MINERAL RESOURCES OF ALASKA, 1913.

By ALFRED H. BROOKS and others.

PREFACE.

By ALFRED H. BROOKS

The present volume is the tenth of a series of annual bulletins[1] treating of the progress of mining in Alaska and summarizing the results achieved during the year in the investigations of the mineral resources of the Territory. In preparing these reports the aim is prompt publication of the most important economic results of the year. The short time available for the preparation of the reports does not permit the complete office study of the notes and specimens; hence some of the statements made may be subject to modification when the researches have been completed. Those interested in any particular district are therefore urged to procure a copy of the complete report on that district as soon as it is available.

This volume, like those previously issued, contains both preliminary statements on investigations made during the year and summaries of the conditions of the mining industry, including statistics of mineral production. It is intended that this series of reports shall serve as convenient reference works on the mining industry for the years which they cover. Lack of funds prevents a visit to every mining district each year by a member of the Survey, and therefore the data used in preparing the summary on mining development are in part based on information gleaned from various reliable sources.

Again, as in previous years, the writer is under great obligations to many residents of the Territory for valuable data. Those who have thus aided him include many mine operators, engineers, prospectors, Federal officials, and officers of banks and of transportation and commercial companies. It is impossible to enumerate all who have contributed information, but special acknowledgment should be made to the Director of the Mint; Wells-Fargo Express Co.; the

[1] Report on progress of investigations of the mineral resources of Alaska, 1904 [to 1912]: U. S. Geol. Survey Bull. 259 [284, 314, 345, 379, 442, 480, 520, and 542, respectively].

Alaska Mexican Gold Mining Co., Alaska United Gold Mining Co., and Alaska Treadwell Gold Mining Co., of Treadwell; George M. Esterly, of Nizina; Stephen Birch, of Kennecott; Charles S. Matthison, of Hope; John L. Abrams, of Fortymile; J. J. Hillard, of Eagle; T. E. Phillip, of Jack Wade; W. J. Reynolds and A. J. Childs, of Deadwood; Frank A. Reynolds, of Circle; E. H. Boyer, R. C. Wood, F. Cook, A. Bruning, American Bank, and First National Bank, of Fairbanks; S. J. Marsh, of Caro; Charles Fornander and A. Cameron, of Ruby; William R. Lloyd, of Glacier; J. C. Felix, of Hughes; Cyril P. Wood, T. L. Thurston, and Charles Estmere, of Iditarod; W. A. Vinal, of Ophir; Harold Seddon and W. F. Green, of Tocotna; William Bailis, of Tuluksak; William Loiselle, of Quinhagak; E. R. Stivers, of St. Michael; J. W. J. Reed, of Nome; G. A. Adams, of Council; P. J. Coston, of Candle; and M. F. Moran, of Shungnak.

The arrangement and manner of treatment in this volume are the same as in those previously issued. First, papers of a general character are presented, followed by those treating of special districts, arranged geographically from south to north. This bulletin contains 21 papers by 11 authors. One of these papers deals with administrative matters, one treats of the mineral deposits of all Alaska, one is a general summary of the mining industry, and the remainder deal more specifically with the economic geology of certain districts. In the geologic papers emphasis is laid on the conclusions having immediate interest to the miner. These conclusions are discussed here briefly but will be more fully treated in reports now in preparation. The need of prompt publication requires that the illustrations in this volume be of the simplest kind.

ADMINISTRATIVE REPORT.

By Alfred H. Brooks.

INTRODUCTION.

The fact that the appropriation for the continuation of the investigation of the mineral resources of Alaska in 1913 was not made until June 23, 1913, much curtailed the field season of several of the parties and thereby greatly enhanced the cost of the work. Out of a total of 14 field parties only 5 had a full season's work. The loss in time, due to the delay in appropriation, amounted to an average of one month, or 29 per cent, for each of 8 field parties. A careful estimate, based on the allotments to these parties and the cost of the additional month of field work, shows that the actual monetary loss occasioned by the delay—that is, expenditure for which there was no return—was $7,120, or over 7 per cent of the total appropriation. There was also a loss of efficiency brought about by the delay of the field work and consequent change of plans which can not be expressed in figures. It can be stated, however, that the delay in appropriation for two successive years, the full appropriation for 1912–13 not being available until August 24, 1912, has put the Alaska field work nearly one year behind. This is indicated by the table showing progress of surveys (p. 9).

Fourteen parties in all were engaged in surveys and investigations during 1913. Of these, two started field work in May, three in June, seven in July, and two in August. The average length of the Alaska field season is 110 days; the average of all the parties in 1913 was 73 days. The 14 parties included 12 geologists, 1 geologic assistant, 4 topographic assistants, 2 hydraulic engineers, and 34 packers, cooks, and other assistants. Nine of these parties were engaged in geologic work, four in topographic surveys, and one in investigation of water resources. The results can be summarized as follows:

The areas covered by geologic exploratory surveys, on a scale of 1:500,000 (8 miles to the inch), amount to 3,500 square miles; by geologic reconnaissance surveys, scale 1:250,000 (about 4 miles to the inch), 2,950 square miles; by detailed geologic surveys, scale 1:62,500 (1 mile to the inch), 180 square miles. Much of the time of the geologists was devoted to special field problems, the results of which can not be expressed areally.

The areas covered by topographic exploratory surveys, on a scale of 1:500,000, amount to 3,400 square miles; by topographic recon-

naissance surveys, 2,535 square miles; by detailed topographic surveys, 287 square miles.

Twenty-five stream-gaging stations were maintained for an average of 12 weeks each. The results served to indicate in some degree the possibilities for developing water power in the lower Copper River basin, along the eastern shore of Prince William Sound, and on Kenai Peninsula. This work also included excursions into the Bering River coal field and the Willow Creek district.

To state the work geographically, two parties worked in southeastern Alaska, one in the Yakataga region, one in the Chitina basin, one in the Prince William Sound, lower Copper, and Kenai Peninsula regions, one on Prince William Sound, two in the lower Susitna basin, two in the upper Susitna basin, two in the Matanuska basin, and one in the Yukon-Koyukuk region. The work of one party was divided between the Fairbanks district and Seward Peninsula.

Among the important results of the year are the completion of the reconnaissance of the marble deposits of southeastern Alaska, a reconnaissance survey of the Yakataga region, a detailed geologic and topographic survey of the Willow Creek district, a topographic and geologic reconnaissance survey of the Broad Pass region, in the upper Susitna basin, the completion of the general survey of the Matanuska coal field, and a geologic exploration of the little-known region lying between the lower Koyukuk River and the Yukon.

The following table shows the allotment, including both field and office expenses, of the total appropriation of $100,000 to the regions investigated. In preparing this table the general office expenses are apportioned to the several allotments, account being taken of variations in character of work. The results are expressed in round numbers. The "general investigations" include, among other things, the cost of collecting mineral statistics and of office work relating to the field investigations of previous seasons.

Approximate geographic distribution of Alaskan appropriation, 1913.

Southeastern Alaska	$7,000
Yakataga region	6,000
Copper River	10,500
Prince William Sound	7,000
Kenai Peninsula	1,500
Susitna basin	25,500
Matanuska basin	23,500
Yukon basin	8,500
General investigations	4,500
Unallotted	6,000
	100,000

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

Approximate allotments to different kinds of surveys and investigations in Alaska, 1913.

Geologic and topographic exploration	$4,650
Geologic reconnaissance surveys	17,450
Detailed geologic surveys	5,350
Special geologic investigations	11,100
Reconnaissance topographic surveys	7,400
Detailed topographic surveys	20,700
Investigation of water resources	6,300
Collecting statistics of mineral production	1,250
Miscellaneous, including administration, inspection, clerical salaries, office supplies, and equipment	20,800
Unallotted	6,000
	100,000

Allotments for salaries and field expenses, Alaskan work, 1913.

Scientific and technical salaries	$38,800
Field expenses	33,930
Clerical and other office and miscellaneous expenses	16,270
Unallotted	6,000
	100,000

The following table exhibits the progress of investigations in Alaska and the annual appropriations since systematic surveys were begun in 1898. A varying amount is expended each year on special investigations yielding results which can not be expressed in terms of area.

Progress of surveys in Alaska, 1898–1913.

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys.[a]					Investigations of water resources.	
		Exploratory (scale 1:500,000, 1:625,000, or 1:1,000,000).	Reconnaissance (scale 1:250,000).	Detailed (scale 1:62,500).	Exploratory (scale 1:500,000, 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.	Measurements of stream volume.
		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	.....	.....	24	185
	1,161,189	72,200	76,035	4,071	51,080	116,580	3,642	459	72	.....	.....
Percentage of total area of Alaska	.....	12.31	12.97	0.69	8.71	19.88	0.62	.....	.....	.....	.....

[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.

GEOGRAPHIC DISTRIBUTION OF INVESTIGATIONS.

GENERAL WORK.

From January 1 to February 15, 1913, most of the time of the writer was devoted to the work of the Alaska Railroad Commission, of which he was vice chairman. During this time G. C. Martin had charge of the division. The writer was engaged in office work until June 30, when he proceeded to Alaska. A plan to visit the Willow Creek district could not be carried out in the time allotted, because of the nonoperation of the Alaska Northern Railroad. Several points on Cook Inlet were visited, and about 10 days were spent with B. L. Johnson in reviewing the geology of the Ellamar district and adjacent regions.

The writer attended the Thirteenth International Geological Congress at Toronto August 7 to 14 as official delegate and later made an excursion through the Canadian Cordillera, visiting a number of mining camps in British Columbia. He arrived in Washington on September 19.

Of the time devoted to office investigations during the year 1913 the writer devoted 33 days to the work of the Alaska Railroad Commission, 20 days to reading and revising manuscripts, 10 days to preparing matter for the annual progress report, 4 days to preparing the annual Alaska press bulletin, 7½ days to work on statistics of mineral production, 12 days to work of the advisory committee on a new Survey building, and 33 days to scientific work.

R. H. Sargent continued the general supervision of the topographic surveys and map compilation in addition to carrying on his own field work. E. M. Aten continued as office assistant and, during the absence of the geologist in charge and of the three senior geologists, acted as administrative head of the division. He also continued to assist in collecting statistics of production of precious metals in Alaska. Two clerks and one draftsman were employed throughout the year and one other clerk for about six months.

SOUTHEASTERN ALASKA.

Reconnaissance geologic surveys of all the mining districts of southeastern Alaska were completed in 1910, and detailed investigations of several of the more important mining districts have also been made. There still remains, however, much work to be done before the stratigraphic sequence, structure, and geologic history of this region can be established. It is only by the solving of the fundamental problems of geology that those of economic importance can be solved. For this reason further study of the geology of southeastern Alaska was undertaken in 1913.

In furtherance of this plan P. S. Smith began field work in the Ketchikan district on May 12 and continued until July 25, when he returned to Washington to take charge of the Alaska division during the writer's absence. Mr. Smith gained much new information, but further field studies must be made before there is justification for publishing the results.

In 1912 E. F. Burchard was temporarily transferred to the Alaskan division for the purpose of applying his special knowledge of the geology of building material to the marble deposits of southeastern Alaska. He completed the reconnaissance of most of the marble deposits of the Ketchikan and Wrangell districts in 1912.[1] In 1913 he extended this work northward into the Juneau and Sitka districts, thus completing the reconnaissance of the more important deposits of southeastern Alaska. A preliminary statement of the results achieved in 1913 is included in this bulletin and a more complete report is in preparation. In the course of the work Mr. Burchard discovered a large deposit of barite on Castle Island, in the Wrangell district. This deposit is described in a later section of this report.

YAKATAGA REGION.

Up to 1913 no geologist of the Survey had visited the Yakataga region, where placer gold had long been mined, petroleum seepages found, and coal deposits reported. The task of visiting this region, so difficult of access, was assigned to A. G. Maddren, who was assisted by E. O. Blades and one boatman. Landing at Katalla and following the beach with canoes and by packing, Mr. Maddren with two men reached Yakataga on July 13 and continued his field work until September 13. Mr. Blades, his assistant, did some work in this region until October 14. In the Yakataga district the party traveled chiefly on foot, carrying their supplies on their backs. In spite of this arduous work and the obstacles of heavy vegetation and glacial streams, they made reconnaissance surveys in places for some 15 miles inland. A fairly complete reconnaissance of the gold and oil bearing district was made and some of the coal beds were examined. The reconnaissance surveys covered an area of about 1,000 square miles. A preliminary statement of results is contained in this volume, and a more complete account is in preparation.

COPPER RIVER REGION.

In 1912 the preparation of a detailed base map of the copper-bearing area tributary to the Kuskulana was begun by D. C. Witherspoon, but was not completed, owing to the lateness of the appropriation. It fell to Mr. Witherspoon, assisted by S. A. Witherspoon with

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

a party of five men, to complete this survey in 1913. The map will be published on a scale of 1 mile to the inch, with 100-foot contours. In 1913 the survey of some 95 square miles was completed in spite of the fact that field work was not begun until July 18, but the work was continued, so far as weather permitted, until October 19. The geologic survey of this area is to be undertaken in 1914.

In connection with the work in the Susitna basin J. W. Bagley surveyed a belt adjacent to the Government wagon road extending from Beaver Dam to Gulkana. C. E. Giffin, while waiting at Valdez for the appropriation bill to be passed, made a similar survey along the wagon road from Beaver Dam to Valdez. The investigation of the water resources of the Copper River basin below Copper Center is described under the heading "Prince William Sound."

PRINCE WILLIAM SOUND.

In accordance with the plan of investigating the mineral resources of Prince William Sound, B. L. Johnson continued work in this field. His work, which began July 13, included a reexamination of some localities in the Ellamar district, which was done in cooperation with the writer. He also spent about two months in making a reconnaissance of the gold deposits of the Port Wells district and some further studies of the Port Valdez district and of Latouche Island. Field work was continued until October 27. A statement of results is contained in this bulletin.

C. E. Giffin utilized a part of the time while waiting at Valdez for the passage of the appropriation bill in making a hurried topographic reconnaissance from the head of Passage Canal to the Turnagain Arm watershed. This work was possible only through the courtesy of Col. Joseph P. O'Neil, commandant of Fort Liscum, who furnished Mr. Giffin with transportation from Valdez to Passage Canal and return. After the close of his field work in the Willow Creek district Mr. Giffin extended this survey through to Turnagain Arm (Pl. II).

INVESTIGATIONS OF WATER RESOURCES OF PRINCE WILLIAM SOUND, COPPER RIVER, AND KENAI PENINSULA.

In 1906 the Survey began the investigation of the water resources of the Nome district, and in 1907 similar investigations were begun in the Fairbanks district. During the succeeding six years stream gaging was done in most of the important placer districts of Seward Peninsula and of the Yukon-Tanana region. The results have been collated for each province and published.[1] Meanwhile, a preliminary study of water-power possibilities in southeastern Alaska was undertaken.[2]

[1] Henshaw, F. F., and Parker, G. L., Surface water supply of Seward Peninsula, Alaska: U. S. Geol. Survey Water-Supply Paper 314, 1913. Ellsworth, C. E., and Davenport, R. W., The surface water supply of the Yukon-Tanana region: U. S. Geol. Survey Water-Supply Paper 342 (in press).

[2] Hoyt, J. C., A water-power reconnaissance in southeastern Alaska: U. S. Geol. Survey Bull. 442, pp. 147–157, 1910.

These various investigations yielded a large number of facts of value to the mine operator and engineer. They cover, however, only a small part of the regions about the water resources of which a demand for information exists. The limits set by the funds available have prevented an expansion of this work. It seemed desirable, however, to make at least a preliminary study of the possibilities of developing water power in the Prince William Sound region and adjacent portions of the Copper River and Bering River basins, as well as in the Kenai Peninsula and Willow Creek districts. This task was undertaken in 1913 and assigned to C. E. Ellsworth and R. W. Davenport.

Work was begun on May 5 and Messrs. Ellsworth and Davenport studied the Prince William Sound region, lower Copper River basin, and the Bering River basin until August 12. They then proceeded to Seward and until September 4 devoted their time to the eastern section of Kenai Peninsula. Mr. Ellsworth then returned to Valdez and continued field work in the Prince William Sound and Copper River regions for the remainder of the season. Mr. Davenport continued investigation on Kenai Peninsula and also spent five days in the Willow Creek district. He returned to Valdez November 5 and took up work in that vicinity until the close of the season on November 25.

In the Bering River region only four days were spent in actual work, and six measurements of stream flow were made. The work in the Copper River basin was extended as far north as Copper Center and eastward on the Chitina as far as the Nizina placer district. Four gaging stations were maintained for an average of 17 weeks each. Forty-six measurements of stream flow were made and one rainfall station was established. Natural water-power sites are known to be widely distributed on streams entering Prince William Sound from the mainland and also from many islands, but because of lack of time the investigations were directed mainly to streams in the vicinity of Cordova, Ellamar, Valdez, and Port Wells, where mining and other activities are most important at the present time. In this region 10 gaging stations were maintained for an average of 12 weeks each, and 82 measurements of stream flow were made. In Kenai Peninsula and the Willow Creek district 10 gaging stations were maintained for an average of 10 weeks each and 51 measurements of stream flow were made.

The object of the reconnaissance was not only to gather data directly pertaining to the possibilities of developing water power in the area, but also to determine the need for such data and to gather information on which plans for a more detailed study could be based. Most of the work was hasty, and many streams of importance were not visited. The records of stream flow obtained cover

only a short period during one season and should be supplemented by longer and more complete studies of the conditions before developments are undertaken. The information gathered during the last season is briefly set forth in this bulletin. A more complete report is now in preparation and will be published as a Survey water-supply paper.

WILLOW CREEK DISTRICT.

Geologic and topographic reconnaissance surveys of the Willow Creek district were made in 1906 [1] and a brief examination of the auriferous lodes in 1910.[2] Since then the important lode-mining developments made in this field have led to a demand for more information, and therefore a detailed topographic and geologic survey was undertaken in 1913.

The base map was made by C. E. Giffin, who, with a party of three other men, began work on July 14 and completed the survey on August 27. In this time an area of 90 square miles was surveyed for publication on scale of 1 mile to the inch, with 100-foot contours. S. R. Capps, who mapped the geology of the same area on the same scale and made a detailed study of the ore deposits, began work on July 14 and closed on September 16. He had the assistance of a packer and a cook. A preliminary statement of results is contained in this bulletin, and the complete report is in preparation.

BROAD PASS REGION.

The Broad Pass region of the upper Susitna basin was explored by the Survey in 1898.[3] Further surveys in this field were planned for the summer of 1912, for which purpose provisions were sent in to Valdez Creek during the previous winter. The delay in the appropriation forced the abandonment of this plan, which was again taken up in 1913, when more supplies were shipped in. The topographic surveys of this field were made by J. W. Bagley, with a party of five, using phototopographic methods. Mr. Bagley began field work on July 9, after a long journey from the coast, and continued until August 23. Some 2,500 square miles was surveyed for publication, on a scale of 4 miles to the inch, with 200-foot contours. F. H. Moffit and J. E. Pogue made a geologic reconnaissance survey of a part of the same area. They began field work on June 29 and continued until August 28, covering an area of 800 square miles. A preliminary statement of results is contained in this volume, and a complete report is in preparation.

