MINERAL RESOURCES OF ALASKA IN 1911.

By ALFRED H. BROOKS and others.

PREFACE.

By ALFRED H. BROOKS.

The mineral industry of Alaska is, for the most part, in a stage of development where the results of even preliminary surveys and examinations have their maximum value to the miner and prospector. This value is much increased by making the results of investigations available at the earliest date possible to those who are developing this new land. As the complete reports and maps can not be prepared and printed for a year or a year and a half after the field work is completed the Survey, in 1905, began the practice of issuing an annual bulletin containing abstracts of the more important economic conclusions reached by its geologists as a result of their explorations. The present volume is the eighth [1] of this series to be published. Such advance publication of results necessitates more or less haste in preparation, and the conclusions set forth may therefore be somewhat modified when the more exhaustive office study has been completed. Hence, those interested in any particular district are urged to procure a copy of the complete report 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 conditions of the mining industry and presents statistics of production and other data. 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 exploration is too small to permit a visit to every mining district each year by a member of the Survey. Therefore the data

[1] Report on progress of investigation of the mineral resources of Alaska, 1904: Bull. U. S. Geol. Survey No. 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.

used in the preparation of the summaries contained in this volume are, in part, based on information gleaned from various sources.

Again, as in previous years, the writer is under great obligations to many residents of the Territory for valuable data furnished. Those who have thus aided include many mine operators, engineers, prospectors, Federal officials, and officers of banks and of transportation and commercial companies. It is impossible to enumerate all who have contributed information, but special acknowledgment should be made to the following: The Director of the Mint; Chas. D. Garfield, of Juneau; Alaska Mexican Gold Mining Co., Alaska United Gold Mining Co., and Alaska Treadwell Gold Mining Co., of Treadwell; R. M. Odell, of Haines; C. C. Noughton, of Katalla; Geo. M. Esterly, of Nizina; Stephen Birch, of Kennecott; Melvin Dempsey, of Dempsey; H. E. Ellsworth, of Seward; W. H. Hammer, of Sunrise; M. M. Reese, of Valdez; Henry S. Tibbey, of Chignik; Thos. H. Hanmore, of Iliamna; R. W. J. Reed, of Nome; John A. Dexter, of Golovin; Geo. W. Woodruff, of Fortymile; A. M. Allma, of Miller House; John L. Abrams, of Eagle; Frank Slaver, of Woodchopper Creek; Edw. H. Boyer, Jos. R. Mathews, Wells Fargo Co., American Bank, and First National Bank, of Fairbanks; T. M. Thurston, Geo. Y. Kilroy, and Cyril P. Wood, of Iditarod; John D. Leedy, of Quinhagak; H. W. Reeth, of Seattle; and W. E. Thorpe, of the Yuba Construction Co. Besides these many mine operators have furnished information in regard to mineral production.

The arrangement and manner of treatment in this volume is the same as in those previously issued. First, papers of a general character are presented, followed by those treating of special districts, treated geographically from south to north. This bulletin contains 19 papers by 12 authors. One of these papers deals with administrative matters, eight are summaries of particular features of the mining industry, and the remainder deal more specifically with the economic geology of special districts. In the geologic papers emphasis is laid on the conclusions having immediate interest to the miner, which will, however, be discussed here briefly but will be more fully treated in reports now in preparation. The need of prompt publication requires that the illustrations in this volume be of the simplest kind.

ADMINISTRATIVE REPORT.

By ALFRED H. BROOKS.

INTRODUCTION.

Thirteen parties were engaged during 1911 in Alaskan surveys and investigations. The length of the field season varied from three to six months, being determined by the climatic conditions prevailing in different parts of the Territory. The parties included 12 geologists, 4 topographers, 2 engineers, and 30 packers, cooks, and other auxiliaries. In addition to these, some gage readers were employed, who gave only part of their time to the work. Seven of the parties were engaged in geologic work, one in both geologic and topographic surveys, three in topographic surveys, and two in investigating water resources.

The areas covered by geologic exploratory surveys, on a scale of 1:500,000 or 1:1,000,000 (8 or 16 miles to inch), amount to 8,000 square miles; by geologic reconnaissance surveys, on a scale of 1:250,000 (4 miles to the inch), 10,550 square miles; by detailed geologic surveys, on a scale of 1:62,500 (1 mile to the inch), 496 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 areally. About 14,460 square miles of topographic reconnaissance surveys, on a scale of 1:250,000 (4 miles to the inch), and 246 square miles of detailed topographic surveys, on a scale of 1:62,500 (1 mile to the inch), were completed.

Sixty-eight gaging stations were maintained in the Yukon-Tanana region in 1911 for an average of 15 weeks each, furnishing data on the water resources of the Fortymile, Eagle, Seventymile, Birch Creek, and Fairbanks districts.

To state the work geographically, two parties were in the Copper River basin, one on Prince William Sound (later transferred to Kenai Peninsula), three on Kenai Peninsula, one in the Susitna basin, four in the Yukon-Tanana region, one in northeastern Alaska, and one in northwestern Alaska.

Among the important results of the year were the completion of a detailed topographic survey of the most important part of the Port Valdez mining district and of a reconnaissance topographic survey of the northern part of Kenai Peninsula. Geologic and topographic reconnaissance surveys of the Hanagita Valley and Bremner River regions were also completed. A geologic and topographic exploration of the Noatak Valley was made, and the geologic reconnaissance mapping of the Circle and Rampart quadrangles was completed.

The following table shows allotment, including both field and office expenses, of the total appropriation of $100,000 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.

Allotment to Alaskan surveys and investigations in 1911.

Copper River region	$18,500
Prince William Sound	4,800
Kenai Peninsula	24,500
Susitna basin	5,100
Yukon basin	23,700
Noatak region	11,700
Northeastern Alaska	5,500
General investigations	6,200
	100,000

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

Approximate allotments to different kinds of surveys and investigations in 1911.

Geologic exploration	$5,200
Geologic reconnaissance surveys	37,600
Special geologic investigations	7,500
Topographic reconnaissance surveys	25,500
Detailed topographic surveys	4,700
Investigation of water resources	6,500
Collection of statistics of mineral production	1,100
Miscellaneous, including clerical salaries, administration, inspection instruments, office supplies, and equipment	11,900
	100,000

Allotments for salaries and field expenses, 1911.

Scientific and technical salaries	$34,860
Field expenses	55,440
Clerical and other office salaries	9,700
	100,000

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 areally.

Progress of surveys in Alaska, 1898–1911.[a]

Year.	Appropriation.	Areas covered by geologic surveys.			Areas covered by topographic surveys.[b]					Water-resources investigations.	
		Exploratory (scale 1:625,000 or 1:1,000,000).	Reconnaissance (scale 1:250,000).	Detailed (scale 1:62,500).	Exploratory (scale 1:625,000 or 1:1,000,000).	Reconnaissance (scale 1:250,000; 200-foot contours).	Detailed (scale 1:62,500; 25, 50, or 100 foot contours).	Lines of levels.	Bench marks set.	Gaging stations maintained part of year.	Stream volume measurements.
		Sq. m.	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Sq. m.*	*Miles.*			
1898	$46,189.60	9,500	.....	.....	12,840	2,070	.....	.....	.....	.....	.....
1899	25,000.00	6,000	.....	.....	8,690	.....	.....	.....	.....	.....	.....
1900	60,000.00	3,300	6,700	.....	630	11,150	.....	.....	.....	.....	.....
1901	60,000.00	6,200	5,800	.....	10,200	5,450	.....	.....	.....	.....	.....
1902	60,000.00	6,950	10,050	.....	8,330	11,970	96	.....	.....	.....	.....
1903	60,000.00	5,000	8,000	96	.....	15,000	.....	.....	.....	.....	.....
1904	60,000.00	4,050	3,500	.....	800	5,480	480	86	19	.....	.....
1905	80,000.00	4,000	4,100	536	.....	4,880	787	202	28	.....	.....
1906	80,000.00	5,000	4,000	421	.....	13,500	40	.....	.....	14	286
1907	80,000.00	2,600	1,400	442	.....	6,120	501	95	16	48	457
1908	80,000.00	2,000	2,850	604	.....	3,980	427	76	9	53	556
1909	90,000.00	6,100	5,500	450	6,190	5,170	444	.....	.....	81	703
1910	90,000.00	.....	8,635	321	.....	13,815	36	.....	.....	69	429
1911	100,000.00	8,000	10,550	496	.....	14,460	246	.....	.....	68	309
Total	971,000.00	68,700	71,085	3,366	47,680	114,045	3,057	459	72	.....	.....
Percentage of total area of Alaska	.....	11.72	12.12	0.57	8.16	19.45	0.52	.....	.....	.....	.....

[a] The areas presented in this table differ somewhat from those previously published. This is due in part to the reclassification of the work and in part to the fact that the areas have been more carefully scaled from the maps than formerly.

[b] In addition to the above, the International Boundary Survey and the Coast and Geodetic Survey have made surveys of parts of Alaska.

GEOGRAPHIC DISTRIBUTION OF INVESTIGATIONS.

GENERAL WORK.

The writer was employed in office work until August, when he proceeded to Seattle and joined the party of the Secretary of the Interior. Details in regard to the itinerary of the Secretary's party have been published elsewhere. It will therefore be sufficient to state that parts of the Bering River coal field and of the Katalla oil field were visited and that the itinerary included journeys over the Copper

River, Alaska Northern, and White Pass railways, down the Lewis River to Lake Labarge, and about 15 miles of the Valdez-Fairbanks military road. The writer left the party at Skagway on September 4 and proceeded to Juneau, where he spent two days in visiting some of the mines. Thence he returned to Valdez, arriving on September 11. The succeeding 10 days he devoted to a rapid reconnaissance of a part of the Port Valdez mining district (see pp. 108–130), reaching Seward on September 24. Ten days were then spent in studying the geology and mineral resources of a part of the Kenai Peninsula in company with Mr. Johnson and Mr. Martin, and conferences were also held in regard to topographic surveys with Mr. Sargent and Mr. Bagley. Returning, the writer reached Seattle on October 15, whence he proceeded to San Francisco to meet the Director of the Survey, and after attending the meeting of the American Mining Congress, at Chicago, returned to Washington, arriving on October 28.

Of the time spent in the office, the geologist in charge has devoted about 38 days to reading and revision of manuscripts, 35 days to preparing matter for progress report, 33 to writing scientific articles, 5 days preparing the annual press bulletin, 7 days to statistics of mineral production, 7 days to public land surveys and the remainder to 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. J. W. Bagley spent considerable time in devising methods and instruments for photo-topographic surveys. These were successfully applied by him in his 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 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. W. W. Atwood also continued some office studies bearing on the coal resources of Alaska.

SOUTHEASTERN ALASKA.

Systematic surveys and investigations were begun in southeastern Alaska in 1901 and continued each season until 1910. The demands for surveys in other parts of the Territory prevented any further work in this province in 1911. This was unfortunate, for though the preliminary examination of much of this area has been made and detailed surveys of the most important mining districts have been

completed, there is still great need for reconnaissance surveys which shall outline more definitely the geologic formations and thus furnish further evidence on the distribution of mineral resources.

Some office work was done on a report treating of Glacier and Lituya bays region, by F. E. Wright. C. W. Wright still has in hand the report on the copper deposits of the Kasaan Peninsula and Copper Mountain regions. His professional duties in Sardinia have prevented him from completing this report as he had hoped. The report on the Sitka mining district has been published and that on the Eagle River district is in press. Both these reports are by Adolph Knopf.

COPPER RIVER REGION.

During a few weeks in the fall of 1900 the lower Copper River was covered by an exploratory survey, which yielded results that have been of inestimable value to prospectors and railway engineers but were not up to the present standards of mapping. In view of the importance of the region it was decided to revise this work, and this task was assigned to D. C. Witherspoon, who was also charged with the work of extending the reconnaissance survey southward from Hanagita Valley to the Bremner River region. Mr. Witherspoon, with a party of four men, began field work on June 13 and continued it until October 3. During this time he revised the mapping of an area of 900 square miles and surveyed a new area of 1,000 square miles. This work was done for publication on a scale of 1:250,000. Mr. Witherspoon also occupied some 20 triangulation stations, which formed part of a scheme for a system of triangulation from Copper Center to Chitina and from Chitina to head of Bremner River.

F. H. Moffit, assisted by Theodore Chapin, made a geologic reconnaissance survey of about 1,500 square miles in the Hanagita Valley and Bremner River region and also examined the copper lodes and gold placer prospects of the region. (See pp. 93–104.) The party, which consisted of three men besides the geologist, began work on June 13 and continued until September 15.

PRINCE WILLIAM SOUND.

J. W. Bagley, with three men, made a detailed topographic survey of the most important part of the Port Valdez mining district. Work in this district was begun on April 25 and continued until July 21, when the party was transferred to Kenai Peninsula. He was assisted by C. E. Giffen up to May 30. An area of 160 square miles was covered in this survey for publication on a scale of 1:62,500, with 50-foot contours. The geologic reconnaissance of this area by the writer, which has already been noted, is reported on pages 108–130.

KENAI PENINSULA.

R. H. Sargent, with a party of four men, began field work at Kachemak Bay on June 9 and carried a topographic reconnaissance survey northward to Turnagain Arm. The work included the revision and original mapping of part of the Sunrise placer district, and later the drainage basin of Resurrection River near Seward was surveyed. Surveys were continued until October 5. All told, an area of 3,100 square miles was surveyed, besides which the mapping of some 660 square miles was revised. These surveys were made for publication on a scale of 1:250,000, with 200-foot contours.

J. W. Bagley, who began work on Kenai Peninsula on July 25 and continued it, so far as weather permitted, until October 13, made detailed topographic surveys of an area of 86 square miles (scale, 1:62,500) in the Moose Pass region and also covered some 360 square miles by reconnaissance surveys, besides revising the mapping of an area of 170 square miles. These surveys were made by photo-topographic methods.

G. C. Martin, assisted by Harmon Lewis, carried a geologic reconnaissance northward from Port Graham to Kenai River, then eastward to Alaska Northern Railway. In addition, Mr. Martin made some special geologic investigations in other parts of the peninsula. The Martin party began field work on June 23 and closed it on September 30, during which time an area of 800 square miles was mapped on a scale of 1:250,000.

In view of the discovery and developments of auriferous lodes in the northern half of Kenai Peninsula, a special investigation of these lodes was determined upon, and B. L. Johnson was assigned to this work. Mr. Johnson began field work near Seward on May 31 and closed it on October 26. He made a more or less detailed examination of most of the important lodes and of many of the gold placers (see pp. 131–173) and also mapped the geology of the area covered by Mr. Bagley's survey in the Moose Pass region.

To summarize the results accomplished in Kenai Peninsula: Detailed topographic and geologic surveys were made of 86 square miles, topographic reconnaissance surveys of 3,520 square miles, and the mapping of 830 square miles was revised. Some 800 square miles were covered by geologic reconnaissance surveys, and in addition most of the important lode and placer deposits were studied in some detail.

It has been decided to incorporate the results of the surveys of the southeastern part of the peninsula made in 1909 [1] by U. S. Grant and D. F. Higgins in a report which shall include all the data collected by the above parties.

[1] Preliminary report on the mineral resources of the southern part of Kenai Peninsula: Bull. U. S. Geol. Survey No. 442, 1910, pp. 166–178.

SUSITNA BASIN.

S. R. Capps, with one man, completed a geologic reconnaissance of the Yentna placer district between June 10 and September 15. The area covered was about 2,000 square miles, and the work included the examination of all the important gold placers of the district. (See pp. 174–200.)

YUKON BASIN.

L. M. Prindle, assisted by J. B. Mertie, with a party of three men, completed the areal reconnaissance mapping of the larger part of the Circle quadrangle, located in the Yukon-Tanana region. Field work was begun on June 23 and continued until September 9, when an area of about 4,000 square miles had been covered. Mr. Prindle also made a study of the placers of Fourth of July Creek. (See pp. 201–210.)

Henry M. Eakin completed the geologic reconnaissance mapping of that part of the Rampart quadrangle (Yukon-Tanana region) which had been previously covered by topographic surveys. He also carried the work west of the Yukon over a previously unmapped area, where some topographic sketch maps were made. The Eakin party, consisting of two men, mapped an area of about 2,000 square miles during the field season, which extended from June 24 to August 29, and also examined the gold placers of the Rampart, Hot Springs, and Gold Mountain districts. (See pp. 271–286.)

The investigation of the water resources of the Yukon-Tanana region, which was begun at Fairbanks in 1907, was continued in 1911. E. A. Porter, who began work April 27, carried on investigations in the Fortymile district, where 27 gaging stations were maintained for 17 weeks and 80 measurements were made; in the Eagle district, where 6 stations were maintained for 15 weeks and 28 measurements made; and in the Seventymile district, where 9 stations were maintained for 14 weeks and 46 measurements made. Mr. Porter continued his field work until September 15. (See pp. 219–239.)

C. E. Ellsworth began work in the Birch Creek district on April 20, where 15 stations were maintained for an average of 15 weeks and 78 measurements were made. Later he extended work to Fairbanks district, where 10 stations were maintained for an average of 15 weeks and 74 measurements made; and to the Salchaket district, where 1 station was maintained for 15 weeks and 3 measurements were made. Mr. Ellsworth continued his field work until August 21. (See pp. 240–270.)

NORTHEASTERN ALASKA.

By courtesy of the boundary commissioner, Mr. O. H. Tittmann, the Survey was enabled to attach a geologist to the party which was engaged in surveying the boundary north of Porcupine River. A. G. Maddren, assisted by J. M. Jessup, was detailed for this work.

Field work was begun on Porcupine River on June 7 and was closed on August 31. The topographic maps of the boundary surveyors (scale 1:45,000) were used as a base, and the areal mapping covered about 400 square miles, in addition to which about 200 square miles were mapped in a reconnaissance way. A brief statement of results is published in this bulletin on pages 297–314.

NORTHWESTERN ALASKA.

P. S. Smith, with C. E. Giffin, topographer, and a party of four men carried an exploration up Alatna River, across the divide to the Noatak, and down that river to the Arctic Ocean at Kotzebue Sound. Field work began on July 1 and closed on August 27. An area of about 10,000 square miles was mapped topographically, of which the principal geologic features of about 8,000 square miles were mapped. (See pp. 315–338.) The party traveled by canoes and had an eminently successful season.

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. As in previous reports, the attention of the mining public is directed to the fact that a rather large number of placer-mine operators still neglect to make returns of production, though the schedules are mailed to them each year. Such action, by decreasing the accuracy of the published totals for each district, injures the mining industry. There is no reason for this failure to make returns, 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 in contact. It is the earnest hope of the writer that all the placer miners of the Territory will soon come to realize that they are not only running no risk in furnishing the Survey with figures showing production but that in withholding them they are injuring the mining industry.

PUBLICATIONS ISSUED OR IN PREPARATION DURING THE YEAR.

During 1911 the Survey published one professional paper, five bulletins, and three separate maps relating to Alaska. One professional paper and six bulletins are in press. In addition to these, the author's work on two other bulletins and one water-supply paper has been completed, and these publications will be sent to press not later than July 1. Six other reports are in preparation, which it is

expected will be ready for publication before the end of the calendar year.

REPORTS ISSUED.

PROFESSIONAL PAPER 70. The Mount McKinley region, Alaska, by Alfred H. Brooks, with descriptions of the igneous rocks and of the Bonnifield and Kantishna districts, by L. M. Prindle; including geologic and topographic reconnaissance maps.

BULLETIN 446. Geology of the Berners Bay region, Alaska, by Adolph Knopf; including detailed geologic and topographic maps.

BULLETIN 448. Geology and mineral resources of the Nizina district, Alaska, by F. H. Moffit and S. R. Capps; including detailed geologic and topographic maps.

BULLETIN 449. A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska, by P. S. Smith and H. M. Eakin; including geologic and topographic reconnaissance maps.

BULLETIN 467. Geology and mineral resources of parts of the Alaska Peninsula, by W. W. Atwood; including geologic and topographic reconnaissance maps.

BULLETIN 480. Mineral resources of Alaska (report on progress of investigations in 1910), by Alfred H. Brooks and others; including general map of Alaska showing distribution of metalliferous deposits.

REPORTS IN PRESS.

PROFESSIONAL PAPER 69. The Yakutat Bay earthquake of September, 1899, by R. S. Tarr and Lawrence Martin. [Issued June 24, 1912.]

BULLETIN 485. A geologic reconnaissance of the Iliamna region, Alaska, by G. C. Martin and F. J. Katz; including geologic and topographic reconnaissance maps. [Issued March 9, 1912.]

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. [Issued March 15, 1912.]

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

BULLETIN 502. The Eagle River region, southeastern Alaska, by Adolph Knopf; including detailed geologic and topographic maps.

BULLETIN 504. The Sitka mining district, Alaska, by Adolph Knopf. [Issued February 2, 1912.]

