	1,451.25	30,000	227	120
1912	1,451.25	30,000	227	140
1913	1,451.25	30,000	227	137
1914	967.50	20,000	152	84
1915	967.50	20,000	152	77
1916	1,451.25	30,000	227	149
1917	725.63	15,000	120	99
1918	1,451.25	30,000	227	227
1919	725.63	15,000	114	128
1920	1,209.37	25,000	320	349
	22,494.36	465,000	3,660	2,501

Stewart[32] has summarized the lode mining developments in the district during 1920 as follows:

Aitken property (Quigley mine).—The twenty-odd claims comprising this property, owned by Quigley & Dalton, are being worked under option by Mr. Thos. P. Aitken. The group practically covers the ridge forming the divide between Friday and Eureka creeks (known as Quigley Mountain) and extends from the low bench bordering Moose Creek to the summit of Quigley Mountain.

Work under this option has continued throughout the past two seasons, and a considerable amount of high-grade ore has been shipped to the Selby smelter, at San Francisco.

Mining and shipping costs under present conditions make shipment of ore running less than 200 ounces in silver to the ton prohibitive. The ore consists principally of silver-bearing galena and gray copper (tetrahedrite).

[31] Capps, S. R., The Kantishna region, Alaska: U. S. Geol. Survey Bull. 687, 1919.

[32] Stewart, B. D., Annual report of the Territorial mine inspector to the governor of Alaska, 1920, pp. 12-14, 1921.

The mine equipment at the Aitken camp consists of a blacksmith shop, ore-assorting table and grizzly, and a combined bunkhouse and boarding house with bunks for fifteen men. Eleven men were employed at the time of visit.

Shipments have been made from two distinct ore shoots. These are practically parallel, running northeasterly and southwesterly and separated by a distance of a few hundred feet.

During the season of 1919 work was confined to the upper or southerly one of these two ore bodies. The workings consist of a shaft 100 feet in depth, from which drifts were run at the 30 and 60 foot levels below the collar. As mined, this shoot has been shown to be over 200 feet in length. A crosscut tunnel was run, at the elevation of the bottom of the shaft, having a length of approximately 300 feet, and from this a drift was run to connect with the bottom of the shaft. No work was being done on this shoot, and the workings were obstructed by ice at the time of visit, in October, 1920.

The ore body now being exploited is opened by a shaft 40 feet deep, connection with the bottom of which is made by a crosscut tunnel, known as the main tunnel, 130 feet long, and a drift on the ore shoot approximately 75 feet in length. A second crosscut 90 feet long has been driven at a distance of about 40 feet from the main tunnel and parallel to it, from which a drift has been run westerly, almost connecting with the main tunnel.

At the time of visit stoping was in progress in the vicinity of the shaft above the main level. A shaft located on the strike of the above-described ore body and about 150 feet east of the main tunnel had been started on the outcrop and was down about 20 feet, with work still proceeding in it. Very good ore was being secured from this shaft.

Galena lode.—The Galena lode prospect is described in United States Geological Survey Bulletin No. 687, pp. 105–106.

This property is now controlled by Mr. James Haney, who has established a camp on the ground and has outlined a systematic program of development, which is being put through this winter.

A sled road has been built to the workings and a season's supplies laid in at the camp.

At the time of visit (October, 1920) approximately 50 tons of high-grade ore had been taken out and sacked for shipment, and it was estimated that at least an additional 100 tons would be sacked during the winter. Surface prospecting had been carried on at numerous places with encouraging results.

During the present winter it is planned to drive a 75-foot crosscut on the ground and then sink a winze on the ore zone in order to prospect the deposit at greater depth. If conditions prove favorable, a lower tunnel is proposed. With a length of 507 feet this tunnel would give a depth of 228 feet below the present tunnel.

As at the Aitken property, the ore on the Galena prospect is steel galena and gray copper, both carrying high silver content.

Red Top lode.—The Red Top lode, owned by Joseph Quigley, lies at the foot of Quigley Mountain, on the bench a short distance south of Friday Creek near its confluence with Moose Creek, and adjoins the Aitken group on the west. Numerous well-constructed and well-planned open cuts expose the outcrop of the ore shoot over a strike length of about 300 feet. The average width of the ore body appears to be about 9 feet.

The work done reveals a very encouraging showing of galena and gray copper ore which is deserving of thorough exploration.

Apex lode.—O. M. Grant has located the Apex lode, adjoining the Galena lode on the west, and lying on the bench between the Galena lode and Moose Creek. An open cut was driven during the 1920 season.

Dalton claims.—Northwest of the Apex lode and lying southwesterly from the Red Top lode are the Star, Jumbo, and Caribou lodes, located by Joseph Dalton, who has done some open-cut work upon them.

RUBY DISTRICT.

The Ruby district has the distinction among the larger Yukon camps of having slightly increased its gold output in 1920 over that of 1919. (See subjoined table.) In this district 30 mines, employing 95 men, were operated in the summer, and 8 mines, employing 34 men, in the previous winter. The largest output of gold was obtained from 6 mines on Long Creek. Greenstone, Poorman, and Birch creeks were next in output of gold. Much the larger part of the mining was done on deep placers, and this work was confined chiefly to deposits rich in gold. Returns that were complete enough to allow the computation of the recoveries of gold were received from 14 mines, in which the value of the gold recovered per cubic yard ranged from $2.14 to $11.80 and averaged $4.85. The value of the average recovery of gold for the entire district, including all forms of mining, is estimated at $3.90 per cubic yard.