[1] Paige, Sidney, and Knopf, Adolph, Geologic reconnaissance in the Matanuska and Talkeetna basins, Alaska: U. S. Geol. Survey Bull. 327, 1907.

[2] Katz, F. J., A reconnaissance of the Willow Creek gold region: U. S. Geol. Survey Bull. 480, pp. 139–152, 1911.

[3] Eldridge, G. H., A reconnaissance in the Sushitna basin and adjacent territory, Alaska: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, pp. 1–30, 1900.

MATANUSKA BASIN.

The detailed survey of the lower and more important part of the Matanuska coal field was completed in 1910,[1] but the upper part of the field was known only through the reconnaissance survey of 1906. The importance of the district justified the further investigation made in 1913.

R. H. Sargent made a base map of 102 square miles in this region for publication on a scale of 1 mile to the inch, with 50-foot contours. He was assisted by R. W. Chaney and five other men and began field work on July 22 and closed on September 26.

The geologic work was done by G. C. Martin, assisted by J. B. Mertie, jr., and R. M. Overbeck, together with three camp hands. This party began field work on July 14 and closed on October 9. It was originally planned that a detailed geologic survey of the entire coal field should be made, but as the party was a month late in the field, owing to delay in the appropriation, this plan proved impracticable. Therefore, only the areas of actual coal outcrops were studied in detail, and at the same time a reconnaissance was extended over a large area to establish the general distribution of the coal measures as well as of the other formations. The locality of the newly discovered placer deposits in this field was also examined. A concise statement of results is presented elsewhere in this volume, and a more complete report is in preparation.

YUKON-KOYUKUK REGION.

The region between the lower Koyukuk and Yukon rivers was up to 1913 but little known. To be sure, prospectors had roamed over it and reported the occurrence of some auriferous gravels, but the existing maps of the west end of this field were very inaccurate, and little placer mining had been going on for several years in the so-called Indian River or Red Mountain district. To meet these conditions H. M. Eakin, with a party of three men, carried a geologic and topographic exploration from a point near the mouth of Dall River southwestward to the Koyukuk, passing through the Indian River placer district. On his return Mr. Eakin traveled in a southerly direction, reaching the Yukon near the mouth of Melozi River. This survey was carried on from June 19 to August 20 and covered an area of about 2,400 square miles, for publication on a scale of 8 miles to the inch. The results are summarized in this volume and will be presented more at length in a report now in preparation. Mr. Eakin also spent about 10 days at the close of the season in a study of the gold placers of the Ruby district.

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

FAIRBANKS DISTRICT AND SEWARD PENINSULA.

The progress in lode mining at Fairbanks led to further studies of this field by Theodore Chapin, who arrived at Fairbanks on August 12 and continued his work until August 31. He then proceeded to Nome and made an investigation of the mining developments in Seward Peninsula. This work occupied him until October 8. His results are presented in other parts of this volume.

COLLECTION OF STATISTICS.

Since 1905 the writer has been charged with the duty of collecting the statistics of the production of precious metals in Alaska. Previous to that time only the total production of Alaska was known, the distribution by districts being only very general and in part entirely inaccurate. Since 1905 an attempt has been made to distribute the gold, silver, and copper production by districts. So far as the lode mines are concerned this distribution has been based on the returns of output reported by the individual producers, who are the only accurate sources of information. As a result accurate figures are now available for both the total lode production and the production by districts. Far different is the case with the gold-placer production. While many operators have shown their appreciation of the fact that accurate statistics are of first importance to the mining industry by promptly furnishing information on production, there is still a large percentage of the total number who make no returns. This neglect on their part greatly diminishes the accuracy of the figures of production published for certain districts. In fact, were it not for the public spirit shown by many residents of the Territory who supplement by estimates the partial statistics collected from producers it would not be possible even to approximate the output of many of the placer camps. The refusal of many operators to furnish statements of production is all the more surprising because it is in such strong contrast to the spirit of cooperation with the Survey they have shown in other matters and is also so different from the attitude of the placer-mine operators in the States, all of whom make returns. It is believed that this action by Alaskan placer miners is due largely to failure to appreciate the importance of accurate statistics. The conditions are, however, very discouraging to those who are trying to serve the mining industry of Alaska by attempting to procure accurate statistics of mineral production.

PUBLICATIONS.

During 1913 the Survey published ten bulletins and one water-supply paper relating to Alaska. One bulletin is in press. In addition the authors' work on one professional paper, two bulletins, and one water-supply paper has been completed, and three publications will soon be sent to press. Three other reports are in preparation. The compilation of a new general map of Alaska is under way. These publications are listed on page 17.

REPORTS ISSUED.

BULLETIN 502. The Eagle River region, southeastern Alaska, by Adolph Knopf; including detailed geologic and topographic maps. (Issued in March, 1913.)

BULLETIN 525. A geologic reconnaissance of the Fairbanks quadrangle, Alaska, by L. M. Prindle, with a detailed description of the Fairbanks district, by L. M. Prindle and F. J. Katz, and an account of lode mining near Fairbanks, by P. S. Smith; including reconnaissance and detailed geologic and topographic maps. (Issued in June, 1913.)

BULLETIN 526. Coastal glaciers of Prince William Sound and Kenai Peninsula, Alaska, by U. S. Grant and D. F. Higgins. (Issued in June, 1913.)

BULLETIN 532. The Koyukuk-Chandalar region, Alaska, by A. G. Maddren; including topographic and geologic reconnaissance maps. (Issued in June, 1913.)

BULLETIN 533. Geology of the Nome and Grand Central quadrangles, Alaska, by F. H. Moffit; including detailed topographic and geologic reconnaissance maps. (Issued in August, 1913.)

BULLETIN 534. The Yentna district, Alaska, by S. R. Capps; including topographic and geologic reconnaissance maps. (Issued in June, 1913.)

BULLETIN 535. A geologic reconnaissance of a part of the Rampart quadrangle, Alaska, by H. M. Eakin; including geologic and topographic reconnaissance maps. (Issued in June, 1913.)

BULLETIN 536. The Noatak-Kobuk region, Alaska, by P. S. Smith; including topographic and geologic reconnaissance maps. (Issued in September, 1913.)

BULLETIN 538. Geologic reconnaissance of the Circle quadrangle, Alaska, by L. M. Prindle; including topographic and geologic reconnaissance maps. (Issued in December, 1913.)

WATER-SUPPLY PAPER 314. Surface water supply of Seward Peninsula, Alaska, by F. F. Henshaw and G. L. Parker, with a sketch of the geography and geology, by P. S. Smith and a description of methods of placer mining, by Alfred H. Brooks; including topographic reconnaissance maps. (Issued in May, 1913.)

REPORTS IN PRESS.

BULLETIN 576. Geology of the Hanagita-Bremner region, Alaska, by F. H. Moffit; including topographic and geologic reconnaissance maps.

REPORTS SUBMITTED FOR WHICH ILLUSTRATIONS ARE BEING PREPARED.

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

BULLETIN 578. The Iditarod-Ruby region, Alaska, by H. M. Eakin; including geologic and topographic reconnaissance maps.

BULLETIN 587. Contributions to the geology and mineral resources of the Kenai Peninsula, Alaska, by G. C. Martin, B. L. Johnson, and U. S. Grant; including geologic and topographic reconnaissance maps.

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

REPORTS IN PREPARATION.

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

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

Geology and mineral resources of the Ellamar district, Prince William Sound, Alaska, by S. R. Capps and B. L. Johnson.

THE MINERAL DEPOSITS OF ALASKA.

By ALFRED H. BROOKS.

INTRODUCTION.

The work of determining the areal distribution and mode of occurrence of Alaska's mineral deposits has been in progress for 16 years, and the results are recorded in many different publications. These are necessarily incomplete, for they relate to a territory almost continental in its dimensions.

In view of the present great interest in Alaska, it has seemed desirable to present a brief summary of what is known of the mineral deposits of the Territory. There is no intention of making a new contribution to economic geology, but solely of presenting a concise and somewhat popular treatment of the subject. As the geology of the metalliferous lodes has been presented at some length in a paper [1] recently published, this subject will receive only cursory treatment here.

The data to be presented are taken from the many Survey publications relating to the geology and mineral resources of Alaska, which are listed at the end of this volume. More special use has been made of the summary reports listed below. No further reference will be made in this paper to the Survey publications relating to Alaska from which data have been taken.

SUMMARY REPORTS ON GEOLOGY AND MINERAL RESOURCES OF ALASKA.

NOTE.—An asterisk (*) indicates that the Survey's stock of the publication is exhausted, but that it can be obtained of the Superintendent of Documents, Washington, D. C., at price indicated.

The petroleum fields of the Pacific coast of Alaska, with an account of the Bering River coal deposits, by G. C. Martin. Bulletin 250, 1905, 64 pp.

*The geography and geology of Alaska, a summary of existing knowledge, by A. H. Brooks, with a section on climate by Cleveland Abbe, jr., and a topographic map and description thereof by R. U. Goode. Professional Paper 45, 1906, 327 pp. $1.

The mining industry in 1906, by A. H. Brooks. Bulletin 314, 1907, pp. 19–39.

Markets for Alaska coal, by G. C. Martin. Bulletin 284, 1906, pp. 18–29.

Outline of economic geology, by A. H. Brooks (in The gold placers of parts of Seward Peninsula). Bulletin 328, 1908, pp. 111–139.

[1] Brooks, A. H., Geologic features of Alaskan metalliferous lodes: U. S. Geol. Survey Bull. 480, pp. 43–93, 1911.

Geology of the Seward Peninsula tin deposits, by Adolph Knopf. Bulletin 358, 1908, 72 pp.

*The distribution of mineral resources in Alaska, by A. H. Brooks. Bulletin 345, 1908, pp. 18–29. 45c.

*The possible use of peat fuel in Alaska, by C. A. Davis. Bulletin 379, 1909, pp. 63–66. 50c.

Mineral resources of Alaska, by A. H. Brooks. Bulletin 394, 1909, pp. 172–207.

The preparation and use of peat as a fuel, by C. A. Davis. Bulletin 442, 1910, pp. 101–132.

Alaska coal and its utilization, by A. H. Brooks. Bulletin 442, 1910, pp. 47–100.

Geologic features of Alaskan metalliferous lodes, by A. H. Brooks. Bulletin 480, 1911, pp. 43–93.

*Railway routes from the Pacific seaboard to Fairbanks, by A. H. Brooks. Bulletin 520, 1912, pp. 45–88. 50c.

*Tin resources of Alaska, by F. L. Hess. Bulletin 520, 1912, pp. 89–92. 50c.

Marble resources of Ketchikan and Wrangell districts, by E. F. Burchard. Bulletin 542, 1913, pp. 52–77.

Surface water supply of Seward Peninsula, Alaska, by F. F. Henshaw and G. L. Parker; with sketch of geography and geology by P. S. Smith, and description of methods of placer mining by A. H. Brooks. Water-Supply Paper 314, 1913, 317 pp.

Surface water supply of the Yukon-Tanana region, Alaska, by C. E. Ellsworth and R. W. Davenport. Water-Supply Paper 342 (in press).

A water-power reconnaissance in south-central Alaska, by C. E. Ellsworth and R. W. Davenport; with a report on water power in southeastern Alaska by J. C. Hoyt. Water-Supply Paper — (in preparation).

GEOGRAPHIC DISTRIBUTION.

MAP OF MINERAL RESOURCES.

The distribution of the mineral resources of Alaska, so far as known, is indicated on the accompanying map (Pl. I, in pocket). This map is based for the most part on the observations of members of the Geological Survey, but some data from other reliable sources have been used relating to localities not yet examined by the Survey geologists. The map is a revised edition of one published in 1912 as Plate I in Bulletin 520.

The distribution of the different kinds of mineral deposits is indicated by symbols, so far as the small scale of the map would permit, but it has not been possible everywhere to make these symbols altogether consistent. The symbol for gold placers marks the localities where placer gold has been found in commercial quantities, but for the most part it indicates only those places where actual mining has been done.[1] The symbol for auriferous lodes indicates chiefly the operating mines but includes some prospects which have not yet been productive. The symbol for copper marks the mine localities, as well as prospects. The symbol for tin deposits indicates both placer and lode deposits, though the latter are for the most part only prospects.

[1] For statistics of mineral production see pp. 46, 47, 52–5, 72.

The fact that the geology of coal is in general much simpler than that of the metalliferous deposits makes it possible to present more facts in regard to its distribution and these with a far greater degree of confidence. On the map the occurrence of sediments belonging to the horizons of the coal-bearing rocks is indicated by stippling, but no attempt is made to distinguish between the coal measures of different geologic ages. The areas shown can be regarded as the most promising fields for coal prospecting, but should not be taken to indicate the actual distribution of workable coal seams. The areas known to carry coal, probably in workable beds, are marked in black with a letter indicating the quality of the coal, and at several of the localities thus marked there has been a little coal mining. The location of petroleum seepages is also indicated on the map. All but one of the known seepages occur on the Pacific coast, the exception being on the north Arctic coast. The symbols for petroleum seepage in the Katalla field, near Controller Bay, also mark the position of several wells from which there has been a small production.

Some marble quarrying has been done in southeastern Alaska, and the known deposits of commercially valuable marble in this field are shown on the map. There are beds of marble in other parts of Alaska, but they have not been sufficiently studied to indicate that they have value.

Besides the production from mineral deposits indicated on the map there has been a small output from garnet, graphite, and jade deposits. A large amount of silver and a little lead have been recovered from ores mined chiefly for other metals. Cinnabar, molybdenite, stibnite, wolframite, scheelite, barite, and other minerals have also been found. Iron ores occur at a number of localities but are undeveloped. Asbestos and mica in workable deposits have been reported. Some sulphur has been found in association with active volcanoes. Granite is very abundant in most parts of the Territory, and some of it is probably suitable for building stone. Limestone and shale suitable for the manufacture of cement have been found at several localities but have not been utilized. Peat is widely distributed. Hot springs are abundant and several have been used for local sanitariums. A little mineral water has been utilized.

MINING DISTRICTS.

Southeastern Alaska.—In southeastern Alaska are the Juneau gold belt, the Porcupine gold-placer district, and the Ketchikan copper district, which contains some auriferous veins. Some iron ore has been found in association with copper in the Ketchikan district and also as distinct ore bodies near Haines. Silver-bearing galena lodes have been found in the Ketchikan and Wrangell districts. Gold lodes occur in Sitka district, where there is also one gypsum mine.

Marble is widely distributed in southeastern Alaska and has been quarried in the Wrangell and Ketchikan districts. Garnets have been mined in the Wrangell district, where a deposit of barite has also been found. There are some small areas of lignite-bearing rock on Admiralty and Kupreanof Islands. Granite is widely distributed in southeastern Alaska. This province contains several hot springs.

Central Pacific coast region.—The name central Pacific coast region is here used to designate the mountain and foothill belt stretching eastward from Copper River to Lituya Bay. In it lies the Bering River coal field, with its high-grade coals. Coal, probably of a bituminous character, has been found in the foothills north of Yakataga, near the head of Yakutat Bay, and is reported on the southwest slope of Mount St. Elias. The Katalla petroleum field, near Controller Bay, lies in this region, and oil seepages have also been found 60 miles to the east at Yakataga. Gold beach placers have been worked at Yakataga and on Lituya and Yakutat bays.

Copper River basin.—The Copper River basin is known chiefly for the copper-bearing lodes of the Kotsina-Chitina district, now being developed, though some gold ores have also been found in its lower portions. The gold-placer districts of Nizina, Chistochina, and Bremner rivers are likewise within the Copper River basin.

Prince William Sound.—Gold and copper-bearing lodes are widely distributed in the Prince William Sound region and have been mined on a productive scale at several places. Some antimony and iron ores have also been found. Granite is rather widely distributed.

Kenai Peninsula.—In the eastern part of Kenai Peninsula there are gold placers, gold lodes, and a few copper-bearing lodes. Chromic iron and antimony lodes have also been found. The western half of the peninsula is underlain by lignitic coal measures, which occur also near Tyonek on the west side of Cook Inlet.

Matanuska and Susitna basins.—The Matanuska Valley is chiefly known for its high-grade coals, which occur in the upper part. In the southwestern part of the valley there are some lower-grade coals. A little placer gold has been found in northerly tributaries of the upper Matanuska, and at one locality some copper ore.

The Willow Creek district, named from a tributary of the lower Susitna, first developed in a small way for placer gold, is now a lode district. Some copper lodes have been found in the lower Talkeetna basin. The gravel of the Susitna Basin carries a little fine gold, but workable placers have as yet been found only in the Yentna district, on Willow Creek, and in the Valdez Creek district, lying in the headwater region. Lignitic coal-bearing rocks are widely distributed in the Susitna Basin.

Iliamna region.—There are some petroleum seepages on the west shore of Cook Inlet, north of Iliamna Bay. Gold and copper bearing lodes have been found in the region tributary to Iliamna and Clark lakes and to Kamishak Bay, and a little placer gold has been mined on a tributary of Clark Lake and in the headwaters of Mulchatna River.

Southwestern Alaska.—For the purpose of this description southwestern Alaska includes the Alaska Peninsula and adjacent islands, with Kodiak Island and the Aleutian chain. A little beach-placer gold has been mined on Kodiak and Popof islands. Some auriferous lodes and a few small areas of lignitic coal have been found on Kodiak Island. The mineral resources of the Alaska Peninsula include the bituminous coals of the Chignik and Herendeen fields, and some deposits of lignitic coal at other localities. Near Cold Bay there are some petroleum seepages. On Unga Island some gold and silver bearing lodes have been developed. A few copper-bearing lodes have also been found on the lower half of the Alaska Peninsula. A few small auriferous quartz veins have been found on Unalaska Island, in the eastern half of the Aleutian chain. Copper ores have been reported from these islands, and some sulphur deposits are said to occur near the vents of some of the active volcanoes. There is a considerable deposit of tuff, a volcanic ash—the recent ejecta of Mount Katmai volcano—that has been utilized as an abrasive.

Eastern shore of Bering Sea.—The eastern shore of Bering Sea from Bristol Bay to Norton Sound is, so far as known, without important mineral resources. A little placer gold has been found on tributaries of Goodnews Bay, a reentrant of the coast at the entrance to Kuskokwim Bay. Placer gold has also been mined on Bonanza Creek, a tributary of Ungalik River, which flows into Norton Sound. Some beds of lignitic coal have been found on Nunivak and Nelson islands and near the mouth of Unalaklik River, tributary to Norton Sound.

Kuskokwim basin.—The known mineral resources of the Kuskokwim basin include widely distributed gold placers, a few gold-bearing lodes, and some beds of lignitic coal. There appears to be a more or less broken belt of gold-bearing rocks which stretches northeastward from Goodnews Bay parallel to the lower course of the Kuskokwim, toward the Iditarod district, and a number of the streams traversing this belt carry auriferous gravels. Some placer gold has also been found in the Tocotna basin and on other westerly tributaries of the Kuskokwim. Cinnabar deposits also occur in this district. Some auriferous quartz lodes have been found in these several placer districts. Lignitic coal has been found on Big River, a southerly tributary of the South Fork of the Kuskokwim. Some coal of better grade has also been found near Iditarod. (See pp. 72–73.)

