

MINERAL RESOURCES OF ALASKA, 1912.

By ALFRED H. BROOKS and others.

PREFACE.

By ALFRED H. BROOKS.

The present volume is the ninth of a series of bulletins¹ published annually, 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 these reports the aim is prompt publication of the most important economic results of the year. The short time available for their preparation does not permit thorough 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.

In addition to presenting preliminary statements on investigations made during the year, this volume, like those previously issued, summarizes the condition of the mining industry and gives statistics of mineral production. It is intended that this series of reports shall serve as condensed statements of the progress of the mining industry for the years which they cover. The fund available for Alaskan investigations is too small to permit a visit to every mining district each year by a member of the Survey. 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 include many mine operators, engineers, prospectors,

¹ Report on progress of investigations of the mineral resources of Alaska, 1904: U. S. Geol. Survey Bull. 259, 1905; Idem, 1905: Bull. 284, 1906; Idem, 1906: Bull. 314, 1907; Idem, 1907: Bull. 345, 1908; Idem, 1908: Bull. 379, 1909; Idem, 1909: Bull. 442, 1910; Idem, 1910: Bull. 480, 1911; Idem, 1911: Bull. 520, 1912.

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 following: The Director of the Mint; Charles D. Garfield, of Juneau; Alaska Mexican Gold Mining Co., Alaska United Gold Mining Co., and Alaska Treadwell Gold Mining Co., of Treadwell; Arthur Thompson, of Katalla; George M. Esterly, of Nizina; Stephen Birch, of Kennecott; Ringwald Blix, of Copper Center; Melvin Dempsey, of Dempsey; H. E. Ellsworth, of Seward; Henry Deyo and O. Roberts, of Valdez; Henry S. Tibbey, of Chignik; Thomas H. Hanmore, of Iliamna; R. W. J. Reed, of Nome; Corey C. Brayton, of Solomon; John A. Dexter, of Golovin; G. A. Adams, of Council; M. F. Moran, of Kiana; E. R. Stivers, of St. Michael; Philip Gallagher, of Nulato; George W. Woodruff, of Fortymile; A. M. Allma, of Miller House; J. J. Hillard, of Eagle; J. A. Kemp, of Steel Creek; T. E. Phillips, of Jack Wade; Frank Slaver, of Woodchopper Creek; Edward H. Boyer, Wells Fargo Co., American Bank, and First National Bank, of Fairbanks; W. B. Ballou, of Rampart; Wm. R. Lloyd, of Kantishna; H. F. Thuman, of Hot Springs; T. M. Thurston, Cyril P. Wood, E. A. Austin, and Charles E. Taylor, of Iditarod; Wm. Babis, of Bethel; and Edward J. Steer, of Georgetown. Besides these, many mine operators have furnished information in regard to mineral production.

The arrangement and manner of treatment in this volume are the same as in those previously issued. Papers of a general character are presented first, followed by those treating of special districts, arranged geographically from south to north. This bulletin contains 12 papers by 10 authors. One of these papers deals with administrative matters, one is a general summary of the mining industry, and the remainder deal more specifically with the economic geology of individual districts. In the geologic papers emphasis is laid on the conclusions that are of immediate interest to the miner, which will, however, 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.

For a number of years Congress recognized the necessity of making the plans for Alaskan investigations far in advance of the opening of the field season by including the annual grant of funds in the first appropriation bill passed. This policy made the money available between the first of January and the middle of February, and thus the plans, including the moving of supplies during the winter, could be carried out economically and efficiently. In 1912 the appropriation for the continuation of the investigations of the mineral resources of Alaska was not made until August 24 and was reduced from \$100,000 to \$90,000. As a consequence of this delay but little could be accomplished and the projects undertaken could be carried out only at relatively heavy expense. Only three parties out of the twelve eventually dispatched to Alaska had a full season's field work, these being supported up to the end of June by the balance left from the funds of the previous year, and from July 1 to the time the regular appropriation became available by the temporary grants made by Congress. Several other parties were dispatched as these temporary grants permitted, but the funds were so inadequate that the parties were undermanned and but poorly equipped.

In spite of the lateness of the appropriation, it was deemed best, in view of the large number of investigations for which there was urgent need, to undertake certain pieces of work. It was, however, fully realized that this work would be very expensive in proportion to the results which could be achieved.

Twelve parties in all were engaged in surveys and investigations during 1912. Of these, two started in April, one in May, two about the 1st of July, and the others between the 10th and 29th of August. The average length of the Alaska field season in the past has been 110 days; the average of 1912 was only 53 days. Moreover, the parties worked late in the fall, when much time was lost owing to unfavorable weather.

Among the important pieces of work which had to be abandoned were an exploration through the western part of the Colville basin to

Point Barrow and geologic and topographic reconnaissance surveys in the Talkeetna and Broad Pass regions. In preparation for the latter work provisions had been dispatched to Valdez Creek, some 300 miles from the coast, at very heavy expense. A reconnaissance of the Yakataga region and detailed geologic and topographic surveys of the eastern part of the Matanuska coal fields and of the Willow Creek gold district were also plans that could not be carried out.

The twelve parties included ten geologists, two geologic assistants, four topographic engineers, one traverseman, two hydraulic engineers, and fourteen packers, cooks, and other assistants. In addition to this, some gage readers were employed who gave only part of their time to the work. Seven of these parties were engaged in geologic work, three in topographic surveys, and two in the investigation of water resources. The results can be summarized as follows:

The areas covered by geologic reconnaissance surveys, on a scale of 1:250,000 (4 miles to the inch), amount to 2,000 square miles; by detailed geologic surveys, on a scale of 1:62,500 (1 mile to the inch), 525 square miles. Much of the time of the geologists was devoted to the investigation of special field problems in the important mining districts, the results of which can not be presented in terms of area. No topographic reconnaissance surveys were made in 1912, but detailed topographic surveys of 298 square miles, on a scale of 1:62,500 (1 mile to the inch), were completed.

In the Yukon-Tanana region 69 gaging stations were maintained in 1912 for an average of 14 weeks each, furnishing data on the water resources of the Fortymile, Eagle, Seventymile, Birch Creek, and Fairbanks districts.

To state the work geographically, one party was in southeastern Alaska, two in the Copper River basin, three in the Prince William Sound region, one on Kodiak Island, three in the Yukon-Tanana region, one in the lower Yukon and Iditarod regions, and one in northeastern Alaska.

Among the important results of the year was a detailed geologic and topographic survey of the mining district near Ellamar and Landlocked Bay, a reconnaissance of the Ruby Creek mining district, and the completion of the geologic survey from Porcupine River northward to the Arctic Ocean. The preliminary investigation of the water resources of the more important mining districts in the Yukon-Tanana region, begun six years ago, was also completed.

The following table shows the allotment, including both field and office expenses, of the total appropriation of \$90,000 to the districts investigated. In preparing this table the general office expenses were divided among the districts in proportions determined by the cost of the surveys in each district, allowance being made for variations in the character of the work. The results are expressed in

round numbers. The item "General investigations" includes the cost of working up field data on districts that were not under survey during the year and the cost of collecting the statistics of production. In past years the total funds have always been allotted. In 1912, however, the conditions already referred to made a full season's work impossible and a part of the money was therefore not allotted. This unallotted balance will be used in the preliminary work necessary to carry on the surveys planned for 1913.

Allotment to Alaskan surveys and investigations in 1912.

Southeastern Alaska.....	\$2, 000
Copper River region.....	20, 500
Prince William Sound and Kodiak Island.....	23, 800
Yukon basin.....	15, 000
Northeastern Alaska.....	5, 000
General investigations.....	7, 700
Unallotted.....	16, 000
	90, 000

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

Approximate allotments to different kinds of surveys and investigations in 1912.

Detailed geologic surveys.....	\$15, 600
Reconnaissance geologic surveys.....	3, 500
Special geologic investigations.....	12, 000
Detailed topographic surveys.....	18, 200
Investigation of water resources.....	5, 000
Collection of statistics of mineral production.....	1, 100
Miscellaneous, including clerical salaries, administration, inspection, instruments, office supplies, and equipment.....	18, 600
Unallotted.....	16, 000
	90, 000

Allotments for salaries and field expenses, 1912.

Scientific and technical salaries.....	\$36, 970
Field expenses.....	18, 370
Clerical and other office and miscellaneous expenses.....	18, 660
Unallotted.....	16, 000
	90, 000

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

Progress of surveys in Alaska, 1898-1912.

Year.	Appropriation.	Geologic surveys.			Topographic surveys.				Investigations of water resources.		
		Exploratory (scale 1:625,000 or 1:1,000,000).	Reconnaissance (scale 1:250,000).	Detailed (scale 1:62,500).	Exploratory (scale 1:625,000 or 1:1,000,000).	Reconnaissance (scale 1:250,000; 200-foot contours).	Detailed (scale 1:62,500; 25, 50, or 100 foot contours).	Lines of levels.	Bench marks set.	Gaging stations maintained part of year.	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		860	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
Percentage of total area of Alaska..	1,061,189	68,700	73,085	3,891	47,680	114,045	3,355	459	72		
		11.72	12.46	0.66	8.16	19.45	0.57				

GEOGRAPHIC DISTRIBUTION OF INVESTIGATIONS.

GENERAL WORK.

The writer was employed in office work of the Alaska division until August 31, when he was appointed vice chairman of the Alaska Railroad Commission. Most of his time from that date to the middle of February was devoted to work of the commission. During this period the administration of the Alaska division was in the hands of George C. Martin, as acting geologist in charge.

The writer, in company with the other members of the commission (Maj. J. J. Morrow, Eng. Corps, U. S. A., chairman; L. M. Cox, civil engineer, U. S. N.; and C. M. Ingersoll), left Washington for Alaska September 2 and returning reached Washington November 27. About two months were devoted to investigations in Alaska, during the course of which Katalla, Kenai Peninsula, the Willow Creek district, Valdez, Cordova, Fairbanks, Chitina, Haines, Skagway, and Juneau were visited. The commission was charged specifically with the duty of investigating the transportation problem and railway routes. Incidentally considerable information on mining development was collected, and this is embodied in the

following pages. The present report does not deal with the work of the commission, the results of which have already been published.¹

Of the time in the office devoted to Survey work during 1912 the geologist in charge has spent about 20 days in reading and revising manuscripts, 40 days in preparing matter for the progress report, 6 days in writing scientific articles, 4 days in preparing the annual Alaska press bulletin, 7 days on statistics of mineral production, 13 days on field plans, and the remainder on routine and miscellaneous matters.

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

Arthur Hollick was employed for about six months and continued the study of the fossil flora of the coal measures of Alaska, a work which, it is believed, will have great economic value in the determination of the stratigraphy of the coal fields.

SOUTHEASTERN ALASKA.

It has long seemed desirable that a geologist specially conversant with building materials should investigate the marble and gypsum deposits of southeastern Alaska. Owing to the conditions already described it was possible to make an allotment for this purpose in 1912, and E. F. Burchard was temporarily transferred to the Alaska division to carry on this work.

Mr. Burchard left Seattle August 29 and spent a month in visiting the known deposits of marble and gypsum in southeastern Alaska. A summary of his results is presented on pages 52-77 of this volume. C. W. Wright was employed for about two months and a half during the summer in completing the preparation of his report, "Geology and ore deposits of Copper Mountain and Kasaan Peninsula, Alaska." This report has been submitted for publication.

COPPER RIVER REGION.

The rapid mining development in the Kotsina-Chitina copper belt made it imperative that the detailed survey and investigation of this field should be extended. As a part of this project, it was decided to begin a detailed survey of the west end of the belt, and this work was assigned to two parties, but the delay in the enact-

¹ Report of the Alaska Railroad Commission, Part I: H. Doc. No. 1346, 63d Cong., 3d sess., pp. 172, with 8 maps; 1913, Part II: S. Doc. No. 1346, 63d Cong., 3d sess., maps and profiles, 1913.

ment of the law carrying the appropriation prevented a full season's work.

D. C. Witherspoon, assisted by S. A. Witherspoon, began topographic work in this field on July 19 and continued until September 30, completing the areal mapping of some 80 square miles on a scale of a mile to the inch, with contour intervals of 100 feet. This mapping covered part of an important copper-bearing district and will be extended westward in 1913.

The geologic mapping and study of the ore deposits of this district were assigned to F. H. Moffit, assisted by Theodore Chapin and J. B. Mertie. The funds were not sufficient to permit work by a separate geologic party, and therefore Mr. Chapin was detailed to accompany Mr. Witherspoon and do such work from his camp as circumstances permitted. Mr. Moffit and Mr. Mertie spent about three weeks in September in the same district but were prevented from continuing the work by the lack of provisions and feed for stock, the railroad to Cordova being blocked for some six weeks. The Moffit party mapped in all about 65 square miles, but another season's work will be required to extend the geologic survey over the economically important part of the district and to investigate the many prospects and mines. The final report on this investigation can be prepared only after further work, but a brief summary of some of the results is presented on pages 81-85 of this report.

PRINCE WILLIAM SOUND.

The detailed topographic mapping of what was then the most important part of the Valdez district was completed by J. W. Bagley in 1911. Since that time valuable prospects have been discovered west of the mapped area, and it therefore seemed desirable to extend work in this field. Mr. Bagley was detailed for this work and was employed on it from August 30 until October 23, mapping 128 square miles, for publication on a scale of 1 mile to the inch, with 50-foot contours.