Placer gold and silver produced in the Ruby district, 1907–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1907–8	48.38	$1,000	7	$4
1909				
1910				
1911				
1912	8,465.63	175,000	1,157	712
1913	37,974.37	785,000	5,188	3,134
1914	48,375.00	1,000,000	6,609	3,655
1915	33,862.50	700,000	4,626	2,345
1916	41,118.75	850,000	5,618	3,697
1917	42,811.88	885,000	6,073	5,046
1918	19,350.00	400,000	3,000	3,000
1919	7,981.88	165,000	1,255	1,406
1920	8,223.75	170,000	1,113	1,213
	248,212.14	5,131,000	34,646	24,212

In the summer of 1920 a galena deposit was discovered 13 miles south of Ruby, on the north side of Beaver Creek, near the mouth of Dome Creek and a mile and a half east of the wagon road from Ruby to Long. The rocks in the vicinity are quartzites and quartzitic schists, which are part of the "Paleozoic or older undifferentiated metamorphic rocks" described by Mertie and Harrington.[33] The locality was visited early in August by G. C. Martin, who reports that several deep trenches and pits and short tunnels had been dug into the hillside. Part of the exposures in these openings may be in place, but it is doubtful whether any rock that is wholly undisturbed had been revealed in them. Most of the galena occurs in narrow

[33] Mertie, J. B., jr., and Harrington, G. L., Mineral resources of the Ruby-Kuskokwim region: U. S. Geol. Survey Bull. 642, pp. 230–231, pl. 11, 1916.

veins and stringers in the schist. The veins seem to cut the bedding planes at a low angle. A vein about 2 feet wide was indicated by the material exposed in one cut, but there was some doubt as to its actual width. In the frozen talus on the lower slope of the hillside blocks of ore, some as much as 2 feet square, lie scattered for at least half a mile up and down the creek. These blocks may have been derived from one lode, but there are indications of the existence of several veins. The ore seen in the talus and in the prospect openings is much oxidized and iron-stained and was apparently derived from a heavy gossan.

INNOKO DISTRICT.

During the summer of 1920 there was an unusually large supply of water for sluicing in the Innoko district, but unfortunately the camp was short of supplies, for the rivers had frozen up early in the fall of 1919 and provisions had to be brought in from the Kuskokwim at a cost of 10 cents a pound for transportation. There was also some shortage of labor.

In all 21 mines, employing 50 men, were operated during the summer of 1920, and 7 mines, employing 36 men, during the previous winter. Of the total gold output (see subjoined table) about $7,000 was won from the placers of the Tolstoi region, chiefly from those of the Madison Creek basin. The largest placer-mining operations in the district were those on Ophir Creek; next in order of production were those on Spruce, Victor, and Ganes creeks. The largest gold output has come from open-cut summer mining. Returns received from six of the large open-cut workings in this district showed that the value of the gold recovery ranged from 74 cents to $1.90 and averaged $1.28 to the cubic yard. These returns are well above the minimum required for profitable dredging. The information at hand indicates that the district includes large areas of dredging ground. Separate plans are now under way to install four dredges. The two dredges for Yankee Creek were frozen in on Kuskokwim River in the fall of 1920. A project for moving the Greenstone dredge in the Iditarod district to Ganes Creek in 1920 failed on account of the early freeze-up. These three dredges may be installed before the end of 1921.

Placer gold and silver produced in the Innoko and Tolstoi districts, 1907–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1907	628.87	$13,000	67	$44
1908	3,483.00	72,000	370	196
1909	16,447.50	340,000	1,746	908
1910	15,721.87	325,000	1,669	901
1911	12,093.75	250,000	1,284	681
1912	12,093.75	250,000	1,284	681
1913	13,545.00	280,000	1,438	869
1914	9,675.00	200,000	1,027	568
1915	9,191.25	190,000	976	495
1916	10,642.50	220,000	1,130	744
1917	8,465.63	175,000	1,113	917
1918	5,805.00	120,000	608	608
1919	6,772.50	140,000	717	803
1920	4,982.62	103,000	529	577
	129,548.24	2,678,000	13,958	8,992

IDITAROD DISTRICT.

Twelve open-cut mines and two dredges were operated in the Iditarod district in the summer of 1920 and employed a total of 176 men. The dredges were operated on Otter Creek, and most of the other mining was done on Flat Creek, but some was done on Chicken, Happy, and Willow creeks. Both the dredges were operated from early in May until about the middle of November and worked on ground about 13 feet deep. Other mines were operated for an average of about 120 days. The average value of the gold recovery for all workings, including the dredges, was 90 cents a cubic yard. Returns from 7 open-cut mines were complete enough to permit computation of the gold recovery, which ranged from 56 cents to $2.40 a cubic yard and averaged $1.45. These returns came from ground ranging from 3 to 15 feet deep. These 7 open-cut mines were worked in part by the hydraulic method, in part by steam scrapers, and in part by pick and shovel.

Placer gold and silver produced in the Iditarod district, 1910–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1910	24,187.50	$500,000	4,254	$2,297
1911	120,937.50	2,500,000	21,270	11,273
1912	169,312.50	3,500,000	29,778	18,313
1913	89,977.50	1,860,000	9,551	5,769
1914	99,652.50	2,060,000	10,578	5,849
1915	99,168.75	2,050,000	10,526	5,337
1916	94,331.25	1,950,000	10,013	6,589
1917	72,562.50	1,500,000	11,050	9,105
1918	59,985.00	1,240,000	9,000	9,000
1919	35,071.88	725,000	5,300	5,937
1920	24,429.37	505,000	3,628	3,954
	889,616.25	18,390,000	124,948	83,423

It is reported that a cinnabar-bearing lode on Montana Creek, tributary to upper Iditarod River, is being developed. (See p. 24.) A galena prospect in the Kaiyuk Range, about 20 miles south of the Yukon below Louden, which was discovered several years ago, was being developed in the summer of 1920. This locality has not been visited by any member of the Geological Survey, but uncertain evidence indicates that areas in the vicinity contain schist and diabase.[34] It was reported in the summer of 1920 that a vein containing 18 inches of solid galena had been discovered, and later that 175 tons of ore was mined from the prospect in the winter of 1920–21.

MARSHALL DISTRICT.

The Marshall district, which lies in the Wade Hampton recording precinct, has been described by Harrington.[35] About 8 mines, employing 30 men, were operated in the district during the summer of 1920. Most of the gold obtained was taken from the Willow Creek placers, which are from 2 to 3 feet deep and from which the gold recovery is $4 to $6 a cubic yard.