Yukon basin.—The gold deposits of the Yukon-Tanana region are the most valuable mineral resources in the Yukon basin. This region comprises the area bounded by the Yukon and Tanana valleys and the international boundary. Auriferous gravels are widely distributed in the region, which includes the important placer districts of Fairbanks, Hot Springs, Birch Creek, and Fortymile, besides a number of lesser note. In most of these districts some auriferous lodes have been found, and those of Fairbanks, at least, have proved to be of commercial value. Some deposits of stibnite and argentiferous galena are known in the Yukon-Tanana region. In the Hot Springs district some tin deposits have also been found. Auriferous mineralization is known south of the Tanana, where the placer districts of Bonnifield and Kantishna are situated. North of the Yukon are the Koyukuk, Indian River, and Chandalar placer districts. In the Koyukuk district some argentiferous lodes have been found, and in the Chandalar district several auriferous lodes have been developed. The Ruby gold placer district lies south of and tributary to the middle Yukon River. Some placer tin has been found in the Ruby district. To the southwest of this are the Innoko and Iditarod districts, where placer gold has been mined and lode gold found. Copper and gold lodes have been found in the headwater region of Tanana and White rivers, both tributaries of the Yukon. The Chisana placer district is also in the headwater region of the Tanana.

Lignitic coal is known in many places in the Yukon basin. The Nenana, the largest of the lignitic coal fields, lies on the south side of the Tanana Valley. There is another considerable area of rocks bearing lignitic coal on the south side of the Yukon between Seventymile River and Woodchopper Creek. Some beds of subbituminous coal occur on the north side of the lower Yukon, between Nulato and the mouth of the Innoko and have been mined in a small way. Hot springs are widely distributed in the Yukon basin.

Seward Peninsula.—The principal resources of Seward Peninsula, are the gold placers of the Nome and other districts. Some gold and silver bearing lodes have been exploited in a small way on the peninsula. A little graphite and garnet has been mined, and mica deposits are reported. Antimony-bearing veins have been developed, and some carrying a little copper are also known. Tin lode and placer deposits have been mined. Some scheelite has been recovered incidental to the mining of placer gold, and bismuth deposits have been found. Iron ore is reported. At Chicago Creek, in the northeastern part of the peninsula, lignitic coal has been mined. A little lignitic coal has also been found in other parts of the peninsula. Several hot springs are known in Seward Peninsula.

Kobuk-Noatak region.—A little placer gold has been mined on a tributary of Squirrel River and near Shungnak, both in the Kobuk basin, and auriferous gravels have been found at several localities in the Kobuk-Noatak region. Lodes carrying copper, gold, and silver have also been found in this region. A little lignitic coal is known in Kobuk basin. Jade has been obtained from this region. One hot spring has been found in the upper Kobuk and one in the upper Selawik valley.

Northern Alaska.—The region here designated northern Alaska includes the area drained by the rivers flowing into the Arctic Ocean north of Kotzebue Sound. No metalliferous deposits are known in this region, but coal is widely distributed. Near Cape Lisburne there are some high-grade bituminous coals, and 40 miles to the east is the Corwin field, containing extensive deposits of subbituminous coal. Coal is also known to occur at Wainwright Inlet and near the mouth of Anaktuvuk River. A petroleum seepage has been found southeast of Point Barrow, near the head of Smith Bay.

GEOLOGIC OCCURRENCE.

GOLD.

Geologic association.—As the placer gold was derived from a bedrock source, its occurrence as well as that of the auriferous lodes is an indication of the distribution of mineralization. (See map, Pl. I, in pocket.) Although all the factors which govern the accumulation of Alaska gold deposits are by no means fully understood, certain facts have been fairly well established. A large part of the auriferous mineralization is in regions which have been intruded by igneous rocks, such as granite or diorite. Many of the gold deposits occur near the contacts of intrusive rocks. These occurrences may be either in the intruded sediments or in the igneous rocks themselves, but their universal association with intrusives in many important districts and their absence where the intrusives are lacking can not be entirely fortuitous. This fact has led to the belief that the metal-bearing solutions which formed the gold deposits probably emanated from the same deep-seated source as the igneous rocks themselves. The mineralization is regarded in general as an after-effect of the igneous activity. This relation of mineralization to igneous rocks is especially noticeable in southeastern Alaska, but it also holds true in the Willow Creek, Fairbanks, Hot Springs, Chandalar, Innoko, Iditarod, and other districts. In general it is probably the law for the occurrence of gold in the entire Yukon and Kuskokwim basins. On Seward Peninsula no such relation between granitic rocks and gold deposits has been established. Here the mineralization along granite contacts is in some localities that of tin and associated ores; in others, galena.

In the Port Wells district of Prince William Sound there is evidence of a definite association of the auriferous mineralization and intrusive granites. Elsewhere on the sound this association is not so evident. At Valdez there are some intrusive dikes, but a genetic relation of these dikes with the gold-bearing quartz veins has not been established. The auriferous lodes of Kenai Peninsula are more or less closely associated with intrusive rocks, and the same is true in the Nizina and Chistochina districts.

The igneous rocks with which the genesis of most of the gold-bearing quartz veins appears to be connected are of the same general type and appear to belong to about the same epoch of intrusion—that of Jurassic and Lower Cretaceous time. The mineralization, which generally followed closely on the intrusion, is of the same general period as in the Cordilleran region of western North America. In view of this fact it becomes important to consider the general distribution of the granitic intrusives believed to belong to this epoch, for so far auriferous mineralization has been found associated only with these Mesozoic intrusives and by no means with all of them. Although both post-Mesozoic and pre-Mesozoic granites and diorites occur in Alaska, they are believed to be without any important mineralizing influence.

The Coast Range granodiorite of southeastern Alaska is the largest of the Mesozoic intrusive bodies and mineralization has been found on both sides of the extended intrusive belt which it forms. There are also many areas of granitic and allied intrusive rocks in the islands of southeastern Alaska and what is known of the geology of the St. Elias Range indicates the presence of similar intrusives there. The Yakataga placers are a further indication of auriferous mineralization in this area. The Talkeetna Mountains, lying north of the Matanuska Valley, are made up largely of granitic and chloritic rocks, probably for the most part intruded during Mesozoic times. The Willow Creek lode district is evidence of the presence of gold along the southwestern margin of this granitic area. Furthermore, several of the streams flowing into the Matanuska and crossing the granitic contact carry a little placer gold. There are many areas of intrusive granite in the Alaska Range, most of the higher peaks, including Mount McKinley, being granite stocks. The granite contacts in this area have been little studied, but some auriferous mineralization has been found along at least one of them. In the Iliamna region, again, there are abundant granitic intrusives and some mineralization. The Aleutian Islands are but little known. On Unimak, in the eastern part of the chain, a granite intrusive is known, and although the gold-quartz veins found here are of no economic value, they indicate mineralization and a possible site of other discoveries.

Granite is widely distributed in the Yukon-Tanana region, and its probable genetic relation to the gold deposits of Fairbanks and other districts has already been mentioned. The same relation appears to exist in the Chandalar, Koyukuk, Innoko, and Iditarod districts. There are abundant granitic intrusive rocks in the region lying between the lower Koyukuk and the Yukon, and here also a little placer gold has been found, giving evidence of mineralization. As already explained, in Seward Peninsula the mineralization definitely associated with granites is not that of gold; hence it may be that the auriferous deposits of this part of Alaska have a different origin from that of the deposits above described.

Types of deposits.—Alaska gold deposits fall into two general groups, lodes and placers. In the lodes the metal occurs in the hard rocks as the contents of veins or mineralized zones, usually in association with other metalliferous minerals. The gold placer is a body of unconsolidated material made up of gravel, sand, or clay containing a sufficient quantity of gold to permit profitable exploitation. This gold is more or less disseminated, but is usually found chiefly in the bottom layer of the deposit and at some places penetrates for considerable distances into the surface of the loose material of the bedrock floor. The placer gold is derived from the disintegration and erosion of auriferous lode deposits in the hard bedrock. The presence of rich placer deposits in a district is a hopeful indication that auriferous lodes occur, yet this does not necessarily follow, for the gold of the bedrock source may be too much disseminated to permit profitable exploitation.

Lodes.—The auriferous lodes of Alaska include many different types. The economically important ones can, however, for the most part be classed in two groups, the fissure veins and the disseminated lodes. There is also another type of minor importance—replacement deposits, in which the ore occurs along channels of solution, chiefly in limestones. In the vein deposits the ore body consists usually of quartz in which iron sulphides and other metalliferous minerals are more or less irregularly distributed. In these the ore body usually follows a more or less well-defined fissure in the country rock. This type is found at Sitka, at Port Valdez, on Kenai Peninsula, on Willow Creek, at Fairbanks, and elsewhere.

The disseminated deposits include those in which the gold and other minerals occur in a zone of fracturing. In deposits of this type the gangue material usually includes a large amount of the country rock, which in itself may be sufficiently mineralized to constitute an ore. Some of the disseminated deposits are zones of fracture, which are permeated by innumerable small quartz veins that carry the metal. These are properly stockwork deposits. Other dis-

seminated deposits follow well-defined zones of movement or shearing bounded by fractures. In still others the walls are ill defined, there being a gradual transition from the lode to the unmineralized country rock; or a mass of igneous rock, such as a dike, may be fractured and then permeated by the mineral-bearing solutions, and the dike thus changed more or less completely into an ore body. As a general rule the disseminated deposits carry less gold than the fissure veins, and can be profitably mined only if they are of large dimensions and so located as to assure cheap exploitation.

The low-grade ores of the Juneau district, including those of the Treadwell mines, are the best examples in Alaska of the disseminated type of deposit. Similar deposits have been found elsewhere in Alaska, but have received little attention because of their unfavorable location. There are also certain ore bodies—in the Juneau district, for example—which are intermediate in type between the disseminated deposits and the fissure veins. This is to be expected, as the metallization is of the same character in both types.

In the Ketchikan district and probably elsewhere in Alaska there are a few gold deposits occurring in limestone. In these the ore bodies occupy channels of solution rather than of fracture, and they can be designated replacement deposits. So far this type of gold deposit in Alaska has been of little commercial importance.

It is not proposed to consider here in detail the mineral character of the gold lodes, which differ more or less in the different districts. In general, however, it may be said that the gold occurs free or in combination with various sulphides. Pyrite is present in nearly all the Alaska gold deposits and other sulphides are common. Many deposits carry some galena and in some it is present in considerable quantities. Tellurides have not been found in commercial quantities in any of the Alaska mining districts. Quartz is the dominating gangue mineral, with some calcite and in certain localities albite feldspar.

Placers.[1]— The formation of placers is determined by (1) the occurrence of gold in bedrock to which erosion has access; (2) the separation of the gold from the bedrock by weathering or abrasion; (3) the transportation, sorting, and deposition of the auriferous material derived by erosion.

It is self-evident that unless there is gold in bedrock, a subject already discussed, placers can not be formed. In most of the rich placer districts there was more or less concentration of auriferous material by weathering before it was sorted and transported by running water. There are, indeed, some gold placers where the concentration is due almost entirely to this weathering process. These are what are called "residual

[1] The genesis of gold placers has been discussed by the writer in The gold placers of parts of Seward Peninsula, Alaska: U. S. Geol. Survey Bull. 328, pp. 111–139, 1908.

placers," of which a few examples have been found in Alaska. The principal agency in the formation of placers is that of sorting and transportation by running water. This action can take place many times—that is, a placer may be formed by water transportation and then destroyed again by new stream cutting, when uplift or increased precipitation has revived the forces of erosion.

A classification of the placers can be made, first, on genesis; second, on form. The primary grouping, according to origin, would be "residual placers," "sorted placers," and "re-sorted placers." The residual placers are those in which there has been little or no water transportation of the gold, the concentration being due primarily to rock weathering, settling, and removal of soluble rock constituent with more or less movement on the hill slopes. The gold of the sorted placers is the result of transportation, sorting, and deposition by water, though in Australia some examples of sorting of gold-bearing material by wind action have been noted. The re-sorted placers are those in which the gold has passed through two or more periods of erosion before its final deposition. The residual placers are practically all of one type. The sorted and re-sorted placers embrace many subordinate types, named according to the form of occurrence.

It will be evident that the sorting and re-sorting of the auriferous gravel may have taken place either under present conditions of erosion and deposition or in an earlier period, when conditions may have been different. It is therefore desirable to distinguish between modern and ancient placers. The modern placers include the deposits of the present period of erosion, the ancient placers those of an older period of erosion having different physical conditions. For example, there is some evidence that the deep gravels of Fairbanks were laid down when the climate was warmer and the precipitation greater than now. Again, the high bench and elevated beach placers at Nome were deposited when the land stood lower relative to the sea than at present and the drainage channels were different. There are some still older gravels in Alaska, deposited in Tertiary time, which are auriferous, and if any of these are found to be locally rich enough to permit mining they will constitute another group of ancient placers.

The foregoing remarks will make it clear that each of the larger genetic groups of placers can be subdivided into modern and ancient according to whether they were formed under present conditions or those of the past. The Alaska residual placers are, however, so far as known, all modern, though there is no inherent reason why ancient residual placers should not be found. The following summary presents the salient features of the above classification and while it is not altogether consistent it will serve for the present discussion.

Classification of Alaska placers.

1. Residual placers.
2. Sorted placers:
   - Modern:
     - Hillside.
     - Creek.
     - River bar.
   - Ancient:
     - Gravel plain.
     - Bench of present streams.
     - Bench of former drainage system.
     - Deep gravel.
3. Re-sorted placers:
   - Modern:
     - Creek.
     - Beach.
   - Ancient:
     - Elevated beach.
     - Deep gravel.

It is evident that this, like most other classifications, contains intermediate types which may belong to either of two groups. Hillside placers, for example, are those that occur on hill slopes and do not occupy any well-defined channels. These, though usually water sorted to a certain extent, grade directly into deposits of a purely residual origin on the one hand and into stream or gulch deposits on the other. Again, a creek or gulch placer may be in part a sorted, in part a re-sorted deposit. Moreover, many of the ancient placers afford no evidence as to whether their gold gravels may not be re-sorted.

Residual placers have been found at a number of localities in Alaska, but have not constituted an important source of placer gold. For example, the hill slope where the Treadwell lode outcrops was formerly covered with the débris of weathering, and this material carried considerable gold. The recovery of this placer gold was one of the first of the mining activities in the Juneau district. A residual placer occurs near the divide between Anvil and Dexter creeks, near Nome. Examples of this type of deposit have also been found on Hill Creek, in the Fairbanks district, and on Happy Gulch, in the Iditarod district.

Sorted placers, or those which are the result of water transportation and deposition during one period of erosion, are the prevalent type of deposit throughout Alaska. To these belong not only those of the present watercourses, but also some of those deposited at an earlier time. These earlier deposits are in part preserved as bench deposits and in part deeply buried by more recent alluvium. The gold-bearing glacial débris is another type of auriferous alluvium, but the known Alaska deposits of this kind can not be classed as placers,

because the gold is too finely disseminated to yield commercial deposits. It is important only in that it has furnished the gold for some of the re-sorted placers.

The hillside placers are occurrences of gold-bearing gravels on valley slopes not occupying well-defined channels but somewhat sorted by water and therefore not strictly residual placers. They form a transitional type between the residual and gulch placers. The placers of the present watercourses, termed creek or gulch placers, may be said to be now in process of formation. This process of erosion and deposition is so slow, however, that the present generation can not be expected to profit by it.

The present stream placers are chiefly deposits not more than 6 to 10 feet deep. They are not everywhere distinguishable from the deeper placers, which, though contained in present streams, have for the most part been laid down under physical conditions different from those which now exist. To cite localities of the occurrence of modern stream placers would be to list most of the placer districts of Alaska.

River-bar placers are those occurring in the larger streams having low gradients. In these the fine gold is deposited at certain places of minimum water movement. Some of these bar placers have locally been found rich enough to permit profitable exploitation by hand labor, but as a rule they are not extensive enough to warrant the installation of dredges. The gold in them seems to be concentrated on the surface and to be very much disseminated or absent in the rest of the deposit. The earliest mining in the Yukon was done on river bars during the low-water season. River-bar placers have also been mined on Birch Creek, on Fortymile and Koyukuk rivers, and on some of the streams of Seward Peninsula. As a whole, the river-bar placers have not been an important source of gold.

The gravel-plain placers occur chiefly in ancient and more or less elevated flood plains and deltas. These are in part modern but chiefly ancient placers and are somewhat intermediate in type between the creek and river placers. Some of the so-called tundra placers of Nome belong to this type. Their present importance has been derived chiefly from the fact that they furnished gold to some of the resorted beach and stream placers.

The commonest types of sorted ancient placers are those in the benches or terraces of present streams. These placers have all the characteristics of the modern stream placers, differing only in the fact that they have been dissected, as a rule because of uplift. Bench placers of this type are known in many of the mining camps of Alaska. A few placers of this type occur at Fairbanks, but these have been buried by later alluvium. One of the best examples of bench deposits is that on the north side of Glacier Creek, near Nome. Such placers

are also found in Kenai Peninsula and in the Fortymile, Koyukuk, Innoko, Iditarod, and various other districts.

The high bench placers are those which resulted from stream action of a former drainage system, now preserved only in fragmentary form. Unlike the bench deposits of present valleys, they have no direct relation to the existing drainage channels. Such placers are not abundant in Alaska. The famous White Channel gravel of the Klondike contains placers of this type, but nothing like this has been found in Alaska. High gravels carrying some gold are known in the Minook Creek basin near Rampart and in the Ruby district of the middle Yukon, but no workable placers have been found in them. On the other hand, some high bench placers near Nome, forming the divide between Dexter and Anvil creeks, have been worked. This period of gravel deposition has not been recognized in other parts of Seward Peninsula.

Some of the richest Alaska placers are those occurring in deeply buried channels, forming the type here designated "deep gravels." The best-known examples of these deposits are found in the Fairbanks district. The Fairbanks deep gravels are the deposits of ancient watercourses which occupied the present valleys but are now buried under an accumulation of 20 to 300 feet of alluvium. Mining operations have shown that the deep gravels have a rather straight course with only a few large bends, and that they lie on a bedrock floor whose downstream slope is a little steeper than that of the present valley bottoms. Most of these channels are centrally located with reference to the bedrock slope of the valley. In this they are in strong contrast to the present streams, which, as a rule, occupy strikingly asymmetric valleys, one wall of which they follow closely. The gravels of these deep channels are in general from 10 to 40 feet in thickness, though the local maximum is much greater. They are covered by 10 to 200 feet of what is generally termed "muck." This is black humus and gray fine sand and silt and clay. Some of this material is talus derived from the valley slopes, and some is probably the deposit of sluggish streams. In the headwater regions of the creeks the deep gravels merge with those of the present streams, and here the entire section consists of gravels. It seems pretty certain that the deep-gravel placers of the Fairbanks district were formed under climatic conditions different from those which now exist. Evidence that will not be presented here makes it probable that when these deposits were formed the climate was warmer and the precipitation greater. Deep-gravel placers are also found in the Hot Springs and Rampart districts, and to this class probably belong some of the placers of other districts of the Yukon-Tanana region. Similar deposits have also been found in the Koyukuk district, and

there are some deposits in Seward Peninsula which belong in this category.

Creek and gulch auriferous deposits that have derived their gold from the destruction of older placers, and therefore belong to the class of re-sorted placers, have been found in many of the Alaska districts. One of the best-known examples of the re-sorting process is the enrichment of the placers of Little Minook Creek, in the Rampart district, by the dissection of the high gravels. Re-sorted creek placers of this type have been found in the Hot Springs, Innoko, and Bonnifield districts and on Seward Peninsula.