The region immediately tributary to Landlocked Bay and Ellamar is one of the best-developed copper-bearing districts of Prince William Sound. For this reason a detailed geologic and topographic survey seemed desirable. The topographic work was assigned to R. H. Sargent, assisted by C. E. Giffin. Work was begun August 26 and continued until October 13. A total of 90 square miles, for publication on a scale of a mile to the inch, with 100-foot contours, was mapped.

S. R. Capps and B. L. Johnson were assigned to make geologic surveys of the same district. They began work August 26 and continued until October 9, making a detailed geologic survey and investigation of mineral deposits in an area of some 60 square miles. The

more important economic results of this investigation are presented in this volume (pp. 86-124), and the final report is in preparation. At the close of the season Mr. Johnson paid a hasty visit to some of the better-developed properties of the region tributary to the town of Seward.

KODIAK ISLAND.

In the aggregate there has been a large amount of prospecting for auriferous lodes on Kodiak Island, and this, together with the fact that considerable mining is done each year on the beach placers, made an investigation of the resources of the island desirable. Plans for carrying on this work systematically in the summer of 1912 were formulated but owing to the delay in the appropriation could not be executed. An additional deterrent was the volcanic eruption of June 6 to 8, which in many places covered outcrops with large quantities of volcanic tuff. Furthermore, an investigation of this volcanic eruption was desirable, not only for its scientific interest but also because of the bearing it had on the industrial advancement of this part of the territory. The Geological Survey had no funds which could be devoted to this purpose, but the National Geographic Society made a grant through which it was possible to dispatch George C. Martin to this field. Mr. Martin spent about a month in investigating the distribution of the volcanic tuff and later undertook such observations on the occurrence of metalliferous deposits in the island as circumstances permitted, being occupied from July 4 until September 4 in this investigation. His results relating to the mineral deposits of Kodiak Island are presented on pages 125-136.

THE YUKON BASIN.

The investigation of the water resources in the Yukon-Tanana region, which was begun at Fairbanks in 1907, was continued in 1912. C. E. Ellsworth and R. W. Davenport began work in the Fortymile district on May 20. Later Mr. Ellsworth extended the investigation through the Circle and Fairbanks district, while Mr. Davenport continued stream gaging in the Fortymile district. This work was continued until September 15. During the season 20 gaging stations were maintained in the Fortymile district for an average of 11 weeks each, and 106 measurements were made. The results give information regarding the run-off of about 6,000 square miles. In the Eagle and Seventymile districts 13 gaging stations were maintained for an average of 15 weeks each, and 70 measurements were made. The results give data relating to the run-off of about 600 square miles. Some 20 gaging stations were maintained in the Birch Creek district for an average of 14 weeks, and 123 measurements were made. This investigation indicates the run-off from about 2,150 square miles.

In the Fairbanks district 16 gaging stations were maintained for an average of 14 weeks, and 82 measurements were made. The data thus obtained give information in regard to the run-off of about 2,000 square miles.

Investigation of the surface water supply of the Yukon-Tanana region has now been carried on for six years in the Fairbanks district, five in the Birch Creek, three in the Fortymile, and two in the Hot Springs and Rampart districts, besides which some miscellaneous measurements have been made. The results obtained are of course entirely inadequate to furnish detailed information regarding the run-off of all the streams in this region. Moreover, none of the stations have been maintained long enough to yield reliable data on run-off. It is believed, however, that the stream-gaging data this winter are sufficient to serve as a guide to the placer miner. In view of the urgent demand for investigations of water supply in other parts of the Territory, the work in the Yukon-Tanana region will be discontinued for the present. The results of the investigations by Mr. Ellsworth and Mr. Davenport in 1912 are presented on pages 203-278. A complete report on the work in this region is in preparation.

The rapid development in lode mining in the Fairbanks district since the detailed surveys were completed two years ago made it desirable that further investigations be made. For this reason P. S. Smith was detailed to go to Fairbanks and investigate the auriferous lode deposits in such detail as time permitted. Mr. Smith spent from September 7 to 25 in this investigation. His results are presented on pages 137-202.

Many demands have been made on the Survey for an investigation of the Ruby placer district, and the work was undertaken in 1912, but the circumstances already recounted did not make it possible to put a large party in this field. H. M. Eakin, however, was detailed for the purpose of investigating the Ruby district and also to supplement previous investigations in the Innoko and Iditarod districts. Mr. Eakin reached Ruby July 18 and, after examining this district, made an overland trip to Innoko and the Iditarod, traveling on foot and without packhorses. The principal results of Mr. Eakin's investigation are presented on pages 279-303 of this volume, and a more elaborate report is in preparation.

NORTHEASTERN ALASKA.

By courtesy of the boundary commissioner, Mr. O. H. Tittmann, the Survey was enabled to continue its geologic investigations along the international boundary north of Porcupine River. A. G. Madren, assisted by J. M. Jessup and G. L. Harrington, was detailed for this work. Field work was begun June 14 and continued until August 25. The topographic maps prepared by the boundary sur-

veyors (scale 1:45,000) were used as a basis and the areal mapping covered 400 square miles. In the course of two seasons Mr. Maddren has in this way carried a geologic survey from Porcupine River northward to the Arctic Ocean, covering an area of about 800 square miles. This work will do much to help elucidate some of the general geologic problems of Alaska. Dr. R. W. Brock, director of the Geological Survey of Canada, had agreed to carry the work southward from the Porcupine to the Yukon. As this work also has been finished, fairly complete information has thus been collected regarding the geology of a belt stretching northward from the Yukon near Eagle to the Arctic Ocean, a distance of nearly 400 miles. Reports on the results of these investigations are now in preparation.

COLLECTION OF STATISTICS.

As in previous years, the statistics of the gold, silver, and copper production of Alaska were collected by the writer, assisted by members of the field force and by Mr. Aten. Every year a larger percentage of the operators show their interest in this work by furnishing data of production, but the work of collecting statistics is still much hampered and the accuracy of the results is impaired by the failure of many operators of placer mines to return the statistical schedules mailed to them each year. The funds available for this work are not sufficient to permit sending a geologist each year to every district and obtaining the data desired by personal conference. Therefore, were it not for the aid rendered by the residents of the Territory in making up the estimates of gold production (see pp. 19, 27-29), it would be impossible to present even approximate figures for the gold output of many of the placer districts. The neglect of operators to furnish information on production injures the mining industry by decreasing the accuracy of the published totals for each district. This failure to make returns is not justifiable, as replies are held absolutely confidential, the figures being used only to make up totals. This is practically the only phase of the Survey's Alaskan work which has not had the full support of nearly every mining man with whom the Survey men have come into contact. It is the earnest hope of the writer that all the placer miners of the Territory will soon realize not only that they are running no risk in furnishing to the Survey figures showing production but that in withholding them they are injuring the mining industry.

PUBLICATIONS.

During 1912 the Survey published one professional paper, six bulletins, and one map relating to Alaska. Six bulletins and one water-supply paper are in press. In addition to these, the authors' work

on four other bulletins and one professional paper has been completed, and these publications will soon be sent to press. Six other reports are in preparation.

REPORTS ISSUED.

PROFESSIONAL PAPER 69. The earthquakes at Yakutat Bay, Alaska, in September, 1899, by R. S. Tarr and Lawrence Martin.

BULLETIN 485. A geologic reconnaissance of the Iliamna region, Alaska, by G. C. Martin and F. J. Katz; including geologic and topographic reconnaissance maps.

BULLETIN 498. Headwater regions of Gulkana and Susitna rivers, Alaska, with accounts of the Valdez Creek and Chistochina placer districts, by F. H. Moffit; including geologic and topographic reconnaissance maps.

BULLETIN 500. Geology and coal fields of the lower Matanuska Valley, Alaska, by G. C. Martin and F. J. Katz; including detailed geologic and topographic maps.

BULLETIN 501. The Bonnyfield region, Alaska, by S. R. Capps; including geologic and topographic reconnaissance maps.

BULLETIN 504. The Sitka mining district, Alaska, by Adolph Knopf.

BULLETIN 520. Mineral resources of Alaska (report on progress of investigations in 1911), by Alfred H. Brooks and others; including general map of Alaska showing distribution of metalliferous deposits.

REPORTS IN PRESS.

BULLETIN 502. The Eagle River region, southeastern Alaska, by Adolph Knopf; including detailed geologic and topographic maps. (Issued March 17, 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 June, 1913.)

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

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

BULLETIN 534. The Yentna district, Alaska, by S. R. Capps; including topographic and geologic reconnaissance maps. (Issued June 17, 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 May 28, 1913.)

REPORTS COMPLETED, FOR WHICH ILLUSTRATIONS ARE BEING PREPARED.

A geologic reconnaissance of a part of the Rampart quadrangle, Alaska, by H. M. Eakin (Bull. 535); including geologic and topographic reconnaissance maps. (Issued June 27, 1913.)

The Noatak-Kobuk region, Alaska, by P. S. Smith (Bull. 536); including topographic and geologic reconnaissance maps.

Geologic reconnaissance of the Circle quadrangle, Alaska, by L. M. Prindle (Bull. 538); including topographic and geologic reconnaissance maps.

The Hanagita-Bremner region, Alaska, by F. H. Moffit (Bull. —); including topographic and geologic reconnaissance maps.

REPORTS IN PREPARATION.

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

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

Geology and mineral resources of the Ellamar district, Prince William Sound, Alaska, by S. R. Capps and B. L. Johnson; including geologic and topographic detailed maps.

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

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

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

The surface water supply of the Yukon-Tanana region, Alaska, by C. E. Ellsworth and Royal W. Davenport.

Four topographic maps were issued as illustrations to reports (see p. 16), of which one was on a scale of 1:62,500 (1 mile to the inch) and three on a scale of 1:250,000 (4 miles to the inch). In addition to these, a general map of Alaska showing the distribution of mineral resources was published as an illustration to Bulletin 520. This map was also issued separately as a publication to be placed on sale. Four reconnaissance and three detailed topographic maps are included in the reports that are in press.

THE MINING INDUSTRY IN 1912.

By ALFRED H. BROOKS.

GENERAL CONDITIONS.

Metalliferous mining in Alaska made important advances during the year 1912. The output of the gold placers was less than in 1911, but the installation of large plants, notably of dredges, in many districts augurs well for the future of this industry. Progress was made in lode gold mining in most of the auriferous districts of the Territory. The output of gold from lodes was greater than in any previous year and probably will double before many years. Copper mining also advanced, partly because several large plants increased their output and partly because a number of small mines were opened on account of the high price of copper. A little oil was produced in the Katalla field, as in the previous year, and the exploitation of marble and gypsum deposits continued in southeastern Alaska. The development of the coal fields still awaits the establishment of a definite policy in regard to the disposition of the public coal lands. The delay in securing cheap fuel for the Territory has now for many years caused a stagnation in many industries. Railway construction and, to a certain extent, railway operation have stopped and many mining enterprises have been hampered if not entirely abandoned on account of the unsatisfactory condition of the fuel problem. Very few Alaskans have any direct interest in coal claims or in mining, but the entire population of the Territory is desirous of seeing the coal fields opened because it is believed that this will bring about advancement in many other industries. Above all, it will encourage the operation and construction of railways, which are of the highest importance to the Territory.

In point of increase in production over previous years copper mining was of first importance in 1912. Several new copper mines were opened in the Prince William Sound region, and development work was actively pushed in the Ketchikan and Kotsina-Chitina districts. There was also a considerable increase in the output of the auriferous lodes compared with that of the previous year. Several lode mines which will be provided with large reduction plants are being opened in the Juneau district. Many smaller lode-mining enterprises were

developed in 1912, notably in the Fairbanks district, on Kenai Peninsula, in the Port Valdez district, and in the Willow Creek district. Promising lode discoveries were made at Port Wells, on Prince William Sound, and the far lesser amount of lode prospecting done in the Innoko-Iditarod region yielded encouraging results.

Though the production from placers at Fairbanks fell off compared with the preceding year, this continues to be the most important placer camp of the Territory. The output of the Iditarod-Innoko region and of the Nome and other districts of Seward Peninsula was about the same as in 1911. The most hopeful feature of the placer-mining industry was the continuation of the installation of dredges. Thirty-eight dredges were operated in Alaska during 1912, three in the Fortymile district, one each in the Fairbanks, Birch Creek, Iditarod, and Kenai Peninsula districts, and the rest on Seward Peninsula. Besides these a number of others were under construction.

PRODUCTION.

The value of the total mineral production in 1912 is estimated at \$22,537,821; in 1911 it was \$20,691,241. The following table shows the sources of this wealth for the two years and the gain or loss in 1912. The statistics for 1912 are not yet completed and the figures given in the table may be subject to change. The output of marble, tin, gypsum, lead, and other minor products is given under a single item, because a separate listing might reveal the production of individual properties.

Mineral production of Alaska, 1911-12.

	1911		1912		Increase (+) or decrease (-).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....ounces..	815, 276	\$16, 853, 256	^a 829, 435	\$17, 145, 951	+ 14, 159	+ \$392, 695
Silver.....do....	460, 231	243, 923	^a 515, 186	316, 839	+ 54, 955	+ 72, 916
Copper.....pounds..	27, 267, 878	3, 408, 485	29, 230, 491	4, 823, 031	+1, 962, 613	+1, 414, 546
Coal.....short tons..	900	7, 200	200	2, 000	- 700	- 5, 200
Marble, gypsum, tin, lead, petroleum, etc.....	.....	178, 377	.....	250, 000	.....	+ 71, 623
.....	.....	20, 691, 241	.....	22, 537, 821	.....	+1, 946, 580

^a Preliminary estimates.