REPORTS COMPLETED, FOR WHICH ILLUSTRATIONS ARE BEING PREPARED.

Coastal glaciers of Prince William Sound and Kenai Peninsula, by U. S. Grant and D. F. Higgins.

The surface water supply of Seward Peninsula, by F. F. Henshaw and G. L. Parker; with sketch of geography and geology, by P. S. Smith, and report on placer mining, by Alfred H. Brooks; including topographic reconnaissance map.

Geologic reconnaissance of Fairbanks quadrangle, Alaska, by L. M. Prindle; with detailed description of the Fairbanks district, by L. M. Prindle and F. J. Katz; including detailed and reconnaissance geologic and topographic maps.

REPORTS IN PREPARATION.

Geology and ore deposits of Kasaan Peninsula and the Copper Mountain region, Prince of Wales Island, by C. W. Wright; including detailed geologic and topographic maps.

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

Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant; including geologic and topographic reconnaissance maps.

The Koyukuk-Chandalar gold region, by A. G. Maddren; including geologic and topographic reconnaissance maps.

The Iditarod-Innoko region, by A. G. Maddren; including geologic and topographic reconnaissance maps.

Geology of the Nome and Grand Central quadrangles, by F. H. Moffit; including detailed geologic and topographic maps.

MAPS.

Five topographic maps were issued as illustrations to reports (see p. 15), of which two were 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 was published as an illustration to Bulletin 480. Three reconnaissance and two detailed topographic maps are included in the reports which are in press. In addition to the above, three topographic maps were issued separately as sale publications, as follows:

Circle quadrangle, No. 641; scale, 1:250,000 (4 miles to the inch); contour interval, 200 feet. Topography by D. C. Witherspoon, T. G. Gerdine, R. B. Oliver, G. T. Ford, and J. W. Bagley. Price 25 cents.

Kasaan Peninsula, Prince of Wales Island, Alaska, No. 540A; scale, 1:62,500 (1 mile to the inch); contour interval, 50 feet. Topography by D. C. Witherspoon, R. H. Sargent, and J. W. Bagley. Price 5 cents.

Copper Mountain and vicinity, Prince of Wales Island, Alaska, No. 540B; scale, 1:62,500 (1 mile to the inch); contour interval, 100 feet. Topography by R. H. Sargent. Price 5 cents.

THE MINING INDUSTRY IN 1911.

By ALFRED H. BROOKS.

GENERAL STATEMENT.

The metalliferous mining industry of Alaska had a very successful year in 1911. Much progress was made in placer and lode gold mining. The copper production was very large, and the outlook for the development of the tin deposits in the Seward Peninsula is more promising than it ever has been. Some successful developments were made in the Katalla oil field, and the output of the marble and gypsum deposits was about the same as in previous years. On the other hand, no advances were made in the exploration of the coal fields, for this phase of the mining industry still awaits the establishment of definite policy in regard to the disposition of the public coal lands. In 1911, therefore, as in previous years, stagnation existed in all enterprises depending on the opening of the coal fields. These enterprises include not only coal mining ventures but railway construction and, to a certain extent, metalliferous mining and other industries whose successful prosecution depends on an abundant supply of cheap fuel.

The favorable showing made by the Alaska mining industry during the year is due, first, to the very large output of copper and, second, to the greater production, compared with 1910, of the gold placer mines in the Innoko-Iditarod region. Aside from the increased production of copper and gold, the most important event of the year was the opening of the Copper River region by the completion of a railway. The industries already stimulated by this road strikingly illustrate the importance of railway communication to Alaska.

Although most of the gold still comes from the placers, much progress was made during 1911 in paving the way for an increased output from auriferous lodes. This work was carried on in most of the gold-bearing areas of Alaska, but the advances were most notable in the Juneau, Valdez, Kenai Peninsula, Willow Creek, and Fairbanks districts. Aside from the increase in copper mining the progress made in developing gold-lode mines is the most encouraging feature of the

year's operations. Great progress was also made in dredge mining, notably in the Nome region. It is estimated that in the entire Territory 27 dredges were operated for the whole or a part of the open season of 1911. In addition to those operated, at least half a dozen were in process of construction.

The value of the total mineral production in 1911 is estimated at $20,650,005; in 1910 it was $16,887,244. In the following table the sources of this wealth, as well as a comparison with the production of the previous year, are presented. The statistics for 1911 are not yet completed and may be subject to change. In the table the output of marble, tin, gypsum, lead, etc., are combined, because a separate listing might reveal the production of individual properties.

Mineral production of Alaska, 1910–11.

	1910.		1911.		Increase (+) or decrease (−).	
	Quantity.	Value.	Quantity.	Value.	Quantity.	Value.
Gold.....ounces..	780,131	$16,126,749	[a] 815,276	$16,853,256	+ 35,145	+ 726,507
Silver.....do....	157,850	85,239	[a] 460,231	243,923	+ 302,381	+ 158,684
Copper.....pounds..	4,241,689	538,695	27,267,871	3,366,584	+23,026,182	+2,827,889
Coal.....short tons..	1,000	15,000	900	9,300	− 100	− 5,700
Marble, gypsum, tin, lead, etc.....	.....	121,561	.....	176,942	.....	+ 55,381
	.....	16,887,244	.....	20,650,005	.....	+3,762,761

[a] Preliminary estimates.

NOTE.—In the above table copper is valued at 12.7 cents a pound for 1910 and 12.35 cents for 1911; silver at 54 cents an ounce for 1910 and 53 cents for 1911.

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, 1880–1911.

By years.				By substances.	
1880–1890.....	$4,686,714	1901.....	$7,007,398	Gold.....	$195,619,776
1891.....	916,920	1902.....	8,400,693	Silver (commercial value)....	1,524,364
1892.....	1,096,000	1903.....	8,941,614	Copper.....	8,705,293
1893.....	1,048,570	1904.....	9,567,135	Coal.....	347,489
1894.....	1,310,257	1905.....	16,478,142	Marble, gypsum, tin, etc.....	731,119
1895.....	2,386,722	1906.....	23,375,008		206,928,041
1896.....	2,980,087	1907.....	20,847,055		
1897.....	2,538,241	1908.....	20,142,272		
1898.....	2,585,575	1909.....	21,141,019		
1899.....	5,703,076	1910.....	16,887,244		
1900.....	8,238,294	1911.....	[a] 20,650,005		
			206,928,041		

[a] Preliminary estimate.

TRANSPORTATION.

As improvement in transportation is the most important element in the advancement of the mining industry, the progress of the year in this respect will be briefly summarized. The Copper River & Northwestern Railway was completed to Kennecott in April, 1911, giving a total length for this line from Cordova, on Prince William Sound, of 197 miles. Repairs were kept up on the Alaska Northern Railway, including the rebuilding of the crossing of Placer River, and traffic was maintained from Seward to the end of the track (71½ miles) for all except the winter months. The owners of this railway state that no extension of the line will be made until the coal fields are opened. No other railway construction was undertaken during the year, but traffic was maintained over the White Pass, Tanana Valley, Seward Peninsula, and other roads.

At the close of 1911 there were 465 miles of railway in the Territory, compared with 371 miles in 1910. This mileage is distributed among nine different railways, from 5 to 197 miles in length. The existing railways emphasize the need of additional transportation facilities. The most urgent need is for a railway to connect an open port on the Pacific with the Yukon basin. (See pp. 45–76.) Until such a line is built only the richest placers and only the most favorably located lodes can be profitably exploited.

There was little change in ocean steamer service during the year. The building of lighthouses and the installing of other aids to navigation increased the safety and promptness of navigation, which will tend to decrease the cost. Attempts to use steamers on the Copper River above Chitina have been practically abandoned, because of the difficulties of navigation. River steamer service has also been discontinued on the Susitna, because of insufficient business. The small amount of freight distributed in this region is now handled by launches. On the other hand, several steamers are now in use on Kuskokwim River, ascending the stream about 600 miles to the mouth of the Takotna. They also run up that stream some 15 miles to a point connected by winter trail with the placer mines on Gaines Creek. The Kuskokwim is navigable to the Forks, about 50 miles above the mouth of the Takotna.

The Alaska Road Commission continued its important work of making mining districts accessible by building wagon roads and trails. Probably the most important undertaking of this kind was the completion of the winter trail from Seward, on the Pacific seaboard, to the Iditarod placer district. This not only serves several placer-mining camps, but also shortens the winter route to Nome by some 300 miles. Work was also continued on the Valdez-Fairbanks trail, which can

now be used not only as a winter route but also as a wagon road in summer. A cut-off was built which connects the wagon road with Chitina, on the railway. At the close of 1911 the total mileage of road and trail constructed by the commission was as follows: Wagon roads, 800 miles; winter sled roads, 534 miles; trails, 1,107 miles; winter trails temporarily staked, 450 miles. The inadequacy of this mileage to serve the many mining districts scattered over a territory of nearly 600,000 square miles is so obvious that no comment is necessary.

METAL MINING.

PRODUCTION.

In 1911 about one-quarter of the gold production came from lode mines and three-quarters from placer mines, the same ratio between lode and placer output that was maintained in 1910. It is to be expected that before long the percentage of lode production will increase, which will result in a greater stability in the annual gold output than is possible where the maintenance of the production depends on the exploitation of rich gravel deposits. The increased use of dredges will also bring about less fluctuation in the annual placer gold production. In the following table, which is based on preliminary estimates, the production of precious metals has been distributed as to sources.

Sources of gold, silver, and copper in Alaska, 1911, by kinds of ores.

	Tonnage.	Gold.		Silver.		Copper.	
		Ounces.	Value.	Ounces.	Value.	Pounds.	Value.
Siliceous ores	1,594,404	204,465.99	$4,226,687	29,829	$15,810	.....	.....
Copper ores	68,975	4,187.78	86,569	320,114	169,660	27,267,871	$3,366,584
Placers	.....	606,622.50	12,540,000	110,288	58,453	.....	.....
	1,663,379	815,276.27	16,853,256	460,231	243,923	27,267,871	3,366,584

To arrive at the total metal production of Alaska the amount of tin produced should be added. This is discussed by Mr. Hess in Bulletin 520–B. A small amount of lead is also recovered each year, incidentally to the treatment of other ores. In the following table the production of gold, silver, and copper is given by years:

Production of gold, silver, and copper in Alaska, 1880–1911.

Year.	Gold.		Silver.		Copper.	
	Quantity (fine ounces).	Value.	Quantity (fine ounces).	Commercial value.	Quantity (pounds).	Value.
1880	967	$20,000			3,933	$326
1881	1,935	40,000				
1882	7,256	150,000				
1883	14,566	301,000	10,320	$11,146		
1884	9,728	201,000				
1885	14,513	300,000				
1886	21,575	446,000				
1887	32,653	675,000				
1888	41,119	850,000	2,320	2,181		
1889	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	61,927	1,282,000	22,261	14,257		
1895	112,642	2,328,500	67,200	44,222		
1896	138,401	2,861,000	145,300	99,087		
1897	118,011	2,439,500	116,400	70,741		
1898	121,760	2,517,000	92,400	54,575		
1899	270,997	5,602,000	140,100	84,276		
1900	395,030	8,166,000	73,300	45,494		
1901	335,369	6,932,700	47,900	28,598	250,000	40,000
1902	400,709	8,283,400	92,000	48,590	360,000	41,400
1903	420,069	8,683,600	143,600	77,843	1,200,000	156,000
1904	443,115	9,160,000	198,700	114,934	2,043,586	275,676
1905	756,101	15,630,000	132,174	80,165	4,805,236	749,617
1906	1,066,030	22,036,794	203,500	136,345	5,871,811	1,133,260
1907	936,043	19,349,743	149,784	98,857	6,308,786	1,261,757
1908	933,290	19,292,818	135,672	71,906	4,585,362	605,267
1909	987,417	20,411,716	147,950	76,934	4,124,705	536,211
1910	780,131	16,126,749	157,850	85,239	4,241,689	538,695
1911	815,276	16,853,256	460,231	243,923	27,267,871	3,366,584
Total	9,463,106	195,619,776	2,578,862	1,524,364	61,062,979	8,705,293

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

The production from the Pacific coast belt is derived principally from the lode mines of southeastern Alaska, but includes also the output of a lode mine of Unga Island, 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 spasmodically since about 1890.

Up to 1909 all the gold from the Copper River and Cook Inlet region was derived from gold placers; since then there has been a small output from the auriferous lodes of Willow Creek and the Kenai Peninsula. The gold output of the Seward Peninsula and the Yukon basin is practically all derived from placers. One gold lode mine and several prospects on Seward Peninsula have been worked spasmodically since 1903, and there has been a small lode production from the Fairbanks district during the last two years. (See p. 30.)

Value of gold production of Alaska, with approximate distribution, 1880–1911.

Year.	Pacific coast belt.	Copper River and Cook Inlet region.	Yukon Basin.	Seward Peninsula and northwestern Alaska.	Total.
1880	$20,000				$20,000
1881	40,000				40,000
1882	150,000				150,000
1883	300,000		$1,000		301,000
1884	200,000		1,000		201,000
1885	275,000		25,000		300,000
1886	416,000		30,000		446,000
1887	645,000		30,000		675,000
1888	815,000		35,000		850,000
1889	860,000		40,000		900,000
1890	712,000		50,000		762,000
1891	800,000		100,000		900,000
1892	970,000		110,000		1,080,000
1893	838,000		200,000		1,038,000
1894	882,000		400,000		1,282,000
1895	1,569,500	$50,000	709,000		2,328,500
1896	1,941,000	120,000	800,000		2,861,000
1897	1,799,500	175,000	450,000	$15,000	2,439,500
1898	1,892,000	150,000	400,000	75,000	2,517,000
1899	2,152,000	150,000	500,000	2,800,000	5,602,000
1900	2,606,000	160,000	650,000	4,750,000	8,166,000
1901	2,072,000	180,000	550,000	4,130,700	6,932,700
1902	2,546,600	375,000	800,000	4,561,800	8,283,400
1903	2,843,000	375,000	1,000,000	4,465,600	8,683,600
1904	3,195,400	500,000	1,300,000	4,164,600	9,160,000
1905	3,430,000	500,000	6,900,000	4,800,000	15,630,000
1906	3,454,794	332,000	10,750,000	7,500,000	22,036,794
1907	2,891,743	275,000	9,183,000	7,000,000	19,349,743
1908	3,448,318	401,500	10,323,000	5,120,000	19,202,818
1909	4,264,716	265,000	11,580,000	4,302,000	20,411,716
1910	4,182,730	351,630	8,062,389	3,530,000	16,126,749
1911	4,265,573	313,538	9,139,145	3,135,000	16,853,256
	56,477,874	4,673,668	74,118,534	60,349,700	195,619,776

The production from the Yukon basin in the above table includes, of course, only that part of the basin on the Alaska side of the boundary. Mining has been going on in the Canadian Yukon since 1885. The following table of the Canadian Yukon will make it possible to compare the output of each year with those of the Alaska districts:

Production of gold in Yukon district, Canada, 1885–1910.[a]

Year.	Quantity (fine ounces).	Value.
1885		
1886	4,387	$100,000
1887	3,386	70,000
1888	1,935	40,000
1889	8,466	175,000
1890	8,466	175,000
1891	1,935	40,000
1892	4,233	87,500
1893	8,514	176,000
1894	6,047	125,000
1895	12,094	250,000
1896	14,513	300,000
1897	120,937	2,500,000
1898	483,750	10,000,000
1899	774,000	16,000,000
1900	1,077,553	22,275,000
1901	870,750	18,000,000
1902	701,437	14,500,000
1903	592,594	12,250,000
1904	407,938	10,500,000
1905	381,001	7,876,000
1906	270,900	5,600,000
1907	152,381	3,150,000
1908	174,150	3,600,000
1909	191,565	3,960,000
1910	220,166	4,550,000
1911		[b] 4,580,000
	6,593,548	136,299,500

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

METALLIFEROUS LODES.

STATISTICS.

The total gold production from the auriferous lode mines of Alaska which have been productive since 1882 is estimated to be 2,550,107 fine ounces, valued at $52,808,921. These mines have also produced 1,029,743 fine ounces of silver, with a commercial value of $626,901. The total copper production up to the close of 1911 was 61,062,979 pounds, valued at $3,905,279. Tin mining began in the York region in 1902, since which time it has been carried on spasmodically. The value of the total tin product, which has come almost entirely from the placers, up to the close of 1910 is $192,042. There has also been some recovery of lead from ores valuable chiefly for other metals.

Alaska's auriferous lodes are estimated to have produced during the year 204,465.99 fine ounces of gold, valued at $4,226,687, as compared with an output of 198,601 fine ounces, valued at $4,105,459 in 1910. The increased production is to be credited to southeastern Alaska, for there was little change in the lode output from other districts. As in 1910, there was much prospecting of auriferous lodes near Port Valdez, in Kenai Peninsula, at Willow Creek, and in the Fairbanks district.

Eighteen 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 1911—six more than in 1910. Work was also done on many gold prospects, a few of which produced some gold as an incident to the development work. Of the producing mines, eight were in southeastern Alaska.

It is estimated that these mines had an output of 1,594,404 tons of ore, as compared with 1,375,612 tons, the total output for 1910. In 1910 the average value of gold-silver contents for all the ores mined was $2.77; the average in 1911 is estimated to have been $2.79.

There were eight productive copper mines in 1911, as compared with seven in 1910. Of these, three were in the Ketchikan district, four on Prince William Sound, and one in the Kotsina-Chitina district. The total copper production in 1911 was 27,267,871 pounds, valued at $3,366,584, compared with 4,241,689 pounds, valued at $538,695 in 1910. About $86,570 worth of gold and $169,660 worth of silver was recovered from the copper ores. It is estimated that in 1911 about 68,975 short tons of copper ore were hoisted, as compared with 39,365 tons in 1910. The average copper content of the ore was about 17.87 per cent, and the gold-silver values about $3.84 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 auriferous lode mines of southeastern Alaska are estimated to have produced gold to a value of $3,990,786 in 1911, as compared with an output of $3,839,626 in 1910. In this region eight gold mines and four copper mines were operated in 1911 and nine gold mines and three copper mines in 1910. Although there was a decrease in the number of productive mines, much dead work was done on several large mining enterprises in the Juneau gold belt, and a number of small properties in the Ketchikan district were systematically prospected. The Chichagoff and Golden Gate mines, in the Sitka district, each supplied ore to 10 stamp mills. It is reported that these two properties are to be consolidated. The success of these two properties has stimulated the development of a number of prospects in the adjacent regions. A customs mill was built at Skagway in 1911 for the purpose of testing ores from the prospects of the vicinity.

There can be no question that the gold output of southeastern Alaska will be much increased within a very few years. In copper mining the advances were less marked, but several properties promise to become productive in 1912, and should copper continue to advance, a considerable increase of the copper output from this field is to be expected.

JUNEAU PRECINCT.

The Treadwell group of mines, on Douglas Island, continued in 1911 to be the source of most of the gold output of southeastern Alaska and, in fact, of the lode production of the entire Territory. Among the important developments on this property was the installation of a new central hoisting plant and crusher, which was completed in 1911. At the Treadwell mine ore was taken from the 1,450 and 1,600 foot levels, and considerable dead work was done on the 1,750-foot level. The 1,210 and 1,320 foot levels furnished most of the ore at the Alaska-Mexican mine, and the mine workings were extended on the 1,460 and, to a less extent, on the 1,570 foot levels. The ore from the Ready Bullion came chiefly from the 1,650-foot and 1,800-foot levels, and the dead work was chiefly on the 1,100 and 1,350 foot levels. In the 700-foot claim productive mining was done chiefly on the 1,210-foot and 1,320-foot levels, and dead work on the 1,600-foot level and in the shaft. Twenty stamps were added to the mill of the 700-foot claim.

Besides the Treadwell group, only two other properties on Douglas Island received any attention in 1911. A new company is reported to have taken hold of the Bear's Nest property and to have done some prospecting. Operations at the Alaska Treasure, on Nevada Creek, which had been temporarily suspended about the close of 1910, were resumed in 1911. The main crosscut was extended from 3,100 to 3,400 feet, giving a depth of 750 feet below the upper (the Hudson) crosscut. Some ore bodies are said to have been found. The work in hand consists in driving from the face of the main crosscut in a northerly direction in the expectation of intersecting the ore body exposed in the Hudson (the upper) level.