The beach placers of Alaska are practically all of the re-sorted type. These are formed by the surf destroying alluvial deposits and concentrating their gold contents. The best-known examples of this class are the Nome beach placers, from which several million dollars' worth of gold has been won. Beach placers also occur along the Pacific seaboard near Lituya, at Yakataga, in the southern part of Kodiak Island, and on Popof Island. Some of these beach placers are annually more or less enriched by surf action. These are usually of small extent and can, therefore, be profitably exploited only by hand labor.

The ancient re-sorted placers probably include the same types as the modern ones. At Nome, for example, there are both buried and elevated beach placers formed at a time when the land stood at a different altitude relative to the sea. Not enough is known of the deep-gravel placers to permit a definite assignment of any of them to the re-sorted type. The great richness of some of them, combined with the irregular distribution of the gold, as in the Koyukuk region, suggests that some of these are re-sorted.

The mineral content of the placers needs no detailed description here. It varies according to the character of the bedrock from which the material has been derived. Besides the gold, other heavy minerals are present in the concentrates. Garnet, magnetite, pyrite, scheelite, wolframite, and sometimes ilmenite are found with placers. In the Nizina district native copper is abundant. In the York region the placer tin deposits were first worked for gold. Alluvial tin is also found in some of the Hot Springs gold placers. Cinnabar has been found in several of the Alaska gold placers. Some of the placers carry native silver, and a few minute grains of platinum have been found in some of the concentrates from the Yukon basin. Placer gold always carries some impurity, in which silver is the most abundant constituent.

COPPER.

Though there are some copper placers in Alaska, most of the valuable occurrences of this metal are in lodes. The copper-bearing lodes have much greater variety of occurrence than the auriferous lodes.

In the absence of definite knowledge regarding the genesis of some of these deposits an entirely consistent classification is not now possible. For the purpose of this writing, however, five types of copper deposits will be recognized, as follows:

1. Contact deposits carrying copper sulphides.
2. Disseminated copper sulphides in intrusive rocks.
3. Veins and fracture zones carrying copper sulphides associated with argillites and ancient volcanic rocks and occurring chiefly in regions of intrusive rocks.
4. Veins and fracture zones carrying copper sulphides cutting limestones and ancient volcanic rocks.
5. Native copper deposits in amygdaloidal lavas.

The contact deposits are closely connected with granitic and dioritic intrusive rocks and are believed to belong to the same epoch of mineralization as the gold lodes above described. The best-known copper lodes having this association are found in altered and recrystallized limestones at the contact with the intrusive rocks. Such occurrences have been found in the Ketchikan, Iliamna, Nabesna, and other districts. The ore bodies, which are of irregular outline and distribution, consist generally of chalcopyrite and pyrite (in places with bornite) in a gangue of garnet, magnetite, epidote, calcite, and quartz.

Disseminated sulphide deposits occur in the intrusive rocks of Kasaan Peninsula. This forms the second type of copper deposit, which as yet is unimportant commercially, but one commercial ore body having been developed at the head of Kasaan Bay. Here bornite is scattered through a heavy green dioritic rock containing much biotite. There is some chalcocite and chalcopyrite in this deposit.

The third type of deposit is that in veins and shear zones cutting slates and ancient volcanic rocks. These have been found chiefly in regions of Mesozoic intrusives and are probably genetically related to these igneous rocks, but they do not lie in the zones of contact metamorphism. Some of them are fissure veins which cut country rock of various kinds, but chiefly ancient volcanic rocks and slates. These differ little from the gold-bearing veins except in their mineral content. Examples of this type have been found in the Ketchikan district and elsewhere in Alaska.

Another variety of this type comprises the mineralized zones of fracture, also in country rock of slates and greenstones. In these the copper may be disseminated but is more commonly in part concentrated in lenses that furnish the workable ore shoots. These ores are in part deposited in open spaces, in part replacements of country rock. Such deposits are found in Ketchikan district but are better known by their occurrence in deposits of the Ellamar district, on Prince William Sound. The Ketchikan deposits of this type are more or

less definitely associated with Mesozoic intrusive rocks. Such a relation to igneous rocks, though suspected, has not been established for the Prince William Sound region. The ores of this type are chiefly chalcopyrite and pyrrhotite, with which are associated pyrite, sphalerite, arsenopyrite, galena, gold, and silver.

The fourth type includes the copper deposits occurring in fissure veins and shear zones, cutting limestone and ancient volcanic rocks. This type is best known from the lodes of the Kotsina-Chitina district. These are associated with ancient basaltic lavas, some of which are amygdaloidal and with which some sedimentary beds are intercalated. Conformably above this series is a heavy limestone, near the lower contact occur the most valuable ore bodies that have yet been developed, but some copper occurs throughout the greenstone, and valuable copper lodes have been found in the limestone a long distance from the contact. In general, the most promising deposits have been found along lines of movement which intersected the contact at different angles. It also appears that the plane of the contact between the two formations locally furnished passage for the solutions, even when no movement had taken place. A few deposits that can be classed as fissure veins have been found in this region, but most of the ore bodies are more or less irregularly distributed replacements of the country rock. The openings along which the solution traveled were in many places minute and were probably caused by deformation. The chief ore minerals of these deposits are chalcopyrite, bornite, and chalcocite.

Primary native copper has been found in an amygdaloidal volcanic sheet at the head of the Middle Fork of White River. These deposits are considered primary in the sense that the copper was deposited in the native state in the amygdules and was not the result of the oxidation of sulphides.

Native copper is also found disseminated in the ancient lavas or greenstones of the Kotsina-Chitina and Nabesna-White River regions. The copper is irregularly distributed in fracture zones and is believed to be secondary, possibly being derived from sulphides in the greenstone. Such copper is probably more or less superficial and has not been sufficiently developed to determine its commercial value. It is therefore not here considered as forming a distinct type of ore deposit. With the exception of those deposits, which may be secondary, Alaska copper deposits bear as a rule little evidence of alteration. In most of the copper districts recent glaciation has removed the products of oxidation, and little evidence of enrichment has been found. In some localities the outcrops of the copper sulphides have been changed to copper carbonates, but this is usually only a superficial alteration.

SILVER, LEAD, AND ZINC.

Most of Alaska's silver output (pp. 53–56) has been derived from the silver content of placer gold, but nearly all the gold lodes and many of the copper lodes carry some silver. This is usually in the form of an argentiferous galena, which in some places forms a considerable part of the value of the ore mined. There has been but little development of lodes valuable for their silver and lead alone, though such deposits occur in the Territory. Many of these are replacement deposits in limestone; some are fissure veins. Nearly all of them carry also minor amounts of gold. Fissure veins containing argentiferous galena have been developed in the Ketchikan and Wrangell districts and elsewhere in southeastern Alaska.

Among the many localities where deposits of galena ore have been found in Alaska the Fish River basin, in the eastern part of Seward Peninsula, deserves mention. Some galena deposits have also been found in the western part of Seward Peninsula, in the Fairbanks district, in the Koyukuk basin, and near Mentasta Pass.

No deposits valuable for their zinc content alone have been found in Alaska. Sphalerite is, however, a common accessory mineral in the gold and silver deposits and in some of the copper deposits.

TIN AND TUNGSTEN.

Cassiterite in the form of stream tin is not an uncommon mineral in some of the auriferous gravels of Alaska. It has been systematically mined only in the York district of Seward Peninsula, but some has been recovered incidentally to gold mining in the Hot Springs district of the lower Tanana. Considerable stream tin associated with wolframite, has also been found on Deadwood Creek in the Birch Creek district. Placer tin has also been found on Midnight Creek, in the Ruby district. Lode tin has been reported in the Hot Springs district, but such ore has thus far been mined only in the York district. Here it occurs associated with granitic and porphyritic intrusive rocks. The tin-bearing lodes occur in part in contact-metamorphic zones between slates and granites, in part in mineralized quartz porphyry dikes, and in part in quartz veins cutting granitic slates and limestones. They are therefore, like many of the gold-bearing lodes, closely associated with intrusive granites and allied rocks. Some of these deposits also carry the tungsten minerals wolframite and scheelite. Scheelite has also been found in some of the auriferous gravels and in some small quartz veins on Seward Peninsula.

IRON AND CHROMITE.

Practically no iron ore has been mined in Alaska, and there has been little prospecting for this mineral. Magnetite is abundant in some of the contact copper deposits of the Ketchikan district and occurs in

similar association in the Iliamna region. Veins of magnetite ore have been found in the Nabesna and Prince William Sound regions, and the latter contains also some hematite. Magnetite deposits segregated from igneous rocks occur near Haines in southeastern Alaska. None of the Alaska iron ores are sufficiently developed to prove their commercial importance. Chromite occurs in a lode deposit near Port Chatham on Kenai Peninsula. Fragments of chromite ore have also been found in the gold placers of Shungnak in the upper Kobuk basin.

ANTIMONY.

Stibnite, the sulphide of antimony, is one of the most widely distributed minerals in Alaska, for it occurs as an accessory in many of the ore bodies of types already described. There are also some lodes in which stibnite is the dominating metallic mineral. All these stibnite-bearing lodes carry more or less gold, and a number of them probably carry enough gold to warrant classifying them with the auriferous lodes. The geologic association of the stibnite deposits is similar to that of the gold ores.

In southeastern Alaska stibnite has been recognized only as an accessory mineral in some of the gold ores. Quartz veins carrying stibnite have been found on Kenai Peninsula, Prince William Sound, and in the Kantishna and Fairbanks districts; also in Nome and in other districts of Seward Peninsula.

OTHER METALLIC MINERALS.

Nickel and cobalt deposits have been reported by prospectors, but in no samples tested by the Survey were these metals found in commercial quantities. A small amount of nickel and traces of cobalt were found by the analyses of some pyrrhotite ores from the Ketchikan district. Similar tests on pyrrhotite ores from Prince William Sound revealed neither cobalt nor nickel.

No commercial bodies of molybdenite have been found. This mineral occurs in some of the auriferous deposits in the Juneau district, notably at the Treadwell mine. Molybdenite has also been found in quartz stringers which cut the sediments that are altered by igneous metamorphism adjacent to the Coast Range granite belt and to other intrusive masses in the Ketchikan district. It has also been seen as an accessory mineral with the gold ores in other parts of Alaska.

A deposit of native bismuth on which a little development work has been done occurs on Charley Creek, tributary to Sinuk River, about 25 miles north of Nome. The bismuth occurs in two small quartz veins cutting schists.

A cinnabar deposit was discovered near Kolmakof, on the Kuskokwim, many years ago and is a perennial source of attraction to pros-

pectors. This deposit has not been studied by members of the Survey but has recently been developed on a small scale. Cinnabar is found as an accessory mineral in some of the auriferous gravels. It is very abundant in the concentrates from placer mining on Daniels Creek, about 60 miles east of Nome. While the bedrock source of this cinnabar has not been found, it evidently lies at a contact of schist and limestone. Cinnabar is also abundant in placers of Iron Creek, on Seward Peninsula.

A few minute grains of platinum have been found in some of the Alaska gold placers, but as yet not in sufficient quantity to be of commercial importance.

COAL.

Most Alaska coal is associated with conglomerates, shales, and sandstone of Eocene age. Some of these coal measures are little disturbed, and in these the rocks are in many places but slightly indurated, being hardly more than loosely cemented gravels, sands, and silts. In rocks of this type the coals are usually lignitic. Where the rocks have been folded and faulted, they are hard, forming conglomerates, sandstones, and shales. In these the associated coals are of higher grade, varying in composition from subbituminous to anthracite.

Alaska's coal resources range in quality from low-grade lignites to anthracite and include high-grade coking and steaming bituminous coals. The lignite and subbituminous coals are by far the most abundant and most widely distributed. They occur as a rule, as already stated, in beds which are but little disturbed, some lying horizontal and others being gently folded and, in some localities, more or less faulted. The higher-grade coals occur in areas of folding and faulting. As a rule, the quality of the coal bears a direct ratio to the amount of deformation, the lignite being in the least-folded rocks and the anthracite in the most.

The strata carrying high-grade coal have steep dips; in some places the beds are overturned and fractures and faults are common. As a result of these movements much of the coal, particularly the anthracite, is so crushed that briquetting will be necessary. Because of this complex structure and attendant crushing the cost of mining some of the high-grade coal will be prohibitive under present market conditions. These facts are emphasized here because it is sometimes assumed that every bed of high-grade coal is a potential source of wealth. On the other hand, in all the high-grade coal fields there are many localities where coal can be profitably mined when transportation to market is available.

The Matanuska field affords an illustration of the changes in quality of coal due to folding. The southwestern part of the field includes only low-grade coals contained in rocks but little disturbed.

To the northeast and inland the deformation of the coal measures increases and the coals are of better grade. At the east end of the field the beds have been profoundly folded and faulted and the coal is anthracite. There is a similar transition in the Bering River field from bituminous coal near the coast to anthracite in the most profoundly disturbed part of the field.

Although it is sometimes asserted that the age of the coal is the determining factor in quality—that is, that the oldest coals are always the best—such is not the general rule in Alaska. There are, indeed, near Cape Lisburne some high-grade coals of Carboniferous age, but, on the other hand, the Jurassic coals near by are not as good as some of the Tertiary coals which have been described above. It is also not true, as is sometimes stated, that the high grade of some of the Alaska Tertiary coals is due to the effect of igneous intrusion. Igneous rocks are abundant in parts of the Matanuska field, but they have not affected the coal except in some places where it has been altered to a coke. The presence of these igneous rocks will, however, increase the cost of mining.

The Eocene coal-bearing rocks are widely distributed in Alaska. In southeastern Alaska they occur on Admiralty and other islands, but, so far as known, contain little coal. The bituminous and anthracite coal of the Bering River field are in rocks of probably the same age. A great thickness of Eocene coal measures occurs on the west side of Kenai Peninsula, and the same formation is represented on the west side of Cook Inlet, where much of it is buried under gravels. There are some Eocene coal-bearing rocks on the Alaska Peninsula and also some coals of Upper Cretaceous age. Lignite-bearing beds, chiefly of Eocene age, occur on the two slopes of the Susitna Basin, and it is not impossible that much of the Susitna lowland may be underlain by this same formation. The bituminous and anthracite coals of the Matanuska field are also of Eocene age.

The Nenana coal field lies north of the Alaska Range and on the south side of the Tanana Valley. The coals in this field are of Tertiary age but probably post-Eocene. It is not impossible that much of the Tanana lowland may be underlain by this same formation. There is also a belt of coal-bearing rock, probably of Eocene age, paralleling the upper Yukon below the international boundary. Small areas of rocks belonging to the same horizon are known in various parts of the Yukon basin. (See pp. 72–73.) Some coal is reported in the upper White River basin. On the lower Yukon there are some Upper Cretaceous as well as Eocene coals. Coal, probably in the main of Eocene age, is reported at various places in the Kuskokwim basin. There are a few Upper Cretaceous or Eocene coal-bearing rocks in Seward Peninsula and the Kobuk region.

As already noted, coals of Carboniferous and Jurassic age occur in the Lisburne region and in other parts of the Arctic slope, though little is known about them.

Less than one-tenth of Alaska's coal fields have been surveyed in sufficient detail to permit a determination of the actual area of coal land. The results of these surveys are included in the subjoined table. This table includes the lands believed to be underlain by coal but does not attempt to distinguish the deposits that are workable under present conditions. This can be determined only by opening the individual coal beds and thus ascertaining the conditions of mining and the physical character of the coal.

Total known areas of coal lands in Alaska coal fields.

Region.	Square miles.	Acres.
PACIFIC COAST REGION.		
Bering River coal field:		
Anthracite and semianthracite	28.8	18,432
Semibituminous	15.5	9,920
	44.3	28,352
Matanuska coal field:		
Anthracite	4.0	2,560
Semibituminous	52.0	33,280
Bituminous	44.0	28,160
	100.0	64,000
Southeastern Alaska: Lignite	10.0	6,400
Kenai Peninsula and Cook Inlet region: Lignite	282.0	180,480
Alaska Peninsula and southwestern Alaska:		
Bituminous	29.7	19,008
Lignite	31.5	20,160
	61.2	39,168
Susitna basin and Knik region: Lignite	22.0	14,080
INLAND REGION.		
Nenana coal field: Lignite	122.0	78,080
Yukon basin (except Nenana coal field):		
Bituminous	162.0	103,680
Lignite	155.0	99,200
	317.0	202,880
NORTHWESTERN AND NORTHERN ALASKA.		
Seward Peninsula: Lignite	48.5	31,040
Cape Lisburne region:		
Semibituminous	14.2	9,088
Bituminous	205.0	131,200
	219.2	140,288
Northern Alaska:		
Bituminous	9.0	5,760
Lignite	93.0	59,520
	102.0	65,280
RECAPITULATION.		
Anthracite and semianthracite	47.0	30,080
Semibituminous	67.5	43,200
Bituminous	454.7	291,008
Lignite	759.0	485,760
	1,328.2	850,048

In addition to the areas listed above there are about 16,000 square miles of which sufficient is known to indicate that it may be underlain by coal. Most of this additional area of possible coal land will fall in the lignite class. This possible coal land is distributed as follows: Pacific coast region, 8,500 square miles; interior region, 4,500 square miles; Arctic slope region, 3,000 square miles.

PETROLEUM.

Petroleum seepages occur near Katalla, on the Pacific coast, and near Yakataga, 60 miles to the east. At Katalla there has been a small production from two or three wells. The surface rocks of the Katalla field are closely folded and faulted shales and sandstones of Tertiary age. Nothing is known as to the sources of the oil, and it may have its genesis far below the formation exposed at the surface. The Tertiary strata through which the seepages flow are intensely deformed, and the field in this respect is comparable to the oil fields of California. On the other hand, the petroleum is similar in composition to that of Pennsylvania fields. The same geologic conditions prevail at Yakataga, but no drilling has been done there.

Petroleum seepages also occur on the west side of Cook Inlet near Iniskin Bay. Here the rocks are Jurassic sediments, chiefly shales and sandstones. These rocks lie in broad open folds, a condition favorable to petroleum accumulation, but on the other hand they are broken by faults. Similar conditions prevail at Cold Bay, 160 miles to the southwest, where petroleum seepages also occur. A little drilling has been done in both these fields, but not enough to prove the presence or absence of commercial oil pools.

Some petroleum residue has been found near the south end of Smith Bay, an indentation on the Arctic coast of Alaska about 60 miles east of Point Barrow. This would indicate the presence of oil seepage, but nothing is known about the geology of the region.

Alaska petroleum, so far as its composition is known, is a refining oil with a paraffin base and a low sulphur content. That which is now being produced near Katalla is refined in a small plant and the gasoline locally marketed. There is no inherent reason why petroleum may not occur in some of the sedimentary rocks of parts of Alaska other than those where it reaches the surface through seepage. Such occurrence is, however, not to be expected in regions of metamorphism or extensive igneous intrusion. While petroleum may occur at depth and not reach the surface through seepage, yet there is now no information to guide the driller. Therefore, if any drilling is to be done, it will first be advisable to search out those areas where the presence of seepages gives best hope of favorable results.

PEAT.