NOTE.—In the above table copper is valued at 12.5 cents a pound for 1911 and 16.5 cents for 1912; silver at 53 cents an ounce for 1911 and 61.5 cents for 1912.

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

Value of total mineral production of Alaska, 1880-1912.

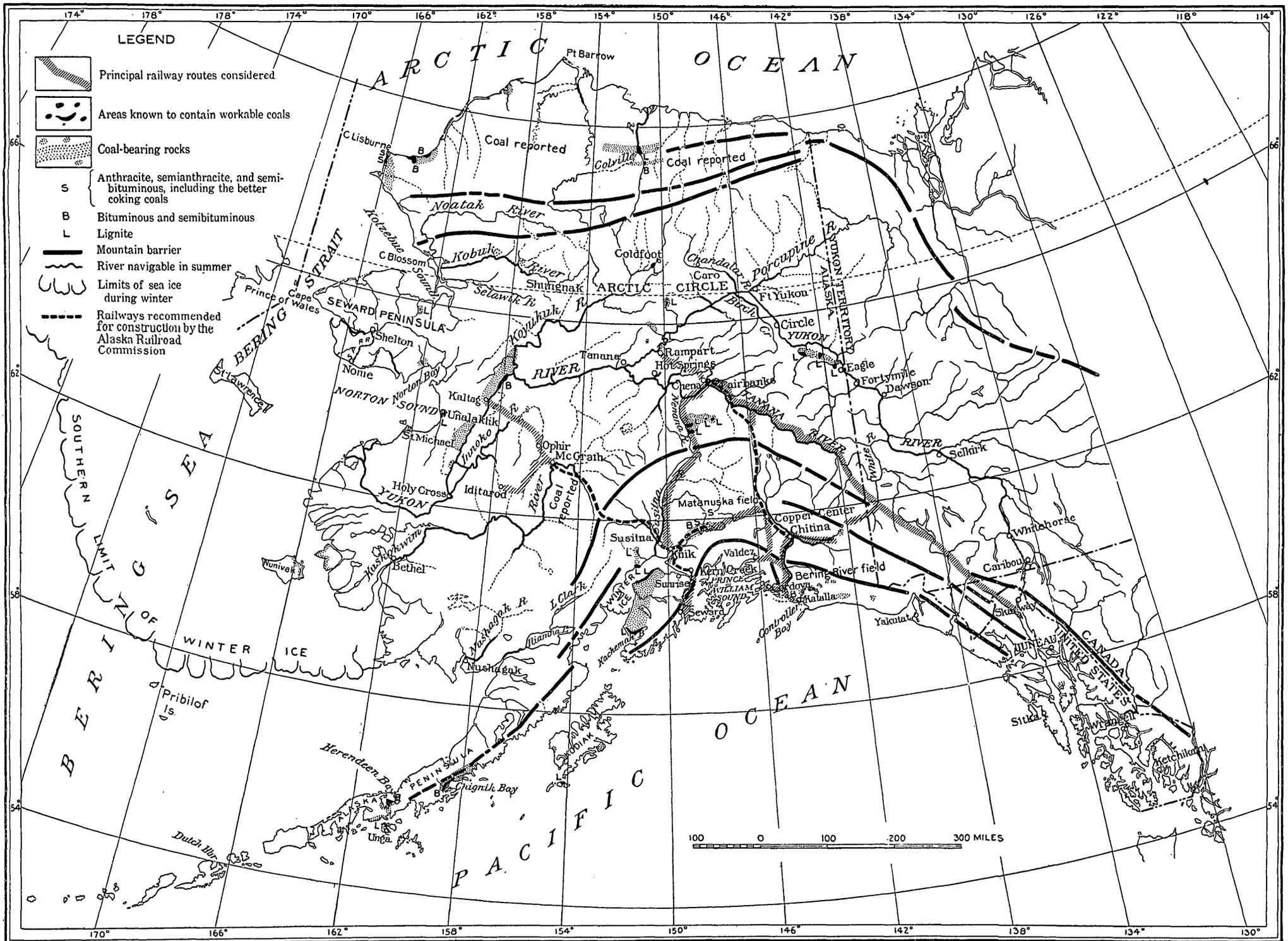
By years.		By substances.	
1880-1890	\$4,686,714	1902	\$8,400,693
1891	916,920	1903	8,941,614
1892	1,096,000	1904	9,567,135
1893	1,048,570	1905	16,478,142
1894	1,310,257	1906	23,375,008
1895	2,386,722	1907	20,847,055
1896	2,980,087	1908	20,142,272
1897	2,538,241	1909	21,141,019
1898	2,585,575	1910	16,887,244
1899	5,703,076	1911	20,691,240
1900	8,238,294	1912 ^a	22,537,821
1901	7,007,398		
			229,507,097

^a Preliminary estimate.

TRANSPORTATION.

With the development of Alaska the inadequacy of the present means of transportation becomes more and more evident. While the Kuskokwim and Yukon river systems of Alaska afford some 5,000 miles of navigable water, this is available for only about three and a half months in the year. Moreover, to utilize this means of communication a long, circuitous route to the mouths of these two rivers is necessary, so that transportation by these routes is both expensive and time robbing.

The Yukon and Kuskokwim basins are separated from the open waters of the Pacific by a series of mountain ranges which afford a serious barrier to inland travel. These ranges are, however, broken by several river valleys and by many passes, and through some of these openings three railways have been built and many others projected. Of the existing lines the White Pass Railway alone reaches the Yukon, about 100 miles from tidewater, but in the headwater region of the river and in Canadian territory. From its northern terminal a river journey of 1,400 miles is necessary to reach Fairbanks, the largest inland settlement. The main line of the Copper River Railway extends inland toward Fairbanks for 132 miles and is over 300 miles from navigable waters of the Yukon. As an inland freight carrier this road therefore serves only the lower Copper River basin. The Alaska Northern Railway has been built for 72 miles from its coastal terminal, about 115 miles from the Susitna Valley, 350 miles from the Kuskokwim Valley, and 390 miles from the Tanana at Fairbanks. This line at present serves only the northern part of Kenai Peninsula and Turnagain Arm. In 1912 the White Pass Railway was operated throughout the year and the Copper River Railway for most of the year. The latter was blocked for six weeks in the fall by heavy rock slides and suffered shorter interruptions in summer by floods and in winter by snowslides. Traffic on the Alaska Northern Railway has not been sufficient to warrant winter operation.



MAP OF ALASKA, SHOWING RAILWAY ROUTES FROM THE PACIFIC SEABOARD TO THE YUKON AND KUSKOKWIM.

Besides these railways, which may be considered trunk lines or the beginnings of them, there are about 125 miles of railway on Seward Peninsula, only a small part of which was operated in 1912. It is reported that some of the railway companies of Seward Peninsula could not afford to operate their lines because of the Federal tax of \$100 a mile. The Tanana Valley Railway, 46 miles long, connecting Fairbanks with the adjacent mining camps, was operated throughout the year. The following table furnishes in concise form data in regard to existing railways in Alaska:

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 Ry., Yakutat to Situk River (narrow gage) (not a public carrier)	9.0
Copper River: Copper River & Northwestern Ry., Cordova to Kennicott (standard gage)	195.0
(The same company has built a few miles of track at Katalla, where the Alaska Pacific Ry. was laid in 1907, and some work was previously done at Valdez, on the Copper River & Northwestern Ry., on the Valdez & Yukon Ry., and on the Alaska Home Ry.)	
Kenai Peninsula: Alaska Northern Ry., Seward to a point near head of Turnagain Arm (standard gage)	71.6
Yukon Basin: Tanana Valley Ry., Fairbanks and Chena to Chatanika (narrow gage)	46.0
Seward Peninsula:	
Seward Peninsula Ry., Nome to Shelton (narrow gage)	80.0
Paystreak branch, Seward Peninsula Ry. (narrow gage)	6.5
Council City & Solomon River Ry., Council to Penelope Creek (standard gage)	32.5
Wild Goose Ry., Council to Ophir Creek (narrow gage)	5.0
	466.0

As this volume may reach those who have not received the report of the Alaska Railroad Commission, it has been thought desirable to present the following extract,¹ which summarizes the results and conclusions of the commission. This matter is illustrated by the map (Pl. I).

Less than five months ago the Alaska Railroad Commission was appointed to investigate the problems of transportation in Alaska, involving the comparative study of a dozen terminals and railway routes aggregating over 3,000 miles [Pl. I], and was directed to submit its report "on or before the 1st day of December, 1912, or as soon thereafter as practicable." This duty involved a consideration not only of the physical and engineering features connected with each project, but also the various industrial phases of no less importance. The great mass of data has been digested

¹Report of Alaska Railroad Commission: 63d Cong., 3d sess., H. Doc. No. 1346, pp. 135-141, 1913.

and the results are presented in the preceding pages. It remains to summarize these results briefly and to present the conclusions of the commission.

The data presented show that the United States possesses in Alaska a frontier territory of great size and of wonderful industrial possibilities. The commission believes that its climate is favorable to permanent settlement and to agriculture, and its mineral resources are vast and as yet but little exploited; that its population is sparse, but only by reason of its inadequate transportation facilities; and that its people are of the same type of hardy pioneers that have carried the United States frontier to its present limits.

In arriving at conclusions and formulating findings the commission has had in mind the terms of the act of Congress constituting its precept, which, briefly stated, provides for recommendations in respect to the best and most feasible railroad routes in Alaska from the seaboard to the coal fields and to the interior navigable waterways, "which will best develop the country resources thereof for the use of the people of the United States." It interprets this precept to mean recommendations—

1. For a railway or railways which give promise of affording the lowest transportation cost to tidewater of coal from one or both of the two best coal fields.

2. The projection of railways along such route or routes as would open the interior to commerce and colonization; the selection of such route or routes to be made after giving due weight to lowest cost and shortest time of construction, maximum economy of operation, and service to the largest areas of known natural wealth, best adapted to permanent colonization; and, finally,

3. That these proposed railways must be based on the best ocean terminals.

The provisions of the enacting clause clearly compel the commission to make choice of routes solely on the basis of physical and economic facts. It therefore can not admit as factors in the problem the existence of railways already built, except in so far as these lines meet the conditions prescribed above. Nor can the local interests of existing coastal settlements be given weight, and still less the personnel or organization of corporations owning interests in existing lines or terminals. The commission conceives its duty to lie in pointing out the route or routes which will best accomplish the ends specified in the acts, without regard to local, corporate, or individual interests.

The routes considered by the commission fall into three classes:

First, those which reach the interior but do not give access to either of the two principal coal fields. In this class are the Skagway route, the Haines-Fairbanks route, the Iliamna-Kuskokwim route, and the Valdez-Fairbanks route.

Second, routes which reach the coal fields only. In this class the routes from Katalla and Controller Bay fall.

Third, the routes which reach the interior and at the same time will furnish economical transportation for the two coal fields. In this class are the Cordova-Fairbanks route, the Seward-Fairbanks route, and the Seward-Innoko-Iditarod route.

These routes will be considered in the order above presented.

For convenience in discussing the relative merits of the various routes under consideration it has been deemed expedient to arrange the physical and economic characteristics of each in such form as to facilitate comparison. Accordingly, two tables have been prepared and are here inserted. Table A shows the various features of the six through or trunk routes, while Table B refers to the proposed coal roads. The headings of the different columns are descriptive of the data furnished and therefore require no further explanation.

TABLE A.—Comparison of trunk lines.

Name of route.	New track mileage.		Total cost of new construction. ^a	Average cost of construction per mile.	Maximum grade (per cent).		Number of summits.	Total lift, north bound.	Average freight rate per ton mile, in cents.	Average rate per passenger mile, in cents.	Through freight rate per ton.	Through passenger rate.
	Existing track mileage.				North bound.	South bound.						
Haines-Fairbanks.	638	.....	\$28,186,000	\$44,300	b2.00	b2.00	2	b4,000	(c)	(c)	(c)	(c)
Cordova-Fairbanks.....	313	132	13,971,000	44,600	1.13	1.51	1	4,260	d8.30 e7	d36.94 e6	d31.15 e6	d26.70 e6
Valdez-Fairbanks.	380	.....	18,545,000	48,800	3.00	3.00	3	3,970	d9.13 e6	d34.69 e6	d26.60 e6	d22.95 e6
Seward-Fairbanks	391	72	17,708,000	45,300	2.3	2.2	3	4,900	d8.55 e6	d40.20 e6	d32.90 e6	d28.20 e6
Seward-Iditarod...	344	72	17,970,000	52,300	b2.00	b2.00	(f)	(f)	d16.5 e11.63	d10	d68.64	d41.60
Iliamna-Kuskokwim.....	400	.....	22,199,000	55,400	(f)	(f)	(f)	(f)	(c)	(c)	(c)	(c)

^a Cost of new construction contains equipment and overhead charges.
^b Estimated from United States Geological Survey topographic maps.
^c No operation studies made.
^d Rate taken from estimate No. 2 (private construction).
^e Rate taken from estimate No. 3 (government construction).
^f Not known.