Some new placer ground is said to have been developed on Stuyak Creek, which enters Yukon River from the west about 8 miles above the Russian Mission, and some on Kato Creek, which is in the immediate vicinity.

Placer gold and silver produced in the Marshall district, 1914–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1914	725.62	$15,000	94	$52
1915	1,209.37	25,000	156	79
1916	13,061.25	270,000	1,686	1,109
1917	20,559.37	425,000	3,300	2,719
1918	7,256.25	150,000	940	940
1919	4,837.50	100,000	624	699
1920	4,353.75	90,000	552	602
	52,003.11	1,075,000	7,352	6,200

INDIAN RIVER AND GOLD HILL DISTRICTS.

Some mining has been done in the Indian River and Gold Hill districts of the middle Yukon, but it has practically ceased. During 1920 only three mines were operated in these two districts, employing eight men in all, and the value of their total output of gold was only $2,000.

[34] Maddren, A. G., The Innoko gold-placer district, Alaska: U. S. Geol. Survey Bull. 410, pp. 43–44, pl. 2, 1910.

[35] Harrington, G. L., The Anvik-Andreafski region, Alaska: U. S. Geol. Survey Bull. 683, 1918.

Placer gold and silver produced in the Indian River and Gold Hill districts, 1911–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1911	483.75	$10,000	69	$37
1912	1,185.19	24,500	170	105
1913	1,548.00	32,000	221	133
1914	1,209.37	25,000	173	96
1915	725.63	15,000	104	53
1916	483.75	10,000	69	45
1917	241.88	5,000	27	22
1918	193.50	4,000	29	29
1919	338.62	7,000	52	58
1920	96.74	2,000	2	2
	6,506.43	134,500	916	580

CHANDALAR DISTRICT.

The Chandalar district,[36] lying north of the Yukon, is one of the isolated camps in which a little placer gold has been mined for a number of years (see subjoined table) and in which a little gold-lode mining has been attempted. Up to 1919 no rich placers had been found in the district, and the mining amounted to little more than getting out a "grub stake" by a few men. In 1919 some promising deposits were discovered on Squaw and Big creeks, and these were systematically developed in 1920, yielding good returns. The principal part of the output of gold has come from these two creeks. These deposits, which include some deep ground, seem to be valuable enough to justify further prospecting. It is said that nearly 50 men are prospecting the district. The gravels mined in 1920 yielded about $5.50 to the cubic yard.

Placer gold and silver produced in the Chandalar district, 1906–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1906–1912	2,902.50	$60,000	416	$241
1913	266.06	5,500	38	23
1914	241.87	5,000	35	19
1915	241.87	5,000	35	18
1916	435.37	9,000	62	41
1917	725.63	15,000	104	86
1918	628.88	13,000	96	96
1919	453.75	10,000	79	88
1920	870.75	18,000	125	136
	5,895.93	122,500	990	748

[36] Maddren, A. G., The Koyukuk-Chandalar region: U. S. Geol. Survey Bull. 532, 1913.

KOYUKUK DISTRICT.

About 20 mines, employing 55 men, were operated in the Koyukuk district in the summer and 5 mines, employing 15 men, during the winter of 1920. The average gold recovery for all mining was about $2.50 a cubic yard. The annual gold output of the district has heretofore been chiefly maintained by the exploitation of very rich deep placers, whose gold content was from $4 to $12 a yard and averaged much more than $5. These bonanza deposits have been of no great extent, but their richness has made their exploitation very profitable. Most of them, however, are very irregularly distributed, and their discovery involves much expensive dead work. The present relatively low average gold recovery is due to the fact that mining now includes a much greater percentage of open-cut work than it did in the past. The mines are now operating on placers which, though of greater bulk than the deep bonanzas, have a much smaller gold content per cubic yard. A number of small hydraulic plants are being successfully operated in the district. Most of the gold output of the district in 1920 came from Myrtle, Nolan, Jay, and Smith creeks.

Placer gold and silver produced in the Koyukuk district, 1900–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1900-1909	106,454.02	$2,200,600	15,242	$8,993
1910	7,740.00	160,000	1,108	598
1911	6,772.50	140,000	970	514
1912	9,675.00	200,000	1,385	852
1913	19,350.00	400,000	2,770	1,673
1914	12,577.50	260,000	1,800	995
1915	13,303.12	275,000	1,902	964
1916	14,996.25	310,000	2,147	1,413
1917	12,093.75	250,000	1,700	1,401
1918	7,256.25	150,000	860	860
1919	5,321.25	110,000	760	851
1920	4,353.75	90,000	146	159
	219,893.39	4,545,600	30,790	19,273

KUSKOKWIM REGION.

The value of the placer gold output of the Kuskokwim region in 1919 was about $350,000 and in 1920 was about $305,000. These figures are only approximate, for many of the mine operators failed to report their output. About 32 placer mines, employing about 125 men, were operated in the summer of 1920, and there was no winter mining. More prospecting, both lode and placer, was done in the Kuskokwim region than in any other part of Alaska. This activity was largely stimulated by the large-scale prospecting of the Treadwell lode property in the Nixon Fork basin, first opened up in 1919.

G. C. Martin has prepared the following statement concerning mining in the McKinley district, of which McGrath is the post office and supply point:

So far as known, only two large and three small placer mines were operated in the McGrath district in 1920. The large operations are the dredge on Candle Creek and a hydraulic mine on Moore Creek, a tributary of Tacotna River. One of the small mines is on Hidden Creek and two are on Ruby Creek, all in the basin of Nixon Fork. The Kuskokwim Dredging Co. operated its dredge on Candle Creek from May 24 to October 13, except during an interruption in September on account of a broken shaft. It employed an average of 22 men and handled 74,597 cubic yards of gravel. The Moore Creek hydraulic plant is mining gravel about 14 feet in depth. The mine on Hidden Creek is exploiting a deposit 75 to 125 feet wide and about 4 feet deep. One of the mines on Ruby Creek is deep, and the other is a small open cut.