Peat occurs in nearly every part of Alaska except in the high ranges. The humidity of the Pacific coastal zone and the consequent luxuriant vegetation favors its accumulation. Southeastern Alaska is heavily forested and in many places has a dense growth of underbrush with a flooring of moss. In southwestern Alaska timber is entirely absent but all the lowland and much of the upland regions are covered with moss, grass, and small shrubbery. The prevailing humidity in both these districts favors the accumulation of vegetable refuse. Though there has been no prospecting for peat in this part of the Territory, deposits at least 15 to 20 feet in thickness are known and some of them are believed to be of good quality.

Central and northern Alaska have a much smaller precipitation. Here, however, the soil is nearly everywhere mantled by a dense blanket of moss and other vegetation. This is especially striking in the extensive timberless areas or tundras which lie along Bering Sea and the Arctic Ocean. In these two provinces the subsoil is usually frozen, and the rain water is retained at the surface. The moss, except in excessively dry weather, is usually saturated with water. All these conditions, which promote vegetable growth and retard evaporation and oxidation, are favorable to the formation of peat. As a matter of fact, there is nearly everywhere a layer of peaty material underneath the soil. Some natural exposures reveal peat deposits having a depth of 30 to 40 feet. While the widespread surface layer of peat is of an inferior quality, some of the deeper-lying beds are probably of higher grade. No data whatever are at hand to estimate the available supply of peat, but as it is found in every part of Alaska and under the great tundras of the north, which form at least a quarter of the Territory, the total supply must be large and possibly exceeds that of the entire United States. It is not known what part of this peat is in beds thick enough and of proper quality to be utilized.

Owing to the presence of more easily available fuel there has been little occasion to utilize any of the peat beds, so practically nothing is known of their fuel value, extent, or thickness, except what has been stated. One of the few deposits of this mineral fuel in Alaska that have been exploited is a peat bed saturated with petroleum residue near Cold Bay, on the Alaska Peninsula, where some years ago the material was used for fuel at the neighboring oil drills. Here, however, it is the petroleum residue rather than the peat which gives the deposit its chief value. A little peat has also been dug and dried for fuel at St. Michael, Nome, and Fairbanks. In the absence of better and cheaper fuel at some places the peat beds will undoubtedly be locally utilized. Where good lignitic or higher-grade coals are available peat will not be used.

STRUCTURAL MATERIAL.

Considerable marble quarrying has been done in southeastern Alaska, and there are also a number of undeveloped occurrences of marble in this region. All the developed deposits occur at or near tidewater, no search having been made for marble in inland regions where high transportation costs would prohibit exploitation. Several varieties have been found among the marbles exploited. The most common variety in southeastern Alaska is a finely crystalline white to bluish-gray marble with gray to dark-bluish veins and clouded areas. Another kind also found in southeastern Alaska but little exploited is a crystalline marble which shows handsome "verde antique" effects and other striking combinations of color, such as green and pink, black and white, and white and yellow.

The marbles are altered limestones, the metamorphism being due for the most part to the intrusion of igneous rocks. They are all believed to be of Paleozoic age. Crystallized limestones are known in other parts of the Territory as well as in southeastern Alaska. Many of these beds are too shattered to yield structural material, but others might be of value if located on tidewater.

The only gypsum deposit that has been found in the Territory occurs in the eastern part of Chichagof Island, in the Sitka district. This deposit, which lies close to tidewater, has been mined for several years. The gypsum is associated with cherty limestones of upper Carboniferous age, but the deposit itself may be younger. There is no inherent reason why gypsum should be found only at this one locality.

Limestones and shales occurring in many parts of Alaska afford a possible source of material for the manufacture of cement. None of these has been tested, and even if they were found suitable they could be utilized only where proper fuel is available.

Granite and allied rocks are widely distributed in Alaska. They are especially abundant in southeastern Alaska, where water transportation is cheap. If any demand arises for building stone, some of these occurrences should yield suitable material.

MISCELLANEOUS NONMETALLIC MINERALS.

A little garnet mining has been carried on near Wrangell, in southeastern Alaska. The garnets at this locality are dark in color and occur in crystalline schist, probably of Mesozoic age. Garnets also occur in the metamorphic schists of the Kigluaik Mountains on Seward Peninsula, where a few have been mined. A little jade has been recovered from the Noatak-Kobuk region.

There are some deposits of graphite-bearing schists in the Kigluaik Mountains of Seward Peninsula, about 50 miles north of Nome. Some of this graphite has possible commercial importance and a few

small shipments have been made. A deposit of barite has been found in the Wrangell district of southeastern Alaska.

Asbestos occurs in the Yukon-Tanana region and the Kobuk basin but has not been found in commercial quantities. Workable deposits of mica have been reported to be present in the Susitna basin and in the Council district of Seward Peninsula.

There are some sulphur deposits around the volcanic vents of southwestern Alaska. A sulphur deposit on Makushkin Volcano, on Unalaska Island, was investigated several years ago with a view to commercial development. The results of this work have not been made public, but the enterprise has not been advanced. Some of the volcanic ash or tuff ejected from the eruption of Mount Katmai on June 6 to 8, 1912, has possible value for use as an abrasive. There is an abundance of this material, the most accessible deposit being that on the shores of Amalik Bay, Alaska Peninsula, where it is 20 feet or more in thickness. A few small shipments of this material have been made.

WATER RESOURCES.

The waters of Alaska can be grouped as surface, ground, and spring water. Surface water is the most valuable, chiefly to furnish power for mining and other industries but also for the use of towns and settlements. Ground waters occur in the Pacific slope region, but as there is an ample supply of surface water they have not been used. In the semiarid regions of the interior, where in some localities the surface water supply is scant, ground water is also not abundant. In this province much of the subsoil is permanently frozen and does not permit water circulation. In some places, however, there is a ground-water circulation below the zone of permanent frost and sometimes within the zone. It is possible that this ground water may in places be sufficient in quantity to have value for local use.

Twenty hot springs are known in Alaska, distributed as follows: Southeastern Alaska, 7; Alaska Peninsula, 2; Yukon basin, 7; Seward Peninsula, 2; Kobuk, 1; Selawik, 1. Mineral springs are also widely distributed, and a little mineral water was formerly exported from southeastern Alaska. Small sanitariums built at a number of hot springs have been an important element in the hygienic life of the people. Some of the hot springs have been used as health resorts, even where no permanent sanitarium had been erected. Hot springs are known in southeastern and southwestern Alaska, in the Yukon basin, and in Seward Peninsula.

The Pacific coastal region, with its high precipitation and strong relief, has many water powers. It should be noted, however, that the run-off is very much reduced during the winter. The best sources of power in this province are the lakes, which afford conditions for

less annual fluctuation than the streams. Only in southeastern Alaska has there been any considerable water-power development. For use in mining a total of 7,374 horsepower was developed by water wheels in Alaska in 1910.[1] This has since then been much increased. There are a number of promising water powers in the lower Copper River basin, in the Prince William Sound, Susitna, and Matanuska regions, and on Kenai Peninsula. There are also a number of water powers in the lake region of Iliamna.

In the Yukon region and in Seward Peninsula low stream gradients are the rule, and this condition, with the low precipitation, is unfavorable to the use of water under head. Nevertheless, even in these regions there is in the aggregate much water available for placer mining, and indeed much of this is now in use. In the higher parts of these provinces there are also some water powers, but these are undeveloped.

[1] Thirteenth Census, Reprint of Supplement for Alaska, p. 606, 1913.

THE ALASKAN MINING INDUSTRY IN 1913.

By ALFRED H. BROOKS.

GENERAL CONDITIONS.

Measured by value of output the Alaskan mining industry was less prosperous in 1913 than in 1912. Extensive developments were continued during the year in some of the gold-lode districts, notably at Juneau and to a lesser extent at Willow Creek and Fairbanks. This activity, consisting chiefly of underground dead work and of the installation of mills, has not yet contributed in any large measure to the gold production, and therefore two-thirds of Alaska's gold output still comes from the placer mines. Less than 40 per cent of the placer gold is produced by large plants, the rest being still won from the rich gravels that can be profitably mined by hand methods. Therefore marked fluctuation in the placer-gold output is inevitable, being due to the exhaustion of bonanzas on one hand and the discovery of new districts on the other. Moreover, these small operations are far more dependent on the local water supply than the large plants. Under such conditions no stability in the production of placer gold is to be expected. A shortage of water is almost a perennial condition in many of the placer camps, where large operations are attempted. Every four or five years there are unusually dry seasons, which may almost entirely curtail all operations except dredging. Such conditions prevailed in 1913 in the Yukon districts, in the Iditarod-Innoko region, and on Seward Peninsula. These conditions, together with the approaching exhaustion of the bonanza deposits of the Fairbanks district, account for the decrease in gold output. It must not be considered from the above statements that there is any shortage of auriferous gravels, but only of those that can be profitably mined under the present high operating cost. New areas of placer ground that could be profitably exploited by dredges, if transportation charges were reduced, are constantly being discovered. Moreover, the installation of dredges in the more accessible parts of Seward Peninsula has continued as in previous years. Deposits of auriferous gravels were found in 1913 in two new and widely separated localities—the upper Matanuska basin and the

upper basin of the Chisana (locally called Shushana), a tributary of the Tanana. What is true of the cost of placer mining applies also to lode mining, except on tidewater. The Fairbanks district has shown what can be accomplished in lode mining under the most adverse conditions of transportation, labor, water, and fuel. Mining in the coastal region is developing at so rapid a rate that it bids fair to overshadow all mining operations in the interior, and no marked progress can be expected in the inland region until a transportation system is provided.

The falling off in copper output is less significant, because it is due solely to the fact that the Kennecott-Bonanza—much the largest copper producer—was closed down, on account of accidents, for about one-third of the year. Tin mining continued in the York region of Seward Peninsula and some prospecting of tin deposits was done in the Hot Springs district of the Tanana Valley. One lignite mine was operated on Cook Inlet, the only one developed on a commercial basis in the entire Territory. The Katalla field produced some oil in 1913, and gypsum and marble deposits were worked in southeastern Alaska, as in previous years.

PRODUCTION.

The value of the total mineral production in 1913 is estimated at $19,416,294; in 1912 it was $22,566,484. The statistics for 1913 are not complete, and the figures given in the subjoined table may be subject to slight change. The output of marble, tin, gypsum, lead, and other minor products is given under a single item, because separate listing might reveal the production of individual properties.

Mineral production of Alaska, 1912–13.

	1912		1913		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....fine ounces..	829,435	$17,145,951	755,947	$15,626,813	− 73,488	−$1,519,138
Silver.....do....	515,186	316,839	362,563	218,988	− 152,623	− 97,851
Copper.....pounds..	29,230,491	4,823,031	21,659,958	3,357,293	−7,570,533	− 1,465,738
Coal.....short tons..	200	2,000	a 2,300	a 13,200	+ 2,100	+ 11,200
Marble, gypsum, tin, lead, petroleum, etc.....	.....	277,823	.....	a 200,000	.....	− 77,823
	.....	22,565,644	.....	19,416,294	.....	− 3,149,350

a Preliminary estimate.

NOTE.—In the above table copper is valued at 16.5 cents a pound for 1912 and 15.5 cents for 1913; silver at 61.5 cents an ounce for 1912 and 60.4 cents for 1913.

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

Value of total mineral production of Alaska, 1880–1913.

By years.				By substances.	
1880–1890	$4,686,714	1902	$8,400,663	Gold	$228,392,540
1891	916,920	1903	8,941,614	Silver (commercial value)	2,060,191
1892	1,096,000	1904	9,567,535	Copper	16,927,518
1893	1,048,570	1905	16,478,142	Coal	360,589
1894	1,305,257	1906	23,375,008	Marble, gypsum, tin, etc.	1,210,377
1895	2,386,722	1907	20,847,055		248,951,215
1896	2,980,087	1908	20,142,272		
1897	2,538,241	1909	21,141,019		
1898	2,585,575	1910	16,887,244		
1899	5,703,076	1911	20,691,241		
1900	8,238,294	1912	22,565,644		
1901	7,007,398	1913	[a] 19,416,294		
			248,951,215		

[a] Preliminary estimate.

TRANSPORTATION.

There was no railway construction in Alaska during 1913. In view of the present interest in Alaskan railways concise data regarding existing lines are presented in the following table:

Railways in Alaska.

	Miles.
Southeastern Alaska:	
White Pass & Yukon route, Skagway to White Pass (narrow gage). Terminal at White Horse, Yukon Territory; total mileage, 102 miles	20.4
Yakutat Southern Railway, Yakutat to Situk River (narrow gage) (not a public carrier)	9.0
Copper River: Copper River & Northwestern Railway, Cordova to Kennicott (standard gage)	195.0
(The same company has built a few miles of track at Katalla, where the Alaska Pacific Railway was laid in 1907, and some work was previously done at Valdez, on the Copper River & Northwestern Railway, on the Valdez & Yukon Railway, and on the Alaska Home Railway.)	
Kenai Peninsula: Alaska Northern Railway, Seward to a point near head of Turnagain Arm (standard gage) [1]	71.6
Yukon basin: Tanana Valley Railway, Fairbanks and Chena to Chatanika (narrow gage)	46.0
Seward Peninsula:	
Seward Peninsula Railway, Nome to Shelton (narrow gage) [1]	80.0
Paystreak branch, Seward Peninsula Railway (narrow gage) [1]	6.5
Council City & Solomon River Railway, Council to Penelope Creek (standard gage) [1]	32.5
Wild Goose Railway, Council to Ophir Creek (narrow gage) [1]	5.0
	466.0

Of these only the White Pass & Yukon, the Copper River & Northwestern, and the Tanana Valley railways, aggregating 261.4 miles of track, were operated as public carriers in 1913. A gasoline car was operated under a cooperative agreement by a citizens' com-

[1] Not operated as public carrier in 1913.

mittee of Seward for about 34 miles on the Alaska Northern Railway. On some of the Seward Peninsula railways freight was hauled by dog teams. This private operation of the lines was undertaken because the railway companies could not afford to pay the tax on public carriers.

In August, 1912, provision was made by law for a commission to investigate railway routes in Alaska and general conditions of transportation. The report[1] of the commission was submitted to the President on January 20, 1913. As a result, Congress gave the matter serious consideration, and a law providing for Government railways in Alaska was enacted on March 12, 1914. As this law is of great importance to the mining industry, it is here printed in full.

AN ACT To authorize the President of the United States to locate, construct, and operate railroads in the Territory of Alaska, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the President of the United States is hereby empowered, authorized, and directed to adopt and use a name by which to designate the railroad or railroads and properties to be located, owned, acquired, or operated under the authority of this act; to employ such officers, agents, or agencies, in his discretion, as may be necessary to enable him to carry out the purposes of this act; to authorize and require such officers, agents, or agencies to perform any or all of the duties imposed upon him by the terms of this act; to detail and require any officer or officers in the Engineer Corps in the Army or Navy to perform service under this act; to fix the compensation of all officers, agents, or employees appointed or designated by him; to designate and cause to be located a route or routes for a line or lines of railroad in the Territory of Alaska not to exceed in the aggregate one thousand miles, to be so located as to connect one or more of the open Pacific Ocean harbors on the southern coast of Alaska with the navigable waters in the interior of Alaska, and with a coal field or fields so as best to aid in the development of the agricultural and mineral or other resources of Alaska, and the settlement of the public lands therein, and so as to provide transportation of coal for the Army and Navy, transportation of troops, arms, munitions of war, the mails, and for other governmental and public uses, and for the transportation of passengers and property; to construct and build a railroad or railroads along such route or routes as he may so designate and locate, with the necessary branch lines, feeders, sidings, switches, and spurs; to purchase or otherwise acquire all real and personal property necessary to carry out the purposes of this act; to exercise the power of eminent domain in acquiring property for such use, which use is hereby declared to be a public use, by condemnation in the courts of Alaska in accordance with the laws now or hereafter in force there; to acquire rights of way, terminal grounds, and all other rights; to purchase or otherwise acquire all necessary equipment for the construction and operation of such railroad or railroads; to build or otherwise acquire docks, wharves, terminal facilities, and all structures needed for the equipment and operation of such railroad or railroads; to fix, change, or modify rates for the transportation of passengers and property, which rates shall be equal and uniform, but no free transportation or passes shall be permitted except that the provisions of the interstate commerce laws relating to the transportation of employees and their families shall be in force as to the lines constructed under this act; to receive compensation for the transportation of passengers and property, and to perform generally all the usual duties of a common carrier by railroad; to make and establish rules and regu-

[1] Railway routes in Alaska: 62d Cong., 3d sess., H. Doc. 1346, pts. 1 and 2, 1913.

lations for the control and operation of said railroad or railroads; in his discretion, to lease the said railroad or railroads, or any portion thereof, including telegraph and telephone lines, after completion under such terms as he may deem proper, but no lease shall be for a longer period than twenty years, or in the event of failure to lease, to operate the same until the further action of Congress: *Provided*, That if said railroad or railroads, including telegraph and telephone lines, are leased under the authority herein given, then and in that event they shall be operated under the jurisdiction and control of the provisions of the interstate commerce laws; to purchase, condemn, or otherwise acquire upon such terms as he may deem proper any other line or lines of railroad in Alaska which may be necessary to complete the construction of the line or lines of railroad designated or located by him: *Provided*, That the price to be paid in case of purchase shall in no case exceed the actual physical value of the railroad; to make contracts or agreements with any railroad or steamship company or vessel owner for joint transportation of passengers or property over the road or roads herein provided for, and such railroad or steamship line or by such vessel, and to make such other contracts as may be necessary to carry out any of the purposes of this act; to utilize in carrying on the work herein provided for any and all machinery, equipment, instruments, material, and other property of any sort whatsoever used or acquired in connection with the construction of the Panama Canal, so far and as rapidly as the same is no longer needed at Panama, and the Isthmian Canal Commission is hereby authorized to deliver said property to such officers or persons as the President may designate, and to take credit therefor at such percentage of its original cost as the President may approve, but this amount shall not be charged against the fund provided for in this act.

The authority herein granted shall include the power to construct, maintain, and operate telegraph and telephone lines so far as they may be necessary or convenient in the construction and operation of the railroad or railroads as herein authorized and they shall perform generally all the usual duties of telegraph and telephone lines for hire.

That it is the intent and purpose of Congress through this act to authorize and empower the President of the United States, and he is hereby fully authorized and empowered, through such officers, agents, or agencies as he may appoint or employ, to do all necessary acts and things in addition to those specially authorized in this act to enable him to accomplish the purposes and objects of this act.

The President is hereby authorized to withdraw, locate, and dispose of, under such rules and regulations as he may prescribe, such area or areas of the public domain along the line or lines of such proposed railroad or railroads for town-site purposes as he may from time to time designate.

Terminal and station grounds and rights of way through the lands of the United States in the Territory of Alaska are hereby granted for the construction of railroads, telegraph and telephone lines authorized by this act, and in all patents for lands hereafter taken up, entered, or located in the Territory of Alaska there shall be expressed that there is reserved to the United States a right of way for the construction of railroads, telegraph and telephone lines to the extent of one hundred feet on either side of the center line of any such road and twenty-five feet on either side of the center line of any such telegraph or telephone lines, and the President may, in such manner as he deems advisable, make reservation of such lands as are or may be useful for furnishing materials for construction and for stations, terminals, docks, and for such other purposes in connection with the construction and operation of such railroad lines as he may deem necessary and desirable.