TABLE B.—Comparison of coal lines.

[Freight rate is calculated for 1,500 tons daily output at mines.]

Name of route.	New track mileage.		Total cost of new construction. ^a	Average cost of construction per mile.	Maximum grade (per cent).		Number of summits.	Total lift, south bound.	Average freight rate per ton mile, in cents.	Through freight rate.	
	Existing track mileage.				North bound.	South bound.				Mines to terminal.	Mines to ship.
Bering River-Katalla-Cordova.....	55	38	\$2,700,000	\$49,000	1.3	0.58	.....	Feet. 145	1.39	\$1.29	\$1.54
Bering River-Lake Charlotte-Cordova.....	38	38	2,054,000	54,000	1.3	1.7	1	360	1.57	1.19	1.44
Bering River-Katalla Bay.....	31	.....	b1,702,000	55,000	1.3	.58	.....	145	2.45	.76	.96
Bering River-Controller Bay.....	25	.....	b1,430,000	57,000	1.3	.58	.....	145	2.79	.69	.89
Matanuska-Chitina-Cordova.....	163	132	8,434,000	51,700	1.13	2.2	1	2,180	1.66	4.90	5.15
Matanuska-Kern Creek-Seward.....	115	72	4,945,000	43,000	2.3	2.2	2	1,750	1.35	3.10	3.35
Matanuska-Valdez.....	230	.....	12,662,000	55,000	3.0	3.0	3	3,980	1.70	3.91	4.16

^a Cost of new construction contains equipment and overhead charges.
^b Exclusive of terminal, which is estimated at \$2,500,000.

Of the routes that do not reach either of the principal coal fields, two have their coastal terminals in southeastern Alaska—namely, at Skagway and at Haines, Pyramid Harbor. These two routes have much in common, but as between the two harbors the location at Haines, with its possibilities of development on both sides of the peninsula and with its good anchorage area, possesses advantages over Skagway.

The commission believes that a railroad will be built at an early date connecting Haines with the Canadian interior, for the development of local resources, and that the development of central Alaska and adjacent portions of Canada will ultimately call

for an extension of this line into the Tanana Valley and possibly on to the Seward Peninsula. The route presents many attractive features, but, in common with the route based on Skagway, the mileage to Fairbanks is excessive, is partly in foreign territory, and as yet no high-grade coal has been discovered which can be conveniently served by either of these routes. The commission therefore feels justified in confining its further considerations to the routes reaching the interior from ports on the Gulf of Alaska west of the one hundred and forty-first meridian.

The third route which does not give access to either of the principal coal fields is the route from one of the harbors on Cook Inlet into the valley of the Kuskokwim. These harbors may be passed over with the statement that no railroad can be based on any of them that will assist in the development of the Territory as efficiently or as economically as can be done by lines reaching the coast farther north and east. They lie too far southwest to develop conveniently the known resources of the interior. The commission, however, desires to state that Iliamna Bay or Iniskin Bay have possibilities for use as a terminal for a short line intended to develop the resources and industries of the immediately tributary region. This eliminates all routes to the interior that will not economically serve either of the two principal coal fields, excepting the route from Valdez.

Valdez has a harbor inferior only to that of Cordova and about equal to that of Seward. There is no probability, however, of its being utilized as an outlet for either Bering River or Matanuska coal. The commission considered the possibilities of developing Matanuska coal by way of this port, but the haul involves the surmounting of two major summits (Tahnetta and Thompson passes) and one minor summit (Ernestine), besides being longer in distance than the haul over the alternate route to Seward. It is not surprising, therefore, that operating costs are shown to be excessive. With industrial advancement it is probable that Valdez will require the construction of one or the other of the lines connecting it with the Copper River valley. The Thompson Pass route would also have value in case equitable trackage arrangements for traffic through to tidewater can not be effected by the proposed Chitina-Fairbanks road.

This leaves for consideration the routes giving economical access to the two coal fields. Before discussing these routes which are affected by the development of these fields it is desirable to briefly consider the coal question.

In the absence of information to the contrary, the commission assumes that the coal deposits of the Bering River and Matanuska fields are on a parity as to quality of product and cost of mining. The heart of the Bering field lies about 30 miles from the coast at either Katalla or Controller Bay, about 76 miles from Cordova, and about 38 miles from the existing tracks of the Copper River & Northwestern Railway. The heart of the Matanuska field is 187 miles from Seward, 115 miles from the present northern terminus of the Alaska Northern Railway. Both fields are reported to contain bituminous coal of good coking and steaming quality, in composition approximating the best coals of the eastern fields in the United States, but both are so folded and crushed as to add to the expense of mining and to much reduce the percentage of lump in the output.

It has been shown by analyses of operation costs (see p. 23) that these coals can probably be delivered at their respective terminal points for the following figures per ton. These figures are based on an assumed output of about 500,000 tons annually and include only transportation and terminal costs.

Estimate of cost of transporting and loading coal.

	Per ton.
Bering River coal to Katalla.....	\$0. 96
Bering River coal to Controller Bay.....	. 89
Bering River coal to Cordova via Lake Charlotte.....	1. 44
Matanuska coal to Seward.....	3. 35

The coal markets of the Pacific have also been discussed, and it has been shown that Alaska coal could probably compete with other coals in the west-coast markets provided that the operators both of the mines and of the transportation lines are content with reasonable profits.

Controller Bay and Katalla each require for terminal development a first cost of construction that will assuredly be high and will certainly require high maintenance charges. Moreover, the completion of such terminal would offer harbor facilities very inferior to those that can at little expense and at low maintenance charge be had at Cordova. While the costs of transportation to these points are lower than that to Cordova, the commission believes that for the reasons cited above and discussed more fully elsewhere (see pp. 96-98), it would be unwise to attempt harbor construction at either Katalla or Controller Bay at present. An additional and important reason for this decision lies in the fact that if either of these places were developed as a coal-shipping port, all Bering River coal used in Alaska would have to be transshipped unless a line from Katalla to a junction with the Copper River Railway were built. It is evident that such a railway would serve, for the present at least, to make harbor construction at either Katalla or Controller Bay superfluous, for it would at once give the coal an outlet to tidewater at Cordova, as well as inland by the Copper River valley.

The commission is of opinion that the routes based on Skagway, Haines, Iliamna Bay, and Valdez are eliminated for the lack of high-grade coal, and those based on Katalla and Controller Bay by the present unsuitable harbor facilities, which would be remedied only by difficult and costly construction. This reduces the discussion to the three routes which penetrate inland Alaska and at the same time give convenient access to the two coal fields. Two of these routes reach the heart of the Tanana Valley—one from Cordova and one from Seward. The third reaches the Kuskokwim from Seward. The two routes into the Tanana will first be compared.

After its study of all available harbors, the commission is of the opinion that the one at Cordova is, without question, the best. It has no disadvantage not possessed by all and one great advantage possessed by no other—namely, an ample area of good anchorage. Seward is evidently the seaport for the Matanuska coal and Cordova the logical outlet for the Bering River coal. The comparisons of transportation rates given in the foregoing table show that for an output of 500,000 tons annually it will cost \$1.91 a ton more to haul Matanuska coal to Seward than it will to haul the Bering River coal to Cordova, and the analysis further shows that for double this output the additional cost will be \$1.11. This places the Matanuska coal at such disadvantage that it could probably not be marketed at tidewater in competition with the Bering River coal.

To now consider the trunk lines to Fairbanks over their two routes. For the purpose of comparison a digest of the analyses of mileage and cost of new construction, mileage between terminals, and freight rates on these two lines is here again presented:

Terminals.	Distance (miles).	New mileage.	Cost of new con- struction.	Average freight rate per ton.	
				Estimate 2, ^a	Estimate 3, ^b
Cordova and Fairbanks.....	445	313	\$13,971,000	\$36.94	\$24.43
Seward and Fairbanks.....	463	391	17,708,000	40.20	27.71

^a Construction by private corporations.

^b Construction by the Government.

It is evident that on the Cordova route the first investment will be less than on the Seward route; the resulting freight rates will be lower; the terminal port offers a better

harbor than the one at Seward; and the tributary coal field promises the earlier development because its product can be marketed cheaper. Each of these economic features points clearly to the advisability of reaching the Tanana Valley via the valley of the Copper River, and the commission therefore recommends the construction of a railway from Chitina to Fairbanks.

The construction of a railway through the Copper River valley to the Tanana would leave a large and very important part of Alaska unprovided for. It would in no way furnish transportation facilities to the rich agricultural lands and mineral wealth of the lower Susitna or make available the coals of the Matanuska fields. While this coal is probably barred for the present from tidewater competition with the Bering River coal, it yet has great value for local use. Moreover, and still more important, a railway to Fairbanks from Cordova will not serve the great Kuskokwim Valley and therefore not fulfill all the demands for rail connection with inland navigable waters. Fortunately, both the Kuskokwim and Susitna valleys can be developed by a railway from Seward to navigable waters on the Kuskokwim.

The building of this line into the Susitna valley is second in importance only to a line to Fairbanks, and its extension into the Kuskokwim should also be provided for as soon as possible, and the commission so recommends.

The commission believes that the two railway lines into which this discussion has resolved itself will form two systems that will at once advance development in the Territory. This recommendation for two trunk lines connecting navigable waters is in accord with the natural evolution of railway construction. In new countries the first lines of communication established are always those built over the main divides and connecting with navigable waters and thus serving to supplement water transportation. It is only in well-settled countries that lines tying together such transverse systems and paralleling waterways are built.

The industrial advancement which will follow the building of the main trunk lines can not fail to call for the extension of many branches to serve adjacent districts. There is no reason to believe that such branches will not follow in Alaska as they have in all railroad history, and such extensions will ultimately provide for intercommunication between the two systems here recommended. Several such extension lines have been mentioned in this report. Those most important, in the opinion of the commission, are the coal branches; the extensions from Fairbanks to the Yukon River, so that the scope of rail service may reach the main Yukon Valley; the extension from the Chitina-Fairbanks line to reach the Nabesna Valley; and one at least of the two routes connecting Valdez with the Copper River valley. In the opinion of the commission the two coal branches should be built at once; the others will follow the demand created by industrial development.

1. Chitina to Fairbanks, 313 miles.....	\$13, 971, 000
2. Bering River coal branch via Lake Charlotte, 38 miles..	2, 054, 000
3. Kern Creek to Susitna Valley, 115 miles.....	5, 209, 500
4. Matanuska coal branch, 38 miles.....	1, 616, 000
5. Susitna Valley to Kuskokwim, 229 miles.....	12, 760, 500

In conclusion it should be stated that the commission is unanimously of opinion that this development should be undertaken at once and prosecuted with vigor, and it can not be accomplished without providing the railroads herein recommended under some system which will insure low transportation charges and the consequent rapid settlement of this new land and the utilization of its great resources.

The board of road commissioners for Alaska ¹ reports that since its organization and up to July 31, 1912, it has constructed 829 miles

¹ Richardson, W. P., Annual report of the board of road commissioners for Alaska for the season of 1912, p. 7.

of wagon road, 599 miles of winter sled roads, and 1,552 miles of trails. Among the most important projects undertaken in 1912 are a wagon road from Juneau to Sheep Creek and extensions of the Circle-Central House wagon road in the Yukon basin and of the Moose Pass road in Kenai Peninsula. The wagon road from Knik to Willow Creek was completed, as was also a sled road from Ruby, on Yukon River, to Long Creek. The importance of this work to the mining industry of the Territory can hardly be exaggerated. Any scheme for railway extension must be supplemented by the construction of wagon roads, if the needs of the Territory are to be well served.

There has been little change in steamboat service to and within Alaska during 1912. The most important river traffic is that of the Yukon and Tanana. It is reported that a direct steamboat service is to be established from Canadian Yukon ports to Fairbanks, which has been made a port of entry. Several steamers are run on the Kuskokwim, though with no great regularity of service. Susitna River is served only by launches, there being no large steamers on this river.

METAL MINING.

PRODUCTION.

In 1912 about 29 per cent of the total gold production came from lode mines, compared with 25 per cent in 1911. This indicates that lode mining is on the increase. It is expected that a very rapid increase in the percentage of lode output will take place in a few years, when the many lode enterprises already started will reach a productive stage. The output from placer mining will probably continue to decrease for several years until more large mining plants have been installed. In the following table, which is based in part on preliminary estimates, the production of precious metals has been distributed as to sources.

Sources of gold, silver, and copper in Alaska, 1912, by kinds of ores.

	Total.	Gold.		Silver.		Copper.	
		Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
	<i>Tons.</i>	<i>Ounces.</i>		<i>Ounces.</i>		<i>Pounds.</i>	
Siliceous ores.....	1,751,824	241,991.05	\$5,002,399	35,696	\$21,952		
Copper ores.....	93,452	7,428.08	153,552	376,593	231,605	29,230,491	\$4,823,031
Placers.....		580,016.25	11,990,000	102,897	63,282		
	1,845,276	829,435.08	17,145,951	515,186	316,839	29,230,491	4,823,031

In addition to the ores listed above, some tin is produced on Seward Peninsula (p. 50), but as most of this output is made by one

company, the figures, in accordance with the policy of the Survey, are not published. A small amount of lead is also recovered each year from Alaska ores. In the following table the production of gold, silver, and copper is given by years:

Production of gold, silver, and copper in Alaska, 1880-1912.