Much prospecting for gold lode veins was done in the Nixon Fork region during the summer of 1920. During the previous winter several hundred tons of ore was taken from the Crystal shaft, which was shipped during the summer. Early in the spring the property from which this shipment was made and the other neighboring claims passed into the control of the Alaska Treadwell Gold Mining Co. Actual mining thereupon ceased, but active prospecting to determine the quantity of ore available was continued throughout the year. Several shafts, 50 to 100 feet deep, and numerous trenches and open cuts were dug, buildings were erected, and a large quantity of mining supplies was shipped up Kuskokwim River. B. D. Stewart, Territorial mine inspector,[37] reports that in September, 1920, three shafts, aggregating 200 feet in depth, drifts totaling 215 feet, and crosscuts totaling 110 feet were run and that 25 men were employed. Wages were $6 a day and board. Underground exploration was continued actively during the winter of 1920–21, with the hope of determining whether the quantity of ore available is sufficient to justify the installation of facilities for shipping or treating the ore.

It is believed that about 7 mines, employing about 12 men, were operated in the Georgetown district of the middle Kuskokwim during the summer of 1920. Reports of production have been received from Donlon and New York creeks, in this district, and of drilling in prospective dredging ground on Holitna River.

About 16 mines, employing 60 men, were operated in the Aniak district during the summer of 1920. The largest gold output was made on Canyon Creek, but gold was mined also on Bear, Crooked, Mary, George, and Marvel creeks and on George River. It is reported that hydraulic plants are being installed on Spruce Creek and Tiny Gulch, both tributary to Bear Creek. Some developments have been continued on a copper and gold bearing lode in the Russian Mountains 12 miles north of Kolmakof, on the Kuskokwim.[38] It is reported that a 50-foot shaft has been sunk on the lode.

The Parks quicksilver mine, on the lower Kuskokwim, was operated in a small way during 1920. E. W. Parks reports the discovery of a stibnite-realgar lode in the vicinity of Barometer Mountain. This mountain lies almost due south of the Parks mine and 5 miles

[37] Op. cit., p. 18.

[38] Maddren, A. G., Gold placers of the lower Kuskokwim: U. S. Geol. Survey Bull. 622, pp. 304–305, 1915.

from the Kuskokwim. Specimens said to have come from this deposit contain stibnite and realgar. The specimens received indicate that the country rocks in which the deposits occur are Mesozoic sandstones and shales, probably of Upper Cretaceous age, and that the geologic relations are probably similar to those of the Parks cinnabar deposit, which have been described by Smith,[39] but no cinnabar was found in the ore. Smith's geologic map [40] shows that the upper part of Barometer Mountain is made up of granite, which is intruded into Mesozoic sediments. This deposit is said to have been opened up by a 100-foot adit.

Mining in the Goodnews Bay district during 1920 was confined to Watermuse, Bear, and Cow Cow creeks. One placer mine was operated on each of these creeks, and a total of 12 men were employed.

SEWARD PENINSULA.[41]

GENERAL CONDITIONS.

The value of the total mineral output of Seward Peninsula in 1920 was $1,331,017, of which $1,300,000 is the value of the placer gold and the rest that of silver, platinum, tin, and coal. In 1919 the total value of the mineral output was $1,423,449, and that of placer gold was $1,360,000. A little platinum was recovered from the gold placers of the Koyuk and Fairhaven districts. (See p. 23.) Tin ore was mined in the York district on a reduced scale as compared with previous years, only one dredge and one small open-cut mine being operated on tin placers. (See p. 22.) A small output of coal was made from a lignite mine in the Fairhaven district. In the aggregate, there was considerable prospecting of lode deposits during the year. An experimental shipment of garnet sand to be used as abrasive was made from Nome in the summer of 1920. (See p. 33.)

The present insufficient steamship service to Nome is a great handicap to all forms of mining. This and the increased cost of transportation and supplies have prevented the development of new mining enterprises. No new mineral deposits were discovered in Seward Peninsula during the year.

PLACER MINING.

About 112 mines, employing 540 men, were operated on Seward Peninsula in the summer of 1920, and 8 mines, employing 60 men, during the previous winter. In 1919 there were about 103 summer mines, employing 555 men, and 10 winter mines, employing about 60 men. This increase in the number of mines does not indicate a

[39] Smith, P. S., The Lake Clark-central Kuskokwim region, Alaska: U. S. Geol. Survey Bull. 655, pp. 139-148, 1917.

[40] Op. cit., pl. 5.

[41] A part of the information here presented is taken from a longer report by S. H. Cathcart, which, because of a shortage of printing funds, it has seemed best not to publish in complete form.

growth of the mining industry, because nearly all were very small operations, and many were worked solely because the unusual abundance of water for sluicing gave opportunity for exploiting placers which under more normal conditions could not be worked. The small scale of the operations is indicated by the fact that returns from 19 of the mines showed a total value of gold output of only $10,870, and a total personnel of only 30 men. Moreover, many of these mines were worked for only a part of the mining season. It is estimated that 1,790,000 cubic yards of gold-bearing gravel were mined and sluiced on Seward Peninsula in 1920. The value of the average gold content of this gravel was about 73 cents to the cubic yard. In 1919 about 2,165,000 cubic yards of gravel was mined and the average gold content was 63 cents to the cubic yard. The decrease in 1920 is due to a decrease in the number of dredges operated.

The sources of the placer-gold output of Seward Peninsula, both by districts and by methods of mining, is shown in the following tables. The figures presented are in part based on estimates, but their possible error is believed to be not over 8 per cent.

Placer gold produced in Seward Peninsula in 1920, by districts.