In 1911, as in previous years, the Perseverance mine, in the Silverbow Basin of the mainland portion of the Juneau gold belt, was operated during the open season, which amounted to 153 days. The mill at the Alaska-Juneau mine was also operated for a part of the year, but chiefly for sampling. Plans to develop this property on a large scale, which have been under consideration for some years took definite form in 1911. About 100 feet of an adit tunnel was completed, which will undercut the ore body of the Alaska-Juneau at a depth of about 600 feet. The portal of this tunnel is on Snowslide Gulch, a tributary of Gold Creek. A tram road for carrying ore has been graded from the portal of the tunnel to a mill at tidewater near Juneau. The tunnel, which follows a fault line, will be about 6,000 feet long. A ditch to bring water from Gold Creek has also been constructed. The California Nevada Copper Co. continued work on its tunnel on the Ebner property. Little information has been obtained regarding the mines north of Juneau. Systematic

development has been continued on the Kensington property at Berners Bay, which will soon become productive. Some plans were also made to reopen the Jualin mine, located in the same district. In the aggregate considerable work was done also on numerous other properties between Juneau and Berners Bay. The mill at the Eagle River mine was operated only a short time during the year, and most of the work at this place was directed to further underground exploration.

KETCHIKAN DISTRICT.

The copper deposits of the Ketchikan district are still by far the most important of its mineral resources, but in 1911 more attention was given to the auriferous lodes than in the previous year. The Mount Andrew and Jumbo mines were producing ore, as in previous years, but details in regard to development are lacking at this writing. At the Jumbo, where about 40 men were employed, a crosscut is being driven to the main haulage adit to bring cars direct to bunkers. Ore shipments were also continued from the It mine, where operations, which had been temporarily suspended, were resumed in April. A 1,400-foot tunnel, destined to undercut the ore body at a depth of 500 feet, was driven at the It mine, and is said to have intersected an ore body. At the Joker mine only assessment work was done in 1911. Some small shipments of ore were made from the Rush & Brown mine, where, it is reported, an ore body of high grade was discovered. Developments have also been pushed at the Redwing mine, which has been equipped with a compressor and is to be put on a productive basis in 1912. It is reported that a 12-foot vein of copper ore has been found on this property. The main tunnel on the Victory property at Seal Bay, Gravina Island, has been driven a distance of 1,900 feet, and other underground developments have been made. New discoveries of copper ore are also reported on the Copper Center and Gopher (Hyda) properties. The Northland Development Co., whose property is near Klawak, continued sinking a shaft and is reported to have blocked out some ore.

The Lon de Van Mining & Milling Co. continued to drive a crosscut tunnel on Georges Inlet, an indentation of Revillagigedo Island, which is intended to cut an ore body outcropping 900 feet above sea level. At the close of the year the tunnel is said to have been driven about 2,000 feet and to have penetrated an ore body carrying chiefly silver-bearing galena and containing some gold. A gold-bearing vein is said to have been discovered on the Goo Goo claim on Thorne Arm. Some further developments were also made on the auriferous lode on the Gervis property near Hollis. Only assessment work was done at the Moonshine and Old Glory mines. Some developments

were made by a company which had a bond on the Goldstream group of claims, located on Gravina Island.

The advances made in the Portland Canal region of British Columbia stimulated prospecting on the Alaska side of the boundary and within the Ketchikan district. Some encouraging results are reported in this field.

PRINCE WILLIAM SOUND.

The mining industry in Prince William Sound had its most prosperous season in 1911, in both development and production. The estimated total value of the minerals produced, including copper, gold, and silver, exceeded $1,000,000. One gold mine, the Cliff, near Valdez, and three copper mines, the Beatson-Bonanza, the Ellamar, and the Threeman, were productive, and several other copper properties were developed sufficiently to give assurance of an output of metal at an early date. Much development work was also done on a score or more of auriferous quartz veins, some of which will probably produce gold in 1912. A customs mill was established at Valdez, to which ore was brought from several quartz claims of the district. The Port Valdez gold-bearing region is described elsewhere (pp. 108–130). Some advances were made in prospecting auriferous quartz veins in the McKinley Lake district, tributary to Cordova, but this field has not developed into a producing district so rapidly as was expected last year. The following notes are by no means complete, but are believed to cover most of the more important operations during the year.

The ore shipped from the Ellamar copper mine was taken from above the upper level, which had been made available by a cofferdam completed in 1910. Work was continued on the property of the Hemple Mining Co., on Landlocked Bay. It is reported that a total of 2,000 feet of tunnel has been driven on this property.

The Threeman Mining Co. completed its wharf and bunkers and made its first shipment of ore in November. The mine is developed on five levels, with an aggregate of 4,000 feet of underground work. Some work was also done by this company on the Mason and Gleason claims, near Irish Cove. Developments were continued on the property of the Standard Copper Mines Co., near Landlocked Bay. In all 50 feet of shaft have been sunk and 1,100 feet of tunnel have been driven on this property. The Fidalgo-Alaska Copper Co. completed its aerial tram, its wharf, and its 1,000-ton bunkers, besides continuing underground developments. Some ore was delivered at the bunkers before the close of the year, although no shipments were made.

In 1911, as in previous years, the Beatson-Bonanza mine, on Latouche Island, was the largest shipper of copper ore on the sound,

and made substantial progress in both surface equipment and underground workings, details regarding which are lacking at this writing. Considerable prospecting was also done on the adjacent Barrack-Girdwood property, and a crew of men were also employed on the claims of the Reynolds Alaska Development Co., near Horseshoe Bay. The Seattle-Alaska Mining Co. completed the installation of a concentrating plant on its property, located near Montgomery Bay. It is reported that at this place a mineralized shear zone carrying copper and high gold values has been crosscut at a depth of 400 feet. The property has been equipped and made ready for production, but no ore has been shipped.

Development work has been continued on the property of the Knight Island Copper Co., located about 3,500 feet from tidewater at Drye Bay. The mine is equipped with an air compressor and drills run by water pressure. There are two tunnels on the property, aggregating 450 feet in length, and a shaft 60 feet deep. Plans have been formulated to put in a wharf connected with the mine by aerial trams. The only ore produced thus far is that won incidentally to development work. Work on the Pandora claim in 1911 consisted of a winze sunk some 20 feet, near the face of the adit, which is 140 feet long. Development work has been done also on other copper prospects on the sound, notably near Cordova, but detailed information regarding these is not now available.

KENAI PENINSULA AND SOUTHWESTERN ALASKA.

Auriferous lode development was active in Kenai Peninsula during 1911. Details regarding mining in this district are presented by Mr. Johnson on pages 131–173. It is reported that an auriferous quartz vein has been found near Malina Bay, on Afognak Island. No new discoveries are reported in the Iliamna region, and but little prospecting was done in this field. The Apollo mine, on Unga Island, was, as in previous years, the only productive property in southwestern Alaska. Ten stamps were operated at this mine during the summer months.

SUSITNA BASIN.

Lode mining in the Willow Creek district made considerable advances during 1911, and some prospecting was done on lodes in other parts of the Susitna basin. A little work was done on a copper-bearing lode on Iron Creek,[1] but no notable discoveries in this part of the field are reported. Some discoveries of gold-bearing quartz are reported from the Valdez Creek district. The occurrence of gold in the Yentna district is described by Mr. Capps on pages 174–200.

[1] Brooks, Alfred H., The mining industry in 1910: Bull. U. S. Geol. Survey No. 480, p. 33.

It is estimated that about 50 men were employed in developing lode prospects in the Willow Creek district during the summer of 1911 and a smaller number during the previous winter. Gold to the value of between $50,000 and $60,000 was produced. The Willow Creek district was not visited in 1911[1] by any member of the Survey, but the following notes on development have been obtained from what are believed to be reliable sources.

The Alaska Gold Quartz Mining Co. operated its three-stamp mill (500-pound stamps) with water power from June 30 to September 17. Over 230 tons of ore were treated. The tailings were yarded, no concentrator having yet been installed. About 300 feet of adit has been driven at this mine and 1,500 feet of open-cut work has been done, the operations in 1911 covering about 150 feet of adit and considerable stripping. Material for two trams, each a little less than 2,000 feet long, is on the ground. In 1911 the ore was trammed about 1,000 feet and then hauled nearly 2,000 feet on a go-devil.

Some developments were continued on the adjacent group of claims belonging to the Alaska Free Gold Co. Here a 20-foot shaft was sunk on a vein in one claim and assessment work was done on the other claims. Some ore from this property was put through the mill of the Alaska Gold Quartz Mining Co. A considerable force of men was employed at the Gold Bullion property from about the 1st of April to the middle of September. A 3,400-foot tram was installed and five new stamps were added to the mill, making seven in all. The mill was started on July 15 and was operated, with some interruptions on account of shortage of water and repairs, until the middle of September. Most of the ore milled was taken from an open cut, but one adit is reported to have been driven about 75 feet. Only assessment work was done on the adjacent Gold Top Mining Co. property.

A force of men was employed for most of the year on the claims of the Matanuska Gold Mines Co. The development work consisted chiefly of open cuts made for the purpose of tracing the veins. An adit some 40 feet in length was also driven. It is reported that water power is available and that a mill will be installed on this property in 1912. The Brooklyn Development Co. resumed operations on its property in 1911 about June 1. A total of 245 feet of underground work, besides considerable open cutting, represents the excavating accomplished to date. A stamp mill was purchased by this company in 1910, but has not yet been installed. So far as known only assessment work was done on other quartz claims located in the Willow Creek district.

[1] The occurrence of gold and the progress of mining in 1910 were described by Frank J. Katz in an article entitled "A reconnaissance of the Willow Creek gold region": Bull. U. S. Geol. Survey No. 480, 1911, pp. 139–152.

FAIRBANKS DISTRICT.

GENERAL CONDITIONS.

Although some lode prospecting was done in other parts of the Yukon-Tanana region, the only notable advances in hard-rock mining were made in the Fairbanks district. The writer was unfortunately prevented from visiting this district, as planned, and for the facts contained in the following summary has been forced to rely on information gleaned from various sources. Had all the mine operators promptly transmitted the statistical data requested on schedules mailed to them, it would have been possible to present more details in regard to the lode-mining developments and thereby to do fuller justice to the district.

It is reported that during 1911 development work in excess of that required annually for assessment work was done on or about 25 to 30 properties. About 8 or 10 of these produced gold to the value of $1,000 or more. Most of the ore produced was crushed at the two customs mills at Chena and Fairbanks, and in addition some ore was treated at three mills erected on different properties in the later part of the year. The equipment of these five mills aggregated 26 stamps. It is estimated that about 875 tons of ore were treated during the year in the district, yielding about $64,100. Probably about 8 or 10 per cent of this represents the value of the concentrates, the rest being free gold. The high value per ton is accounted for by the fact that much of the ore sent to the mills is picked and does not represent an average of the ore mined. It is estimated in the district that transportation and milling charges have averaged $20 to $30 a ton, prices that prohibit the shipment to the mills of any but high-grade ores, so that mills have been erected on several properties. Most of the ores also carry silver. The ores mined in 1911 are estimated to have yielded 582 ounces of silver, valued at $308.

The total amount of hard-rock underground work done at the close of 1911 is estimated to have been about 6,000 feet whereas the amount done at the close of 1910 was about 3,000 feet. About two-thirds of the hard-rock work represents adits, crosscuts, and drifts, and the remainder represents shafts, raises, and winzes. The total gold production of the quartz lodes to the close of 1911 has a value of about $120,000, which will probably nearly pay for the underground work done. The lode mining so far has been almost entirely in the hands of local men, backed by local capital.

NOTES ON MINING PROPERTIES.

Although claims were staked and more or less prospecting was done during the year in much of the Fairbanks district, the most important developments were confined to certain areas, which will be mentioned in geographic order from east to west.

The most easterly prospect in the Fairbanks Creek belt is the Charles claim, located near Coffee Dome, where a ledge is reported to be 18 inches wide. A 50-foot shaft, showing 3 feet of ore, is said to have been sunk on the Eureka claim, and work was continued on the McCarty Creek ledge. Both these properties produced some ore, which was milled at Chena. A 30-foot shaft, in which a ledge 1 foot wide is reported to have been exposed, was sunk on the Governor claim, in the upper Fairbanks Creek basin.

The divide between Wolf and Fairbanks creeks was the scene of considerable development work. Here some ore was taken from the Pennsylvania claim, and some 350 feet of adits has been driven on the Russian Kid. More extensive developments took place in 1911 on the Rexall, located close at hand. Here the total developments are reported to include a 127-foot crosscut and a 50-foot drift, revealing a vein from 8 inches to 2 feet 8 inches wide. Considerable ore was shipped from this property to one of the customs mills. A new ledge some 18 inches wide is said to have been discovered in this vicinity. Work was continued on several properties in the upper Cleary Creek basin. At the Free Gold (Roads & Hall) a total of about 1,200 feet of underground work had been completed at the close of 1911. In midsummer a five-stamp mill (1,000-pound stamps) was erected on the Free Gold mine. It was operated about one month and then closed on account of shortage of water. Not only was ore treated at the mine but shipments were made to the Chena customs mill.

Work was continued in 1911 on the adjacent property of the Tanana Quartz Hydraulic Co., which is said to have two veins, one 10 inches to 7 feet, and the other 4 feet wide. The development work done is said to aggregate about 400 feet. It is not yet known whether any ore was shipped from this property.

After being closed down for several months the Tanana Quartz Mining Co. again started operations in March, 1911. A 50-foot winze was sunk from main tunnel and drifting began on the vein at this depth, which is said to be 14 to 30 inches wide. Another vein, reported to be 4 feet wide, is exposed in a 70-foot adit. Some shipments of ore were made to one of the customs mills, and in October a five-stamp mill was erected on the property. Water for the mill is procured from a well sunk in the creek bottom, close at hand. Some ore was shipped from the Pioneer property, on Chatham Creek, where the total development is said to consist of 128 feet of adit. Some work is also known to have been done on the Jupiter-Mars, Rex, and on other properties of the vicinity, but details are lacking.

Much work was done on the Newsboy property, located near the divide between Cleary Creek and Little Eldorado. Here a shaft was sunk to a depth of some 200 feet and the mine was opened on two

levels. At the close of the year the sinking of a shaft to the 315-foot level was being pushed, as was the drifting on the 215-foot level, where the vein is said to be 4 feet wide, with no marked change in gold content. Ore was shipped to a customs mill from the 65-foot and 115-foot levels, where stoping was done. In October a five-stamp mill was installed. Some drilling was done for water, but it appears that the mill was supplied from the shaft. Considerable work was also done on what is known as the Cleary Extension of the Newsboy. Developments were continued in 1911 on the Rainbow property, on Skoogy Gulch, and some shipments were made to mill at Chena. A 2½ to 3 foot vein is said to be developed. The workings include two shafts and drifts and crosscuts, the total aggregating about 500 feet. Some ore was also shipped by Hirchberger & Zimmerman from a vein said to be 1 to 5 feet wide, which is located near the Rainbow.

Anderson & Birch have opened up a vein at the head of Granite Gulch, near Pedro Dome. They shipped some ore from this property to the Citizens' Test Mill, at Fairbanks. Freeman & Sharf also did some work on a vein located at the head of Fox Gulch. Some silver-bearing galena, also carrying gold, was found on this property. The Wild Rose claim, which is somewhere in Dome Creek basin, also received attention during 1911. Ore was shipped from this property to the Citizens' Test Mill at Fairbanks.

The Reliance Mining Co. did relatively a large amount of work on its property in the upper Dome Creek basin, shipping some ore to the Chena Mill. It is said that a vein on this property has been traced for a long distance by open cuts. A 100-foot shaft has been sunk on a vein which is reported to be 7 feet wide at the bottom of the shaft. One adit has been started to tap this vein at the bottom of the shaft and a second adit for the purpose of developing the vein at a depth of 200 feet. At last reports the upper adit had been driven 60 feet, the lower 160 feet. A second shaft has been sunk 50 feet near the entrance of lower level. Practically all workings are said to be on the vein and to be well timbered.

Developments were continued in 1911 on the Freiderich property, near Ridgetop, and some ore was shipped. On this property a 100-foot shaft has been sunk and 120 feet of adit has been run. The latest available reports are that a 2-foot vein has been developed in which there is a very rich ore chute 8 inches wide. At a depth of 70 feet in the shaft a very rich pocket of ore was struck.

It is said that about 280 feet of shaft and 60 feet of drifting was done on a property near the divide between Wildcat and Vault creeks, owned by Hoel Bros., Johnson, and Witmer. Current reports are to the effect that a 30-foot ledge carrying low-gold values and a richer vein, 8 inches to 2 feet in width, have been found on this property. The Little Eva claim was staked on the west slope of the valley of

Eva Creek in 1910. Among the first developments was a 70-foot adit, which was later abandoned. Later a shaft was sunk to a depth of 40 feet and a 12-inch vein was found, which was followed for 40 feet by a drift, then lost by faulting. Later the vein was picked up again by a 30-foot crosscut.

Much work was done in 1911 on the Ryan ledge, located near the divide between Eva and St. Patrick creeks. It is reported that a 3 to 8 foot ledge was traced for some 1,200 feet by drilling and test pits. Two other undeveloped ledges are said to have been found on this property. Some ore was shipped to the customs mill from this property. No information is available at this writing regarding the developments of other lode claims in the Fairbanks district. It is quite possible that there may be some, not here listed, on which an amount of work has been done equal to that done on those here described.

SUMMARY AND CONCLUSIONS.

The mining developments in the Fairbanks district have borne out Mr. Prindle's[1] hypothesis that igneous intrusions determined the loci of mineralization. Nearly every lode reported occurs in the schists near their contact with granitic or other intrusives. An obvious deduction from this fact is that the search for auriferous lodes should be directed to the contact zones of the granitic or other intrusive rocks which have not yet been prospected.

The notes at hand do not furnish any additional data on which to base conclusions regarding the probable continuity of the veins. There seems to be little question that a number of the lodes that have been developed follow well-defined fissures. Probably no greater irregularity in the veins will be revealed by more extensive mining than has already been found. The evidence at hand indicates that the veins are in part, at least, faulted, a condition which must be reckoned with in estimating the cost of mining.

Most of the veins thus far developed are small, being 3 feet or less in width. Some veins, reported to carry high values, are 5 to 7 feet wide and several much wider lodes carry low values in gold, but have received relatively little attention. The data at hand are too fragmentary to indicate whether there is more than one system of fissuring. Mr. Prindle's studies have, however, shown that there were at least two periods of quartz veining—an older, during which it appears that some large quartz veins were formed which are relatively little mineralized, and a later period of deformation, during which some of the veins of the first generation were fractured and then recemented. So far as known, the rich gold-bearing veins were introduced during this second period of intrusion.

[1] Prindle, L. M., Auriferous quartz veins in the Fairbanks district: Bull. U. S. Geol. Survey No. 442, 1910, pp. 210-229.

The average gold content of the lodes developed in the district has not been determined, for the results of the little systematic sampling that has been done are not available to the writer. Much of the ore milled has been taken from small rich stringers which would not afford sufficient material to warrant systematic development. Again, a good part of the ore treated at the mills and taken from the larger veins was hand sorted and therefore the returns do not express the average contents of the lodes. It has already been pointed out that operators who desired to meet in part the expenses of development have been forced to do this because of the high cost of transporting and milling the ores.

There are no new data on the probable character of ores at depth. Practically all the developments have been on the slopes of ridges and above ground-water level. Therefore, although a depth of about 300 feet has been attained, this does not appear to be below the zone that is affected more or less by surface waters. No change in character of ore has been reported at the greatest depths attained.

The miner in the Fairbanks, as in other inland districts, is always confronted with the high cost of transportation, which is reflected in the expense of supplies, equipment, and labor. This cost will not be materially reduced until a railway to tidewater has been constructed. The high cost of fuel is another drawback, but could be reduced by making available the extensive coal deposits of the Nenana field, some 60 miles away. More difficult to overcome is the scarcity of water near many of the properties that have been opened up. In some of the valleys water for milling could probably be obtained by drilling, though efforts thus far made to obtain a water supply by drilling have not been successful. An alternative plan is to locate the mills near the watercourses that maintain a supply during the winter and in dry summers. For the information of those who are not familiar with the winter conditions at Fairbanks it may be added that, aside from the scarcity of water, they are not unfavorable to lode mining.

NOTES ON AURIFEROUS LODES IN OTHER DISTRICTS.

Relatively little prospecting was done on the lodes of the Bonnifield district in 1911, but assessment work has been kept up. Late in the fall about a ton of ore was taken from a ledge in the Wood River basin, which will be sledded to Fairbanks for a mill test. It appears that the only lode developments in the Chandalar region were those of the Alaska Chandalar Mining Co., which continued driving an adit on its property in the Squaw Creek basin. This company has secured the use of a small prospecting mill, erected in 1910, on the Gold King claims, and will utilize it for testing ore.

It is reported that some quartz veins bearing gold, silver, and antimony have been found in the basin of the Riglugalic River, an easterly tributary of the lower Kuskokwim. The country rock is reported to be slate, with granitic and other intrusive rocks, and the mineralization to occur along shear zones. A group of claims called the Royal Quartz mines has been staked in this region, and a little development work has been done.

A customs mill was erected at Nome late in the summer of 1911, and considerable ore was tested there during the last month of the year. This has stimulated development work on a number of lode prospects in the Seward Peninsula.