Year.	Gold.		Silver.		Copper.	
	Quantity.	Value.	Quantity.	Commercial value.	Quantity.	Value.
	<i>Fine ounces.</i>		<i>Fine ounces.</i>		<i>Pounds.</i>	
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	99,687		
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
	10,292,541	212,765,727	3,094,048	1,841,203	90,294,477	13,570,225

The total production of gold in Alaska is in the following table distributed according to districts. No systematic collection of statistics of Alaskan gold production was made previous to the year 1905. Therefore the figures presented in this table for the years preceding 1905 are probably in considerable error—possibly as much as 15 per cent. It should be noted that, as complete statistical returns are not even yet available, owing to the fact that some producers do not furnish information of output, the other figures in this table are also not entirely correct. The error of distribution is believed to be less than 3 per cent. This error will not be entirely eliminated until the complete cooperation of all mine operators is secured.

The production from the Pacific coast belt is derived principally from the lode mines of southwestern Alaska but includes also the output of a gold-lode mine on Unga Island and of several gold and copper lode mines on Prince William Sound, 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 but steady producer. The beach placers along the Pacific seaboard have been worked each year on a small scale since about 1890.

Up to 1909 all the gold produced in the Copper River and Cook Inlet region was obtained from placers. Since then several small lode mines on Kenai Peninsula and in the Willow Creek district have been productive. Much the larger part of the gold produced in the Yukon basin and Seward Peninsula has been derived from placers. In the last three years there have been a number of productive lode mines in the Fairbanks district (see pp. 137-202), and since 1903 a little lode gold mining has been undertaken at different times in Seward Peninsula.

Value of gold production of Alaska, with approximate distribution, 1880-1912.

Year.	Pacific coast belt.	Copper River and Cook Inlet region.	Yukon basin.	Seward Peninsula and north-western Alaska.	Total.
1880.....	\$20,000				\$20,000
1881.....	40,000				40,000
1882.....	150,000				150,000
1883.....	300,000		\$1,000		301,000
1884.....	200,000		1,000		201,000
1885.....	275,000		25,000		300,000
1886.....	416,000		30,000		446,000
1887.....	645,000		30,000		675,000
1888.....	815,000		35,000		850,000
1889.....	860,000		40,000		900,000
1890.....	712,000		50,000		762,000
1891.....	800,000		100,000		900,000
1892.....	970,000		110,000		1,080,000
1893.....	838,000		200,000		1,038,000
1894.....	882,000		400,000		1,282,000
1895.....	1,569,500	\$50,000	709,000		2,328,500
1896.....	1,941,000	120,000	800,000		2,861,000
1897.....	1,799,500	175,000	450,000	\$15,000	2,439,500
1898.....	1,892,000	150,000	400,000	75,000	2,517,000
1899.....	2,152,000	150,000	500,000	2,800,000	5,602,000
1900.....	2,606,000	160,000	650,000	4,750,000	8,166,000
1901.....	2,072,000	180,000	550,000	4,130,700	6,932,700
1902.....	2,546,600	375,000	800,000	4,561,800	8,283,400
1903.....	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904.....	3,195,400	500,000	1,300,000	4,164,600	9,160,000
1905.....	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906.....	3,454,794	332,000	10,750,000	7,500,000	22,036,794
1907.....	2,891,743	275,000	9,185,000	7,000,000	19,349,743
1908.....	3,448,318	401,500	10,325,000	5,120,000	19,294,818
1909.....	4,264,716	265,000	11,580,000	4,302,000	20,411,716
1910.....	4,182,730	351,630	18,062,389	3,530,000	16,126,749
1911.....	4,265,573	313,538	19,139,145	3,135,000	16,853,256
1912.....	4,904,753	358,401	18,857,797	3,025,000	17,145,951
	61,382,627	5,032,069	82,976,331	63,374,700	212,765,727

^aIncludes a small production from the Kuskokwim basin.

The output of the Yukon basin given in the above table includes, of course, only that of the Alaska camps. Gold to the value of \$4,000,000 or \$5,000,000 is annually produced from the Klondike and other smaller Canadian Yukon districts. Since 1910 there has been a small annual gold output from the lower Kuskokwim basin, and in the above table this is included in the output of the Yukon basin.

METALLIFEROUS LODES.

STATISTICS.

The total gold production from the auriferous lode mines of Alaska which have been productive since 1882 is estimated to be 27,966,622 fine ounces, valued at \$57,811,300. These mines have also produced 1,065,439 fine ounces of silver, with a commercial value of \$648,853. The total copper production up to the close of 1912 was 90,293,397 pounds, valued at \$13,570,225. Tin mining began in the York region, Alaska, in 1902. During the last two years, owing to the installation of a dredge, the mining of placer tin has been systematically prosecuted. Up to the close of 1911 tin to a total value of \$244,451 has been produced. From 50 to 60 tons of lead is annually recovered from Alaska ores.

Alaska's auriferous lodes are estimated to have produced during the year 241,991 fine ounces of gold, valued at \$5,002,399, compared with an output of 204,466 ounces, valued at \$4,226,687, in 1911. Most of this increase is to be credited to the Juneau district, yet there was relatively a considerable increase of output in most of the other gold lode districts.

Twenty-four 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 in Alaska in 1912—five more than in 1911. Of the producing mines, seven were in southeastern Alaska. Work was also done on many gold prospects, a few of which produced some gold as an incident to the development work.

It is estimated that these mines had an output of 1,751,824 tons of ore, compared with 1,594,404 tons in 1911. In 1911 the average value of gold and silver contents for all the ores mined was \$2.66 a ton; the average in 1912 is estimated to have been \$2.93.

There were eight productive copper mines in 1912, the same number as in 1911. Of these, three were in the Ketchikan district, four on Prince William Sound, and one in the Kotsina-Chitina district. In addition to the output of the eight productive mines, there were some small shipments of copper ore from several properties that are being developed. The total copper production in 1912 was 29,230,431 pounds, valued at \$4,823,031, compared with 27,267,878 pounds, valued at \$3,408,485, in 1911. About \$153,552 worth of gold and \$231,605 worth of silver was recovered from the copper ores. It is estimated that in 1912 about 93,452 short tons of copper ore were hoisted, compared with 68,975 tons in 1911. The average copper content of the ore was about 15.64 per cent and the value of the gold and silver about \$4.11 to the ton. The large average copper percentage is due to the very high grade ores shipped from the Bonanza-Kennicott mine.

SOUTHEASTERN ALASKA.

GENERAL CONDITIONS.

The seven auriferous lode mines operated in southeastern Alaska in 1912 produced gold to the value of \$4,418,392, compared with an output of \$3,904,217 from eight mines in 1911. A much larger annual gold output is to be expected within a few years, when several large enterprises now under way reach a productive stage. No great progress was made in developing copper properties in southeastern Alaska. Sufficient work was done at several mines to indicate that they may soon become shippers.

The following notes on mining development are believed to cover the most important events of the year. As, however, no geologist visited the region, it is impossible to present a complete record of all the mining activity. The information here set forth is largely taken from the schedules returned by the lode-mine operators and owners. Unfortunately, many of those interested in nonproducing properties fail to return the schedules. The writer desires to call attention to the fact that the schedules are of great value as a record of mine and prospect development of the nonproductive as well as of the productive properties. In the interest of the mining industry all connected with the development of the properties are urged to furnish a statement of their operations to the Geological Survey promptly each year.

JUNEAU PRECINCT.

Though only five gold mines were producing in the Juneau precinct during 1912, the activity in development work was so great as to augur well for the future gold output. The Treadwell group of mines continues to overshadow all other enterprises, but several other properties are being developed on a large scale.

The Treadwell companies completed the installation of the first unit of a hydroelectric plant on Nugget Creek, with an ultimate capacity of 3,000 kilowatts. The central hoisting and crushing plant was practically completed. Changes were also made in pumps and minor machinery from steam to electric power. As usual, the mines of the Treadwell group were operated throughout the year. At the Treadwell mine the ore was taken chiefly from the 750, 1,250, 1,450, and 1,600 foot levels, while dead work was done on the 1,750-foot level. The ore mined at the Alaska-Mexican was taken from the 1,100, 1,210, 1,320, and 1,460 foot levels, and considerable dead work was accomplished on the 1,460 and 1,570 foot levels. At the Ready Bullion the ore was taken chiefly from the 1,500-foot level and much work was done on the 2,000-foot level. At the Seven Hundred Foot claim ore was taken from the 990, 1,100, 1,210, and

1,320 foot levels, and drifts were also advanced on the 1,570, 1,600, and 1,750 foot levels.

The mill of the Perseverance mine, the property of the Alaska-Gastineau Co., was operated, as in the past, from May to October. This 100-stamp mill and crushing plant was completely destroyed by fire December 4, 1912. The underground operations consisted in enlarging and retimbering the main adit, drifts, and shaft and driving about 500 feet of drift. These operations were undertaken preparatory to connecting the mine workings with a working and transportation tunnel which is being driven from the Sheep Creek side of the divide and about 2,500 feet of which had been completed at the close of 1912. This tunnel will be 8,000 to 9,000 feet in length and will be about 650 feet below the main level of the Perseverance mine. It is to develop not only the Perseverance mine but also the Silver Queen and other properties lying on the Sheep Creek side of the divide. Construction has been started on a milling plant near the mouth of Sheep Creek, to have a capacity of 6,000 tons a day. A hydroelectric plant is to be installed on Salmon Creek.

The 30 stamps of the Alaska-Juneau mine were operated from May to October and were supplied with ore from open cuts. The heading of the new adit tunnel being driven from Gold Creek was advanced to 4,383 feet by the close of the year but is still about 1,700 feet from the ore body. It will undercut the ore body of the Alaska-Juneau about 600 feet below the old workings. The ore is to be trammed from the portal of the adit to a mill which will be erected near tidewater.

The California-Nevada Copper Co., which owns the Ebner mine, on Gold Creek, went into a receivership and a new company, called the Alaska-Ebner, is said to have been organized to take over the property. Some work was also done on the Salmon Creek side of the divide, on what is believed to be a northwesterly extension of the mineralized zone opened by this mine.

At the Petersen property, near Pearl Harbor, north of Juneau, the developments in 1912 consisted of an inclined shaft sunk 50 feet, together with some open cuts. The driving of the new lower adit near the stamp mill was continued at the Eagle River mine. While some work was undoubtedly done at other properties in the region lying between Juneau and Berners Bay, the writer has no information in regard to it.

It is reported that the driving of the adit on the main level of the Kensington mine, at Berners Bay, was continued during 1912. Development work was also continued at the Jualin mine, in the same district. A large air compressor was being installed at the close of the year.

The writer has little information about developments south of Juneau. It is reported that a 100-foot tunnel and a 40-foot upraise were completed on the Daisy Bell claim, near Snettisham, and that this work revealed a 4-foot body of ore. Some work was also done on a group of claims located near the point at the junction of Gastineau Channel and Taku Inlet.

KETCHIKAN PRECINCT.

No noteworthy advances were made in the Ketchikan precinct in 1912. Only three copper mines were producing. Two gold mines, which are equipped with stamps, were also operated, and some gold was probably produced, but of this there is no definite information at this writing. The high price of copper has stimulated the development of copper deposits, and as a result considerable advance was made on several properties. The Jumbo mine was operated throughout the year. On this property 136 feet of shaft was sunk during the year and the aggregate of drifting amounted to 450 feet.

The Rush & Brown mine continued productive operations throughout the year. The shaft was sunk to a depth of 184 feet and drifting was continued on the first and second levels, from which the ore was stoped. Some work consisting of drifts and crosscuts, was done at the Copper Mountain mine, which has long been idle. Some developments were also made at the Red Wing mine. Work was continued on the long adit of the It mine, from which some shipments were made. So far as learned, the Mount Andrew mine was idle for most of the year, though plans were made to put it again on a productive basis. Some work was also done on the Victory and Sanford groups of copper claims, near Seal Bay. It is reported that the Northland Development Co. has done considerable underground work on a copper property located on "Big Harbor."¹

Work was continued on the main level of the Lon de Van property, on George Inlet. A crosscut was completed in January, 1912, encountering the ore body 2,064 feet from the portal and about 900 feet below the outcrop of the vein. Since then the ore has been followed some 1,600 feet by drifting. The ore is said to contain silver, lead, gold, copper, and zinc.

The Princeton Mining & Milling Co. continued work on its property near Dolomi. A 100-horsepower boiler and air compressors were installed. In the fall of 1912 a 10-stamp mill was erected. Late in the year the Goldstream mine, on Gravina Island, was again opened, and the 5-stamp mill is said to have been operated. Developments were said to have been resumed in 1912 on the Moonshine silver-lead

¹ The location of "Big Harbor" is not known to the writer, but it is probably one of the indentations of Dall Island, in the western part of the Ketchikan district.

property, which is located on Cholmondeley Sound. Work was continued on the Martin-Bugge properties, near Smugglers Cove, on the mainland north of Ketchikan. The developments in 1912 consisted of drifting on the vein on both sides of the adit and in increasing the surface equipment.

SITKA AND OTHER PRECINCTS.

The Chichagof and Golden Gate mines were combined under one management in 1912. The former was operated for the entire year; the latter for the last nine months of the year. A total of 300 feet of sinking, 160 feet of raising, and 2,800 feet of horizontal work was done in these two mines during 1912. It is reported that a discovery of rich gold ore was made by Bernard Hirst in 1912 near the Chichagof mine.