District.	Value of gold output.	Summer.		Winter.	
		Mines.	Miners.	Mines.	Miners.
Nome	$540,000	30	216	5	20
Solomon and Casadepaga	50,000	8	32	.....	.....
Koyuk	160,000	14	55	3	33
Council	360,000	17	70	.....	.....
Kougarok	55,000	14	52	.....	.....
Fairhaven	135,000	23	90	2	8
Port Clarence, etc.	.....	6	25	.....	.....
	1,300,000	112	540	10	61

Placer gold produced in Seward Peninsula in 1920, by methods of mining.

Method.	Number of mines.	Number of miners.	Value of gold.
Dredging	17	145	$475,000
Hydraulic (includes all operations where any water is used to move gravel to sluice boxes)	28	200	500,000
Underground	14	65	155,000
Open-cut (other than hydraulic)	53	130	170,000
	112	540	1,300,000

In the Inmachuk region, as in other parts of the peninsula, gravels occur underneath basaltic volcanic flows.[42] During the last two years some of these buried gravels have been prospected with reported favorable results. In 1920 a considerable body of gravel on Candle Creek, in the Fairhaven district, was thawed by the cold-water method, with a view of dredging it in 1921. Some systematic investigations of

[42] Moffit, F. H., The Fairhaven gold-placer district, Alaska: U. S. Geol. Survey Bull. 247, pp. 31–35, 1905.

placer gravel were made in different districts of the peninsula during the summer of 1920, but on the whole not many projects looking to future large-scale operations were under way.

Dredging.—In 1920 17 gold dredges operating on the peninsula produced $475,000 worth of gold; in 1919 24 dredges produced $450,000 worth. In 1920 the dredges mined about 930,000 cubic yards of gravel containing about 51 cents worth of gold to the cubic yard; in 1919 the dredges mined only 865,000 cubic yards of gravel containing gold worth 52 cents to the yard. This greater efficiency of the dredges in 1920 lies in the fact that many of the small and comparatively inefficient dredges that contributed to the total yardage mined in 1919 were not operated in 1920 because of greater costs. Though the season of 1920 was not particularly favorable for dredging because the seasonal frost stayed in the ground rather far into the summer, the average length of operation was nearly 70 days in 1920, as compared with 50 days in 1919. The low average of 1919 was due entirely to the inefficiency of the small dredges, some of which were operated for less than 30 days. The longest operating season reported for any one dredge in 1920 was 96 days, and the longest in 1919 was 110 days.

Gold dredges operated on Seward Peninsula in 1920.

Nome district:
- Dexter Dredging Co., Dexter Creek.
- Center Creek Dredging Co., Center Creek.
- Dry Creek Dredging Co., Dry Creek.
- Arctic Creek Dredging Co., Arctic Creek.
- Alaska Mines Corporation, Flat Creek.
- Julian Dredge, Osburn Creek.

Solomon district:
- Esquimo Dredging Co., Solomon River.
- Shovel Creek Gold Dredging Co., Shovel Creek.
- Burness-Iverson-Johnson Dredge, Big Hurrah Creek.

Council district:
- Northern Light Mining Co., Ophir Creek.
- Wild Goose Mining & Trading Co., Ophir Creek.
- Crooked Creek Dredging Co., Crooked Creek.
- Flume Dredge Co., Melsing Creek.
- Flume Dredge Co., Basin Creek.

Kougarok district:
- Bering Dredging Co., Taylor Creek.
- Kelliher Dredging Co., Kougarok River.

Port Clarence district:
- Budd Creek Dredging Co., Budd Creek.

Deep mining.—Of the 14 mines working deep placers covered by a heavy overburden and carrying little or no gold that were operated in 1920 there were five each in the Nome and Koyuk districts, three in the Fairhaven, and one in the Kougarok. The deep mines of the Koyuk district produced about $86,000 and those of the Nome district about

$40,000 worth of gold. Of the total number of deep mines, seven were operated for a part of both the winter and the summer, one during the winter only and six during the summer only. The returns from 12 of these mines are sufficiently complete to permit the following analysis. These mines were operated from 30 to 307 days and an average of 146 days. They averaged nearly six employees per mine and hoisted and sluiced about 39,950 cubic yards of gravel, the value of whose gold content ranged from $2.86 to $12.62 a cubic yard. The richer of the deposits were those exploited by small miners, who were evidently working on rich pockets of placers. The average gold tenor for all the mines was $3.87 a cubic yard. An average of 3.8 cubic yards of gravel was mined per man per day, this average including all men employed both on the surface and underground.

Hydraulic and other open-cut mines.—Many of the operations classed as hydraulic were those in which only a part of the work of moving the granite to the sluice box is done by water under head. Water is not abundant enough nor are the grades steep enough in most of Seward Peninsula to permit ordinary hydraulic mining. Six hydraulic elevators were operated in 1920. The abundant rainfall during 1920, except in the Fairhaven district, favored hydraulic mining. The value of the gold recovery from the open-cut mines ranged from 45 cents to $2.40 to the cubic yard. Seventeen large open-cut mines, most of which did much hydraulic work, showed an average gold recovery of 70 cents to the cubic yard.

Gold and silver produced on Seward Peninsula, 1897–1920.

Year.	Gold.		Silver.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Value.
1897	725.63	$15,000	87	$52
1898	3,628.12	75,000	435	256
1899	135,450.00	2,800,000	16,254	9,752
1900	229,781.25	4,750,000	27,574	17,097
1901	199,822.61	4,130,700	24,579	14,747
1902	220,677.07	4,561,800	26,481	14,035
1903	215,994.38	4,465,000	24,171	13,052
1904	201,462.52	4,164,600	24,175	14,021
1905	232,200.00	4,800,000	27,864	16,997
1906	352,812.50	7,500,000	43,537	29,605
1907	338,625.00	7,000,000	25,497	16,828
1908	247,680.00	5,120,000	20,577	10,905
1909	207,077.50	4,260,000	20,871	10,853
1910	169,312.50	3,500,000	20,317	10,971
1911	149,962.50	3,100,000	17,996	9,718
1912	145,125.00	3,000,000	17,415	10,710
1913	120,937.50	2,500,000	12,094	7,305
1914	130,612.50	2,700,000	15,673	8,667
1915	140,287.50	2,900,000	17,510	8,878
1916	142,706.25	2,950,000	14,271	9,391
1917	125,775.00	2,600,000	13,770	11,346
1918	53,599.50	1,108,000	6,022	6,022
1919	65,790.00	1,360,000	6,940	7,773
1920	62,887.49	1,300,000	6,813	7,426
	3,892,932.32	80,660,100	430,923	266,407

LODE MINING AND PROSPECTING.