SEC. 2. That the cost of the work authorized by this act shall not exceed $35,000,000, and in executing the authority granted by this act the President shall not expend nor obligate the United States to expend more than the said sum; and there is hereby

appropriated, out of any money in the Treasury not otherwise appropriated, the sum of $1,000,000 to be used for carrying out the provisions of this act, to continue available until expended.

SEC. 3. That all moneys derived from the lease, sale, or disposal of any of the public lands, including town sites, in Alaska, or the coal or mineral therein contained, or the timber thereon, and the earnings of said railroad or railroads, together with the earnings of the telegraph and telephone lines constructed under this act, above maintenance charges and operating expenses, shall be paid into the Treasury of the United States as other miscellaneous receipts are paid, and a separate account thereof shall be kept and annually reported to Congress.

SEC. 4. That the officers, agents, or agencies placed in charge of the work by the President shall make to the President annually, and at such other periods as may be required by the President or by either House of Congress, full and complete reports of all their acts and doings and of all moneys received and expended in the construction of said work and in the operation of said work or works and in the performance of their duties in connection therewith. The annual reports herein provided for shall be by the President transmitted to Congress.

Approved, March 12, 1914.

Early in May the appointment of the Alaskan Engineering Commission, for the purpose of carrying out the provisions of the above act, was officially announced. The members of this commission are William C. Edes, Lieut. Frederick Mears, United States Army, and Thomas Riggs, jr. Surveys of railway routes have been begun by the commission.

In 1913 both official topographic and private railway surveys were made across the neck of land which separates the head of Turnagain Arm from Passage Canal (locally known as Portage Bay), a western arm of Prince William Sound. Mr. Giffin, of the Geological Survey, made a topographic reconnaissance of this region (Pl. II), and a party of the Coast and Geodetic Survey made soundings of the head of Passage Canal, mapped the adjacent shore line, and carried the mapping across the first divide. The private railway survey was run from the head of Passage Canal to Turnagain Arm. All this information points to the conclusion that, with one 2-mile tunnel and a second tunnel or rock cut half a mile in length, a railway can be built across this divide which will avoid all glaciers, with a maximum grade not exceeding 0.3 per cent for both inward and outward bound traffic. The distance by this route from tidewater on Passage Canal to mile 64 on the Alaska Northern Railway is about 10.5 miles. Official information as to conditions of navigation, wind, etc., on Passage Canal are lacking at this writing. The topography and nearness of Portage Glacier suggest that strong winds will probably blow on Passage Canal at certain times in the year.

These facts are here set forth, because if the Portage Glacier route proves feasible for a railway, it will be of great importance to the mining industry, for it will give the Matanuska coal an outlet to an open harbor on Prince William Sound with only a slight grade to overcome.

The distance from the coal field to tidewater by this route is about 125.5 miles. It will not be necessary to discuss here the possible effect of the use of this route on other inland mining districts.

As this new route may become of much importance to the mining industry it will be of interest to record briefly the history of its exploration. As far back as 1794 the English navigator Capt. George Vancouver reported that the Russians had long used the Portage Glacier as a route from Prince William Sound to Turnagain Arm. It was frequently used by prospectors up to about 1907, when the completion of the Alaska Northern Railway gave more easy access to Turnagain Arm. The first official survey of the Portage Glacier region was made in 1898, when Capt. (now Col.) E. F. Glenn, United States Army, sent a party from Passage Canal across Portage Glacier to Turnagain Arm. While Col. Glenn in his report does not specifically state that the Portage Glacier route was not feasible for a railway, the logical inference from his statements[1] is to that effect. Moreover, the map illustrating these explorations and accompanying the volume indicates that no railway route is available unless a tunnel under a glacier were feasible. Mendenhall,[2] who accompanied the Glenn expedition as geologist, also makes no mention of the feasibility of the Portage Glacier route for a railway.

In 1899 Glenn again took up explorations in this region, the subparty being under the command of Capt. (now Maj.) Joseph S. Herron, United States Army. Herron crossed from Passage Canal by a route lying 10 miles north of Portage Glacier and therefore did not see the proposed railway route and makes no mention of it in his report.[3]

It could hardly be expected that the explorations above cited could definitely determine the feasibility of this route, for the surveys were only hasty reconnaissances made early in the spring, when the valleys were deeply buried in snow. Moreover, the examinations of the Portage Glacier route were only incidental to more extended inland explorations. It is probable that, because of the snow, the absence of ice from the valley lying inland of the first ridge west of the head of the Passage Canal was not noted by the Glenn party. It is this ice-clear valley which makes the route feasible for a railway. No other official surveys than those recorded above had been made of this pass when the Alaska Railroad Commission made its report; hence it reported[4] that this route was probably not feasible. While the official data available to the commission were all unfavorable to

[1] Reports of explorations in the Territory of Alaska (Cook Inlet, Susitna and Copper rivers), War Dept., Adjt. General's Office, pp. 103-104, 110, Washington, 1899.

[2] Mendenhall, W. C., A reconnaissance from Resurrection Bay to the Tanana River, Alaska, in 1898: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, pp. 300-301, 1900.

[3] Herron, J. S., Exploration in Alaska in 1899, War Dept., Adjt. General's Office, No. 31, Washington, 1901.

[4] Railway routes in Alaska: 62d Cong., 3d sess., H. Doc. 1346, p. 82, 1913.

this route, it had been advocated by a number of persons more or less familiar with the general region. Several years ago Mr. George Palmer, who has lived in the Cook Inlet region for more than 20 years, told the writer of the Portage Glacier railway route but could not give any detailed account of it. Mr. Henry Deyo, an experienced railway engineer of Valdez, expressed an opinion of the feasibility of this route in 1912, but at that time he had not seen it himself. The same year Tarr and Martin, who had been studying the glaciers of Prince William Sound and Kenai Peninsula, prepared a report [1] in which they advocated the Portage Glacier route for a railway. Their publication, however, gave no evidence that they had personally examined the route. The Alaska Railroad Commission had no time to verify these reports, and in the opinion of the writer was fully justified in stating, as it did, that the route was probably not feasible.

Wagon road and trail construction was continued by the Board of Road Commissioners [2] for Alaska, and up to the close of the fiscal year 1913 a total of 862 miles of wagon road, 617 miles of winter sled road, and 2,167 miles of trail was completed. The need of more wagon roads for the development of mineral resources has long been recognized by those familiar with the conditions of transportation. Railway construction is of first importance to the Territory, and second only to this is the building of a system of tributary wagon roads.

There is little else to record in the improvement of transportation in the Territory. More aids to navigation have been installed, but the facilities are still entirely inadequate to the needs of the merchant marine. Communication with Fairbanks was somewhat improved. During the summer several automobile trips were made over the military wagon road from Chitina to Fairbanks. A new direct steamboat service was established between upper Yukon points and Fairbanks.

METAL MINING.

PRODUCTION.

In 1913 about 31 per cent of the total production of gold came from lode mines, the balance from placer mines. The output of lode gold in 1912 was about 29 per cent of the total; in 1911 it was 24 per cent. This indicates a gradual transition from placer to lode mining. A decrease in placer mining must be expected until railways have so reduced the cost of operation as to make the less valuable auriferous gravels available to profitable exploitation. In the following table, based in part on preliminary estimates, the production of precious metals has been distributed as to sources:

[1] Tarr, R. S., and Martin, Lawrence, An effort to control a glacial stream: Assoc. Am. Geographers Annals, vol. 2, pp. 38-39, 1912.

[2] Richardson, W. P., Lieut. Col., Report of Road Commissioners for Alaska, 1913.

Sources of gold, silver, and copper in Alaska, 1913, by kinds of ore.

	Total quantity.	Gold.		Silver.		Copper.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	Tons.	*Fine oz.*		*Fine oz.*		*Pounds.*	
Siliceous ores	1,614,506	232,916.58	$4,814,813	30,897	$18,662		
Copper ores	135,756	6,385.50	132,000	273,179	165,000	21,659,958	$3,357,293
Placers		516,645.00	10,680,000	58,487	35,326		
	1,750,262	755,947.08	15,626,813	362,563	218,988	21,659,958	3,357,293

To arrive at the total metal production the value of the tin output, not here published, should be added. A small amount of lead is also recovered each year incidentally to the treatment of other ores. In the following table the production of gold, silver, and copper is given by years:

Production of gold, silver, and copper in Alaska, 1880–1913.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Commercial value.	Quantity.	Value.
	Fine ounces.		*Fine ounces.*		*Pounds.*	
1880	967	$20,000			3,933	$826
1881	1,935	40,000				
1882	7,256	150,000				
1883	14,561	301,000	10,320	$11,146		
1884	9,723	201,000				
1885	14,512	300,000				
1886	21,575	446,000				
1887	32,653	675,000				
1888	41,119	850,000	2,320	2,181		
1889	43,538	900,000	8,000	7,490		
1890	36,862	762,000	7,500	6,071		
1891	43,538	900,000	8,000	7,920		
1892	52,245	1,080,000	8,000	7,000		
1893	50,213	1,038,000	8,400	6,570		
1894	62,017	1,282,000	22,261	14,257		
1895	112,642	2,328,500	67,200	44,222		
1896	138,401	2,861,000	145,300	99,087		
1897	118,011	2,439,500	116,400	70,741		
1898	121,760	2,517,000	92,400	54,575		
1899	270,997	5,602,000	140,100	84,276		
1900	395,030	8,166,000	73,300	45,494		
1901	335,369	6,932,700	47,900	28,598	250,000	40,000
1902	400,709	8,283,400	92,000	48,590	360,000	41,400
1903	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904	443,115	9,160,000	198,700	114,934	2,043,586	275,676
1905	756,101	15,630,000	132,174	80,165	4,805,236	749,617
1906	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907	936,044	19,349,743	149,784	98,857	6,308,786	1,261,757
1908	933,290	19,292,818	135,672	71,906	4,585,362	605,267
1909	987,417	20,411,716	147,950	76,934	4,124,705	536,211
1910	780,131	16,126,749	157,850	85,239	4,241,689	538,695
1911	815,276	16,853,256	460,231	243,923	27,267,878	3,408,485
1912	829,435	17,145,951	515,186	316,839	29,230,491	4,823,031
1913	755,947	15,626,813	362,563	218,988	21,659,958	3,357,293
	11,048,488	228,392,540	3,456,601	2,060,191	111,954,435	16,927,518

In the following table the total gold production is distributed according to districts, so far as the information at hand will permit. The error in distribution for the production previous to the year 1905, when the systematic collection of statistics of Alaska's mineral output was begun, is believed to be less than 15 per cent. Complete

statistical returns from all producers are not even now available, so that there is probably still some error in the distribution of the totals to the various districts. This error is, however, believed to be less than 3 per cent, and it is hoped that in future it may be eliminated altogether.

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

Up to 1909 all the gold from the Copper River and Cook Inlet region was derived from gold placers; since then there has been an output from the auriferous lodes of Willow Creek and Kenai Peninsula. The gold output of Seward Peninsula is practically all derived from placers, but there has been a little lode mining. Since 1910 there has been a small lode production from the Fairbanks district, which in 1913 amounted to about 9.5 per cent of the total.

Value of gold production of Alaska, with approximate distribution, 1880–1913.

Year.	Pacific coast belt.	Copper River and Cook Inlet region.	Yukon basin.	Seward Peninsula and northwestern Alaska.	Total.
1880	$20,000				$20,000
1881	40,000				40,000
1882	150,000				150,000
1883	300,000		$1,000		301,000
1884	200,000		1,000		201,000
1885	275,000		25,000		300,000
1886	416,000		30,000		446,000
1887	645,000		30,000		675,000
1888	815,000		35,000		850,000
1889	860,000		40,000		900,000
1890	712,000		50,000		762,000
1891	800,000		100,000		900,000
1892	970,000		110,000		1,080,000
1893	838,000		200,000		1,038,000
1894	882,000		400,000		1,282,000
1895	1,569,500	$50,000	709,000		2,328,500
1896	1,941,000	120,000	800,000		2,861,000
1897	1,799,500	175,000	450,000	$15,000	2,439,500
1898	1,892,000	150,000	400,000	75,000	2,517,000
1899	2,152,000	150,000	500,000	2,800,000	5,602,000
1900	2,606,000	160,000	650,000	4,750,000	8,166,000
1901	2,072,000	180,000	550,000	4,130,700	6,932,700
1902	2,596,600	375,000	800,000	4,561,800	8,283,400
1903	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904	3,195,400	500,000	1,300,000	4,164,600	9,160,000
1905	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906	3,454,794	332,000	10,750,000	7,500,000	22,036,794
1907	2,891,743	275,000	9,183,000	7,000,000	19,349,743
1908	3,448,318	401,500	10,323,000	5,120,000	19,292,818
1909	4,264,716	265,000	[a] 11,580,000	4,302,000	20,411,716
1910	4,182,730	351,630	[a] 8,062,389	3,530,000	16,126,749
1911	4,265,573	313,538	[a] 9,139,145	3,135,000	16,853,256
1912	4,904,753	358,401	[a] 8,857,797	3,025,000	17,145,951
1913	4,529,529	378,643	[a] 8,183,641	2,535,000	15,626,813
	65,912,156	5,410,712	91,159,972	65,909,700	228,392,540

[a] Includes a small production from the Kuskokwim basin.

The production given for the Yukon basin includes, of course, only that from the Alaska camps. Mining has been carried on in the Canadian Yukon since 1885; the output of this region is presented in the next table. Since 1910 some placer gold has been derived from the lower Kuskokwim basin; this is included with the Yukon gold production in the above table.

Production of gold in Yukon districts, Canada, 1885–1913.[a]

Year.	Quantity.	Value.	Year.	Quantity.	Value.
	Fine ounces.			*Fine ounces.*	
1885	4,387	$100,000	1901	870,750	$18,000,000
1887	3,386	70,000	1902	701,437	14,500,000
1888	1,935	40,000	1903	592,594	12,250,000
1889	8,466	175,000	1904	407,938	10,500,000
1890	8,466	175,000	1905	381,001	7,876,000
1891	1,935	40,000	1906	270,900	5,600,000
1892	4,233	87,500	1907	152,381	3,150,000
1893	8,514	176,000	1908	174,150	3,600,000
1894	6,047	125,000	1909	191,565	3,960,000
1895	12,094	250,000	1910	220,166	4,550,000
1896	14,513	300,000	1911	224,197	4,634,574
1897	120,937	2,500,000	1912	268,447	5,549,296
1898	483,750	10,000,000	1913 [b]	352,900	5,835,554
1899	774,000	16,000,000			
1900	1,077,553	22,275,000		7,338,642	152,318,924

[a] From reports of Mines Branch, Dept. Mines, Ottawa, Canada. [b] Preliminary estimate.

This table is here included because the variation in gold output well illustrates the normal evolution of a placer-mining district. The output of gold to and including 1896 is that of the pioneer who operated before the richest deposits had been found. The high production from 1897 to 1904 represents the recovery of gold from the bonanza deposits mined without the use of elaborate equipment. From 1905 to 1908 there was a marked decline in output due to the fact that the rich placers had been mined out and the equipment for exploiting the gravels of lesser gold tenor had not yet been installed. Since 1908 the gold output has steadily increased as a result of dredging and hydraulicking. A similar sequence of events is to be expected in the Alaskan placer districts, most of which are at present on the decline owing to the fact that the richest deposits are approaching exhaustion. With the decrease in cost of installation and operation that will follow railway construction an increase of the placer-gold output will take place.

GENERAL FEATURES.

The total production of gold from the auriferous lode mines of Alaska since 1882 is estimated to be 28,199,538 fine ounces, valued at $62,628,113. These mines have also produced 1,096,336 fine ounces of silver, having a commercial value of $667,516. It is estimated that since mining began in 1880 Alaskan gold placers have yielded 8,005,136 fine ounces of gold, valued at $165,480,848. These mines have also produced 1,610,503 fine ounces of silver, having a com-

mercial value of $996,069. The total production of copper from the Alaskan mines up to the close of 1913 was 111,954,455 pounds, valued at $16,927,518. Most of this copper has been produced since 1901, when systematic mining of this ore began.

Tin mining began in 1902, when the tin placers of the York district were developed in a small way. In the last three years the annual output of tin has been much increased by dredging operations. There has also been a small output of lode tin. The total production up to the close of 1913 is estimated to be 383 short tons of metallic tin, valued at $360,000.

Some of the Alaskan gold ores carry considerable galena, and from this source some lead has been recovered. The total output of lead in Alaska since 1892, when the galena-bearing ores were first systematically mined, is estimated to be about 800 short tons, valued at $57,000.

Alaska's auriferous lodes are estimated to have produced during the year 232,916 fine ounces of gold, valued at $4,814,813, compared with an output of 241,991 fine ounces, valued at $5,002,399, in 1912. There was, however, a great advancement in lode development near Juneau and Fairbanks and much prospecting in various other districts.

Thirty gold-lode mines, including several properties in the new lode districts, which made only small outputs, were operated the whole or a part of the year 1913 in Alaska—six more than in 1912. Work was also done on many gold prospects. Of the producing mines 14 were in the Fairbanks district, 7 in southeastern Alaska, 3 in the Willow Creek district, 2 at Valdez, 2 in Kenai Peninsula, and 2 in southwestern Alaska. It is estimated that these mines had an output of 1,614,506 tons of ore, compared with 1,761,814 tons in 1912. In 1912 the average value of the gold and silver contents for all the ores mined was $2.85 a ton; the average for 1913 was $2.99.

There were seven productive copper mines in 1913, as compared with eight in 1912. Of these, three were in the Ketchikan district, three on Prince William Sound, and one in the Kotsina-Chitina district. The total production of copper in 1913 was 21,659,958 pounds, valued at $3,357,283, compared with 29,230,491 pounds, valued at $4,823,031, in 1912. About $132,000 worth of gold and $165,000 worth of silver was recovered from the copper ores. It is estimated that in 1913 about 135,736 short tons of copper ore was hoisted, compared with 93,452 tons in 1912. The average copper content of the ore was about 7.95 per cent, and the value of the gold and silver in the ore about $2.17 to the ton.

The value of the placer gold produced in 1913 is estimated at $10,600,000; that of 1912 was $11,990,000. The decrease is to be accounted for in large measure by the shortage of water. At Fairbanks, in the Innoko-Iditarod region, and on Seward Peninsula the

sluicing season was probably less than half of the normal length. The total decrease in the value of the placer-gold production from these three most important regions is estimated to have been over $2,250,000. On the other hand, the value of the gold output from the Ruby district in 1913 was more than $500,000 greater in 1913 than in 1912. The other Alaskan camps yielded about the same in 1913 as in 1912.

It is estimated that a total of about 700 placer mines were operated in 1913, but many of them for only part of the season, compared with 720 in 1912. About 150 mines were operated during the winter, employing probably 800 men, and 650 in summer, employing about 4,500 men. In addition to this, some 1,500 to 2,000 men were engaged in prospecting and other nonproductive work relating to placer mining.

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

Estimated total amount of gravel sluiced in Alaska placer mines and value per cubic yard of gold recovered, 1908–1912.