During 1912 nothing of importance occurred in lode development in the Porcupine, Skagway, and Wrangell districts. There was, however, considerable lode prospecting in the Wrangell and Porcupine districts. Mention of the gold placers of the Porcupine district will be found on page 43.

PRINCE WILLIAM SOUND.

GENERAL FEATURES.

Much advance was made in developing the mineral resources of Prince William Sound during 1912. Three copper mines made regular shipments of ore, and smaller shipments were made from several other properties that are under development. While only one gold mine was productive, in the aggregate considerable ore was recovered from other properties incidentally to mining operations. It is estimated that the mineral production of Prince William Sound in 1912 had a value of \$1,250,000, compared with \$1,000,000 for 1911.

PRINCIPAL COPPER MINES.

The most important localities of copper production were the region tributary to Ellamar and Landlocked Bay, described on pages 86-124, and Latouche Island. The Beatson-Bonanza mine on Latouche Island was operated throughout the year, though in December operations were somewhat hampered by the destruction of the electric power plant by fire.

The Knights Island Copper Co. employed a force of men in September and October in driving a 50-foot drift. Development work is reported on three properties located near Fidalgo Bay, namely, those of the Fidalgo-Alaska Copper Co., the Fidalgo Mining Co., and Mason & Gleason. The Fidalgo Mining Co. is the only one of these companies which has made report to this office. On this property some 600 feet of underground work has been done, and an aerial tram is being installed.

PORT VALDEZ DISTRICT.

The Cliff gold mine was operated throughout the year. In October the mine workings had been extended to the fifth level, and it is currently reported that the vein and its tenor had been found to persist to this depth. At the Gold Bluff, located not far from the Cliff mine, about 240 feet of underground work was done in 1912. Some developments are also said to have been made at the Bluff and on the Sealy-Davis properties. A new company is said to have taken over the Bluebird mining claim, west of Shoup Bay, and to have started systematic development.

Much work was done on the Alice claim, on Shoup Bay. An air compressor and pump were installed, and a two-compartment shaft sunk to a depth of more than 100 feet. The Thompson & Ford property, about 2 miles from Shoup Bay, is said to have been developed by a 400-foot adit tunnel and two crosscuts. At the Owl property, which is close at hand, the developments are reported to consist of 230 feet of adit tunnel. Some work was done during the year on a number of other claims in this part of the district.

Of the properties in the Columbia Glacier region the Mayfield, 9 miles from Shoup Bay, is the most extensively developed. This property has been developed by adit tunnels on two levels, aggregating 500 feet in length. The Cameron-Johnson property, in the same general district, has 267 feet of adit. Some shipments were made from this property, the ore being hauled to tidewater at Shoup Bay.

In the Mineral Creek district developments were continued on the Hercules, Millionaire, and other properties. Important discoveries of ore are reported to have been made at the Ramsay & Rutherford group of claims, on the east side of Valdez Glacier. Two intersecting auriferous quartz veins, having widths of 1 to 7 feet, are said to occur on this property. In 1912 a crosscut was driven, which intersected the larger vein at a depth of about 45 feet, and the ore body was then followed by drifting for some 90 feet. A winze has been sunk about 40 feet below this level and 90 feet below the surface, and from the bottom of this a crosscut was carried to the vein, which showed a width of 2 feet or more. An air compressor and a hoist have been installed at this mine and preparations have been made for continuing work.

Besides those above chronicled, other mining developments have taken place in the Port Valdez district and adjacent country. Some auriferous veins have been found in the region tributary to the military road extending inland from Valdez. Valuable discoveries are reported to have been made in the Tiekel region and also in the Tasnuna Valley, not far from Marshall Pass. The evidence in hand indicates that mineralization has been widespread in the Port Valdez

district and adjacent regions and that there is therefore good hope of finding other workable deposits than those thus far discovered.

The Midas copper property, on Solomon Gulch, a tributary to Port Valdez from the south, was taken over by a new company in 1912 and systematically developed, and some ore was shipped. Some 300 feet of tunnel, three crosscuts, and upraises aggregating 100 feet have been completed. Preparations have been made to continue work on a large scale. This is the only copper property that has been developed in the Port Valdez district, though a little copper ore is reported from other localities.

PORT WELLS DISTRICT.

No geologic examination of the Port Wells region has been made since Grant and Higgins's reconnaissance in 1905. According to their report¹ the bedrock of the region consists of slates and graywackes, with some areas of intrusive granite and, in certain localities, many small dikes of light-colored igneous rock. At the time of their visit to this district no mineral deposits of importance had been discovered. The mining developments in the Valdez district stimulated the search for gold deposits in the Port Wells district, for the prospector correctly reasoned that, the geologic conditions being similar, the chances were good for finding workable ore bodies. Several promising discoveries are reported to have been made in this field in 1911 and others in 1912.

According to the best information available the gold veins thus far found are located chiefly along the two shores of Port Wells, though some have been found on Harriman Fiord and some on the peninsula separating Port Wells from Unakwik Inlet, to the east. As in all new camps, prospecting and therefore discoveries have been confined chiefly to the region close to tidewater. A small settlement known as Port Wells, including one or two stores, is located near the point which marks the southeast shore of the strait connecting Port Wells and College Fiord. Although a post office, this place had no regular mail service; communication is kept up with Cordova and Valdez by gasoline launches that make occasional trips under charter.

The veins of the district, according to Mr. Stephen Roe, to whom the writer is indebted for information, generally trend about northeast and southwest and cut across the country rock. It is stated that the ores carry free gold, auriferous pyrite, silver-bearing galena, and, in some places, chalcopyrite. The gangue is quartz with some calcite. Though but little underground work has been done, some of the veins are said to have been traced a thousand feet or more. The veins are said to have good walls, in many places with a gouge.

¹ Grant, U. S., and Higgins, D. F., Reconnaissance of the geology and mineral resources of Prince William Sound, Alaska: U. S. Geol. Survey Bull. 443, 1910.

In the absence of an official examination, it is perhaps not safe to publish second-hand information on the width of the veins. It will suffice to state that experienced prospectors who have visited the district say that the ore bodies are large enough to assure profitable exploitation if they are found to persist at depth and hold their tenor. No large ore bodies have been reported, however, though many small ones said to carry much gold have been found.

Near Port Wells settlement the Golden vein is said to have been followed by a 30-foot drift which undercut the outcrop about 25 feet. At the Gold Wonder some 60 feet of work is reported, and at the Nugget property, said to be on same vein, 150 feet of underground work was done. Adjacent is the Consolidated property, developed by a 45-foot shaft. It appears that the Herman-Everman property, on Bettles Bay, an indentation of the west side of Port Wells, is the most extensively developed in the district. Here a shaft more than 70 feet deep was put down in 1912, and sinking was being continued at the close of the year, with the plan of reaching a depth of 100 feet and then driving on the vein. Some work has also been done on the Singletary-O'Neil property, on Harriman Fiord. Gold-bearing veins are also reported to have been found on College Fiord, on Esther Island, and on the mainland near the lower end of Esther Passage.

KENAI PENINSULA.

While no lode properties were developed on a large scale in the Kenai Peninsula during 1912, yet in the aggregate considerable work was accomplished. Details in regard to some of the mining activity are lacking, but the following data, in part based on notes furnished by B. L. Johnson, are believed to cover most of the important developments during the year. Three small stamp mills were operated by the Kenai-Alaska, Primrose, and Skeena-Lechner mining companies for a part of the summer season. Some gold was also recovered by means of arrastres, but the total production of lode gold in 1912 was less than \$20,000 in value. The dead work accomplished was considerable in spite of the fact that, as indicated above, but few of the mines were productive.

Some work was done on an auriferous quartz vein located on the beach about half a mile from Seward and also on a mineralized zone about a mile from the 4-mile post on the Alaska Northern Railroad.

The so-called Mile Seven property, including the Homestake and Bear groups of claims, located on Lost Creek near Seward, was staked in 1911, and prospecting was begun in the fall of that year. It is reported that up to the close of 1912 some 450 feet of underground work had been done, besides considerable open-cut work. The owners considered the ore bodies revealed by these operations

to justify the installation of a 2-stamp prospecting mill, which began operation in January, 1913.

In 1912 a 3-ton mill was erected and operated for a part of the season on the Primrose property, on Porcupine Creek, which is tributary to Kenai Lake. This deposit is apparently in the same mineralized belt as the one on Lost Creek. It is said to be developed by a shaft 45 feet in depth and 350 feet of adits and drifts.

An aerial tram was installed on the property of the Kenai-Alaska Gold Co., on Falls Creek. Underground developments were continued in 1912, including 80 feet of drifts and a 50-foot winze. The stamp mill was operated for about six weeks.

Work was also continued on the Skeena-Lechner property, in the same district. Some ore from this mine was milled at the small plant of the California-Alaska Co. near by. Considerable underground work was done at the Skeena-Lechner mine, the details of which are lacking at this writing. At the Hickey property, near mile 21, the adit tunnel was extended to a length of about 200 feet in 1912.

It is reported that considerable work was done in 1912 on the Bluebell quartz claim, located on Porcupine Creek. Late in the fall a small stamp mill was in process of installation on this property. Some work was done on the Independence quartz claim, where ore was treated in an arrastre. A small mill was put on the Imhoff property, in the southern part of the Moose Pass district. In the aggregate considerable prospecting was done on other properties in the Moose Pass district, but no important single developments are reported. A 50-foot shaft was seen on the Kenai Star quartz prospect, on Palmer Creek, in the Hope region. Some work was done in 1912 on the Conway prospect, west of Bird Point, on Turnagain Arm, from which a test shipment of 2 tons of ore was made.

SOUTHWESTERN ALASKA.

As in previous years, the Apollo mine, on Unga Island, was in 1912 the only productive lode property in southwestern Alaska. Prospecting, however, was continued at several other localities, notably in the Iliamna region. A preliminary report on the mineral resources of Kodiak Island is presented elsewhere in this volume (pp. 125-136).

The writer is indebted to Mr. Thomas W. Hanmore, United States commissioner at Iliamna, for the following notes on mining in the adjacent region. He reports that William Duryea has driven two adit tunnels on his property,¹ located on Silver Creek, near Iliamna Lake. One of these is said to have cut galena ore at a depth of 150 feet, and the other a body of arsenopyrite ore, as well as a zinc-lead

¹ Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region, Alaska: U. S. Geol. Survey Bull. 485, pp. 124-125, 1912.

ore deposit. Considerable development work was done by Pete Morris on a group of claims located near Kontrashibuna Lake.¹ Further prospecting by diamond drills is planned. E. E. Taylor drove a 40-foot adit tunnel on a copper-bearing lode, known as the Knudsen claim, located not far from the north shore of Iliamna Lake.² Further discoveries of copper-bearing ore are said to have been made on the Millet claims,³ located in the same general district. New discoveries of silver-lead ores are said to have been made by William Gleason on Kijak River, near Lake Clark. It is also reported that C. H. McNeil and Norman B. Cook have found some copper-bearing veins on Okchiak Creek, a tributary to a southwest bight of Kamishak Bay.

WILLOW CREEK DISTRICT.

Three quartz mines—the Gold Bullion, Alaska Free Gold, and Gold Quartz—were operated in the Willow Creek district in 1912. Each of these properties is equipped with a small mill which operated during the summer season, crushing in all about 3,000 tons of ore and producing gold to the value of about \$100,000. The properties have thus far been operated only on a small scale, chiefly owing to the high cost of transportation. Therefore, perhaps the most important event of the year was the completion of a wagon road up the Little Susitna, rendering the eastern part of the district accessible. Plans are now being made looking to larger developments by continuing certain properties and developing hydroelectric power on the Little Susitna. Several discoveries of gold-bearing quartz are said to have been made in 1912, notably one by A. C. Shough, reported to be a quartz vein carrying a large amount of gold, located on the east side of the upper Little Susitna basin.

Two discoveries of metalliferous lodes that may prove important are reported to have been made in the region tributary to the Willow Creek district. One of these is an occurrence of copper ore (bornite) on the south side of Sheep Mountain, in the upper Matanuska basin. According to Paige and Knopf⁴ Sheep Mountain is made up of andesitic greenstones and other volcanic rocks, with at least one intrusive mass of granitic rocks. While there had been no lode prospecting in this field at the time of their investigation (1906), yet they noted evidence at Sheep Mountain of pyritiferous mineralization, and a sample collected by them showed a trace of gold. The geologic evidence in hand indicates that the locality is well worth further prospecting.

¹ Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region, Alaska: U. S. Geol. Survey Bull. 485, p. 122, 1912.

² Idem, pp. 122-123.

³ Idem, p. 22.

⁴ Paige, Sidney, and Knopf, Adolph, Geologic reconnaissance in the Matanuska and Talkeetna basins, Alaska: U. S. Geol. Survey Bull. 327, pp. 23 and 65, 1907.

The writer is indebted to Mr. H. H. Sharp, of Knik, for information about some lode prospects located on Peters Creek, a tributary from the southeast to Knik Arm. These occurrences are about 20 miles from tidewater. The bedrock is said to be slate and graywacke, with some intrusives. As described, the mineral occurrences consist of auriferous stringers and veins in a mineralized zone which trends northeastward. Some of the veins are said to have been traced by means of stripping for 300 to 400 feet.