Little work was done on the lodes of Seward Peninsula in 1920. Explorations that were in progress at several localities have been discontinued for the present. The necessity of resuming annual assessment work occasioned some prospecting, but it was very desultory. About 50 men were engaged in lode prospecting for a part of the year.

The only production from lode mining in 1920 was that made by the gold-quartz property of Megan, Somerville & Megan, at Bluff. A dump mined during the winter was milled in the spring. Mr. Tom Ward worked three men for part of the summer on his copper property near Kougarok Mountain. He planned to sink on and crosscut the ledge in the winter of 1920–21. During the winter of 1920 a force of about 20 men was employed in exploring the tin lode on Cassiterite Creek. A 250-foot inclined shaft was sunk on the dike from a station on the lower tunnel. Work was discontinued in May.

Twenty men were employed during the winter and eight during the summer in prospecting the lead-silver property on Kugruk River. The developments on the property now consist of a 140-foot shaft and of 250 feet of drift on the 40-foot and 150 feet of drift on the 140-foot levels. The showing is considered favorable by the owners. Work was discontinued in September.

COMMERCIAL CONDITIONS.

There was some shortage of labor on Seward Peninsula during the summer of 1920, but it was not serious. Most of the dredging companies brought their crews with them, so that the dredges could not be operated until after navigation opened, about the end of June. The summer wage for common labor was $6 and board for an 8-hour day, but many of the larger companies insisted on a longer day. The winter wage in the Koyuk district was $5 and board for an 8-hour day. The average dredge wage for engineers and winchmen was $9 and board, the men working in 12-hour shifts. Many of the men were brought in and taken out during the summer, and probably most of them were paid for the entire season, including time spent in travel.

Board at Nome cost $2.50 to $3.50 a day, and it probably cost the mining companies at least $2 a day to feed their men. The cost of provisions at Nome in the summer of 1919 is indicated by the following retail prices per pound: Bacon, 75 cents; butter, 85 cents; sugar, 30 cents; flour, 10 cents; beans, 20 cents; potatoes, 15 cents; rice, 20 cents; eggs, 85 cents a dozen.

The price of coal per ton at Nome in 1920 was $39 in summer and $45 in winter. Fuel oil sold at $6 a barrel, gasoline at 60 cents a

gallon, and distillate at 49 cents a gallon. At Dime Creek, in the Koyuk district, where there is timber, the price of wood was $16 a cord.

In 1920 the first of the summer fleet arrived at Nome on June 13, but shore ice prevented landing of freight until June 23. Storms began July 4, and tied up all coastwise shipping for three weeks and seriously interfered with the unloading of the vessels. The last of the freighters did not leave Nome until August 4, so that their return trips were delayed until September, a delay that seriously hampered mining. Three dredges did not receive their supplies and provisions until September and lost practically the whole season.

The freight rates vary, of course, with the classification, but the ordinary freight rate from Seattle to Nome and Anchorage was about $19 a ton l. c. l.[43] To this rate must be added the lighterage charge paid on all freight for transportation from shipside to beach. In 1920 the lighterage at Nome for ordinary freight was $10 a ton.[44] It is to be hoped that the completion of the jetty at the mouth of Snake River, which is now being built by the Government and which will give a safe harbor for barges and small craft, will lead to a reduction of the lighterage charges.

Even after the freight is landed on the beach at Nome or other settlement the miner may still have to meet the heavier cost of overland transportation. For the mines that are reached by the good local roads leading out from Nome the cost of transportation is only about $3 a ton. On the other hand, the price charged for hauling freight from Nome to Boulder Creek (10 miles) was $50, to Goldbottom Creek (16 miles) $66, and to Manila Creek (20 miles) $94 a ton. In the Koyuk district freight rates from steamer landing on Norton Sound to Dime Creek, a distance of 20 miles, are $50 a ton in summer and $30 a ton in winter. The above rates show that the placer miner, unless he is on the good system tributary to Nome, must pay from $2.50 to $5 a ton per mile for the land transportation of his freight, which has already cost him $30 to $50 landed on the beach. This is one of the best arguments for more road construction in the Alaska placer camps.

All this goes to show that cost of transportation is the heaviest drain on mining. The total cost of delivering freight to the camps on Seward Peninsula[45] is estimated as follows: Ocean freight,

[43] Examples of freight rates are coal (c.l.), $13.65; explosives, $35.50; automobiles, $64.50 to $109 per ton. The freight rate to Golovin in 1920 was $21; Teller, $23.50; Lost River, $26.25; York and Kotzbue settlement, $29.

[44] Examples of lighterage on different classes of freight at Nome are as follows: Coal, $8; machinery, $10; explosives, $14 a ton. Lighterage at Bonanza, $15; at Teller, $7.50; and at Kotzebue, $8. The following coastwise freight rates were in effect in 1920: Nome to Dime Landing, $20; Nome to Solomon, $12; Teller to York, $10; Teller to Kotzebue, $40.

[45] According to report of R. W. J. Reed, customs collector of the port of Nome, dated October 21, 1920, the following freight was landed in 1920: General merchandise, 7,599 tons; coal (domestic), 2,511 tons; (foreign), 315 tons; lumber, 734,574 feet b. m.; live stock, 16 head.