GOLD PLACERS.

GENERAL CONDITIONS.

The value of the placer-gold production in 1911 is estimated at $12,540,000; that of 1910 was $11,984,806. This increase was due to the fact that the output from the Innoko-Iditarod region was more than three times as large and that of the Hot Springs district more than twice as large as in the previous year. Moreover, the production of the Fortymile and Birch Creek districts made substantial increases in 1911 over those of 1910. On the other hand, the output of the Fairbanks and Seward Peninsula districts was about $2,000,000 less in 1911 than in 1910.

It is estimated that a total of 740 placer mines were operated in Alaska during 1911, compared with 650 in 1910. About 170 mines were operated during the winter, employing about 670 men, and 775 during the summer, employing about 4,900 men. In addition to these probably 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 a large number of facts. Therefore, although the table is only approximately correct, it indicates the magnitude of the true figures.

Estimated total amount of gravel sluiced in Alaska placer mines and value per cubic yard of gold recovered, 1908–1911.

	Total quantity of gravel (cubic yards).	Value of gold recovered per cubic yard.
1908	4,275,000	$3.74
1909	4,418,000	3.66
1910	3,800,000	3.20
1911	5,790,000	2.17

The figures presented in the above table, showing the gradual decline of the average gold recovery per cubic yard, are a reflection of the improvements in mining conditions. They show that year by year deposits carrying less gold are being successfully exploited and are furnishing a larger percentage of the placer-gold output of the Territory. This is the most encouraging feature of Alaska placer mining, for it assures a degree of permanency which can not be hoped for so long as the gold output is won chiefly from the quickly exhausted rich bonanzas which have heretofore played so large a part in furnishing the gold. That there is still room for improvement is indicated by the fact that the average gold recovery from placer mines in the States is less than 13 cents a cubic yard.

Twenty-seven dredges were in profitable operation in Alaska during 1911, in addition to which half a dozen were in course of construction. It is estimated that these dredges handled between 2,100,000 and 3,000,000 cubic yards of material and that the aggregate value of their gold output was about $1,500,000. Hydraulic mining is playing from year to year a more important part in the placer-mining industry of Alaska. In 1911 hydraulic plants were operated in the Porcupine, Nizina, Kenai Peninsula, Birch Creek, and Seward Peninsula placer districts. Underground placer mining is now being done more cheaply than formerly but is still and will remain the most expensive method of gold recovery. The improvements in methods of recovering gold and the wide distribution of placer gold in Alaska give assurance of a continuation of profitable mining, in spite of the rapid exhaustion of the bonanza deposits. It is not to be expected, however, that the annual gold output from the placers will increase, or even hold its own, unless improved means of transportation are established.

SUMMARY OF PLACER MINING BY LOCALITIES

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 1911 an output valued at $325,000, as compared with $425,000 in 1910.

Southeastern Alaska.—The only placer mining in southeastern Alaska was done in the Juneau and Porcupine districts. One mine was operated in Silverbow Basin by hydraulic methods, supplemented by pick and shovel. Two hydraulic mines were worked in the Porcupine district, one on Porcupine and one on Cahoon Creek. Considerable work was also done on Nugget Creek, where preparations are being made to install a hydraulic plant.

Beach mining.—As in previous years, from 25 to 40 men were engaged in mining beach placers at several places between Lituya Bay and Unga Island. Yakataga is the most important center of this industry. According to C. C. Naughton, of Katalla, from 15 to 20 men were engaged in beach mining near Yakataga in 1910 and 1911. Most of these worked about two months in the year, but some worked five or six months. The gold-bearing beach gravels stretch from a point 1½ miles west of the settlement of Yakataga to a point about 15 or 16 miles east of it. The gold appears to be concentrated in the beach by wave action, and as this process continues there seems to be no diminution in the amount of gold. Mining is done by shoveling into sluice boxes that are washed by water taken from a lagoon or lake which is separated from the sea by an elevated beach. This elevated beach carries gold, but not in sufficient quantity to justify exploitation, at least not by the manual methods now in use.

The hydraulic plant installed on White River some years ago was again operated in 1911. White River is about 8 miles east of Yakataga and the placer mine is about 5 miles from the beach. The best values have been found on a bench whose floor is about 10 feet above the water level. The gravel is said to be about 8 feet thick. The coastal region near Yakataga is heavily timbered and contains some coal and petroleum seepages. Some beach mining was done in 1911 near Anchor Point on Cook Inlet (p. 161) and on Popof and Unga islands. It is reported that some new beach placers were discovered late in the summer of 1911 near Uyak, on Kodiak Island.

Copper River region.—Mining operations in the Nizina district are described on pages 93–107 of this report. About 100 men were engaged in mining in the Chistochina (Chisna) district in 1911, and the gold output is reported to have had a value of about $80,000. The most extensive operations were on Slate Creek, Miller Gulch, and Chisna River. Milo Dempsey continued the installation of a hydraulic plant on the Chisna, but did not finish a new ditch. Some mining was done with this plant. A drill was used to prospect ground on the Chistochina.

Cook Inlet and Susitna River region.—Descriptions of mining operations on the Kenai Peninsula and in the Yentna district are presented in this bulletin on pages 131–200. A little placer mining was done on Willow Creek, on the upper Chickaloon, and in the Talkeetna and Cashwitna basins.

Five placer mines were reported to have been worked in the Valdez Creek basin during 1911. During the summer an examination was made of some of these properties, with a view of consolidation and operations on a large scale. It is reported that this plan will be carried into execution.

YUKON BASIN.

Production.—The value of the placer production of the Yukon basin, including the Innoko-Iditarod region, is estimated at $9,050,000 in 1911, as compared with $8,020,000 in 1910. This gain is due largely to the increased production from the Innoko-Iditarod region, but the output from the Hot Springs, Birch Creek, and Fortymile region was greater than in 1910. Nearly $5,000,000 worth of gold passed through Fairbanks in 1911, but of this amount about $500,000 came from the Tanana Valley districts other than Fairbanks. The gold placer [1] mining developments of the Yukon-Tanana and Ruby Creek districts are described on pages 211–314.

Bonnifield and Kantishna districts.—There appear to have been no important developments in the Bonnifield and Kantishna districts in 1911. The total value of the gold output from this region, lying south of Tanana River, was less than $50,000. Details are lacking in regard to mining in the Bonnifield region, but the productive creeks were probably the same that produced last year, including Moose Creek and tributaries of the Tatlanika, Totatlanika, and Wood River. About 20 men were engaged in mining in the Kantishna district, chiefly on Glenn, Bearpaw, Eureka, and Moose creeks and McKinley Fork.

Chandalar and Koyukuk districts.—A little productive mining was done on Big Creek, in the Chandalar district. It is reported that a shaft was sunk on Crooked Creek to a depth of 286 feet and one on Mammoth Creek to a depth of 172 feet, but that no workable placers were found. Both these are in the Chandalar district.

It is estimated that gold to the value of $140,000 was produced from the Koyukuk district in 1911, whereas the output was $160,000 in 1910. Among the important events of the year was the finding of valuable placers in the benches of Sheep Gulch and of the extension of the pay streak on Nolan Creek. Some new discoveries of gold-bearing gravel are also reported in the basin of Hammond River. In 1910 auriferous gravels were found in the basin of Indian Creek, which is a tributary of Koyukuk River from the east about 4 miles above Waite Island, 374 miles from the mouth of the Koyukuk. These discoveries were made on Snyder and Felix creeks, which are tributaries to the headwaters of Indian Creek. The scene of the discovery can be reached by an overland journey of about 20 miles from Hughes City, a new settlement on the east bank of the Koyukuk, about 380 miles by river from the Yukon. Placer-gold prospects are also said to have been found on Dome Creek, which flows northward, being a part of the Kanuti drainage basin. This district is often known as the Red Mountain region of the Koyukuk.

[1] Lode mining is described on pp. 32-36.

The bedrock of these creeks is reported to be slate and granite and the gravels to be shallow. Several claims were worked in this district in 1911, the value of the output being estimated at $14,000. The discovery is said to have attracted about 50 to 100 men, about 20 of whom remained to do further prospecting. This district lies in a belt running between Koyukuk and Yukon rivers, in which auriferous gravels are known to be widely distributed, but within which but little productive mining has yet been done.

Innoko-Iditarod region.—Placer mining was very successful in the Innoko-Iditarod region during 1911, the value of the gold output being estimated to have been about $3,000,000, compared with a value of $825,000 for the output of 1910. The open season was unusually long, mining continuing until November. As a consequence only a part of the gold mined during the year was brought out by the usual steamer route. More than half a million dollars' worth of gold is said to have been transported by dog team to Seward, and most of this did not reach the States until after the close of the year. As a consequence many conflicting statements were current in regard to the amount of gold produced.

The district is now connected with Seward by a good winter trail, along which road houses have been established. Moreover, the wireless station at Iditarod furnishes communication at all times with the outside world. Some roads and trails have been constructed in the district, details concerning which are lacking. It is reported that the horse tram connecting Iditarod with Flat Creek is to be replaced by a narrow-gage railway.

Most of the placers are shallow and are mined by open-cut methods. Consequently there is little work in the district in winter, when probably not over 15 or 20 mines are operated. Most of these are in the Innoko part of the field. The fact that there is little winter work for miners and that transportation to the region is expensive makes the operating costs high. These conditions are not favorable to those who expect to work for wages.

The valuable gold discoveries made thus far are limited to a few creeks, and the mines are few in number compared with the amount of gold produced. The conditions have therefore not been favorable to the prospector and small operator. Furthermore, the real miner and prospector has been discouraged by an almost universal practice of staking large areas in association claims by those who have little thought of systematic development of the lands they thus preempt. As a consequence many men left the region, and reports were circulated which did not do justice to the promising possibilities of this field. The best information at hand indicates that considerable areas in this region give promise of yielding returns to careful prospecting.

The developed gold placers of the Innoko-Iditarod region can be grouped into three districts. The first district in amount of production is the Iditarod district, which includes the streams of the Iditarod River basin. The second Innoko district embraces the headwater region of the river of the same name. The third district embraces the creeks tributary to Takotna and other streams which flow into the Kuskokwim.

Flat Creek, a tributary of Otter Creek, was the largest producer of gold in the entire region in 1911. Mining was also done on Otter Creek and on several of its tributaries besides Flat, including Glen Gulch and Black Creek. In 1911, as in 1910, the mines of the Willow Creek basin made a considerable output. Mining was also done on the divide between the head of Flat Creek and Happy Gulch, which flows into Willow Creek, as well as on Gold Creek, also tributary to Willow. Chicken Creek is also reported to have been the scene of productive mining in 1911. Late in the year good prospects are reported to have been found on Bonanza Creek, to which Chicken Creek is tributary. Good prospects are also said to have been found on Little Creek, tributary to the upper Iditarod. No information is at hand regarding developments on other creeks of the Iditarod district.

Much prospecting and considerable mining has been done on the Kuskokwim side of the divide. Of the tributaries of the Takotna, Moore and Fourth of July creeks were the scene of considerable mining. These creeks head in the same divide with streams that flow into Georgetown[1] River. In this part of the field there was some mining on Donlin, Julien, Beaver, Marietta, and Crooked creeks, and on Snow Gulch, and prospects are said to have been found on Michigan, Ruby, Kieland, Spruce, and other creeks.

It is estimated that in the Innoko district about 13 claims were worked by 25 men during the winter, and about 25 claims were worked by some 200 men during the summer. The largest output of gold came from the mines of Yankee, Ophir, and Gaines creeks, but mining was also done on Little, Spruce, and other streams. A ditch was completed which will furnish water for mining the benches on Spruce Creek.

Kuskokwim and Goodnews Bay region.—The reports of prospectors indicate that placer gold has been found at numerous places in a belt that stretches southwestward from the Iditarod district to Goodnews Bay on Bering Sea. It is rumored that placer gold has been found on "Holokuk, Hoholitna, or Holiknuk" River. This is probably Chulitna River, which flows into the Kuskokwim from the south about 100 miles above Georgetown. Auriferous gravels were found

[1] Variously called the Ukinilok and Yuniluk River.

in the Chulitna basin about 10 years ago, but so far as known they have never been developed. Another discovery is reported on "Anniok River" and on its tributaries, Cripple and Salmon creeks. "Anniok River" is unknown to the writer, but it is probably the stream joining the Kuskokwim from the north about 100 miles below Georgetown—the stream called Yukwonilnuk River on the maps. A little placer mining was done on Tuluksak River, which flows into the lower Kuskokwim from the east about 100 miles above Bethel. It is reported that about $15,000 was taken from these placers in 1911. Rigugalik River joins the Kuskokwim about 30 miles below the mouth of the Tuluksak. Fine gold has been found on this stream, and in 1911 some tests were made with a small hydraulic plant, which is reported to have yielded encouraging results. The bedrock is said to be arkose, sandstones, and slate, with interstratified volcanic rocks and intrusive granites.[1] Gold prospects are said to have been found on the Kwisluk and Eek and other rivers that flow into the Kuskokwim from the east below the mouth of the Rigugalik.

In 1910 placer gold was found in streams tributary to Goodnews Bay, a small indentation of the east shore of Kuskokwim Bay. In August, 1911, workable placers were found in this district, on Butte Creek, about 25 miles from tidewater. Here mining was done on four claims, which made a total output of about $12,000. There are said to be about 20 men in the district. The bedrock is reported to be slates, with some limestones and schists cut by igneous dikes.[2]

These fragmentary data indicate that geologic conditions similar to those known in the Iditarod region occur in a zone stretching through to Bering Sea. Although no very rich placers have yet been found, the presence of alluvial gold and other evidences of mineralization in this field are encouraging to the prospector.

NORTHWESTERN ALASKA.

The placer districts of Seward Peninsula are the only productive ones in northwestern Alaska except those of the Kobuk Valley, from which the output is very small. An account of mining in Seward Peninsula, specially of the developments in dredging, is presented on pages 339–344. During 1911 a little mining was done in both the Shungnak and Squirrel River districts of the Kobuk Valley. The total value of gold output from this region, as reported by operators, is only about $15,000. There is reason to suppose that several operators did not reply to the request for statement of production,

[1] The writer is indebted to H. W. Reeth for information about this region.

[2] The writer is indebted to John D. Leedy for information about the Goodnews Bay district.

and that gold to the value of about $35,000 was produced in 1911. Though several claims were worked in the Squirrel River district, most of the production came from two or three. During the winter some shafts were sunk to considerable depth (75 feet is reported), but the results do not seem to have been encouraging, except on one claim, where coarse gold was found at a depth of 28 feet.

Klery Creek appears to be the only stream in the Squirrel River region on which productive mining has been done, though alluvial gold has been found on other streams. At least two placer mines were worked in the Shungnak region, but high water seriously hampered operations. A nugget valued at about $600 was found on Dahl Creek in 1911. This nugget is a large, subangular, thin slab of gold, to which no schist or quartz is attached. The occurrence of alluvial gold in the Noatak is described on pages 315–338.

COAL.

Only one coal mine in all Alaska was operated commercially in 1911, but a little coal was mined at several places in the Territory, chiefly by those who themselves utilized the product. The total estimated output of coal in 1911 was about 900 tons; the total output in 1910 was about 1,000 tons.

The Chignik Coal Mining Co.[1] operated its mine, located on Thompson Creek about 2 miles from tidewater at Chignik Bay. During 1910 and 1911 an entry about 1,000 feet long was driven at this mine. In this a roll was encountered which cut out the coal for 210 feet, but beyond this roll the bed was again picked up. The bed is said to be 10 feet thick and to include 8 feet of coal, occurring in two benches separated by shale. A wagon road about 2 miles long has been built to connect the mine with the wharf. Bunkers have been erected at the mine and at the wharf. Plans are under consideration to build either an aerial or surface tram. The coal mined has been sold to local steamers and canneries. Some coal was mined along the beach at Cook Inlet, much of it being picked below high tide without actual excavation. A little coal was probably also mined in the Chicago Creek region of Seward Peninsula to supply some near-by placer camps, and doubtless some other small coal mining of this kind was done in other parts of the Territory, but no information concerning these small enterprises is at hand.

[1] The writer is indebted to Henry S. Tibbey, manager of the property, for information about developments.

Coal consumption of Alaska, by sources, 1899 to 1911, in short tons.

Year.	Imported from States, chiefly from Washington.		Produced in Alaska, chiefly subbituminous and lignite.[a]	Total domestic.[b]	Total foreign coal, chiefly bituminous, from British Columbia.[b]	Total coal consumed.
	Bituminous.	Anthracite.				
1899	[c] 10,000	.....	1,200	11,200	50,120	61,320
1900	15,048	.....	1,200	16,248	56,623	72,871
1901	[c] 24,000	.....	1,300	25,300	77,674	102,974
1902	[c] 40,000	.....	2,212	42,212	68,363	110,575
1903	64,625	1	1,447	66,073	60,605	126,678
1904	36,689	.....	1,694	38,383	76,815	115,198
1905	67,707	6	3,774	71,487	72,567	144,054
1906	68,960	533	5,541	75,034	47,590	122,624
1907	45,130	1,116	10,139	56,385	88,596	144,981
1908	23,402	491	3,107	27,000	72,831	99,831
1909	33,112	.....	2,800	35,912	74,316	110,228
1910	32,138	.....	1,000	33,138	73,904	107,042
1911	32,255	.....	900	33,155	88,573	121,728
	492,066	2,147	36,314	531,527	908,577	1,440,104

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

The annual coal consumption in Alaska is shown in the above table, which indicates that there was an increase in the use of coal in 1911 as compared with 1910. This increase is probably due to the amount used by the Copper River Railway, which began operating a regular train service during 1911. The consumption of coal in 1912 will probably be considerably less, for oil is rapidly supplanting coal as fuel. Of the larger consumers of fuel in the Territory the Copper River Railway, most of the ocean steamers, the Treadwell group of mines, most of the Yukon river boats, and 18 of the 24 dredges operated on Seward Peninsula are using oil-consuming engines. The passenger service on the Tanana Valley and Alaska Northern railways is maintained by gasoline motor cars. The increased use of fuel oil and gasoline in Alaska is shown by the table on page 46. These facts clearly indicate that the local market for Alaska coal is certainly not increasing.

PETROLEUM.

There was considerable activity in the Katalla oil field during 1911. In the previous year two wells, located near Katalla Slough, between 1902 and 1904, which had been purchased by the Amalgamated Development Co., were cleaned out, a tank was erected on Kanak Island, Controller Bay, and connected by pipe line with the wells, and a small refinery was erected on Katalla Slough. No use appears to have been made of the tank; but in 1911 oil was pumped from the wells and refined, the product being disposed of at Cordova, Valdez, and other local settlements. In August, 1911, this company had erected a new derrick near the producing well and prepared to do some more drilling.

Meanwhile the British Columbia Katalla Oil Co. erected a derrick on Mirror Slough, about 7 miles northwest of Katalla, and in August had reached a depth of about 500 feet. Later in the year the Mirror Slough Oil Co. put in a rig near the one mentioned above. It is also reported that further drilling is to be done on Katalla Slough and on Katalla and Martins rivers. The season of 1912, therefore, promises to be one of considerable activity in this field. In describing the oil from this region Martin [1] says: "The petroleum is clearly a refining oil of the same general nature as the Pennsylvania petroleum. It resembles the latter in having a high proportion of the more volatile compounds and a paraffin base and in containing almost no sulphur." Oils of this character should find a special market on the Pacific seaboard, in which the fuel oils of California could not compete.

The following table gives the shipments of petroleum products to Alaska from 1905 to 1911, inclusive:

Shipments of petroleum products to Alaska from other parts of the United States, 1905–1911, in gallons.

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

MISCELLANEOUS MINERAL PRODUCTS.

The value of the total marble and gypsum production in 1911 is estimated at $140,000, compared with $117,162 in 1910. One marble quarry and one gypsum mine were operated in 1911, the same number as in 1910. These properties are in southeastern Alaska. During 1911 work was continued on a deposit of garnet in the Wrangel district in southeastern Alaska, from which some shipments have been made at various times. In 1911 surveys of this property were made for patent.

[1] Martin, G. C., Geology and mineral resources of the Controller Bay region, Alaska: Bull. U. S. Geol. Survey No. 335, 1908, p. 124.

RAILWAY ROUTES FROM THE PACIFIC SEABOARD TO FAIRBANKS.

By ALFRED H. BROOKS.

INTRODUCTION.