NABESNA-WHITE RIVER REGION.

The advances made in developing the metalliferous lodes in the Kotsina-Chitina copper belt, on the south side of the Wrangell Mountains, have in a measure reawakened interest in the Nabesna-White River copper belt, north of the Wrangell Mountains. Productive lode mining in this field is dependent on railway connection with tidewater, but meanwhile there is reported to be considerable prospecting, about 25 prospectors being in the field. Supplies are now brought in chiefly by boat up White River. Another route of approach, also frequently used, is over the Skolai Pass from the inland terminal of the Copper River Railroad. Both copper and gold bearing lodes are being prospected in this field. The deposits are in part on the Canadian side of the international boundary. A group of copper claims, said to be owned by the Northern Commercial Co. and located on the Middle Fork of White River, were surveyed for patent in 1912. Coal is reported to occur on the Canadian side of the White River basin.

YUKON BASIN.

The advances in lode-mining development in the Yukon basin during 1912 were practically confined to the Fairbanks district. Lode mining at Fairbanks is described in a separate chapter of this volume (pp. 137-202). There was also a small lode mine in operation in the Innoko district (see p. 298), and a little work was done on lode prospects in the Chandalar, Fortymile, and other Yukon districts. Most of these localities of lode occurrence are so isolated that the cost of operation is almost prohibitive. It is only by reducing transportation costs by building railroads and wagon roads that any advances in the lode-mining industry of inland Alaska can be brought about.

SEWARD PENINSULA.

There is little information at this writing in regard to lode mining in Seward Peninsula during 1912. It is reported that work was continued on a number of prospects located chiefly in the Nome dis-

tract. Ore from some of these was treated at the Nome customs mill. The New Era Mining Co. installed a small prospecting mill at Snow Gulch to test an auriferous lode. Some work was also done on the Consolidated group of claims near Topkok. There were undoubtedly other developments of equal importance, but they have not been reported to the writer.

GOLD PLACERS.

GENERAL FEATURES.

It is estimated that since mining began in Alaska in 1880 the gold placers of the Territory have yielded 7,488,491 fine ounces of gold, valued at \$154,800,875. These mines have also produced 1,652,016 fine ounces of silver, with a commercial value of \$960,743.

The gold placer mines of Alaska are estimated to have produced in 1912 gold to the value of \$11,990,000, compared with an output in 1911 valued at \$12,540,000. This decrease is due to a general falling off in nearly all the placer camps. The gold output of Fairbanks, Hot Springs, Seward Peninsula, and several of the less important districts was less in 1912 than in 1911, while the output of the Iditarod-Innoko region and of the Koyukuk district alone showed any marked increase compared with previous years. It is not to be expected that under present industrial conditions there will be any stability of placer-gold output in the Territory. So long as the high cost of transportation prevails, the production of placer gold must depend on the exploitation of bonanza deposits, for these alone can be expected to yield profitable returns. Relatively little progress has been made in undertaking the mining of the extensive bodies of auriferous gravels carrying a low gold tenor except in Seward Peninsula, where the installation of dredges has continued.

It is estimated that a total of about 720 placer mines were operated in 1912, compared with 740 in 1911. It is also estimated that about 150 placer mines were operated in the winter, employing 900 men, and about 600 during the summer, employing about 4,500 men. In addition to these, from 1,000 to 1,500 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 the available facts. Therefore, although the table is only approximate, it probably indicates something of 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.

Year.	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1908.....	4,725,000	\$3.74
1909.....	4,418,000	3.66
1910.....	4,036,000	2.97
1911.....	5,790,000	2.17
1912.....	5,700,000	2.10

The progressive reduction in the gold tenor of the gravels mined is the most hopeful feature of Alaskan placer mining, because it indicates a lessening of cost of operation. The decrease of average gold tenor in 1912, compared with the previous year, is due largely to the increased use of gold dredges, notably in Seward Peninsula. Hydraulic mining is also on the increase and will undoubtedly play a more important part in the placer-mining industry of Alaska than it has in the past. It is to be noted, however, in this connection that in a large proportion of the Alaska placer districts water supply, stream gradients, and other essential conditions are unfavorable to hydraulic mining. Under these circumstances future improvement in mining methods must be in the direction of using mechanical equipment, such as dredges and drag-line excavators. In spite of the reduction in the output of placer gold in Alaska, there can be no question that a large field for profitable mining ventures would be opened by decreasing operating costs through improvement of transportation facilities.

Thirty-eight dredges were operated in Alaska in 1912, compared with 27 in 1911. In addition to these, a dozen or more were in various stages of construction. It is estimated that these dredges handled between 3,200,000 and 3,600,000 cubic yards of material. Gold to the value of about \$2,200,000 was recovered by dredging. Of these dredges, one was in Kenai Peninsula, three in the Fortymile district, one in the Fairbanks district, one in the Birch Creek district, and the rest in Seward Peninsula.

PACIFIC COAST REGION.

For the purposes of this discussion the Pacific coast region will be defined as covering not only the seaboard but all the drainage basins tributary to it, including the Copper and Susitna. The placers of this province are estimated to have had in 1912 an output valued at \$320,000, which was practically the same as the value of the output in 1911.

Southeastern Alaska.—One mine operating near Juneau and two or three in the Porcupine district continue to be the only placer mines

in southeastern Alaska. It is reported that some investigations of auriferous gravels on Montana Creek, near Juneau, were made with a view to the installation of a dredge. A hydraulic plant was operated on Porcupine Creek and another on Calhoun Creek during the open season of 1912. Some work was also done on other creeks of the district, notably on Glacier Creek, where preparations were made to install a hydraulic plant.

Beach mining.—About 15 or 20 men were engaged in beach mining in the Yakataga district. The hydraulic plant on White River, in this district, was not operated in 1912, work on this property being concentrated on extending the ditch line. The beach placers of Kodiak Island are described elsewhere in this volume (pp. 134–136). Some beach mining was done on Popof Island, as in previous years.

The writer is indebted to Mr. Stephen Roe, of Port Wells, for some notes on the occurrence of beach placers on Middleton Island. There appears to have been no beach mining done on this island for several years, but it seems desirable to put in the permanent record some account of these deposits. Middleton Island is located in the Gulf of Alaska about 50 miles south of the entrance to Prince William Sound. A flat-topped upland, whose surface stands about 120 feet above the sea,¹ occupies most of the island. The surface of the upland is somewhat pitted, some of the depressions being occupied by lakes. In most places the upland falls off to the beach by an escarpment, which contains partly consolidated gravels with some boulders, apparently of glacial origin. In places hard rock is exposed in the escarpment.

The gold placers that have been worked occur at the southwest end of the island. They are beach placers at the foot of bluffs, in material which has been subject to wave action. Garnet is found in association with the placer gold. Most of the gold is flat, and typically it occurs only in small grains. Some small nuggets, the largest of which had a value of 83 cents, have been found. The first mining on the island, so far as known, was done in 1901, and gold to the value of about \$8,000 has been recovered from these placers.

Copper River region.—Mining operations in the Nizina district are described on pages 84–85 of this report. There was also in 1912 a little placer mining in the Bremner district, of the lower Copper River region. It is estimated that seven placer mines were operated in the Chistochina district (Chisna) in 1912, employing about 45 men, and that the value of the output was probably less than in 1911. The conditions were unfavorable because of the lateness of the spring break-up. Prospecting with churn drill was continued on Chisna River. Preparations were also made to undertake a large placer-mining enterprise on Slate Creek.

¹ Alaska Coast Pilot, Notes from Yakutat Bay to Cook Inlet and Shelikof Strait (2d ed.), Coast and Geodetic Survey, 1910.

Kenai Peninsula.—Mining continued on Kenai Peninsula on about the same scale as in previous years. About 20 to 25 mines were operated, of which 8 or 10 were hydraulic mines. The largest of the hydraulic mines is located on Crow Creek, north of Turnagain Arm, and is not on Kenai Peninsula proper, though it is in the same general district. One dredge was operated on Kenai River, and considerable prospective dredging ground on another property was tested with a churn drill.

Susitna basin.—The Yentna district, described below, is the most important placer camp of the Susitna basin. In 1912 a little placer mining was done also on Willow Creek and on Caribou Creek, tributary to the upper Matanuska. A few small plants were operated on Valdez Creek, which lies in the headwater region of Susitna River. A number of claims that have been worked on Valdez Creek in previous years were idle in 1912 pending the launching of a larger mining enterprise.

The season of 1912 was a prosperous one in the Yentna district. Water was abundant—in fact, at times some of the streams were so flooded as to interfere with mining operations. It is estimated that about 100 men were engaged in mining. The most important operations were on Thunder, Dollar, Nugget, Willow, and several other tributaries of Cache and Peters creeks. Plans have been made for installing a hydraulic plant on Thunder Creek. Some placers occurring in elevated gravels on Dollar Creek were developed, it is reported, with good results. Some mining was also done on Twin Mills and other creeks of the west end of the Yentna district.

Iliamna region.—According to Thomas W. Hanmore, a little mining was done in the Mulchatna basin and in some streams tributary to Lake Clark, all in the Iliamna region. A little coarse gold was taken from the placers of Portage Creek, which flows into Lake Clark from the west. In the Mulchatna region the prospectors directed their attention to the benches, and encouraging results are reported from Bonanza and Ptarmigan creeks.

YUKON BASIN.

GENERAL STATEMENT.

It is estimated that the value of the gold produced in the Alaska portion of the Yukon basin was \$8,645,000 in 1912, compared with \$9,050,000 in 1911. This decrease is due to the falling off of the output from the Fairbanks and Hot Springs districts, for the other Yukon camps either held their own or somewhat increased their output compared with the preceding year. Probably the most encouraging feature of the year's activity was the definite proof of the presence of workable placers in the Ruby district. (See pp. 279-292.)

The Fairbanks district continued in 1912 to be the largest producer of placer gold of the Yukon. It can not maintain this position long without a radical change in mining conditions which will make it possible to exploit profitably its extensive bodies of low-grade placers. But little has been accomplished in this direction, and the best hope of the future lies in obtaining direct railway connection with tide-water. Accounts of the mining progress during the year in the Yukon-Tanana region are presented on pages 203-222 of this report, and in the Ruby, Innoko, and Iditarod districts on pages 279-303. It remains here, therefore, to consider only the mining in some of the more isolated camps that were not visited by any member of the Survey in 1912. The data presented were obtained from what are believed to be reliable sources.

Bonnifield and Kantishna districts.—The Bonnifield and Kantishna districts are remote camps in which mining costs are excessive. So far as learned, placer mining was continued in these districts on about the same scale as in previous years. About 50 or 60 men were engaged in mining in these two districts, and the gold output in 1912 is estimated to have a value of about \$50,000, which is approximately the same as that of 1911. Several men who were formerly engaged in placer mining in the Kantishna district have turned their attention to prospecting auriferous lodes. A fact bearing on a possible easterly extension of the placer gold of the Bonnifield district has recently come to the writer's notice. This is to the effect that several years ago a little placer gold was mined on McCumber Creek, a tributary of Jarvis Creek. Jarvis Creek flows into the lower Delta River from the southeast. This evidence and other facts known about the geology suggest that the gold-bearing rocks of the Bonnifield district may extend into the unsurveyed region lying south of the Tanana and east of the Delta.

Koyukuk and Chandalar districts.—Only one or two placer mines were operated in the Chandalar district during 1912, and these in only a very small way. On the other hand, the Koyukuk district had an exceedingly prosperous season. It is estimated that more than 400 men were employed in the Koyukuk district during the mining season. It is reported that some very rich placer ground was found on Hammond River by sinking to a depth of 60 to 120 feet. Some successful prospecting with churn drill is said to have been done in this field. The gold found is chiefly very coarse, one nugget worth \$280 being reported. Work continued in 1912 on Emma, Smith, Swift, Nolan, Minnie, and other creeks previously developed, but details in regard to these operations are lacking. Mining was also continued in the Indian River region, in the southwestern part of the Koyukuk district.

KUSKOKWIM BASIN.

Much of the Kuskokwim basin is still but little known. Although prospectors have roamed over most of it, little thorough prospecting has been done except in those streams which head in the Innoko divide. A small amount of placer gold has been found in the head-water region of the Kuskokwim, but no mines have been developed. The mining in that part of the Kuskokwim lying near the Iditarod-Innoko district is described elsewhere in this report (pp. 299-303).

During the last few years there has been considerable prospecting of the region tributary to the lower Kuskokwim, between the Iditarod district and Bering Sea. The information at hand indicates that the geologic conditions in this region are similar to those in the Iditarod. Auriferous gravels have been found at many places in the region, but so far as has been learned no very rich deposits have been disclosed. Placer mining on a small scale has, however, been carried on, notably in the Anniak River, Tuluksak River, and Goodnews Bay regions. The value of the total gold production to date is estimated to be between \$75,000 and \$100,000. In 1912 there were probably some 200 men in this general field, most of whom were engaged in prospecting rather than in productive mining. So far as can be learned (for the district has not been examined by a geologist), considerable low-grade placer ground has been found which would not yield profitable returns under present costs and methods of mining. Some richer gravels that have yielded returns to the ordinary manual methods of operation have also been found. Plans have been formulated for the installation of dredges and hydraulic plants with the purpose of exploiting some of the gravels of lesser gold tenor. This region presents no greater difficulties of transportation than other inland districts of Alaska which have been profitably exploited. Ocean vessels can enter Kuskokwim River and transfer their freight direct to river steamers. The placers, however, are 30 to 60 miles from the limits of steamboat navigation, and in the absence of wagon roads this presents a serious obstacle to the installation of heavy machinery. The localities¹ where productive mining has been reported are on Bear Creek and its tributaries and other streams in the Tuluksak basin. These placers are said to be nearly 100 miles distant from the Kuskokwim. In 1911 considerable excitement was caused by the finding of gold placers in the Anniak River basin. So far as can be learned, the discoveries made did not justify the inrush of miners which took place. It is reported, however, that several promising finds have been made and that a number of claims on Marvel Creek were worked in 1912. This stream is said to be about

¹ In the absence of any map of the region it is difficult to locate the scenes of reported discoveries. This difficulty is increased because a single stream may be called by two different names.