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

In some of the districts there was not even water enough for the dredges. As a consequence there were only 35 gold dredges operated in 1913, compared with 38 in 1912. It is estimated that these dredges handled about 4,100,000 cubic yards of material and made a gold recovery to the value of about $2,200,000, which is the same as the Alaska gold-dredge production of 1912. There were also six or eight dredges which, for one reason or another, were not operated in 1913, and a number of others are under construction or planned.

The discovery of auriferous gravels in the upper Matanuska region and in the upper basin of the Chisana, already noted, furnishes new fields for the prospector. These discoveries curtailed the gold output in some of the larger camps, because they drew away many miners, and thus caused a shortage of labor.

The dredging of placer tin in the York district, in the western part of Seward Peninsula, was continued during 1913. Work was also carried on at the lode-tin mine on Lost River, in the same district. Here a small concentration mill was erected and some concentrates were shipped. It is reported that there was considerable prospecting for lode tin at Ear Mountain, in the north-central part of the peninsula. A little placer tin which occurs with the auriferous gravels of the Hot Springs district has been mined. It is reported that in 1913 lode tin was found in this region.

REVIEW BY DISTRICTS.[1]

SOUTHEASTERN ALASKA.

Seven lode-gold mines, about four placer-gold mines, and three copper mines were operated on a productive basis in southeastern Alaska during 1913. Far more important was the extensive development of lode mines in the Juneau district and, to a lesser extent, in the Berners Bay region. The operating mines produced 201,360 ounces of gold, valued at $4,229,648; 29,211 ounces of silver, valued at $17,643; and 599,903 pounds of copper, valued at $92,985. A total of 1,589,746 tons of gold ore and 7,276 tons of copper ore was hoisted in 1913.

Juneau district.—The extensive mining developments, continued at Juneau during the year, bid fair to make it the center of one of the largest gold-producing districts on the continent. While in 1913 only the four mines of the Treadwell group were operated on a productive basis, a very large amount of development work was done on several other properties.

The ore of the Alaska Treadwell mine was taken chiefly from the 750, 1,250, 1,450, and 1,600 foot levels, but developments were made on the 2,100-foot level. The central shaft was sunk to a depth of 2,270 feet. At the Alaska-Mexican mine the ore came chiefly from the 1,100, 1,210, 1,320, and 1,460 foot levels. Most of the ore of the Ready Bullion mine was recovered from the 1,500, 1,650, 1,800, and 2,000 foot levels, and the most important dead work consisted of a shaft and the extension of the 2,200-foot level. The ore of the Seven Hundred Foot mine was taken chiefly from the 1,100, 1,210, and 1,320 foot levels; the dead work consisted of the sinking of a shaft and developments on the 1,450, 1,570, and 2,100 foot levels. Work was continued on the Nugget Creek power project.

The driving of the adit tunnel of the Alaska-Gastineau Co. was vigorously pushed throughout the year. Work was also continued on No. 1 shaft of the old Perseverance mine. These two workings

[1] Some of the districts are reviewed at greater length in later sections of this volume. In previous reports the review by districts was separated into sections on lode mining and placer mining. Here all the metalliferous deposits are discussed under each district.

were connected in April, 1914, thus giving an outlet, on one hand, to the surface at the Perseverance mine, and, on the other, to a point near sea level at Sheep Creek. The adit is 8 by 10 feet and 10,500 feet long. Meanwhile much development work has been done on the fifth to the tenth levels, inclusive, of the Perseverance mine, and mill construction and other surface improvements are well under way. One power plant on Salmon Creek for this enterprise is completed, and work on a second was continued during the year as weather conditions permitted.

The Snowslide Gulch adit of the Alaska-Juneau mine, 6,538 feet in length, was completed. A raise was then started which reached the surface in March, 1914. A working level was also started. A tram was built from the portal to the mill site near Juneau, where the first unit of a large reduction plant is approaching completion, and other surface improvements have been made. The company states that it plans later to put in a main adit tunnel from the mill site near Juneau, which will be 9,000 feet long and 400 feet lower than the present adit. Power is to be furnished from a hydroelectric plant on Nugget Creek.

Plans are under way to open the Ebner property, lying adjacent to the Alaska-Juneau on the north. This mine has been idle for some years but, it is said, will pass under a new management, with a promise of early development, as soon as certain legal complications have been settled. It is reported that some work has been done on a property lying north of the Ebner, which is said to be an extension of the stringer lead system in which the mines described above are located. So far as known the only other mining done near Juneau consisted of some placer operations in the upper Gold Creek basin.

Work was continued on the new adit tunnel of the Eagle River mine, located 800 feet below the old workings. This has been driven 1,900 feet and is reported to have intersected the ore body. Some developments were also made on the Peterson and Auk Bay properties. The driving of the adit of the Kensington mine, in the Berners Bay region, was continued. Two lodes, the Eureka and Kensington, had been crosscut by the adit, and in 1913 it was extended toward the Johnson lode, and this lode is said to have been crosscut 4,800 feet from the portal, at a depth of 800 feet. Some drifting on the lode was also done. It is reported that work was continued at the Jualin mine, consisting of the sinking of a shaft and surface improvements. Information is lacking at this writing regarding any other mining developments in the Berners Bay region. There is also no information at hand regarding mining operations in the southern part of the Juneau district.

Other districts.—Hydraulic plants were operated on Porcupine, Calhoun, and Nugget creeks in 1913. Another plant was installed

on Glacier Creek, and preparations made for putting in a dredge on the lower part of Nugget Creek. Developments were continued in a small way on some quartz properties in this district.

The two 10-stamp mills of the Chichagof mine, formerly operated as two mines—the Chichagof and Golden Gate, in the Sitka district, were operated throughout the year. A new hydroelectric power plant and an air compressor are being installed and underground developments were continued. At the Hirst property, also in the Sitka district, the vein is reported to have been crosscut at the upper level, and another crosscut has been started 165 feet below this and 350 feet below the surface. About 1,250 feet of underground work has been done on this property.

The Jumbo and Rush & Brown copper mines, in the Ketchikan district, were operated on a shipping basis, and some developments were made on other copper properties, notably at the mines of the Northland Development Co., on the west side of Prince of Wales Island. The small stamp mills at the Valparaiso and Harris River gold mines were operated in 1913, and some developments were made on the Londevan and Bugge properties. The details in regard to mining in the Ketchikan district are presented elsewhere in this volume.

Mining was continued on the beach placers near Yakataga on about the same scale as in previous years. This district does not properly belong under southeastern Alaska, and as it is described at length in a later section of this report, it will only be mentioned here.

COPPER RIVER REGION.

Mining operations in the Copper River basin in 1913 included the development of copper mines in the Kotsina-Chitina belt, gold-placer mining in the Nizina, Bremner River, and Chistochina districts, and gold-lode prospecting at various localities.

Kotsina-Chitina district.—There was no great activity in the Kotsina-Chitina copper belt during 1913. With the present high freight rates on copper ore and in the absence of any spurs or branch lines of railways, operators found little encouragement to push development work. There was, moreover, a shortage of labor, due to the exodus to the Chisana placer district. The Kennecott-Bonanza continues to be the only productive mine, and its operation was hampered by the destruction of the tramway and compressor plant by a snowslide and fire. As a consequence, shipments were made for only about eight months during the year. Work was also continued on the Jumbo claims near by, belonging to the same company. Some small shipments of ore were made from this property, and the route for an aerial tram was surveyed. Some development work was done on

the Dan Creek and other copper properties in the east end of the Kotsina-Chitina belt.

The Mother Lode mine is on the McCarthy Creek side of the Bonanza divide. Here the underground workings were extended during 1913, and a 6,600-foot aerial tram connecting the mine with a proposed wagon road following down McCarthy Creek valley was built. The wagon road has not been completed, but meanwhile some ore was sledded to the railway, a distance of about 13 miles. An air compressor, driven by a gasoline engine, is being installed. A gold quartz vein, located near McCarthy and belonging to the Bonanza Gold Mining Co., is reported by the owners to have been developed on a small scale. It is also stated that a small prospecting mill was installed on this property and that a small shipment of concentrates was made.

There was comparatively little mining at the west end of the field. Developments are reported on the Hubbard & Elliot property, on Nugget Creek, and on the Berg claim, on the east side of the Kuskulina River. Some work was also done by the Great Northern Development Co., which shipped ore from its property during the winter of 1912–13.

A small vein of quartz and calcite carrying considerable gold was found in the Kotsina region. As near as determined, this vein is located above timber line, some 4 miles north of Strelna station, on the south slope of the ridge separating Elliott Creek from Kotsina River. This discovery is not on Elliott Creek, as has been reported.

Nizina and Bremner districts.—In the Nizina placer district two large hydraulic plants were operated throughout the year and a third after it had been rebuilt. About 80 men were employed during the open season. In September, 1912, the hydraulic plant of the Dan Creek Mining Co. was almost totally destroyed by an unusually severe flood. The diversion dam and intake works were washed out. The entire pipe line, which followed the creek bottom, was either buried under gravel and débris or broken up and washed away, and the cut was filled from bank to bank. The flume and gold-saving apparatus were buried under about 15 feet of sand, gravel, and bowlders. In 1913 the plant was reconstructed and about 10 box lengths of the old cut cleaned out. The new pipe line follows along the left bank well above extreme high-water level and includes 6,400 feet of riveted steel pipe tapering from 30 down to 15 inches in diameter. It crosses Boulder Creek on a trestle 500 feet long at a maximum height of 36 feet. In connection with the pipe line about 600 feet of flume has been constructed and 150 feet of 5 by 7 foot tunnel driven through solid rock.

The Nizina Mining Co.'s plant on Chititu Creek was damaged by the flood of September, 1912, but not so severely as the plant on

Dan Creek. During the early summer the damaged section was reconstructed and the cut, which was partly filled with flood deposits, was cleaned out. Productive mining was carried on for the remainder of the season. The Nizina Mining Co. also operated an hydraulic plant on Rex Creek throughout the summer.

Five or six men were engaged in mining on Chititu Creek and its tributaries independent of the Nizina Mining Co. On Jolly Gulch and automatic dam was constructed.

Several years ago placer gold was discovered on a bench on the right side of Tiekel River, about 3 miles above the mouth. This ground has been prospected, and it is asserted that the gold content is sufficiently high to warrant the installation of a hydraulic plant. A winter road has been built from this property to the railway, and it is planned to haul hydraulic equipment over this roadway during the winter of 1914. There was also considerable gold-lode prospecting on the headwaters of Tiekel River.

The Budd Mining Co. commenced the installation of a hydraulic plant on Gold Creek, where it proposed to work gold placers in the basin above the lower falls. A timber dam 25 feet high and 100 feet long at the top and 212 feet of 3 by 6 foot flume were built early in the spring. On June 13, 1913, the dam was destroyed by high water and no further work was done during the season. Drill tests are said to show a gravel deposit 9 to 50 feet thick, with an average of about 25 feet.

Gold-lode prospecting.—The gold-bearing quartz of lower Copper River and the Lake McKinley region continues to attract prospectors, but no important developments have yet been made.

Chistochina district.—From 30 to 40 men were engaged in productive mining on nine or ten properties in the Chistochina placer district. A small hydraulic plant was installed and some ground was prospected with a view to the installation of a dredge.

PRINCE WILLIAM SOUND.

The value of the total mineral production of the Prince William Sound region in 1913 was $1,327,950, compared with $1,250,000 in 1912. The Ellamar and Beatson copper mines were operated to their full capacity, and shipments were also made from the properties of the Fidalgo Mining Co. and the Fidalgo-Alaska Copper Co. The Dickey Copper Co. opened the Mason & Gleason claim, on Fidalgo Bay, and mined some ore which will be sledded to the beach during the winter. Developments were continued by the Three Man Mining Co. and the Land Lock Bay Copper Co. Work was suspended during the summer at the Midas copper mine, near Valdez, but was resumed by a new company which purchased the property in the fall.

The Cliff mine, in the Port Valdez district, was operated throughout the year, and small mills were erected at the Gold King, Cameron & Johnson, Mountain King, and Minnie properties. Work was also done on about 25 other claims. It is estimated that about 200 men were engaged during 1913 in mining and development work in the Port Valdez district. There was considerable prospecting of auriferous quartz veins in the Port Wells district, and it is estimated that some work was done on about a hundred different claims. The mining developments on Prince William Sound are described in some detail in later sections of this volume.

KENAI PENINSULA.

In the aggregate there was considerable gold-lode prospecting in Kenai Peninsula during the year, but no important developments. Placer mining was continued on about the same scale as in previous years. The total value of the gold produced in the peninsula in 1913 was less than $50,000. At the Kenai-Alaska Gold Co.'s mine about 400 feet of crosscuts were driven and 150 feet of drifts along fissures. The aerial tram that was broken last year was repaired and the mill was run for a short time.

Work was continued at the Skeen-Lechner mine. A 4-stamp mill was completed in September and operated for the later part of the year by hydroelectric power. An aerial tram connects the mine with the mill. There was also much underground work, aggregating at the close of the year some 1,000 feet in length. On the property of the Primrose Mining Co. a 150-foot crosscut and a 30-foot raise were opened. A small prospecting mill was used for testing the ore, and a larger mill has been planned.

Late in the summer the Gold Stamp Mining Co. installed a 2-battery mill of five stamps near its claim on Bear Creek. Water power is to be utilized for this plant. Unfortunately, operations were suspended in October, owing to a lawsuit.

Development work was continued on the Gilpatrick lode, in the Moose Pass district. Some ore from this claim was treated in an arrastre. The Moose Pass Mining Co. continued operations in a small way on its claim, located near the head of Quartz Creek, and installed a small prospecting mill during the summer. Assessment work was done and some developments were made on the Bluebell, Sevenmile, Kenai Star, Tenderfoot, and other quartz claims.

About 15 placer mines, employing 40 to 50 men, were operated for a whole or a part of the open season of 1913. Operations were more or less hampered on some creeks by a scarcity of water. Most of these operations were on a very small scale, but hydraulic plants were operated on Resurrection, Bear, and Crow creeks. The testing of dredging ground on Kenai River and elsewhere was continued.

SOUTHWESTERN ALASKA.

Kodiak Island.—The Aniak Gold Mining Co., whose property is near Uyak, on Kodiak Island, continued work on its property. It is reported that 115 feet of shaft was sunk and 77 feet of drifts opened. The stamp mill was operated to test the ore. There was also some mining of beach-placer gold on Kodiak Island, as well as prospecting of gold-lode deposits.

Iliamna region.—The following notes on the Iliamna region are based chiefly on information furnished by Mr. Thomas W. Hanmore, United States commissioner at Iliamna. With the exception of the recovery of a few hundred dollars' worth of gold from the gravels of Portage Creek, a tributary of Lake Clark, there was no productive mining in the Iliamna region. There was, however, considerable prospecting and development of copper and gold bearing lodes in this region.

The McNeil-Cook group of claims is located about 17 miles from tidewater at Kamishak Bay, an indentation of the southwest shore of Cook Inlet. The ore is chalcopyrite, said to carry considerable gold and to occur in well-defined leads. The developments consist of open cuts and one adit 23 feet in length. The description of the region suggests that the occurrence may lie in a southwesterly extension of the mineralized belt[1] lying between Iliamna Bay and Iliamna Lake.

Nothing was done on the Dutton copper property in 1913 except some sampling. Work was continued in a small way on the Duryea claims, on claims near Kontrashibuna Lake, on the Millet claims, near Iliamna Lake, and on the Gleason claims, near Lake Clark. A few men are still prospecting in the Mulchatna placer district.

Alaska Peninsula.—So far as known there was little mining development on the Alaska Peninsula in 1913. No report has been received from the Apollo mine, but it is rumored that the mill was run for a short time and that some underground work was done.

SUSITNA AND MATANUSKA BASINS.

Albert Creek placers.—During the summer of 1913 considerable local excitement was caused by the discovery of auriferous gravels in the region adjacent to the upper Matanuska basin. As a consequence, 75 to 100 prospectors were attracted to this region. Placer gold was found on Albert Creek, a branch of Crooked Creek, tributary to Nelchina River. The Nelchina is one of the forks of the Tazlina, which joins Copper River from the west about 8 miles above Copper Center. This region is described in a later section of this volume.

[1] Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region: U. S. Geol. Survey Bull. 485, p. 138, 1912.

Willow Creek district.—Mining in the Willow Creek lode district continued on about the same scale as last year. Three mills—the Gold Bullion, Alaska Free Gold, and Gold Quartz—were in more or less continuous operation, and about 70 men were employed in mining and milling. About 3,000 tons of ore was milled, with a gold recovery to the value of $100,000. Several promising discoveries of quartz veins were made during the year, and plans were under way to install mills at three additional localities next spring. A somewhat detailed account of the Willow Creek district is contained in a later section of this report.

Yentna district.—Placer mining in the Yentna district was continued in 1913 on about the same scale as during the last few years. No important new discoveries were made and the production was all obtained from creeks whose value had already been proved. In several localities preparations for more extensive mining by hydraulic methods had been made, but an unusual scarcity of water through practically the whole working season affected all the properties, and several claims which for a number of years have been profitably operated yielded little or nothing this year. The shortage of water in the summer of 1913 is attributed to an unusually light snowfall during the preceding winter, the snow banks which ordinarily supply the streams throughout the open season having this year disappeared early in the spring. No member of the Geological Survey visited the Yentna district in 1913, and the information here given was supplied by a number of miners who were seen after the close of the mining season by S. R. Capps.

As usual, Cache and Peters creeks and their tributaries furnished most of the gold production. On Cache Creek proper the Cache Creek Mining Co. worked on a low bar just above the sawmill, and it is reported that the ground mined yielded satisfactory returns. Hydraulic methods were used, the water being obtained from Rambler Creek.

On upper Cache Creek only a small amount of the creek gravels was mined. An attempt was made to establish the value of some higher bench deposits near the canyon, but the results of this prospecting are said to have been unsatisfactory. Prospecting was continued on lower Cache Creek below the lower canyon, and the existence there of extensive unfrozen gravel deposits suitable for dredging is reported.

Preparations were made for active mining on Gold Creek. A ditch half a mile long, to obtain water under pressure, was completed, and some ground sluicing was done, but the failure of the water supply prevented the owners from cleaning up the cut, and no production was made. Mining operations were conducted at four localities on

Nugget Creek. At a point a short distance below the canyon, on the south side of the creek, several men were employed in exploiting the elevated bench gravels. These benches have been shown to carry considerable gold, and some unusually rich spots are said to have been discovered. Several men were engaged in prospecting the high bench ground north of the canyon. A ditch 2 miles long supplied water under pressure, and many cuts were made in the attempt to locate a valuable placer. It is reported that the results were encouraging. Two men were mining on lower Nugget Creek and had ground-sluiced a considerable area when a freshet washed out their boxes and filled the cut with gravel.

The Thunder Creek Mining Co. continued mining on lower Thunder Creek and is said to have employed eight to ten men continuously. There was also one other mining venture on upper Thunder Creek. Mining was conducted on Falls Creek at only one locality.

One of the most important mines of the district, operating on an old channel in the valley of Dollar Creek, was this year unfortunately involved in litigation, so that little work was accomplished. An adequate place to dump tailings was lacking, and operations were confined to cleaning up a portion of the cut made in 1912. Near this mine the Conhardt Mining Co. was also operating, employing from six to ten men.