The full industrial development of inland Alaska can be brought about only by constructing railways to some of the open ports on the Pacific. Many railways have been planned and parts of some have been constructed, but the work done supplies only in small degree an urgent need. Though Alaskans have long been clamoring for adequate transportation facilities, the general public outside of the Territory has only recently begun to understand that the opening up of the mineral wealth and arable lands of this great empire is a matter of national importance. Since public interest has been aroused there has been much discussion about the relative merits of the several possible railway routes from the Gulf of Alaska to navigable waters of the Yukon. Much of the discussion has consisted either of ex parte statements by those who were advocating some particular route or of generalizations by those who were inadequately informed as to the true conditions. As a matter of fact, topographic maps have been made by the Geological Survey as well as private railway surveys, which afford a very large amount of information about most of the railway routes under consideration, the harbors and shore lines have been charted by the Coast and Geodetic Survey, and investigations of the mineral wealth have been made by the Geological Survey, and of the arable lands and forests by the Department of Agriculture. All these data, together with the statistics on population, commerce, and industries, as well as the climatic records of the Weather Bureau, constitute a wealth of information bearing on railway routes.

It is here proposed to summarize the data obtained from these various sources, which will help to elucidate the problems of railway location. Two articles [1] on this subject, published five and six years ago, will be freely drawn upon, but much information which has been made available since these articles were published will also be utilized.

[1] Brooks, Alfred H., Railway routes [Alaska]: Bull. U. S. Geol. Survey No. 284, pp. 10–17, 1906; Railway routes in Alaska: Nat. Geog. Mag., May, 1907, pp. 165–190.

As this summary must of necessity be brief, it can include but few details regarding the several routes, which aggregate over 2,000 miles. Details can be obtained from Government reports on Alaska, a list of which is given on pages 76–88. For convenience of reference this list is arranged by routes and includes also references to certain unpublished data in the Government archives, consisting chiefly of notes and plats of private railway surveys on file in the General Land Office.

COST OF RAILWAY CONSTRUCTION.

In any discussion of railway routes the cost of construction is obviously important, and, although this matter lies entirely outside of the writer's experience and should be left to the engineer, a few facts bearing on it will be presented. First, it should be noted that the cost of construction in Alaska is usually estimated by engineers at from 50 to 100 per cent more than similar work in the Western States. It is obvious also that the cost per mile will be a variant determined by the limitations put on curvature and grade and also by the character of the work. Moreover, the cost of building a railway over any particular route must be estimated by experienced engineers from detailed location surveys. But few such estimates have thus been made, and these have not been made public. Some 270 miles of railway have been built over the routes here to be discussed, including the Alaska Northern and Copper River railways. It appears that the average cost per mile of these railways has been about $60,000 and $90,000, respectively. The White Pass & Yukon Railway (110 miles long, running from Skagway to White Horse) is reported by the management [1] to have cost an average of $62,000 a mile.

These figures are not to be regarded as average costs of a railway from tidewater to the Yukon. They represent not only the pioneer work, which is always expensive, but appear to include the cost of terminals and expensive bridges, and all the routes built include the most difficult construction which would be required in Alaska. These railways traverse the rugged coastal mountain barrier, where difficult engineering problems must be solved. This coastal province presents a strong contrast to the region of broad, open valleys and gently rolling upland that lies beyond the coastal ranges—a region where railway construction would be simple, and, except for bridges, comparatively inexpensive. Experienced engineers [2] familiar with northern conditions estimate that a serviceable standard-gage rail-

[1] Statement of O. L. Dickinson: Hearings before Committee on Territories of the House of Representatives on Transportation in Alaska, Apr. 6, 1912, p. 79.

[2] Hawkins, E. C., Railroads in Alaska: Hearings before Committee on Territories of the House of Representatives, 59th Cong., 1st sess., Feb. 1, 1906, p. 60. Joslin, Falcon, Railroads of Alaska: Hearings before Committee on Territories of the Senate, 62d Cong., 2d sess., Apr. 12, 1912, p. 9. Swanitz, A. W., Transportation in Alaska: Hearings before Committee on Territories of the House of Representatives, Apr. 6, 1912, p. 86.

way could be built from tidewater to Fairbanks at an average cost of about $40,000 a mile.

CONDITIONS AFFECTING RAILWAY LOCATION.

CLASSIFICATION AND ANALYSIS.

For the purpose of clarifying the discussion to follow, an attempt will first be made to analyze and classify the principal factors that enter into the problem of railway location. As classified by the writer the most important of these fall into two general groups which can be termed (1) commercial and (2) geographic. The first of these includes all matters relating to present and future traffic, including developed and undeveloped resources and population as well as to competitive and supplementary lines of transportation. Obviously this class embraces the most important elements in the problem, for without adequate tonnage no railway can be a financial success, no matter how favorable may be the topographic conditions. In the second group fall the geographic conditions which embrace the physical features of the proposed route. Obviously these are of secondary importance, for if the assured tonnage warrants it almost any physical obstacle will yield to modern engineering. Certain subdivisions of the commercial and geographic conditions are indicated in the following table which is intended to present a terse analysis of the problem of railway routes.

I. Commercial conditions:
  (1) Developed resources. (Statistics of production and commerce.)
  (2) Undeveloped resources:
    Mineral. (Economic geology.)
    Agricultural. (Climate, soil, botany, and distribution of arable lands.)
    Timber. (Distribution, quality, and quantity of forests.)
  (3) Population.
  (4) Competitive or supplementary lines of transportation. (Navigable waters and existing railways.)

II. Geographic conditions:
  (1) Position. (Terminals and connecting lines of transportation.)
  (2) Distances. (Comparison of distances of different routes.)
  (3) Relief. (Mountain ranges, passes, and valleys in relation to distances and gradients.)
  (4) Watercourses. (Depths and widths of rivers as affecting construction of bridges or ferries.)
  (5) Climate. (Snow, rain, etc.; their effect on cost of construction and maintenance.)

Among other conditions which may affect railway location are political boundaries, but with the present methods of handling customs matters boundaries are usually not important. If, however, a railway is to be put to military use they become all-important.

It will be evident, too, that the financial backing of any particular railway enterprise may exert very great influence on the choice of routes. Thus a lack of capital may force the choice of a route where the first cost of construction is lowest and without regard to considerations of ultimate economy in construction, operation, and maintenance.

COMMERCIAL CONDITIONS.

DEVELOPED AND UNDEVELOPED RESOURCES.

The area which would be developed by railways from the Pacific to upper Yukon waters is roughly blocked out by the Yukon on the north, the Pacific Ocean on the south, the international boundary on the east, and the Alaska Range on the west. (See Pl. I, in pocket.) This province, here termed central Alaska, includes about 200,000 square miles, or more than a third of the entire area of the Territory. It includes the extensive gold-placer districts of the Yukon-Tanana region, in which lies the Fairbanks district. This region has produced gold to the value of about $67,000,000, and its gold output for 1911 had a value of about $6,000,000. In the same province, to be opened up by railway, are a number of smaller placer districts, including those of the Copper and Susitna valleys, which have produced some $4,500,000 worth of gold, of which $300,000 represents the value of the production of 1911. Though not immediately in the province tributary to the railway routes discussed, the Iditarod-Innoko district could be reached by a branch line from the Susitna Valley. In 1911 this district produced gold to the value of $3,000,000.

The entire region tributary to the railway routes here considered has produced gold to the value of about $75,000,000, of which about $9,300,000 represents the value of the output in 1911. The mining has been done in spite of very high operating costs due to the lack of means of transportation. Auriferous gravels are very widely distributed in this province, and many that can not be exploited under present conditions could be profitably worked if transportation were provided.

Relatively little search has been made for auriferous lodes in the province, for under the existing primitive and expensive methods of transportation there has been little hope of profitable exploitation of lodes, even if they were found. The prospect of finding auriferous lodes in part of this field is encouraging, and a little gold-lode mining has been done on Kenai Peninsula, in the Willow Creek region of the Susitna basin, and in the Fairbanks district.

There is only one productive copper district in this field, except that of Prince William Sound, which does not need railway trans-

portation. The Kotsina-Chitina copper-bearing district lies in the lower Copper River basin and includes the famous Kennicott-Bonanza mine. Ore shipments from this property were begun in April, 1911, as soon as the Copper River Railway was completed. The activity in this district since then illustrates strikingly the benefit of railways. Another copper belt lies in the headwater region of Tanana and White rivers, and some copper ore has also been found in the Susitna basin, but these two districts, being far from railways, are entirely undeveloped. Some silver-lead, iron, and tin deposits have also been found in this central Alaska region, but they are undeveloped and their value has not been determined.

The coal fields of the central Alaska region are extensive and include the best coal of the Territory (Pl. I, in pocket). Of these, the Bering River field includes 45 square miles and the Matanuska field over 80 square miles of coal land. They contain high-grade steaming and coking bituminous coal and some anthracite. Their development awaits the settlement of the coal-land question and the construction of railways. Lignitic coals are widely distributed in central Alaska. The Nenana, the largest inland field of lignitic coal, contains about 165 square miles of coal land.

In this province there are extensive tracts of arable lands, which are almost unutilized. The largest areas of agricultural lands are in the Susitna and Tanana valleys and there are smaller areas in the basins of Copper and other rivers. Considerable profitable farming has been carried on near Fairbanks, where a local market is reached by wagon roads. A large number of homesteads have been taken up near Knik, in the Susitna region, and more would be entered if there were any means of getting products to market. Agricultural land in Alaska is not likely to yield any crops for export for a long time, but with the increase of local markets that will follow mining development, brought about by the building of railways, a farming population would be attracted. In addition to the farming lands there are much larger areas of good grass land, and cattle raising is likely to become an important industry. With the decrease of the western ranges in the States Alaska may before long be drawn upon for beef and mutton.

Except at a few places near the seaboard, there is little or no merchantable timber in central Alaska. In favored localities spruce trees reach diameters of 2 feet, but in most places the diameter of few of the largest trees exceeds 12 to 18 inches. This timber has great value for local use, but its consumption as fuel should be discouraged as far as possible by developing the coal fields. At Fairbanks and other places there are sawmills, which supply in part the local demands for lumber.

POPULATION.

The present population of central Alaska is about 22,000, or one-third of the total population of the Territory. These are mostly whites and include probably[1] over half of the total white population of the Territory. The largest coastal towns of central Alaska are Cordova (population 1,152), Valdez (population 810), and Seward (population 534). Fairbanks, which is in the Tanana Valley and is the inland objective point of most of the railways, has a population of 3,541. There are some 150 people in the town of Chena, located on the Tanana River 10 miles below Fairbanks. In 1910 the population of these two towns and of the tributary mining camps aggregated 7,875. The census on which these figures are based was taken in winter, so only the permanent residents were enumerated, the number being augmented each summer by several thousand men who spend only the open season in the mining camps.

The population of central Alaska not included in the towns above mentioned is scattered in small settlements and mining camps. There has been a considerable influx of population to the lower Copper River basin since the railway was completed to this province in 1911.

The town of Chitina, on the west bank of the Copper, where the railway turns eastward, is the nearest point to Fairbanks on the Copper River Railway, and much of the inland travel that formerly started from Valdez now goes from Chitina. Practically no settlements have been established along the military road between Valdez and Chitina and Tanana except road houses, but several hundred miners and prospectors live in camps that are tributary to it. There are also several hundred people in the mining camps of Kenai Peninsula and adjacent region. In this part of the field the largest settlements are Hope, Sunrise, Girdwood, and Knik, which have a population probably aggregating about 200. The Yentna placer district has a population of probably 200. No settlements have been established in the upper Susitna basin or north of it as far as Tanana River except a few mining camps in the Valdez Creek and Bonnifield districts. Most of the settlements in the Iditarod-Innoko region have sprung up since the census was taken, so that the population of this region is not known but probably includes 1,500 or 2,000 people. Though it will be evident from the above statements that the population of central Alaska is scant, it must be remembered that up to the present time the industrial conditions have been such as attract only the placer miner. Even placer mining has been limited almost entirely to the exploitation of bonanzas. No titles have been granted for coal lands, and even if titles had been given the coal

[1] The census of Alaska was taken in 1910 and the details of it have not yet been published. The total population is reported to be 63,700, of which about 36,000 are whites.

could not be mined without railways. Copper and gold lode deposits and much of the low-grade placer ground can not be developed without improved transportation facilities. In the absence of means of communication only the arable lands that lie close to the settlements have been taken up, so that the farming population is very small.

COMPETITIVE AND SUPPLEMENTARY MEANS OF TRANSPORTATION.

A number of good harbors along the Pacific seaboard of Alaska are available for coastal terminals of railways leading inland. These harbors are open throughout the year and are from 1,000 to 1,400 statute miles from Puget Sound. At present a steamboat service of six trips a month is maintained with most of these ports, and in addition some freighters carry coal and other supplies north and bring back salmon and copper ore.

Three routes are now in use for reaching Fairbanks and other settlements in the interior. A military road connects Valdez on the coast and Chitina on the Copper River Railway with Fairbanks. The distance by this route from Chitina to Fairbanks is about 324 miles; from Valdez to Fairbanks, winter trail, about 376 miles. Most of the travel over this route is in winter, when it is also used for the mail service. Freight for the local mining camps is also hauled over this road during the winter at a cost of 10 to 20 cents a pound.

Most of the freight for Fairbanks is shipped to St. Michael by ocean vessels and thence by steamers up Yukon and Tanana rivers. From Seattle by this route the ocean voyage is about 2,700 miles and the river journey about 1,100, and usually about a month is used in transit. Moreover, this route is open only from about the end of June to the middle of September. Some freight and many passengers are carried to Fairbanks by the so-called White Pass route. This route necessitates an ocean voyage of about 1,000 miles to Skagway, in southeastern Alaska, and thence a railway journey of 110 miles by the White Pass & Yukon Railroad to White Horse, in Yukon Territory, where transfer is made to a Canadian river steamer, which is used as far as Dawson, a distance of about 460 miles. The distance from White Horse to Dawson by winter road is 330 miles. From Dawson an American bottom is utilized going down the Yukon and up the Tanana to Fairbanks, a distance of about 1,000 miles. The actual journey from Seattle to Fairbanks by this route occupies about two weeks, but is usually much longer when delays occur at transfer points. River navigation on this route is usually possible from about the 1st of June to the end of September. It is used chiefly for urgent freight and passengers.

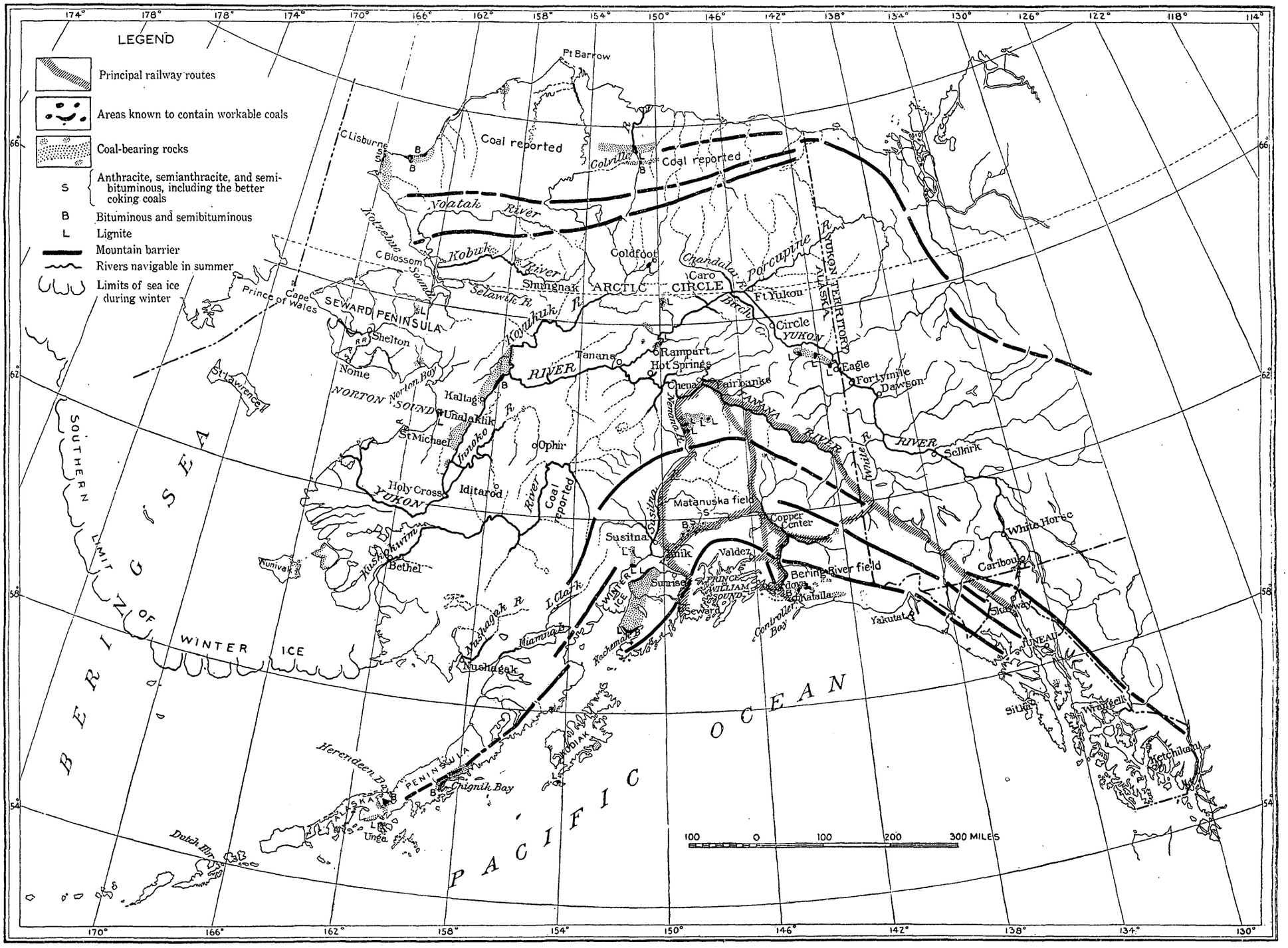
Both the upper and lower routes are subject to interruptions because of low stages of water, which at times has interrupted all

navigation for 10 days at a time. At best these routes are available only during four months in the year. The high freight charges are at least in part accounted for by the fact that the profits on the larger investment of river steamers and equipment must all be made in less than a third of the year. Wood, too, is expensive, and a large number of the steamers are using California petroleum for fuel. An additional item of expense is the cost of transshipping at least once by the lower Yukon River route, or three times by the upper river and White Pass route. Freight charges to Fairbanks are from $50 to $150 a ton, the average being probably $75. This cost is incurred to reach a point less than 500 miles distant from the Pacific coast. By feasible railway route to the coast, and thence by ocean steamer, Fairbanks is only about 2,000 miles distant from Seattle, though supplies are now transported nearly 4,000 miles by the indirect route now in use.

No exact figures are available on the amount of freight carried to the Yukon, but it was estimated at about 30,000 tons in 1910. The cost of transportation on this freight from Puget Sound to the end of river navigation was probably about $2,500,000, or about $250 for every man, woman, and child in the district and about 25 per cent of the value of the entire gold output of the region. An equal sum was probably expended for hauling the freight from the river bank to the mines.

The Yukon and Kuskokwim basins embrace some 5,000 miles of waters navigable by river steamers (Pl. II). This mode of transportation, as has been shown, is both expensive and time consuming. It has served the purpose of the pioneer and has made possible the opening of the richer placer districts without expenditure of the large amount of capital needed for railways. But gold and copper lode mining and many large placer-mining operations, not to mention coal mining, are impossible without railways, supplemented by an adequate system of wagon roads. Steamboats should be relied upon to supplement railways and not to supplant them.

Little need be said of the other means of communication in central Alaska. The Alaska Northern Railway supplemented by wagon roads and trails makes accessible the mining camps of the Kenai Peninsula. A winter sled road has been built from end of track to the Iditarod-Innoko region. This trail passes near the Yentna placer district, which can also be reached by steamboats and launches up Susitna River and its tributaries. There is also a trail from Knik to the Willow Creek lode district and another up the Matanuska Valley to the coal field. In summer small launches ply on Cook Inlet and between the end of the railway on Turnagain Arm to Knik and up Susitna River. Ocean steamers during the open season can go up Knik Arm as far as Ship Creek.



MAP OF ALASKA SHOWING RAILWAY ROUTES FROM THE PACIFIC SEABOARD TO FAIRBANKS.

COMPILED, 1912, BY ALFRED H. BROOKS.

The Tanana Valley Railway at Fairbanks, 45 miles in length, together with a number of good wagon roads, renders the tributary mining camps accessible. There are also some good winter roads and trails in other districts of the Yukon-Tanana region.

To sum up: Central Alaska, whose area is about three-quarters that of Texas, has less than 300 miles of railway, not over 600 miles of wagon road, and probably less than 1,000 miles of trail; Texas has nearly 13,000 miles of railways and about 130,000 miles of wagon road.

GEOGRAPHIC CONDITIONS.

Details in regard to geographic position of terminals, distances, and topography of proposed railway routes are given on pages 57–76, and it is therefore necessary here to consider only the larger features of relief and drainage and the general climatic conditions.

RELIEF AND DRAINAGE.