60 miles from the Kuskokwim. Another scene of active mining is on a stream called "Orolik" River, which is said to flow into the Kuskokwim from the east near the settlement of "Quinhagak" (Kwinak?) and which may be the stream marked on the official maps as Kanektok River. This is probably the same general locality as the placers which have been worked for several years in the so-called Goodnews Bay region. It is reported that a dredge is being installed in this district.

NORTHWESTERN ALASKA.

Seward Peninsula.—The value of the gold output of Seward Peninsula in 1912 is estimated to be \$3,025,000; that of 1911 was \$3,135,000. This small reduction is very significant in view of the fact that all forms of mining except dredging were much hampered by low water during the first part of the mining season. Dredging operations were also hindered by the unusual lateness of the spring. Considering these conditions, the gold output is remarkably large, and there is reason to believe that it has reached its minimum for many years to come.

There was an increase in the commerce of Seward Peninsula in 1912 compared with 1911. According to the records of the customhouse, 26,231 tons of general merchandise and 125 head of live stock were received and 1,603 passengers arrived at Nome in 1912, compared with 21,685 tons of merchandise, 31 head of live stock, and 1,514 passengers arriving in 1911. In spite of the fact that crude oil and gasoline are being largely substituted for coal as a source of power, 16,405 tons of coal were received in 1912, compared with 7,660 tons in 1911. In lumber alone the receipts in 1912 were less than those of the previous year.

When in any year there is a shortage of water for placer mining at Nome and other Seward Peninsula camps, it is often accounted for by the statement that the season was "unusually dry." As a matter of fact, the records go to show that since mining began at Nome in 1899 there have been only six summers during which there was any considerable rainfall. In other words, eight summers out of fourteen have been relatively dry. Many placer miners have been unwilling to accept the fact that the climate of Seward Peninsula is semiarid. The records kept for six years at Nome by Arthur Gibson show a total annual precipitation ranging from 9.46 inches (in 1909) to 18.31 inches (in 1911), with an annual average of 14.42 inches. The rainfall in the mountainous portions of the peninsula is greater¹ than at Nome, and this helps the flow of some of the streams whose

¹ Henshaw, F. F., and Parker, G. L., Surface water supply of Seward Peninsula, Alaska: U. S. Geol. Survey Water-Supply Paper 314, pp. 19-28, 1912.

waters are utilized for placer mining. While there are no complete records, it is probable that even in the mountainous parts of the peninsula the precipitation is less than 25 inches. Fortunately for the placer miner, about seven-twelfths of the precipitation takes place during the months from June to September, inclusive, and July and August are usually the wettest months in the year. These conditions of climate have been met by the introduction of dredges whose operation is less affected by low water than that of any other method of placer mining.

In classifying the gold production by districts and by method of recovery, the writer is much hampered by the fact that a number of the large operators fail to return promptly the schedules mailed to them each year. This neglect seriously impairs the accuracy of the statistics and undoubtedly hurts the mining industry. The following figures on the gold production are therefore based in part on estimates, but these are founded on the best data available.

The value of the output from the several districts in 1912 is estimated as follows: Nome, \$1,150,000; Solomon and Casadepaga, \$750,000; Council, \$600,000; Fairhaven, \$290,000; Kougarok, \$160,000; Port Clarence, \$50,000. It is of importance to the mining industry to know the proportion of gold derived from each form of mining. Neglect on the part of some of the operators to report production makes it possible only to approximate this classification. The best information available indicates that gold to the value of about \$1,700,000 was recovered by dredging, about \$1,040,000 by various open-cut mining methods, including some hydraulicking, and about \$260,000 by deep mining. This is in strong contrast to the conditions a few years ago, when several million dollars' worth of gold was annually won by underground mining, and the output of the dredges was but a small fraction of the total.

During the year 31 gold dredges were operated in Seward Peninsula, compared with 22 in 1911. Three dredges, two of them small ones built previous to 1912, were not operated. The eleven new dredges installed in 1912 were operated for only a part of the season, a few making only test runs. Four dredges under construction were not completed in time for operating. In addition to these, a number of other dredging enterprises are under way. Most of the dredges which were completed in time began work about the middle of June, but some were delayed on account of the lateness of the season. The dredging season usually closes about the middle of October, but some were operated for a month or more longer. Of the dredges operated nine were located in the region tributary to Nome, nine in the Solomon River basin, two in the Casadepaga, six in the Council, two in the Kougarok, two in the Fairhaven, and one in the Port Clarence district. Eighteen of the dredges are reported to have a

bucket capacity of less than 2 cubic feet, six a capacity of 3 to 3½ cubic feet, three of 5 cubic feet, and four of 9 to 10 cubic feet.

The daily capacity of these dredges averages about 1,000 cubic yards. It is estimated that between 2,500,000 and 3,000,000 cubic yards of gravel was handled by the dredges during the year. If these figures are correct, it would indicate an average gold recovery of 52 to 64 cents a cubic yard. In considering these figures it should be noted that the average recovery per cubic yard is increased by the large output of a comparatively few dredges that are working on very rich ground.

Most of the dredges are excavating only material which is not permanently frozen. In a few places dredging ground has been artificially thawed. Janin¹ records one plant located near Nome which was thawing ground at a cost of 20 cents a yard, but there the gravels were only 8 to 10 feet deep. At present no thawing of deep ground has been successfully undertaken on any considerable scale.

Of the dredges operated in 1912 five use coal, four crude oil, twenty-two gasoline, and one, located in the Council district, wood. It is estimated that the equipment of these dredges aggregates about 4,000 horsepower. Two dredges, located near Nome, are operated by electricity, the power being furnished from a station equipped with a machine burning crude oil. Charles Janin,¹ an experienced engineer, who has given much study to the dredging industry of Seward Peninsula, has expressed the opinion that "it is doubtful if at the present time a central plant to generate electricity would be a profitable enterprise."

As already stated, underground mining operations are very small compared with those of a few years ago. Open-cut mining was seriously hampered by the lack of water, a condition which existed until about July 1, when some light rains fell. During August there was considerable rain, and during the second half of the season open-cut mining was done on about the same scale as in the previous year.

An item worthy of note is the discovery of placer gold in the southeastern part of Seward Peninsula, where there has been heretofore but little mining. In 1912 some mining was done on Placer Creek, a tributary of Koyuk River, and good prospects are said to have been found on Sweepstakes Creek, another tributary. Placer gold has also been found on two small creeks in the Darby Mountains not far from Golovin Bay.

Kobuk district.—During 1912 mining was continued in a small way in the Dahl and Squirrel river regions of the Kobuk district. The

¹ Janin, Charles, Gold dredging on Seward Peninsula: Min. and Sci. Press, Sept. 28, 1912, p. 398.

information at hand indicates that no important developments were made. It is reported that workable placers have been found on Lynx Creek. This stream flows into Kogoluktuk River, which in turn is tributary to the Kobuk about 3 miles east of Shungnak.

TIN MINING.

The York Dredging Co. continued in 1912 to operate its dredge in the tin placers of Buck Creek, in the western part of Seward Peninsula. Operations were begun on June 29 and continued until October 14. In the same district the lode-tin deposits of Cape Mountain were examined by mining engineers with a view to systematic development. The tin-bearing lode prospects of Lost River were taken over by a new company and systematic development of them was begun. About 300 feet of underground work was completed, and further developments have been planned.

NONMETALLIFEROUS DEPOSITS.

The nonmetalliferous deposits of Alaska that have been developed are coal, petroleum, marble, gypsum, graphite, and garnets. The marble-quarrying industry of southeastern Alaska is described elsewhere in this report (pp. 52-77). A little graphite was mined from a deposit in the Kigluaik Mountains of Seward Peninsula.

George C. Martin, who studied the ejecta of the Katmai Volcano (see p. 13), has suggested to the writer that this tuff might have value as an abrasive. The most accessible deposits¹ are on the shores of Amalik Bay, Alaska Peninsula, where there are accumulations 20 feet or more thick at the foots of cliffs and mouths of streams in close proximity to deep sheltered water.

Some sulphur deposits that have been found in the volcanic region of southwestern Alaska have attracted some notice. In 1912 it was reported that promising sulphur deposits had been found near Stepovak Bay, on the Alaska Peninsula. The following notes on gypsum and garnet mining in southeastern Alaska have been prepared by E. F. Burchard:

In 1912, as heretofore, only one gypsum mine was in operation. This mine, operated by the Pacific Coast Gypsum Co., was visited by E. F. Burchard, of the Survey, in October, 1912. The gypsum deposit is situated in the eastern part of Chichagof Island, about a mile from Iyoukeen Cove. The limits of the deposit have not yet been ascertained. At the surface the deposit is covered by gravel except near the shaft house, and no footwall nor hanging wall has been encountered in the mine workings. Several solution channels filled with gravel, more or less cemented, have been encountered in mining. The gravel is of the same character as that in the bed of Gypsum Creek. The gravel-filled channels extend below the 160-foot level. One channel has been tunneled for 35 feet without being cut through. Thin dikes of basaltic rock cut the gypsum beds, and a vein of anhydrite ranging in thickness from 6 inches to more than 10 feet has been encountered in the lower workings. This anhydrite is much harder to drill than the inclosing gypsum, and it is left in the

¹ Martin, G. C., The eruption of Mount Katmai of June, 1912: Nat. Geog. Mag., Feb., 1913.

mine. The gypsum is generally of a light bluish-gray color, although some is white, and occurs in massive beds which dip 30°-60° NE. The main body of gypsum is of a high degree of purity.

The mine shaft is 160 feet deep, with a 26-foot sump. The first level is at 75 feet and the second at 160 feet. The general trend of the gypsum deposit is in a direction slightly north of west, and the levels extend for 750 feet east and west and 270 feet north and south, with the shaft near the middle of the exploited area. Altogether, the underground workings are reported to measure probably 1 mile.¹ Overhand stoping is the method employed in mining, and considerable broken gypsum rock is stored in the stopes.

The gypsum is hoisted to rock bins of 1,200 tons capacity, from which it is dumped into tram cars and drawn by a steam locomotive to the wharf. Owing to a recent collapse of the old wharf about 2,500 tons of gypsum rock which had been stored in the bunkers were lost. A new wharf was under construction in 1912. It will carry bunkers near the middle instead of at the outer end, as on the old one, but the tramway will extend the whole length of the wharf. The production of gypsum from this mine, which began in 1906, was slightly curtailed during 1912, owing to the difficulty in loading rock while the new wharf was under construction, but a much larger output is assured for 1913. Shipments of crude gypsum are made by steam barges to Tacoma, Wash., where the material is calcined and manufactured into wall plaster of various grades in the company's plaster mill.

Adjoining on the east the claims now being worked for gypsum by the Pacific Coast Gypsum Co. and extending to the shore of Chatham Strait are other claims which have been located on reported deposits of gypsum.

Progress was made in the development of the garnet mine in southeastern Alaska, although no shipments of garnet are reported. This mine is situated on the mainland about 7½ miles north of Wrangell and is being developed by the Alaska Garnet Mining & Manufacturing Co. The garnets occur in an area of crystalline schist, principally in three ledges of dark-gray mica schist containing hornblende. Fresh exposures examined in September, 1912, by E. F. Burchard showed an abundance of garnets locally. The garnets are dark in color and are probably of the variety almandite, $\text{Fe}_3\text{Al}_2(\text{SiO}_4)_3$, in which the iron is present in the ferrous state. The crystals, which are for the most part remarkably symmetrical, consist of modified dodecahedrons and trapezohedrons, ranging in diameter from less than one-sixteenth of an inch to more than 1 inch, but generally between one-fourth and three-fourths of an inch. The garnet-bearing schist is being mined from open cuts and tunnels, and the garnets, which are easily loosened by splitting the schist, are stored in bins. As the garnets are too dark for gem material, it is probable that they will be utilized in the manufacture of abrasives.

Alaska coal fields continue to be undeveloped. The only coal mining done is that of lignitic coal for local use at Cook Inlet, on Seward Peninsula, and at several other localities. The total production in 1912 did not exceed 100 or 200 tons.

One company has continued operations in the Katalla oil fields in 1912, as in 1911. One of the two producing wells is said to have been sunk to a depth of about 800 feet. The oil is procured by pumping and is refined in a small plant located near Katalla. The gasoline finds a ready sale in the coastal settlements of this part of Alaska. There are several other oil companies which control property in this field, but these seem to have done little in the way of development during 1912.

¹ The above approximate measurements were furnished to the Survey by Mr. T. H. George, superintendent of the mine.