Seattle to Nome, $200,000; lighterage at Nome, $106,000; local distribution, $170,000. These figures include freight landed by coastwise, river, and land transportation and are based on the costs considered on preceding pages and on estimates of percentages of total freight delivered to each district. The figures are only approximate, but they are underestimates rather than overestimates. They amount to $476,000, equal to about 29 per cent of the value of the total gold output of the peninsula in 1920. This cost of transportation has to be met by the mining industry, for except for the production of a little salt fish and reindeer meat, Seward Peninsula has no other industries.

KOBUK REGION.

As a result of the high cost of transportation and supplies mining has almost ceased in the Kobuk region. Three small mines, however, were operated on Dahl Creek, and four on Kleary Creek, and in all 10 men were employed for a short time in winter and summer. The value of the total gold output of these mines was about $8,000. Plans have been made to install a hydraulic plant on Dahl Creek.

The coastal port for this district is Kotzebue, to which the freight rates from Seattle, including lighterage, are about $40. From Kotzebue the freight is taken by boat up the Kobuk to Shungnak, the local supply point of the Dahl Creek region. The cost of this river transportation is $40 a ton. Therefore, the miner in the Dahl Creek region pays freight amounting to at least $80 a ton on all his supplies.

ADMINISTRATIVE REPORT.

By ALFRED H. BROOKS.

During 1920 eight parties were engaged in surveys and investigations in Alaska. These parties included 7 geologists, 2 topographers, 1 hydraulic engineer, and 14 packers, cooks, and other auxiliaries. Five parties were engaged in geologic work, one in topographic survey, one in investigations of water powers in southeastern Alaska in cooperation with the Forest Service, and one was a combined geologic and topographic party.

The funds available for field and office work for the season of 1920 included an appropriation of $75,000 and an unexpended balance of $10,400 from the appropriation for the previous year. The subjoined tables show the allotments of these funds geographically by types of work and by salaries and field expenses. A balance of $13,800 will be used for the field work of 1921. In these tables the money devoted purely to office work has not been allocated to the several projects, as in previous administrative reports. These overhead charges, including administration, amount to about 23 per cent of the total and may be properly allocated to the projects at this ratio.

Approximate general distribution of appropriations for investigations in Alaska, field season of 1920.

	1919–20	1920–21
General geologic investigation		$2,700
Southeastern Alaska		9,240
Prince William Sound		1,400
Cook Inlet	$3,500	8,910
Southwestern Alaska		1,000
Susitna region	3,750	5,610
Yukon basin	1,600	4,420
Kuskokwin basin	300	5,380
Seward Peninsula	1,150	3,200
Administrative		4,250
Collection of mineral statistics		1,900
Miscellaneous expenses, including clerical work, office supplies, etc	100	13,190
Balance to be allotted to field work, 1921		13,800
	10,400	75,000

Approximate allotments to different kinds of surveys and investigations, field season of 1920.

	1919–20	1920–21
Reconnaissance geologic surveys	$3,400	$13,820
Special geologic investigations	1,150	13,825
Topographic reconnaissance surveys	5,750	9,870
Investigation of water resources	.....	4,345
Administrative	.....	4,250
Collection of mineral statistics	.....	1,900
Miscellaneous expenses, including clerical work, office supplies, map compilation, etc	100	13,190
To be allotted to field work, 1921	.....	13,800
	10,400	75,000

Allotments for salaries and field expenses, field season, 1920.

	1919–20	1920–21
Scientific salaries	.....	$29,395
Field expenses	$10,300	16,115
Clerical salaries and miscellaneous expenses	100	15,690
To be allotted to field work	.....	13,800
	10,400	75,000

The following table shows the progress of investigations in Alaska and the annual grants of funds since systematic surveys were begun, in 1898.[1] It should be noted that a varying amount is spent each year on special investigations that yield results which can not be expressed in terms of area. In 1917, when the war broke out, nearly all the Alaska funds were allotted to the investigation of minerals such as platinum, sulphur, antimony, etc., which were then of special importance, and few areal surveys were made. Since then the reduction of the annual appropriation and the increased cost of all field work has not permitted extensive geologic and topographic surveys. Little progress has therefore been made in extending the topographic and geologic surveys which are essential to obtain an adequate knowledge of the mineral resources of the Territory.

[1] The Geological Survey made some investigations of the gold and coal deposits of the Pacific seaboard region in 1895 and of the Yukon region in 1896.

Progress of surveys in Alaska, 1898–1920.

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; 25, 50, or 100 foot contours).	Lines of levels.	Bench marks set.	Gaging stations maintained part of year.	Stream-volume measurements.
		Sq. m.	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Miles*			
1898	$46,189	9,500	.....	.....	12,840	2,070	.....	.....	.....	.....	.....
1899	25,000	6,000	.....	.....	8,690	.....	.....	.....	.....	.....	.....
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	.....	.....	.....	.....
1914	100,000	1,000	7,700	325	600	10,300	10	.....	.....	.....	.....
1915	100,000	.....	10,700	200	.....	10,400	12	3	2	9	.....
1916	100,000	.....	5,100	636	.....	9,700	67	.....	.....	20	.....
1917	100,000	.....	1,750	275	.....	1,050	.....	.....	.....	19	.....
1918	77,000	.....	3,500	.....	.....	1,200	.....	.....	.....	.....	.....
1919	75,000	.....	2,700	.....	.....	2,300	.....	.....	.....	19	.....
1920	76,000	.....	1,480	.....	.....	770	.....	.....	.....	19	.....
1921	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
1922	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	1,788,189	73,200	108,965	5,507	51,680	152,300	3,731	462	74	.....	.....
Percentage of total area of Alaska	.....	12.48	18.58	0.94	8.81	25.97	0.64	.....	.....	.....	.....

[a] The Coast and Geodetic and International Boundary surveys have also made topographic surveys in Alaska. The areas covered by these surveys are of course not included in these totals.