A rugged mountain mass called the Pacific mountain system (see Pl. II), which fringes the coast line of British Columbia and stretches northward into Alaska, presents along thousands of miles of the Pacific seaboard a formidable barrier to inland travel. This mountain system, however, is broken by a number of transverse valleys and low passes which form natural highways into the interior. Beyond the coastal mountains lies a province of less relief, which presents but few obstacles to railway or road construction.

The Pacific mountain system, which is represented by a single range 50 to 80 miles in width along the boundary of British Columbia and Alaska, broadens out as it enters the Territory, reaching an extreme width of 200 miles and being made up of a number of parallel ranges. Through this series of ranges the railway engineer who desires to tap the mineral resources of inland Alaska must seek a route.

In southeastern Alaska three rivers—the Unuk, Stikine, and Taku—have their sources beyond the coastal barrier, and hence their valleys are possible railway routes to the inland region. Such routes would, however, serve to open up Canada and not Alaska and will not here be considered. Farther north Skagway River reaches far back into the mountains, though it does not traverse the entire coast range. The White Pass, 2,880 feet high, separates its waters from those flowing into the Yukon and is used by the White Pass & Yukon Railway. A few miles to the north is Chilkoot Pass, 3,100 feet high, not feasible for a railway route, but long an Indian route into the interior and extensively used during the Klondike days. About 40 miles south of Chilkoot Pass Chilkat River debouches into Pyramid Harbor, an arm of Lynn Canal. This river also lies entirely within the mountains, and its headwaters are separated from streams flowing into the Alsek

by passes about 3,200 feet high. West of Icy Strait the St. Elias Range forms the coastal barrier and is traversed by Alsek River, whose sources lie in the plateau region of the interior. The valley of Alsek River, though perhaps topographically feasible as a railway route, will probably never be used. for reasons which will be considered later (p. 60).

The Copper River valley is the first gap in the mountains west of the Alsek (Pl. III). This stream drains a large basin which lies entirely within the Pacific mountain system. In its lower 130 miles the valley of this stream is narrow, but it broadens out above, embracing the gravel-floored upland called the Copper River Plateau. The southwest margin of this plateau is drained westward by Matanuska River, which flows into Cook Inlet. The watershed between the two basins lies at an altitude of about 2,800 feet. The lowest part of the divide between the Copper and Susitna waters is between the Middle Fork of the Gulkana, flowing east, and McClaren River, flowing west, and is about 3,000 feet high. Several broad passes lead from the Copper River basin into the Tanana Valley, one of which, between Chistochina and Delta rivers, is about 3,300 feet, and another, the Mentasta Pass, about 2,900 feet above the sea. The headwaters of the Copper are separated from the Nabesna, a tributary of the upper Tanana, by a broad gap having an altitude of 3,400 feet. Skolai Pass, probably about 5,000 feet high, separates the head of White River from streams flowing into the Chitina, an eastern tributary of the lower Copper River. Between the head of Lowe River, which enters Prince William Sound at Valdez, and the Tasnuna, a westerly tributary of the Copper, is Marshall Pass, about 1,900 feet in altitude. Thompson Pass, about 2,500 feet high, is also on the divide that separates Lowe River drainage from that flowing into the Copper. Nearly all of the above-described passes have at one time or another been proposed for railway routes. The Copper River Railway has been built up Copper River for some 131 miles and thence eastward for 67 miles to the Bonanza mine.

The Chugach Mountains, which at the mouth of the Copper form the coastal barrier, swing to the west around Prince William Sound, and, bending to the south, merge with the range that forms the backbone of Kenai Peninsula. West of this range lies Cook Inlet, which occupies a part of a broad depression between the Kenai Mountains on the east and the southwestern extension of the Alaska Range. This trough is extended northward by the Susitna basin, which is bounded on the east by the Talkeetna Mountains and on the west by the Alaska Range. The Talkeetna Mountains are separated from the Chugach Mountains, to the south, by the Matanuska Valley, a broad trough whose upper end opens to the Copper River Plateau. (Pl. III.)

RELIEF MAP OF CENTRAL ALASKA

Compiled from maps by U. S. Geological Survey

Scale $\frac{1}{2,500,000}$

APPROXIMATELY 40 MILES TO 1 INCH

25 0 25 50 75 100 MILES

25 0 25 50 75 100 KILOMETERS

1912

ENGRAVED AND PRINTED BY THE U.S.GEOLOGICAL SURVEY

The upper Susitna waters are separated from the Nenana basin by Broad Pass, about 2,700 feet high. An account has already been given of the divide between the Susitna and Matanuska waters on the west and the Copper River drainage on the east. On the west the rugged Alaska Range separates the waters of the Susitna from those flowing into the Kuskokwim. Several passes lead from the Yentna basin, tributary to the Susitna from the west, to the Kuskokwim Valley. Of these, Rainy Pass, about 2,950 feet high, is probably the lowest.

As upper Cook Inlet can not be navigated in winter on account of ice, it is important to consider the passes leading through the Kenai Mountains to open waters on the east side of the peninsula. There are several of these passes, one of which, between Placer River and Kenai Lake drainage (1,060 feet high and probably the lowest) is used by the Alaska Northern Railway. This railway also crosses another divide, about 700 feet high, between Kenai Lake and the streams tributary to Resurrection Bay. A route long used by natives journeying from Cook Inlet waters to Prince William Sound crosses a glacier-covered pass said to be about 1,000 feet high, lying between the head of Turnagain Arm on the west and Portage Bay on the east.

High, rugged, snow-covered mountains lie west of the upper half of Cook Inlet and form what seems to be an impassable barrier. Farther south, however, these mountains split up into a number of subordinate ranges of no great altitude and in the Iliamna Lake region are broken by several low passes, which lead to waters flowing into Bristol Bay. To the west are streams which flow into Kuskokwim River and which have not been surveyed. This region is said to be a rolling upland, with no high ranges and many broad valleys. Still farther west lies the main Kuskokwim Valley, which is separated from the Yukon by only a low watershed.

CLIMATE.

Central Alaska includes two provinces which are climatically very distinct. The Pacific seaboard is characterized by heavy precipitation, cool summers, and comparatively mild winters. This climate contrasts strongly with that of the region beyond the mountains, which is semiarid, has short, hot summers, and long, cold winters. Variations between these extremes are found in the many subordinate climatic provinces of the region.

In the coastal region stretching from Lynn Canal to Cook Inlet the total precipitation varies from 54 to 190 inches and the winter snowfall from 4 to 14 feet. The average temperature for the three summer months is from 50° to 54° F.; for the three winter months from 20° to 30° F. In different parts of the region there are 127 to 208

days in the year on which there is more or less precipitation. The incomplete records indicate an average annual precipitation of about 28 inches at Skagway, 126 inches at Katalla, 133 inches at Cordova, 74 inches at Valdez, 54 inches at Seward, and 35 inches at Sunrise on Turnagain Arm.

The lower Copper River valley has very much the same climate as that of the coast, but above the Tasnuna it is more of the inland type. At Copper Center the precipitation is about 9 inches annually, and the snowfall about 3 feet. Few records have been made in the Matanuska and Susitna valleys, but these districts are drier than the coast. At Chickaloon, on the Matanuska, one year's records showed precipitation of only 10 inches. At Fairbanks the average annual precipitation during a record covering five and a half years was 12 inches. At the mouth of the Tanana the records show about the same precipitation. At Eagle, near the boundary, the mean annual precipitation is less than 12 inches. In the Yukon-Tanana region the average temperature for the three summer months is about 54° F., and for three winter months about −12° F. The average snowfall in that region is 2½ to 5 feet. There is some precipitation for about 80 days in the year, but the total precipitation indicates that few of the rains are heavy.

The heavy snowfall along the seaward slope of the mountains is the only serious climatic obstacle to the operation of railways. Another drawback is the very marked fluctuation in the run-off. With the opening of spring the winter snows melt rapidly, and there is a correspondingly rapid rise in the streams. The danger to bridges and trestles is increased by the presence of ice, which may be not only thrown directly against structures but also may form temporary dams, which break and precipitate a sudden flood that carries cakes of ice.

The presence of glaciers in the Pacific mountain system may also affect railway construction. Glacial streams are heavily charged with sediment and are subject to great fluctuation. Their channels are constantly shifting. These conditions may considerably increase the cost of railways that must cross glacial streams, especially if the crossing be made near the ice front.

Some of the passes that will be described are filled with glacial ice, and hence are impassable for railways. For example, Prince William Sound is separated from the head of Turnagain Arm by a neck of land only 15 or 20 miles wide, and the divide is said to stand only 1,000 feet above the sea, but this pass is ice covered and unavailable for a railway.

Most of the Alaska glaciers are retreating, but some have advanced within the last decade.[1] Therefore in projecting railway routes that

[1] Tarr, R. S., The Yakutat Bay region: Prof. Paper U. S. Geol. Survey No. 64, 1909.

pass close to the front of glaciers the possibility of an ice advance should be carefully considered. Moreover, some of the moraines of existing glaciers, which appear to be made up entirely of gravel, sand, and loose material, may prove on excavation to be composed very largely of ice. Excavation of the glacial detritus will reveal the ice, which on exposure will thaw and cause endless difficulties in maintaining the grade. Glaciers are, however, limited to the Pacific mountain system and chiefly to the coastal slopes.

The fact that the ground is frozen in many places in the interior must also be considered in railway construction. In most of the Yukon basin the ground is frozen to bedrock. At one locality near Fairbanks ground frost was encountered to a depth of over 300 feet. In summer the ground thaws to a depth of only 18 inches to 2 feet. The ground is not everywhere frozen, for the beds of the larger watercourses are as a rule not frozen, and some other ground, such as the high gravel benches along valley walls, where drained, proves to be unfrozen. The talus-covered slopes of valleys are generally frozen, and a cut made into them leads to thawing, which is in places followed by slides that may be disastrous to railroad construction work. In building across frozen ground engineers have found it advisable to expose as little of the ground as possible to the air, in order to prevent thawing.

PRINCIPAL ROUTES.

LINES AND GRADES.

The foregoing account of the topography indicates that there are a number of possible routes of approach for railways from the Pacific to central Alaska. Those which are most important to this discussion fall into three general zones: (1) From Lynn Canal by way of the Chilkat, Alsek, White, and Tanana River basins; (2) by way of the Copper and Tanana basins; (3) by way of Kenai Peninsula and Susitna and Tanana River basins. Within these general zones there are several alternate routes. All the above routes are shown on the accompanying map (Pl. II), on which the mountain barriers as well as the transverse valleys and passes are indicated. The foregoing descriptions of the topography and the features represented on the map (Pls. II and III) indicate that there are other possible railway routes to the interior of Alaska. These also will be briefly described, though they do not pertain to the main subject of this article. All these routes will be described in geographic order from south to north.

Generalized profiles (Pl. IV) have been made of the principal routes. These profiles are based on the best information obtainable and indicate approximately distances and grades. This matter is presented in somewhat greater detail in the table of distances and

altitudes, which are included in the description of the principal routes to Fairbanks. It can not be too strongly emphasized that the surveys of these routes are far from complete and that the data here presented can be of service to the locating engineer only in suggesting the general choice of routes. Accurate distances and grades can be determined only by detailed location surveys.

WHITE PASS ROUTE.

The White Pass & Yukon Railway, a narrow-gage road, has its coastal terminal at Skagway (Pls. I and II), which is at the head of Lynn Canal, about a 1,000-mile journey by inland water from Seattle, and is well provided with wharves. The railway ascends Skagway River for about 12 miles, then, leaving it, crosses White Pass at the international boundary, 20 miles from tidewater, at an altitude of about 2,880 feet. In this distance there is a grade of a little less than 4 per cent for a distance of some 15 miles.[1] From the pass the railway has a down grade for 90 miles to its terminal at White Horse (elevation 2,090 feet), on Lewis River. The steamboat trip down Lewis and Yukon rivers to Dawson (460 miles) takes about two days; the return journey about four. The steamboat route from Dawson to Fairbanks is about 1,000 miles long.

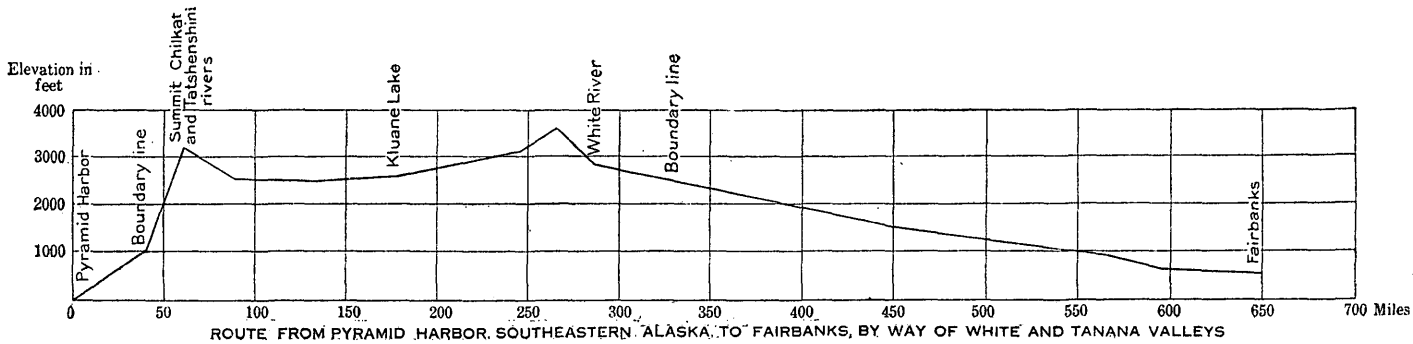
All but about 20 miles of this railway lies in Canadian territory. The chief reason for mentioning this railway here is because some plans have been suggested for extending it to the copper district of the White River valley and to other parts of the Yukon basin, which would bring it into competition with other railway routes here described. Moreover, it would in a certain degree compete with any railway built to Fairbanks, to which point, in connection with river steamers, it now handles freight and passengers.

The White Pass Railway could be extended to Lake Kluane by building about 120 miles. This route would lead over easy grades. At Lake Kluane it would intersect the route to be described from Lynn Canal to the Tanana. The distance from Lake Kluane to the White River copper deposits is about 120 miles.

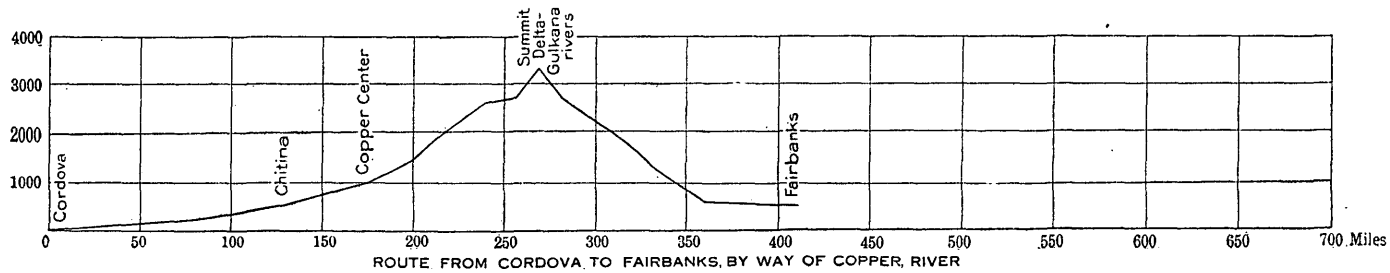
ROUTE FROM PYRAMID HARBOR, SOUTHEASTERN ALASKA, TO FAIRBANKS, BY WAY OF WHITE AND TANANA VALLEYS.

The Pyramid Harbor-Tanana Valley route (Pls. II and IV) leaves tidewater at Pyramid Harbor, which is about 1,000 miles by inland water route from Seattle. Pyramid Harbor affords good water and shelter and presents no difficulties in wharf construction. The route extends up Chilkat River and crosses the international boundary about 6 miles from tidewater. Several passes, about 3,200 feet in

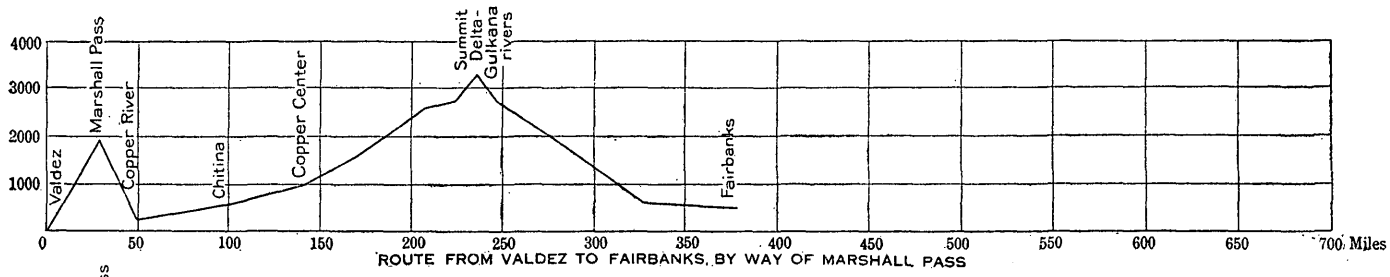
[1] Dickinson, O. L., Transportation in Alaska: Hearings before the Committee on Territories, House of Representatives, Apr. 6, 1912, p. 74.



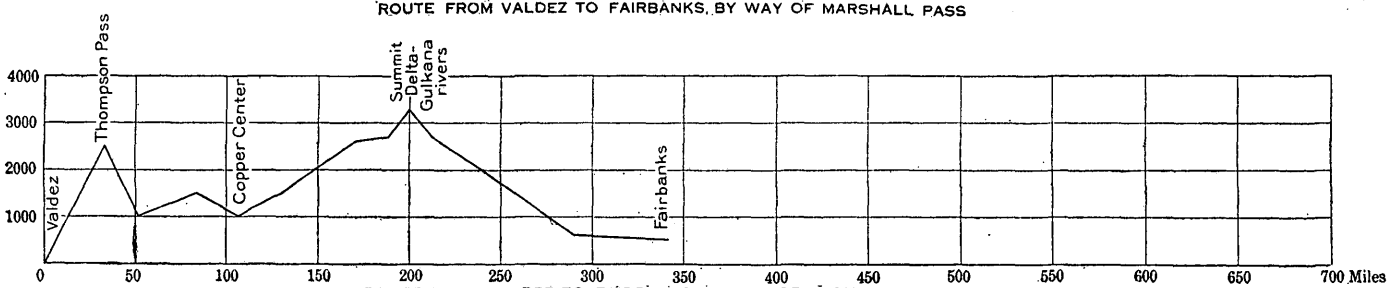
ROUTE FROM PYRAMID HARBOR, SOUTHEASTERN ALASKA, TO FAIRBANKS, BY WAY OF WHITE AND TANANA VALLEYS



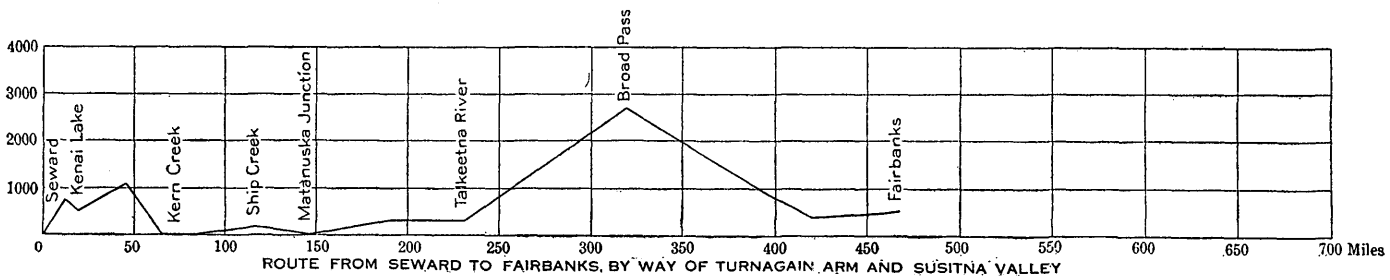
ROUTE FROM CORDOVA TO FAIRBANKS, BY WAY OF COPPER RIVER



ROUTE FROM VALDEZ TO FAIRBANKS, BY WAY OF MARSHALL PASS



ROUTE FROM VALDEZ TO FAIRBANKS, BY WAY OF THOMPSON PASS



ROUTE FROM SEWARD TO FAIRBANKS, BY WAY OF TURNAGAIN ARM AND SUSITNA VALLEY

GENERALIZED PROFILES OF PRINCIPAL RAILWAY ROUTES FROM THE PACIFIC COAST TO FAIRBANKS.