In the main valley of Peters Creek mining was conducted near the mouth of the lower canyon at two places. One outfit, said to have operated on the benches above the mouth of the canyon, was compelled to discontinue work in June on account of the scarcity of water. A short distance below the mouth of the canyon another company built a dam across Peters Creek and is said to have opened some rich placer ground. A freshet, however, washed out the dam and prevented further mining after a small amount of gold had been recovered.

Willow and Poorman creeks, in the Peters Creek basin, were both mined in the early summer, but operations were discontinued in mid season because of lack of water. It is said that low water also put a stop to work on Bird Creek during most of the season.

Little is known of the results of the season's mining in the tributaries of Mills and Twin creeks, but it is reported that the streams were so low that practically nothing was accomplished.

To summarize, the best information obtainable indicates that under average conditions of stream flow the gold output of the Yentna district in 1913 would have been considerably above the average for the last five years. As a result of a shortage of water and of a lawsuit which restricted the operations of one important mine, the output for the season of 1913 was less than that of 1912.

Valdez Creek district.—The most important development during the year on Valdez Creek, a tributary of the upper Susitna, was the installation of a large hydraulic plant for the recovery of gold in a buried channel. This plant was completed before the close of the summer, and some sluicing was done. There were also some smaller operations on Valdez Creek and its tributaries. These operations are described elsewhere in this volume.

YUKON BASIN.

The dry weather and other conditions already discussed gave the Yukon districts very unfavorable conditions for placer mining. The value of the placer production is estimated to be about $7,780,000 in 1913, compared with $8,645,000 in 1912. The newly discovered Chisana placer-gold district, in the upper Tanana Valley, was encouraging to the prospector but caused a movement of miners that resulted in a shortage of labor in several camps. On the other hand, the progress in lode mining at Fairbanks is a very hopeful feature of the year's history. Most of the Yukon districts are described in some detail in other parts of this volume, so that only a summary statement will be given here.

Chisana district.—In May, 1913, William E. James and Peter Nelson found gold placers on a small stream, called by them Little Eldorado, which flows into Bonanza Creek, tributary to Chatenda or Johnson Creek. Chatenda Creek is an easterly fork of the upper Chisana River, locally called the Shushana. During the summer mining was done on Discovery claim and on some other claims in the neighborhood. The value of the total output from the district is variously estimated between $30,000 and $70,000. Gold has also been found on several tributaries of Chapolda or Wilson Creek, which lies across the divide north of Johnson Creek and flows westward into the Chisana. This district is a part of the Nabesna-White River region, where some copper prospects are being developed. It is described in greater detail elsewhere in this volume.

Fairbanks district.—During 1913 quartz mining made steady progress in the Fairbanks district. There were 13 lode properties that produced more or less, and 10 of them were equipped with mills. Gold to the value of $350,000 was produced from the quartz mines of the district in 1913 and $200,000 in 1912. This makes the total production from the gold lodes of the district about $674,000—a remarkable showing considering the handicap under which the lode mines are placed by the high cost of fuel, labor, and supplies.

About 130 placer mines were operated in the Fairbanks district for a whole or a part of the year. These gave employment to about 700 men in winter and 1,800 in summer. The value of the placer gold

produced was about $3,300,000. The chief creeks named, in the order of the value of their production, were Chatanika Flats and Cleary, Ester and tributaries, Goldstream and Engineer, Dome, Pedro, Fairbanks, and Little Eldorado. Gold was also mined on Vault, Treasure, Wildcat, Fish, and Happy creeks. Some new discoveries were made on Alder, Smallwood, and Happy creeks, and the productive area in the Chatanika Flats, at the mouths of Dome and Cleary creeks, was enlarged. New mines were also opened on Fairbanks and Dome creeks. Mining in Fairbanks district is described at greater detail elsewhere in this volume.

Smaller Yukon districts.—Twenty mines, including two hydraulic plants, were worked for a whole or a part of the season in the Birch Creek district. One dredge was operated on Mastodon Creek. About 130 men were employed during the summer, and there was considerable winter work, but shortage of water prevented the sluicing of the dumps. Mastodon, Eagle, and Half Dollar creeks were the principal producers.

In the Fortymile region the shortage of water greatly hampered mining operations. About 25 mines were worked in the winter and 15 in the summer. One dredge was operated on south fork of Fortymile Creek. Operations were continued on about the same scale as in the past in the Eagle, Seventymile, Rampart, Kantishna, Tenderfoot, and Bonnifield districts. The Hot Springs district continues to be one of the large producers of gold in the Yukon region, chiefly from Sullivan, Patterson, and American creeks.

Ruby district.—All told 41 plants were engaged in mining in the Ruby district, operating 38 claims on 14 creeks and employing a total of about 230 men. The most significant new development in the district was the discovery of valuable placer ground on several creeks in an area about 30 miles south of the Long Creek locality. The chief discoveries are on Poorman Creek, tributary to the North Fork of Innoko River, and on Duncan and Tenderfoot creeks, tributary to Poorman Creek from the north. Pay gravel has been struck also on Tamarack Creek, a tributary of the Solatna that heads against Duncan Creek. Good prospects are reported from Spruce Creek, a tributary of the Solatna west of Tamarack Creek, heading in Twin Butte Mountain. The Ruby district is described elsewhere in this volume.

Chandalar and Koyukuk districts.—The owners report that work was continued on the Little Squaw quartz property, in the Chandalar district, that the adit on the vein was driven about 100 feet, making a total distance from the portal of 178 feet, and that a winze was sunk about 50 feet. This makes a total depth below the outcrop of about 100 feet. The ore recovered in mining was hauled to the 3-stamp prospecting mill and there treated. On the Carter property, in the

same district, a crosscut has been driven for 400 feet and is said to have intersected the ore 200 feet below the surface. A little placer mining was done on two claims in the Chandalar district.

Reports from the Koyukuk district are very meager, as but few of the mine operators there return the schedules mailed to them each year. Nor has the writer been able, as he has in nearly all the other Alaska mining districts, to find anyone who is willing to furnish the Survey with any information on mining development. It is therefore impossible to do justice to this important camp in the annual reports on the mining industry of Alaska.

From best reports, between 300 and 400 men were engaged in placer mining on the Koyukuk in 1913, and the season was a profitable one, although there was some shortage of water, as in the other Yukon camps. The most important developments were those on Hammond River, where some deep rich gravels were developed. A little mining was done in the Indian River district of the middle Koyukuk basin. Here 13 claims were worked in a small way. The Indian River region is described in a later section of this report.

Iditarod district.—As in the other Yukon camps, the shortage of water greatly hampered mining operations in the Iditarod district. This condition, together with the fact that certain claims were not worked because they were being combined for the purpose of exploiting them in a large way, led to a great curtailment of gold output compared with the previous year. The value of the gold produced in the Iditarod district was about $1,860,000. There was some prospecting of lode claims and some promising deposits have been found, but the cost of mining is so great that few have been attracted to quartz development.

The dredge installed on Flat Creek in 1912 was worked throughout the open season. A second large dredge was built on Flat Creek in 1913, and also operated. Preparations have been made for the installation of a dredge on Otter Creek, which it is expected will be completed for operating in 1914, and also one on Moore Creek, a tributary of the Kuskokwim.

The largest part of the gold produced in the Iditarod district came from the mines on Otter and Flat creeks, but mining was also done on Happy, Willow, Moore, Chicken, and Black creeks and Glenn Gulch. Most of the mining is done in open cuts, steam scrapers being extensively used.

Innoko district.—Shortage of water curtailed the Innoko gold output in 1913, estimated to have a value of $280,000, of which about $80,000 worth was mined in the winter. Sixteen claims were worked in the winter, employing about 50 men, and 28 in summer, employing about 125 men.

The most important developments were on Little Creek, where a considerable area of rich placer was found. The productive creeks, named in the order of the value of their production, were Little, Ophir, Spruce, Colorado, Fox, Ganes, and Yankee. Some claims on Yankee Creek have been combined for the purpose of mining by dredge. Dredging ground was also prospected on Ganes Creek, with reported favorable results.

There was some extensive prospecting of Candle Creek, which flows into the Tokotna, a tributary of the Kuskokwim. Mr. Harold Seddon reports that the country rock is granite, and that the gravels are 9 to 12 feet deep, near the head of the creek, and increase in thickness rapidly downstream. About a mile from the head of the creek the gravels are 25 feet deep, and about half a mile farther down they are 56 feet deep. Two miles still farther downstream shafts sunk to 125 feet have failed to reach bedrock and were abandoned on account of water. The upper creek was prospected with bedrock drain and the claims below by shafts and drilling, and the returns are said to be satisfactory. There was a considerable inrush of prospectors in the region lying between the Innoko and Ruby districts. The scene of new discoveries is in part in the Innoko basin but belongs to the Ruby district and has been referred to on page 68. It is described at greater length in another article included in this volume.

KUSKOKWIM BASIN.

In the lower half of the Kuskokwim basin there are many creeks on which some mining has been done, but about which there is very little information. It is planned in 1914 to investigate a part of this region, but meanwhile the writer is forced to rely on information gleaned from various sources. What is known of the mining developments in that part of the basin included in the Iditarod and Innoko districts has been already presented. There is a mineralized area lying south of the lowest big bend of Kuskokwim River and draining in part to the north through Anniak River, which joins the Kuskokwim from the south about 25 miles below Kolmakof and in part to the northwest through Tuluksak River, tributary to the Kuskokwim from the east about 30 miles above Bethel. Within this area considerable gold-bearing gravel has been found and mining has been going on for several years. In 1913 a hydraulic plant was in the course of installation on Marvel Creek, in the Anniak basin. There has been some mining on Marvel, Cripple, and other creeks of the Anniak district.

Across the divide is Bear Creek, a tributary of the Tuluksak, and here mining has gone on for several years. Gold is said to be dis-

tributed throughout the length of the creek. In 1913 considerable ground was prospected on Bear Creek with a drill, and preparations were made for the installation of a steam scraper. Mining has also been done on Bonanza Creek, a tributary of Bear Creek.

Eek River flows into the Kuskokwim from the east about 50 miles below Bethel. In 1913 placer gold was found in the headwater region of the Eek, indicating that the region between the Tuluksak and Goodnews Bay districts is also mineralized. About a dozen men were engaged in mining and prospecting in the Goodnews Bay region. The gravels are said to be of low tenor, but good dredging ground is reported. A little mining was done during 1913 on Butte, Snow Gulch, and Kowkow creeks, in this district, but as a rule the values are too low to permit profitable recovery with the crude methods now in use.

SEWARD PENINSULA.

The drought which prevailed all over northern Alaska was especially pronounced in Seward Peninsula. So low were the streams that even some of the dredges could not operate, and for others it was necessary to make artificial basins by cutting into the bedrock or by building dams. As a result the gold recovery of 1913 in the Seward Peninsula camps was only $2,500,000, compared with $3,100,000 in 1912.

Thirty-one dredges were operated for a part or the whole of the summer, with an estimated gold recovery of $1,300,000. These dredges had a combined daily capacity of 33,300 cubic yards. Four new dredges were installed in 1913, and several others were in course of construction. The building of several others is under contemplation. In addition to the 31 operated, there were six dredges that were idle in 1913. Of other than dredge mining there was very little. Some deep mining was done during the winter near Nome and in the Fairhaven district. In some places there was not water enough in the summer to sluice the winter dumps. A little hydraulic mining was done in several districts when the water supply permitted. The dry season also hampered the small operators throughout the peninsula. There was some development of auriferous lodes in Seward Peninsula, but no production.

The dredge used for mining placer tin in the York district was operated throughout the open season. There was also a large amount of development work done on the tin-bearing lode at Lost River, where a small concentrating mill was installed. Details about mining in Seward Peninsula are presented in separate papers included in this volume.

KOBUK REGION.

The placer mines of the Kobuk region produced about $40,000 worth of gold in 1913. Most of this came from Klery Creek, in the Squirrel River district, but there was also a little mining on Lynx and Dahl creeks and on Shungnak River. Some work was done on the Malfiatti copper claim, in the Hunt River valley, and the results are said to be satisfactory. The remoteness of the Kobuk region makes all forms of mining very expensive and has discouraged prospecting.

MINERAL FUELS.

As no patents have been granted to coal lands and no leasing law has been passed, Alaskan coal fields still continue undeveloped. The only exception is the Wharf mine, on Port Graham, located on about 65 acres of coal land, to which patent was granted in 1913. This mine has been opened and its coal, which is lignitic, has found a local market. There has also been a little mining of lignitic coal for individual use at various other localities in Alaska. The following table shows the coal consumption of Alaska from 1899 to 1913:

Coal consumption of Alaska, by sources, 1899 to 1913, in short tons.

Year.	Imported from States, chiefly from Washington.		Produced in Alaska, chiefly subbituminous and lignite.[a]	Total domestic, chiefly from Washington.[a]	Total foreign coal, chiefly bituminous, from British Columbia.[b]	Total coal consumed.
	Bituminous.	Anthracite.				
1899	c 10,000	.....	c 1,200	11,200	50,120	61,320
1900	15,048	.....	c 1,200	16,248	56,623	72,871
1901	c 24,000	.....	c 1,300	25,300	77,674	102,974
1902	c 40,000	.....	2,212	42,212	68,363	110,575
1903	64,625	1	1,447	66,073	60,605	126,678
1904	36,689	.....	1,694	38,383	76,815	115,198
1905	67,707	6	3,774	71,487	72,567	144,054
1906	68,960	533	5,541	75,034	47,590	122,624
1907	45,130	1,116	10,139	56,385	88,596	144,981
1908	23,402	491	3,107	27,000	72,831	99,831
1909	33,112	.....	2,800	35,912	74,316	110,228
1910	32,138	.....	1,000	33,138	73,904	107,042
1911	32,255	.....	900	33,155	88,573	121,728
1912	27,767	.....	355	28,122	59,804	87,926
1913	61,666	.....	c 2,300	63,966	60,600	124,566
	582,499	2,147	38,969	623,615	1,028,981	1,652,596

[a] By calendar years. [b] By fiscal years ending June 30. [c] Estimated.

The writer is indebted to Mr. Charles Estmere for notes on an occurrence of coal in the Iditarod district. The locality of this occurrence is about 4 miles from Iditarod, near the Flat Creek tramway. Mr. Estmere reports that the coal bed strikes about N. 60° E. and dips about 50° S. It has been opened by an incline to a depth of about 50 feet below the outcrop. The bed is reported to vary from 15 to 30 inches in thickness and to have a shale roof and slate floor. There is evidence of considerable shearing along the footwall.

A sample of this coal was received from Mr. Estmere and analyzed by A. C. Fieldner, chemist of the Bureau of Mines, with the following results:

Analysis of coal from locality near Iditarod.

[Air-dry loss, 0.0.]

	Air dried.	As received.	Moisture free.	Moisture and ash free.
Moisture	1.40	1.42		
Volatile matter	6.60	6.60	6.70	7.23
Fixed carbon	84.75	84.73	85.95	92.77
Ash	7.25	7.25	7.35	
	100.00	100.00	100.00	100.00
Sulphur	1.10	1.10	1.12	1.21

This analysis indicates that the coal is anthracite. The sample received was chiefly slack, and the data at hand indicate that the coal bed is crushed. It is doubtful whether this coal could be utilized without briquetting. Its high grade and close proximity to a good market justify further expenditures in prospecting.

About 600 tons of coal was mined on one of the Cunningham claims, in the Bering River field, in 1912. This operation was conducted under a special appropriation made to the Navy Department but was under the supervision of the Bureau of Mines. The coal was taken from two beds in the bituminous part of the field. It was brought to the coast in the summer of 1913 and given official tests on a warship, and also at Annapolis. These tests show that the coal mined will not yield a fuel suitable for Navy use. The complete report has not been published at this writing.

In 1913 a similar test of Matanuska coal was undertaken. About 1,100 tons of coal was mined at Chickaloon during the summer, and this was sledded to the coast at Knik during the winter of 1913–14. This coal is to be subjected to a steaming test, as was the coal from the Bering River field.

The Alaskan oil lands were withdrawn from entry in 1906, and only those claims located previous to that date are subject to entry. Patents have been granted to a few claims in the Katalla oil field, near Controller Bay, and some of these have been placed on a productive basis. No development work has been done in any other oil field since the withdrawal.

The moderate production of petroleum at the well-known seepage locality near Katalla was continued during 1913. A small experimental refinery installed there several years ago for the manufacture of gasoline was somewhat improved in 1913. By cleaning several of the old shallow wells 600 to 700 feet deep and by drilling one or two new holes to a depth of 800 to 1,000 feet the daily pumping capacity of the property was increased to about 60 barrels of crude oil a day. One thousand feet seems to be about the limit in depth from which oil may be obtained within the area now producing.

The oil thus obtained appears to be a more or less superficial and localized accumulation stored in much-shattered shales whose relation to deeper or more extensive sources is not known. In all there are about 10 of these relatively shallow wells on the property whose possible yield varies from 2 to 10 barrels a day. However, these are not all being steadily pumped. The gasoline is sold in a limited market about Prince William Sound, and as the demand of this market varies, the refinery is not operated at a uniform rate of production. In quality the gasoline is fully as good as that brought from the United States.

While the coal consumption in Alaska has remained nearly stationary, the use of fuel oil has very much increased. The Treadwell group of mines now uses California oil, as do many of the dredges at Nome, steamers running to Alaska, and the Yukon River boats. The Copper River Railway is now in part equipped with oil-burning locomotives, and the Alaska Northern Railway, when operated at all, uses a gasoline car. The Tanana Valley Railway also runs a gasoline passenger coach. The following table indicates the increased use of oil-burning and gasoline engines in Alaska:

Shipments of petroleum products to Alaska from other parts of the United States, 1905–1913, in gallons.

Year.	Crude.		Naphtha.		Illuminating.		Lubricating.	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
1905..	2,715,386	$91,068	713,496	$109,921	627,391	$113,921	83,319	$31,660
1906..	2,688,100	38,409	580,978	100,694	568,033	109,964	83,992	32,854
1907..	9,104,300	143,506	636,881	119,345	510,145	99,342	100,145	37,929
1908..	11,891,375	176,483	939,424	147,104	566,598	102,567	94,542	36,423
1909..	14,034,900	334,258	746,930	118,810	531,727	98,786	85,687	35,882
1910..	18,835,670	477,673	788,154	136,569	626,972	95,483	104,512	38,625
1911..	18,142,364	406,400	1,238,865	167,915	423,750	57,896	100,141	34,048
1912..	15,523,555	309,804	2,736,739	344,739	672,176	100,722	154,565	60,949
1913..	15,682,412	453,756	1,735,658	272,661	661,656	106,603	150,918	61,966

STRUCTURAL MATERIAL AND MISCELLANEOUS.

There were no important developments in the marble or gypsum industry of Alaska in 1913. While marble is widely distributed in southeastern Alaska,[1] the only locality of production in 1913 was on Marble Island, near Shakan. Here quarrying is done on a large scale. Some development work was done on marble deposits at a number of different localities in southeastern Alaska.

The only gypsum deposit thus far found in the Territory is on Chichagof Island, in the Sitka district. The shipping facilities of the plant, which is close to tidewater, were improved in 1913.

Some volcanic tuff (ash) was shipped from Kodiak in 1913 for use as an abrasive. This was derived from the débris resulting from the eruption of Mount Katmai in June, 1912.

[1] Some of the marble deposits of southeastern Alaska are described in a later section of this volume.