The writer was engaged in office work until July 4, when he accompanied Hon. John Barton Payne, Secretary of the Interior, and Hon. Josephus Daniels, Secretary of the Navy, to Alaska. In the course of this journey a part of the Matanuska coal field and the Government railroad were examined. Through the courtesy of Admiral Hugh Rodman the writer was later enabled to visit Cold Bay, on the Alaska Peninsula. This part of the journey was made on the United States destroyer *McCullough*, commanded by Capt. H. W. Sears. Through the courtesy of Captain Sears the writer was transported to Juneau and later went to Cordova by passenger steamer. A visit was then made to the Bering River coal field and the Katalla oil field. The time from August 24 to September 13 was spent in examining the copper and gold lodes of Prince William Sound and in studying the local geology. A part of this work was done in company with O. C. Ralston, metallurgist of the United States Bureau of Mines.

Later, again in company with Mr. Ralston, the writer devoted 10 days to an examination of some of the copper deposits of the Ketchikan district. Returning, the writer reached Washington October 4. Of the nine months devoted to office work during the year 1920, 51 days were devoted to progress report, 8 days to preparation of annual press bulletin, 11 days to field plans, 7 days to reading manuscript, 22 days to military geology, 9 days to geologic studies, and 43 days to preparation of a report on conditions in Alaska, for the Secretary of the Interior.[2]

R. H. Sargent was on furlough for about three-fourths of the year. While on duty he was occupied chiefly in the administration of the Alaska topographic surveys and map compilation.

S. R. Capps was on furlough until February 21, 1921. While on duty he was engaged chiefly in continuing his report on the geology and mineral resources of the region tributary to the railroad.

G. L. Harrington was on furlough all but about one week in the year and while on duty devoted his time chiefly to the report on the Ruby-Iditarod district.

J. B. Mertie, jr., was on furlough until March 31, 1921, and gave the rest of the fiscal year to continuation of the report on the Ruby-Iditarod district.

C. P. McKinley devoted about two months to the compilation of a topographic map of the Katmai region from photographs furnished by the National Geographic Society.

Miss Lucy M. Graves, chief clerk, has continued to carry much of the burden of the administration of the Alaska division and has acted as chief during the absence of the geologist in charge and of the senior geologist, G. C. Martin. The details of collecting the statistics of the mineral production of Alaska have been in the hands of T. R. Burch.

G. H. Canfield continued water-power investigations in southeastern Alaska up to April 1, when the work was suspended on account of lack of funds. A record of five years of stream flow has now been obtained for about 19 of the best of the water-power sites in southeastern Alaska. In view of the demands for other investigations in Alaska the continuation of the stream gaging does not appear to be justified under the present reduced appropriation. This work could not have been done without the cordial cooperation of the Forest Service, which has rendered much valuable assistance in providing local transportation, office space, and gage readers. The great importance of this water-power investigation, both to the pulp-wood and mining industry, is generally recognized, and it is hoped that funds will be available for its continuation at an early date.

[2] Report of Alaska Advisory Committee, Alfred H. Brooks, chairman: Appendix H of Report of the governor of Alaska to the Secretary of the Interior, pp. 103–114, Washington, 1921.

Lewis G. Westgate completed the geologic reconnaissance survey of the Portland Canal region of the Ketchikan district between July 19 and September 24. A summary report of his results is given in another part of this volume.

F. H. Moffit, with Herbert Insley as geologic assistant and C. P. McKinley as topographer, made a geologic and topographic reconnaisance survey covering 380 square miles in the Tuxedni Bay region of Cook Inlet between June 10 and September 10. It was originally planned to extend this survey southward to include the Iliamna Bay oil field, but this extension proved impossible on account of the almost unprecedented rainfall of the summer, which both retarded the field work and swelled the rivers and swamps so much as to make a part of the region impassable for a pack train. Mr. Moffit's report is contained in another part of this report.

J. R. Eakin made topographic reconnaissance surveys of an area of 390 square miles on the southern slope of the Alaska Range, in the headwater region of the Susitna basin. The field work, which was carried on from June 27 to August 28, was greatly retarded by rainy weather, which made it impossible to carry the survey across the range as had been planned.

Philip S. Smith devoted the time from July 17 to September 22 to a continuation and revision of the geologic reconnnaissance mapping of the Salcha-Goodpaster region. His survey, which included the investigation of mineral resources, covered a total area of 1,200 square miles, of which about 500 had been previously unmapped.

G. C. Martin continued the study of the geology and mineral resources of the Ruby, Iditarod, and Innoko districts. He also made a special investigation of the auriferous lodes of the Nixon Fork basin of the Mount McKinley district, in the upper Kuskokwim basin. The results of this work are presented in another part of this volume. The field work was carried on from July 1 to August 29.

S. H. Cathcart devoted from July 3 to September 19 to a geologic study of some of the mineral deposits of Seward Peninsula. This study is a part of a project for an intensive investigation of the mineral bearing lodes of the peninsula, which unfortunately, because of lack of funds, could not be continued in 1921. A statement of Mr. Cathcart's results is given in another part of this volume.

During 1920 the Survey issued two bulletins relating to Alaska—Bulletin 682, The marble resources of southeastern Alaska, by E. F. Burchard, and Bulletin 712, Mineral resources of Alaska, 1918, by G. C. Martin and others. A report on the mining industry of Alaska for 1920, with estimates of mineral output, was issued on January 1, 1921. On December 31, 1920, there were in press Bulletin 719, "Preliminary report on petroleum in Alaska," by G. C. Martin

(issued February, 1921); Bulletin 714, Mineral resources of Alaska, by Alfred H. Brooks and others (separate chapters issued between February and April, 1921). Two reports, including topographic maps ("The geology of the York tin deposits, Alaska," by Edward Steidtmann and S. H. Cathcart, and "The Kotsina-Kuskulana district, Alaska," by F. H. Moffit and J. B. Mertie, jr.), were transmitted in 1920 but have not yet been sent forward for printing, owing to shortage of funds for publication. As this shortage makes it impossible to foresee when reports and maps can be published, it does not seem desirable to list some 10 manuscripts and 7 topographic maps that are in various stages of preparation.