COMPILED, 1912, BY ALFRED H. BROOKS.

height, lead from the Chilkat basin to the Alsek basin. Once over this divide the railroad route follows a series of natural depressions and valleys all the way to Fairbanks. These depressions, which parallel the inland front of the St. Elias Range (Pl. II), afford an admirable route for a railway. One route would be by Dalton Port and thence due west to Kaskawulsh River and up that stream to a low divide that separates it from Slims River, which flows into Lake Kluane. An alternate route would go farther northeast, by Lake Dezadeash and on to Lake Kluane. Detailed surveys would have to be made to decide which of these two routes is the better, but either would be entirely feasible. The route would continue to the west along the south side of Lake Kluane and beyond, crossing Donjek River in an almost straight course to the canyon of White River, where a suitable place for a bridge could be found. From this place the route would cross the broad flat that separates the White and Tanana basins. The rest of the route would be down the Tanana Valley, probably on the north side.

As will be seen from the accompanying table of distances and altitudes, the only bad grade is the one to the first divide from the coast. As a part of the route lies transverse to the main drainage lines, many bridges would have to be built. Of the larger streams crossed the Alsek, the Donjek, and the White would be the most expensive to bridge.

Approximate elevations and distances along railway route from Pyramid Harbor to the Tanana Valley and Fairbanks.

	Elevation.	Local distances.	Distance from Pyramid Harbor.
	Feet.	*Miles.*	*Miles.*
Pyramid Harbor	0	0	0
Klaheela River crossing		24	24
Alaska-Yukon Territory boundary line		19	43
Divide between Chilkat and Tutshenshina rivers	3,200	20	63
Dalton Post	2,520	26	89
Alsek River	2,500	44	133
Oconnor Glacier		32	165
South end Kluane Lake	2,600	14	179
Donjek River crossing	3,100	67	246
East branch White River divide	3,600	16	262
White River crossing	2,800	25	287
Alaska-Yukon Territory boundary line (141st meridian)		41	328
Tanana crossing	1,500	119	447
McCarty, mouth of Delta River	900	120	567
Washburn	600	29	596
Fairbanks	510	52	648

The Chilkat basin is well timbered (chiefly with spruce and hemlock) and contains some auriferous gravels, though the producing district lies somewhat off the proposed railway route. The copper deposits of Rainy Hollow, on the Canadian side of the boundary and 20 miles off the main route, are but little developed. In the inland

region the route lies near no developed mineral resources until it reaches Lake Kluane, where there is a small placer district. It should be borne in mind, however, that what little is known of this region indicates that it may contain a continuation of the mineralized belt of southeastern Alaska and may possibly contain workable ore deposits. The copper belt of the upper White and Tanana basins, which lies near this route (Pl. I), is almost entirely undeveloped, but the prospect of finding workable ore bodies is encouraging. The placer districts of the Yukon-Tanana region are in part tributary to this route. The Tanana and Alsek basins are timbered with spruce and contain also considerable grazing and agricultural land.

There can be no doubt that this is a natural route into the interior and that a railway along it would open up a large inland region that contains valuable resources. Long before the white man came to the region this route was used by the natives in their intertribal intercourse. It has the disadvantage that for about 300 miles it traverses Canadian territory, and it would therefore not afford an all-Alaskan route. Moreover, it would not help to develop the resources of the Copper River and Susitna River basins.

YAKUTAT BAY-ALSEK ROUTE.

The lower Alsek River valley lies transverse to the St. Elias Range and has been proposed as a route into the interior (Pl. II). The line would run southeastward from Yakutat Bay for about 50 miles to the mouth of the Alsek. A narrow-gage railway, called the Yakutat Southern, has already been built for about 9 miles of this distance for the purpose of bringing fish to the salmon cannery at Yakutat. The Alsek Valley is only in part surveyed, but no doubt a railway could be built through it. It would intersect the Pyramid Harbor-Tanana route about 200 miles from the coast and would there attain an altitude of about 2,500 feet.

Yakutat Bay, which is about 1,150 statute miles (1,000 nautical miles) by sea from Puget Sound, is but an indifferent harbor and, so far as known, the proposed railway would not tap any mineral deposits, though such may exist in the unexplored St. Elias Mountains. It is open to the same objection as the Pyramid Harbor route, for it passes through Canadian territory. Much of the route being unexplored, a table showing distances and altitudes along it is not here given.

ROUTES TO BERING RIVER COAL FIELD.

The surveyed portions of the Bering River coal field include about 45 square miles known to be underlain by high-grade steaming and coking bituminous and anthracite coal. The field lies on the coastal flank of the Chugach Mountains and extends into the unsurveyed

portion of the mountains. The coal field lies about 12 miles in an air line north of Controller Bay, 12 miles northeast of Katalla Bay, and 50 miles east of Orca Bay, an arm of Prince William Sound (Pls. II and III).

The southwestern end of the field touches Bering Lake, which is a very shallow tidewater inlet of Controller Bay. A small amount of coal has been brought to the coast on barges from Bering Lake, but the field can be developed on a large scale only by building a railway from the coast. Three general routes of approach to the coal field have been surveyed, and each has been advocated as the best by engineers who were familiar with local conditions. These are (1) from Controller Bay, (2) from Katalla Bay and Fox Islands, and (3) from Cordova on Orca Bay. Controller Bay, as a whole, is a shallow body of water with, however, a deep channel sheltered from the Pacific by Ocalee Spit, Kayak, Wingham, and Kanak islands. Ocalee Spit and Kanak Island are low, with no relief except sand dunes. Kayak and Wingham islands have considerable relief. Controller Bay is bounded on the north by the mainland, here a treeless coastal swamp traversed by many winding streams and broken near the sea by tidal inlets. A deep waterway called Ocalee Channel enters Controller Bay between Wingham and Kanak islands. It trends northeastward for about 4¼ miles and is continued beyond, to the east and northeast, for about 3 miles. At the entrance the channel is a little over half a mile wide and has a depth of about 66 feet at mean low water. It continues for this width about 3 miles, and then narrows to about five-eighths of a mile, and at the big bend shoals to about 42 feet. It maintains this depth of water and width of channel for about 2 miles to the southeast, beyond which it narrows, but except for one shoal 36 feet deep, practically maintains this depth of water to the extreme end of the channel, where it is a little less than a quarter of a mile wide. From half a mile to a mile of water about 3 feet deep separates the Ocalee Channel from the tidal flats which skirt the mainland and are about 2 miles wide. Ocalee Channel is separated by about a mile of shoal water and tidal flats from the southern end of Kanak Island.

About 3 miles from the entrance a narrow channel, a little over a mile in length, extends northward between Kanak Island and the tidal flats. This has a depth of nearly 20 feet and lies about three-quarters of a mile east of the southern end of Kanak Island. Bering River empties into the ocean at the north end of Controller Bay. Its silt-laden waters in part reach the sea through the shallow strait separating Kanak Island from the mainland to the north.

Controller Bay was first investigated as a tidewater outlet for the coal some 10 years ago, when the main features of the hydrography

were determined by J. L. McPherson, a Seattle engineer. Since then the Coast and Geodetic Survey has charted the bay, disclosing the channel described above. As there are no landing facilities on Controller Bay, nor any buoys or beacons to mark the channel, it has never been much used by vessels. Surveys have been made for at least half a dozen different tidewater terminals on Controller Bay and there seems to be little choice between these terminals. The railways surveyed with terminals on the mainland would require about 3¼ miles of approaches across the tidal flats and shoal water that intervene between the shore and the channel. From the shore the railways would traverse about 20 to 25 miles of gravel flat at water grade to reach the margin of the coal field. This route would all be on water grade, the rise to the margin of the coal field being only some 50 feet. To reach different parts of the coal field many spurs and branches would have to be constructed. Bering River is the only large stream to be bridged and offers no difficulties.

Those who advocate the Controller Bay route contend that it is the shortest way to the coal field from tidewater and offers the best grade, with very cheap construction of the land line. They also point out that Controller Bay is only 1,300 statute miles (1,100 nautical miles) from Puget Sound, as compared with 1,400 for Cordova. They contend that while the channel is ample for present shipping the soft silt bottom could readily be dredged to meet any requirements of the future. Three chief points have been made against Controller Bay as an outlet of the coal field. First, it is asserted that cost of a terminal will be so expensive that interest charges will offset the cost of the extra haul to Cordova. Second, that while the bay is sheltered from the sea the adjacent lands do not afford adequate protection against the winds, which at certain seasons of the year are severe. Third, that the ice which forms on the mud flats and in the mouths of the rivers is carried into the bay in large cakes, which on being moved back and forth by the tide in the narrow channel, will be a serious menace to shipping as well as to the railway approaches. In reply to these criticisms it should be said that Controller Bay has now been under observation for a number of years by those who are advocating it as a railway terminal and that the engineers employed in this work are confident that the advantages of its use are greater than its disadvantages.

In 1907 two plans were in execution for providing a coastal terminal near Katalla, on the mainland about 10 miles west of Controller Bay. One of these provided for a breakwater from Palm Point, which was to make Katalla Bay, now exposed to storms from the south-southwest, available for shipping. Inside of this proposed breakwater depths of 20 to 30 feet are found within a quarter of a mile of the land. It was proposed to build a railway from this point up to

the coal field and also one up Copper River. A wharf was built, later destroyed by the storms, and some 7 or 8 miles of track were laid. No work has been done on the project since 1907. From this terminal the surveyed railway route extends up Katalla River and across the flat, about 50 feet above sea level, to Bering Lake, which is shallow and could be crossed on trestles. The nearest coal could be reached with about 12 miles of track and the heart of the field with about 20 miles. This project would have the same easy grades as the route from Controller Bay. The Copper River line was planned to swing around Martin Point and follow up the alluvial flat that marks the eastern margin of the Copper River delta. It would join the present Copper River Railway about 30 miles from Katalla.

The second plan for a railway from the coast near Katalla contemplated making a harbor at the Martin Islands by building breakwaters. It was proposed to connect Whale Island with the mainland by a causeway, and to connect this island with Fox Island by breakwater, and also to extend a breakwater westward from Fox Island. The harbor thus formed would have a depth of 24 to 40 feet. The plan was to build a railway from this terminal into the coal fields and up Copper River along the routes already described. In 1907 work was started on this project and several miles of track were laid, since which time it appears that nothing further has been accomplished.

The third route of approach to the Bering River coal field is from the town of Cordova, on Orca Bay, which will be described below. This route is in part in use by the Copper River Railway, now in operation. The railway takes an easterly course from Cordova across the flats, which here intervene between the highlands and the sea. Many small glacial streams but no large rivers are crossed before Copper River is reached. Copper River is crossed 5 to 10 miles below the head of its delta by several bridges connecting islands that lie between the channels. The nearest point to the coal field is on the east side of the Copper and about 38 miles from Cordova. From this point there are two alternate routes to the coal field. One of these runs southeastward and reaches the field by way of Katalla. This is on water grade and has already been described. By this route the distance from Cordova to the coal is about 90 miles. The other route runs eastward from Copper River, crosses Martin River, and, passing near the southern margin of Martin Glacier, climbs to a pass about 350 feet high, beyond which it descends to the coal field by way of Lake Charlotte. The distance from Cordova to the coal field is about 60 miles by this route.

The quality and extent of the Bering River coal has already been described (pp. 60–61). There are no other resources known in the

region except the petroleum of the Katalla field. The extent of this field is not known, but oil has been found by drilling at several localities, besides which there are numerous seepages. This petroleum is a refining oil and hence should find a ready market on the west coast (pp. 43–44).

The lower slopes of the hills to the edge of the flats in the Controller Bay region are densely forested with spruce and hemlock, which will yield lumber of fair quality. The best timber extends up to an altitude of about 1,200 feet. This timber will have value for local use, though none for export. Good grass is found in the flats, where there is also some arable land. There is little prospect for agriculture in the district, though truck farming will probably be carried on in places when the development of the coal creates a local market. There are quite a number of good water powers in the district.

These railway routes to the Bering River coal field have been described in greater detail than the general purpose of this article would seem to justify because of the great public interest taken in them. Although the opening of the Bering River coal field is important to industries in Alaska as a possible source of fuel, yet it will in no way settle the transportation problem of the Territory, for these coal fields are near the coast, and a railway to them will not give access to the great inland region.

COPPER RIVER ROUTES.

As already pointed out, Copper River affords a good route of access into the interior. (See Pls. III, IV.) Three different general routes up the valley of this river have been proposed—(1) from Cordova or Katalla up Copper River, (2) fromValdez across Marshall Pass down the Tasnuna to the Copper and up that stream, and (3) from Valdez over Thompson Pass down to Tonsina and to the Copper. The first is the longest and is by water grade. The second is over a 1,900-foot pass near the coast, and the third over a 2,500-foot pass, also near the coast. These routes will first be described and next an account of the branch lines will be given, to be followed by a brief review of the resources of the region to be opened up.

CORDOVA-FAIRBANKS ROUTE.

The town of Cordova is on the east side of Orca Bay, which is tributary to Prince William Sound. It is about 1,400 statute miles (1,210 nautical miles) from Seattle and about 60 miles from the entrance to Prince William Sound. The harbor at Cordova is well sheltered. Though the channel at the present wharf is only about a

quarter of a mile wide ample provision can be made on Orca Bay for terminals for all future needs. Among other projects is an ocean terminal and town site, which has been located in a broad flat that opens out at the head of Orca Bay 8 miles northeast of Cordova. The Cordova-Fairbanks route extends up Copper River to the mouth of the Gulkana, ascends that river and one of its tributaries, crosses the divide to Delta River, and descends that stream and the Tanana to Fairbanks. The Copper River Railway has been built along this route as far as the mouth of the Chitina, where it turns east to traverse the southern margin of the Kotsina-Chitina copper belt.

This railway has already been described as far as the Copper River crossing, where it would join a proposed line to the coal field. Here it turns northward and at mile 49 crosses the Copper just above Childs Glacier. From this glacier to the town of Chitina (mile 131) it follows the west side of Copper River. Above Tasnuna River the building of the line involved much heavy rock work. At Chitina there is a bridge across the Copper, and from there the line is extended up Chitina River for about 66 miles, to the Kennicott-Bonanza mine, its present terminal. From Chitina the route to Fairbanks follows the left bank of the Copper as far as the mouth of Gulkana River, crossing in turn the Tonsina, the Klutina at Copper Center, and the Tazlina. Somewhere near the mouth of Gulkana River it would leave the Copper and follow the valley of the former stream as far as its Middle Fork. Here it would cross the Gulkana and follow the Middle Fork to its head in a broad gap, some 3,100 feet high. The information at hand indicates that from the Chitina to the pass there would be little or no rock work. For the most of this distance the river valley proper is marked by an escarpment of gravel and silt, which forms the eastern margin of the Copper River Plateau. From the pass the route would descend to the Tangle Lakes and thence follow the outlet stream draining these to Delta River. An alternative route would follow the Gulkana to the lake at its head and then cross to the Delta over a divide about 3,300 feet high. There is also another pass, about 3,000 feet high, between Gulkana Lake and the Tangle Lakes, which might be preferable.

The route down Delta River would run along the east side of the valley to avoid a glacier that discharges from the west, so that it would be necessary to bridge the Delta below the canyon. In the Delta Valley considerable rock work would be required. After crossing the Delta the route would lead probably nearly straight to Fairbanks, a bridge being built across the Tanana. One bridge could be avoided by following the Delta to its mouth and then bridging the Tanana, but this would increase the length of track about 14 miles.

Approximate elevations and distances along railway route from Cordova to Fairbanks, by way of Copper River.

	Elevation.	Local distances.	Distance from Cordova.
	Feet.	*Miles.*	*Miles.*
Cordova	0	0	0
Tasnuna crossing	240	82	82
Chitina	580	49	131
Crossing of Copper at Kotsina River	540	51	132
Copper Center	1,000	43	175
Tazlina River crossing	1,150	7	182
Gulkana River crossing	1,500	16	198
Crossing of creek outlet of Gulkana Lake	2,600	42	240
Paxsons	2,700	15	255
Summit near Gulkana Glacier	3,300	12	267
Delta River at mouth of Phelan Creek	2,700	13	280
Black Rapids	2,300	15	295
Donnely, on Delta River	2,000	12	307
Washburn, on Tanana River	600	51	358
Fairbanks	510	52	410

ROUTE FROM VALDEZ TO FAIRBANKS BY WAY OF MARSHALL PASS.

Surveys have been made for a railway from Valdez to Copper River by way of Marshall Pass. The town of Valdez is at the head of Port Valdez, a northeastern arm of Prince William Sound. The bay is deep and well sheltered and affords excellent conditions for wharves and terminal facilities. Several town sites have been located on the bay, but Valdez, built on the delta of the streams draining Valdez Glacier, is the only important settlement. It is about 1,420 statute miles (1,230 nautical miles) from Seattle.

From Valdez to Marshall Pass (elevation 1,900 feet) the distance is about 30 miles, and the route would lie up Lowe River. Engineers report that a good deal of rock work will be necessary for about half this distance. Beyond the pass the route would descend the broad valley of Tasnuna River to the Copper, which would be reached in about 31 miles. From this point the route would be identical with the one up the Copper, already described. The distance from Valdez to Fairbanks by this route is about 380 miles.

Approximate elevations and distances along railway route from Valdez to Fairbanks by way of Marshall Pass.

	Elevation.	Local distances.	Distance from Valdez.
	Feet.	*Miles.*	*Miles.*
Valdez	0	0	0
Loop in Heiden Canyon		26	26
Marshall Pass	1,900	2	28
Tasnuna River at Copper River	240	21	49
Chitina	580	49	98
Copper Center	1,000	44	142
Tazlina River crossing	1,150	7	149
Gulkana River crossing	1,500	16	165
Crossing of creek, outlet of Gulkana Lake	2,600	42	207
Paxsons	2,700	15	222
Summit at Gulkana Glacier	3,300	12	234
Delta River at mouth of Phelan Creek	2,700	13	247
Black Rapids	2,300	15	262
Donnely, on Delta River	2,000	12	274
Washburn, on Tanana River	600	51	325
Fairbanks	510	52	377

ROUTE FROM VALDEZ TO FAIRBANKS BY WAY OF THOMPSON PASS.

Thompson Pass is about 8 miles west of Marshall Pass, and the route to it from Valdez is up the Lowe River valley, which it leaves about 18 miles from tidewater. Here it turns northward, and in a distance of about 15 miles more crosses Thompson Pass (elevation about 2,500 feet). A better grade can be obtained by swinging around toward the head of Lowe River, thus increasing the mileage of approach to the pass. Beyond the pass the route follows down Tsina River to the point where that stream joins the Kanata to form the Tiekel. It thence follows up the Kanata Valley to Ernestine Pass and crosses a divide, about 1,800 feet high, to Mosquito Creek, which it follows to its junction with the Tonsina. Beyond Tonsina there are two alternative routes; one would follow the Tonsina Valley to the Copper and would be the natural route to the Chitina Valley; the other would keep to the north, and after climbing about 400 feet would join the Copper River route about 10 miles below Copper Center. From there on the route to Fairbanks would be identical with the one already described from Cordova. The distance from Valdez to Fairbanks by this route is about 342 miles.

Approximate elevations and distances along railway route from Valdez to Fairbanks by way of Thompson Pass.

	Elevation.	Local distances.	Distance from Valdez.
	Feet.	*Miles.*	*Miles.*
Valdez	0	0	0
Loop in Heiden Canyon		26	26
Thompson Pass	2,500	7	33
Tiekel River	1,000	19	52
Tonsina River crossing	1,500	31	83
Copper Center	1,000	24	107
Tazlina River crossing	1,150	7	114
Gulkana River crossing	1,500	16	130
Crossing of creek, outlet of Gulkana Lake	2,600	42	172
Paxsons	2,700	15	187
Summit at Gulkana Glacier	3,300	12	199
Delta River at mouth of Phelan Creek	2,700	13	212
Black Rapids	2,300	15	227
Donnely, on Delta River	2,000	12	239
Washburn, on Tanana River	600	51	290
Fairbanks	510	52	342

Some grading has been done on several railways leading out of Valdez designed to cross either Marshall or Thompson Pass. A little rock work was also done at the Keystone Canyon, in the Lowe River valley. These projects seem to have been quiescent for a number of years, except for some new surveys over the Thompson Pass route.

CHITINA VALLEY AND WHITE RIVER ROUTES.

A trunk line up the Copper Valley will necessitate a number of feeders to reach the mining camps tributary to it. The present railway up the Chitina Valley can be regarded as the most important of

these feeders, but this itself will have to be supplemented by a number of spurs to reach many of the copper deposits. It has been suggested that this line be extended up Nizina and Chitistone rivers to Skolai Pass and across the divide to the White River copper deposits. Only a part of this route has been mapped by the United States Geological Survey. It appears, however, that the distance to the pass from the nearest point on the railway is about 25 miles, and from the pass to the flats at the head of White River is about 15 miles. Skolai Pass, which is occupied by a glacier, stands probably less than 5,000 feet above the sea. The railway at the proposed junction point has an elevation of about 1,400 feet, whereas the White River Flats, on the other side, are approximately 4,000 feet above the sea. This route traverses a rugged mountain region and would be expensive to construct. A railway reaching White River by this route would tap only the eastern end of the copper-bearing zone. The western end is in the Tanana drainage. To reach this by direct route from White River would necessitate crossing a divide about 6,400 feet high, to Chisana River, the east fork of the Tanana, a distance of about 25 miles, where a descent to about 4,000 feet would be made. The route would then be continued northwestward over the Cooper Pass (5,600 feet), and in a distance of about 25 miles would reach Nabesna River, the west fork of the upper Tanana. At the Nabesna the elevation would be about 3,000 feet. The same districts could be reached from White River on water grade, but by a very circuitous route, by extending the railway down the White Valley and crossing the flat which separates it from the Tanana basin. This route has already been described (pp. 59–60). Then, by building down the Tanana Valley, the upper Chisana and Nabesna regions could be reached by branch lines. This would require a total length from White River of about 160 miles, but the road would be easy of construction. It seems probable that this Nabesna-White River copper region can be best opened up by a railway from Pyramid Harbor (already described, pp. 60–62), or from Copper River by way of Batzanitas, or Mentasta Pass. (See pp. 69–71.)

ROUTE FROM COPPER RIVER TO MATANUSKA COAL FIELD.

A project for building a railway from Copper River to the Matanuska coal field has received some consideration. This route is only in part covered by the maps of the Geological Survey, and hence some of the distances and altitudes here stated are only approximate. A private survey has been run over the route, but the results are not yet available. The route leaves Copper River at the mouth of the Tazlina (elevation, 1,100± feet,) about 7 miles above Copper Center, 114 miles from Valdez by way of Thompson Pass and 182 miles from Cordova, and follows up the Tazlina for about 50 miles to a point

within 10 miles of its glacial source. Here the route would reach an altitude of about 2,200 feet. From this point the route ascends to Tanneta Pass, 2,800± feet above the sea, in a distance of about 10 miles. From Tanneta Pass it would continue down one of the streams tributary to the Matanuska and reach the easternmost known coal in a distance of about 30 miles, here having an altitude of about 1,400 feet. About 18 miles more would carry the railway to the mouth of the Chickaloon (elevation 800 feet), in the heart of the Matanuska field.

To summarize briefly: The proposed railway would start at an elevation of 800 feet in the coal field, and in a distance of about 50 miles would reach the watershed at an altitude of 2,800 feet. It is possible by striking the Chickaloon higher up that 200 or 300 feet of elevation could be saved. From the watershed it would run on a down grade to Copper River for a distance of about 60 miles. The distance from the Matanuska coal field to Valdez by Thompson Pass would be about 222 miles and to Cordova by lower Copper River route about 290 miles.

BRANCH LINES TO UPPER COPPER, TANANA, AND WHITE RIVER REGION.

A railway through the Copper River valley and down Delta River, without branch lines, would fail to provide for the upper Copper basin and adjacent portions of the Tanana and White basins—a region of much mineral promise. The Chistochina or Chisna gold-placer district could be reached from the main line by branches on several routes. One route would start from the main line, about 20 miles from the Copper and near the Sourdough road house, would extend across a low divide to Gakona and up that stream to Chisna, centrally located in the gold field. This route would be on water grade and would be about 50 miles long. Another route would trend eastward from a point near the Delta River divide, leaving the main line at an altitude of about 3,200 feet, lead eastward, passing near Summit Lake, and reach Chisna by crossing two low divides in a distance of about 30 to 40 miles.

From Chisna a good route, about 50 miles long, extends eastward by way of the Mankomen Valley to Mentasta Pass, which has an elevation of about 2,900 feet above the sea. There is a good route from Mentasta Pass down Tok River to the Tanana, a distance of about 40 or 50 miles. A line could be extended up the Tanana on water grade to the copper deposits of the Nabesna, Chisna, and White rivers, as already described. About 240 miles of track would be required to reach all parts of this copper district. There is a more direct route to the copper-bearing district from Mentasta Pass by way of the pass (elevation 3,200 feet) at the head of Little Tok River, which leads into Tuck Creek, a tributary of the Tanana. By

this route the different parts of the Nabesna-White River copper district could be reached from Mentasta Pass by about 240 miles of track.

A more direct route into this copper belt leads up the main Copper River valley from the Gulkana. This route would pass the native settlement of Batzulnetas and ascend Tanana Creek to a pass about 3,400 feet high to Jack Creek, a tributary of Nabesna River. From the Nabesna there are the two alternate routes to White River, a long one by water grades, and another, a direct route, over two high divides, which have already been described (pp. 67–68). The distance from the main line at the Gulkana by this route is about 90 miles. It may be added that construction work will be easy in this entire upper Copper River and White River region.

It will be evident that the White River region can be reached from the Copper River valley either by long, circuitous routes having easy grades or by shorter routes having steep grades. The distance from the head of White River over Skolai Pass to Cordova is about 240 miles; to Valdez, by way of Marshall Pass, about 160 miles. By direct route to the Copper River valley at Batzulnetas, the distance from White River to Cordova is about 340 miles; to Valdez, by way of Thompson Pass, about 270 miles. The route from White River, by way of the upper Tanana, to Cordova is about 440 miles; to Valdez, by way of Thompson Pass, about 370 miles. Going eastward, the distance from White River to tidewater at Pyramid Harbor (see pp. 67–68) is about 300 miles.

SUMMARY OF COPPER RIVER ROUTES.

The Copper River valley affords an excellent route to the interior of central Alaska. The Copper River Railway, now in operation, has aided much in developing the copper and gold deposits of the Chitina Valley. This road could be extended into the Tanana Valley by way of Delta River or by way of Mentasta Pass. An alternate plan is to build from Valdez over Thompson Pass or Marshall Pass to Copper River. Branch lines might be built to the Nabesna-White River region. The two copper belts, one north and the other south of the Wrangell Mountains, could thus be made accessible. Some productive placer districts would also be served by these lines, as would some auriferous lodes that have been found but that are undeveloped. The Matanuska coal field lies about 100 miles west of the central Copper River, and the Bering River coal field about 30 miles southeast of the Copper River delta. Either field could furnish the coking coal needed to smelt the copper. In this province there are also some water powers that could be utilized for mining development.

The timber resources of this region are not specially good. Around Cordova and Valdez there is some fairly good spruce and hemlock which, in the sheltered valleys, reaches up the hill slopes to an altitude

of about 1,000 feet. There is no timber in the lower Copper Valley except an occasional cottonwood grove. Above Tasnuna River scattered spruces are found. In the Chitina Valley spruces grow up to an altitude of 2,000 to 3,000 feet. In favored localities along the valley cottonwood trees up to 18 inches in diameter are found. There is a similar growth of timber along the main Copper above the Chitina, but the trees growing at higher elevations, notably those on the Copper River Plateau, are stunted and have no value except for fuel. Similar forest conditions prevail in the upper Copper Basin and adjacent regions.

On the hill slopes above timber line, where they are not too steep, good grass usually grows in summer. There is little good grass on the Copper River Plateau, but some is found in the valley bottoms below the plateau level. The upper Copper, Tanana, and White River basins are noted for their good grass lands. Here the snowfall is so light that winter pasturage can be had, and the region gives promise of becoming a good cattle country.

There is much arable land in the valley bottoms of the Copper River and adjacent region. The plateau does not seem favorable for agriculture. The mineral and agricultural resources of the Tanana Valley have already been discussed (pp. 48, 60).

ROUTE FROM SEWARD TO FAIRBANKS BY WAY OF TURNAGAIN ARM AND SUSITNA VALLEY.

The Susitna Valley and Broad Pass, at its head leading to the Tanana Valley, affords a favorable railway route to inland Alaska. As the upper part of Cook Inlet is closed to navigation from about November 1 to April 1, a railway up the Susitna must find an open port on the east side of Kenai Peninsula. Such a route has been found to Resurrection Bay, and is now being utilized by the Alaska Northern Railway. This railway has been completed from Seward, on Resurrection Bay, to Kern Creek, on Turnagain Arm, a distance of 71½ miles. The Matanuska coal field is the objective point of this railway, but construction work has been stopped pending a settlement of the coal-land question. Seward, which is excellently located at the head of Resurrection Bay, is about 1,420 statute miles (1,235 nautical miles) from Seattle. The harbor is good, and the conditions are favorable for terminal facilities. The railway route to Fairbanks has been described briefly as follows:[1]

It leaves the Pacific seaboard at Seward, about 1,235 nautical miles from Seattle, on Resurrection Bay, and, traversing a broad, heavily timbered valley, climbs by easy grade to 700 feet at mile 12. It then descends to Kenai Lake, about 500 feet in altitude. Another easy grade brings it at mile 45 to a second pass, 1,060 feet in altitude. Both

[1] Brooks, Alfred H., The Mount McKinley region: Prof. Paper U. S. Geol. Survey No. 70, 1911, pp. 220-221. Some of the elevations and distances have been corrected in this quotation to agree with the latest information.

these summits are reached with a maximum grade of 2 per cent. From this second summit it descends by a series of loops, trestles, and tunnels with a maximum grade of 2.2 per cent to the valley of Placer River. It is stated by the company that by changing the location of the line to the west wall of the Placer River valley this descent can be made with a maximum grade of only 1.5 per cent. Placer River, which has a glacial source, is crossed on pilings, and the line then follows the east side of the valley. Swinging around the head of Turnagain Arm on a broad grass-covered and timbered flat, the railway crosses two more small glacial rivers. It then follows the north side of Turnagain Arm with a series of rock cuts and fills. The line, which is standard gage, is completed and in operation to Kern Creek, 71½ miles from Seward (1910). Beyond this point location surveys have been made and in all about 2 miles of grading completed.

From Kern Creek the surveyed line follows the north side of Turnagain Arm to Point Campbell, at the entrance to Knik Arm. Here there are no serious difficulties except in the last 10 miles, where there will be a good deal of heavy rock work. The line follows the east shore of Knik Arm from Point Campbell to the mouth of the Matanuska, which is about 140 miles from Seward. It appears that in this part of the line very little rock work will be required. After crossing the Matanuska it is planned to extend the main line westward to the Susitna and a branch line about 40 miles long up the Matanuska Valley to the coal field. Much of the branch line will require no heavy construction.

The coal field appears to be the immediate objective point of this railway, but the manager reports that plans and preliminary surveys have been made for extending the line up the Susitna to the junction of the Chulitna and up that stream to Broad Pass, about 2,700 feet in altitude and about 320 miles from Seward. So far as known, an easy grade can be maintained to this point, and there are no serious engineering difficulties. From Broad Pass the route follows down Nenana River to the Tanana Flats, and here again, it is believed, an easy grade can be established. From this point any locality on Tanana River can be easily reached. If the route is extended north of the Tanana, that river could best be bridged at the big bend near Tortella. Details in regard to this route are presented in the following table, in which the distances and altitudes given are, however, only approximate:

Approximate elevations and distances along railway routes from Seward to Fairbanks by way of Susitna Valley.

	Elevation.	Local distance.	Distance from Seward.
	Feet.	*Miles.*	*Miles.*
Seward, Resurrection Bay	0	0	0
First summit	700	12	12
Kenai Lake	500	6	18
Second summit	1,060	27	45
Head of Turnagain Arm	.....	18	63
Kern Creek (end of track, 1911)	.....	8	71
Ship Creek	180	44	115
Mouth of Matanuska River	.....	32	147
Matanuska Branch (Junction)	.....	2	149
Willow Creek	300	38	187
Talkeetna River	300	43	230
Broad Pass	2,700	88	318
Nenana River (mouth of canyon)	800	79	397
Tanana River at mouth of Nenana River	400	23	420
Chena	490	41	461
Fairbanks	510	7	468

The company reports that plans for a branch line to the Kuskokwim, Innoko, and lower Yukon have also been made, but it is not known that this route has yet been surveyed. Such a line would cross Susitna River and ascend the Skwentna Valley

to Rainy Pass, about 2,950 feet above tide level and about 150 miles from the Matanuska junction described above. From Rainy Pass to the Kuskokwim at the mouth of Tatina River, where the elevation is about 1,000 feet above the sea, the distance is about 15 miles. The route would then be down the Kuskokwim and across a divide not over 1,000 feet high to the Innoko, the distance being about 160 miles. The distance from Seward to the Innoko or Haiditarod is about 520 miles. [The distance from Seward to navigable waters on the Kuskokwim is about 320 miles; to the mouth of the Takotna, 430 miles.]

Various deviations from the accepted route of the Alaska Northern Railway have been proposed, but appear not to have been very seriously considered. It has been suggested that an easier grade to tidewater on the north side of Kenai Peninsula might be obtained by a route that extended down Sixmile Creek to Sunrise. This, however, would necessitate climbing to an altitude of about 1,300 feet at Moose Pass or 1,500 feet at the divide at Johnson Creek. This route would leave the present track in the vicinity of Trail Lakes. An alternate plan would be to swing around the north shore of Kenai Lake and cross the 1,300-foot divide at the head of Quartz Creek. The latter route would require some heavy rock work along the north shore of Kenai Lake. These routes would be 10 to 20 miles longer to tidewater than the existing line. About 18 miles of track, including much rock work, would be required to carry the line from Sunrise to the head of Turnagain Arm, there to be connected with the present railway. Therefore, though the grade on the Turnagain Arm side might be better over some of these routes, the expense of the additional mileage would hardly seem warranted.

In this connection it will be well to refer to a proposed scheme for bridging Turnagain Arm from Snipes Point, near Sunrise, on the south side, to Bird Point on the north side. The distance between these points is a little over 2 miles and the water is shoal. The enormous tides in the arm and the presence of ice in winter would seem to make this an exceedingly difficult, if not impossible, feat of engineering. So far as known to the writer, this project has not been indorsed by any competent engineer.

Before the Alaska Northern Railway was built several other plans were devised for a railway into the Susitna Valley. One of these was a route from Kachemak Bay northward along the west front of the Kenai Mountains to Turnagain Arm and around the head of the arm. This route is much longer than the one from Seward and misses most of the important developed gold resources of Kenai Peninsula, and its ocean terminal is inferior to that on Resurrection Bay. Another plan was to build from Snug Harbor or some other bay on the west side of Cook Inlet and follow the shores of the inlet northward to the Susitna Valley. This route would run on water grade, but would be longer to the Matanuska coal field than the one from Seward. Its ocean terminal would also be very inferior to that

at Resurrection Bay and is sometimes blocked with ice. Another plan is to build from Portage Bay, on the west side of Prince William Sound, to Turnagain Arm. Though the distance is only some 15 or 20 miles the fact that the pass (1,000 feet) is occupied by a glacier seems to prohibit its use for a railway.

The establishment of a summer port of shipment near Ship Creek, on Knik Arm, is a part of the project of the Alaska Northern Railway. The charts of the Coast and Geodetic Survey show that a channel having a depth of about 36 feet enters Knik Arm and extends to the vicinity of Ship Creek, which is on the line of the proposed route of the Alaska Northern Railway. This is about 60 miles from the Matanuska coal field, which is reached from this point by water grade. The mouth of Ship Creek is about 1,650 statute miles (1,430 nautical miles) by ocean route from Seattle. This port would be available only from about May to October, being usually impassable during the remainder of the year on account of ice.

The Susitna route to Fairbanks traverses an area that includes important gold and coal resources, as well as some of the best agricultural lands in the Territory. Whatever may be the relative merits of the routes through the Copper and Susitna valleys to Fairbanks, it is certain that a railway up the Copper can not develop the resources of the Susitna Valley.

The Alaska Northern Railway route traverses auriferous districts in Kenai Peninsula and along the northern shore of Turnagain Arm. About 150 miles inland the main line will approach within 30 or 40 miles of the Matanuska coal field and close to the Willow Creek lode district. In the Susitna Valley it passes within 30 or 40 miles of the Yentna placer district. Copper and gold deposits have also been reported in other parts of the Susitna basin, but little is known about them. Beyond Broad Pass the route traverses the Nenana coal field, which contains very extensive deposits of lignite that should be of value for developing the Yukon-Tanana gold field. This gold field, which will be tapped by this route, has already been referred to (p. 48). The region, as a whole, contains little merchantable timber. There is a good stand of spruce and hemlock in the flat adjacent to Resurrection Bay, on lower Glacier Creek, and on a few other streams on Turnagain Arm, some trees measuring as much as 4 feet in diameter. Few of the largest trees in the heart of the peninsula measure more than 12 to 16 inches in diameter. Spruce, cottonwood, and birch are the principal forest types. Timber runs up to altitudes of 2,000 feet above the sea, but the best is confined to the valley floors and lower slopes. The same kind of forest is found in the Susitna and Matanuska region, where timber line is about 2,000 feet, but above 1,500 or 1,800 feet the trees are very scattering. Spruce, birch, cottonwood, and tamarack grow in the Tanana basin.

In the lowland areas some timber is found measuring 18 inches to 2 feet, but in most places the largest timber does not generally exceed 12 to 16 inches. In the Tanana basin timber line is about 3,000 to 3,200 feet above sea level, but the best timber is below 2,000 feet.

The Susitna basin and the adjacent region contains a large amount of good agricultural land and extensive tracts that are valuable for their grass. The Tanana Valley also contains much agricultural and grass land.

ROUTES FROM COOK INLET TO THE KUSKOKWIM AND LOWER YUKON.

This paper is concerned chiefly with routes from the Gulf of Alaska to the Tanana, but as plans have been made for a railway from Cook Inlet to the Kuskokwim, this project will also be briefly considered. It is proposed to build a railway from some port on the west side of Cook Inlet, through the Iliamna Lake region, thence across to the Kuskokwim Valley, and from there to the Yukon. Only a part of this region is covered by Geological Survey maps, and little is known of the topography and resources of the remainder.

In 1902 to 1908 a railway route was surveyed by the Alaska Short Line Railway Co. from Iliamna Bay westward to the Yukon. Iliamna Bay is a deep indentation of the mainland, but the larger part of it is too shallow for ocean-going vessels. Vessels therefore must lie near the entrance, and terminal facilities would be expensive to construct. By ocean route Iliamna Bay is about 1,530 statute miles (1,330 nautical miles) from Seattle. The proposed railway route leads from a point near the head of the north arm of the bay over a divide about 900 feet high to Iliamna Lake. It then swings around the eastern end of Iliamna Lake, crosses the outlet of Clark Lake, and extends up Chulitna River, crossing a low divide to Mulchatna River. It appears that the divide west of the Mulchatna probably drains into the Kuskokwim and that the proposed railway route would reach the latter stream somewhere near the big bend and not far from the Iditarod placer district. The plan of the Alaska Short Line Railway Co. contemplated reaching Yukon River at Anvik. Plans have also been proposed to extend this line to Nome, on Seward Peninsula. No data are at hand regarding distances or altitudes for most of this route. It appears, however, that 450 miles of track should reach the Yukon and that there are no high divides to overcome. It also appears that construction of most of the route would not be expensive. This railway is projected to reach the lower Kuskokwim and Yukon basins, but it would be in a measure a competitive route with the one from the Susitna over Rainy Pass to the Kuskokwim.

Not much is known of the resources of the region. In the Iliamna region there are some undeveloped gold and copper deposits. Some placer gold has been found on the Mulchatna. The Iditarod-Innoko region produced placer gold to the value of $3,000,000 in 1911, and some placer gold has been found at several localities to the southwest, between the Iditarod district and Bering Sea. From the meager information at hand the region seems to be of less agricultural promise than that along the other routes already described.

SUMMARY.

In the foregoing pages an attempt has been made to present a concise and unprejudiced statement of the known facts bearing on railway routes into Alaska from the Pacific. The subject is large and can not be adequately discussed in the few pages devoted to it. Moreover, the data are very incomplete, but it is hoped that this outline may be of service to those who are interested in Alaska transportation problems. No conclusions are here presented as to which is the best route into the interior. To arrive at a conclusion it would be necessary to take into account the cost of construction, which must be determined by the engineer. Of the feasibility of constructing any of the three trunk routes—Pyramid Harbor-Tanana, Copper Valley, and Susitna Valley—there can be no question (Pl. IV). The first would bisect central Alaska, but would not help the Copper or Susitna regions. The resources of the Copper basin and the Susitna basin must be developed by different railways. The only question is which one should now be extended through to the Tanana. In the opinion of the writer the resources of central Alaska justify the belief that eventually all three railways will be built to the Tanana and extended into other parts of the Yukon basin.

GOVERNMENT PUBLICATIONS AND RECORDS RELATING TO RAILWAY ROUTES.

INTRODUCTION.

The foregoing account of railway routes is based on a study of the many Government publications, including maps and records, all of which are summarized or mentioned here in order that they may be consulted by those who desire more detailed information than can be presented in this brief article. The publications mentioned are by no means all that have been issued relating to this subject, but it is believed that the list is sufficiently comprehensive to serve as a general guide.

Publications containing general data will be considered first, and reports dealing more specifically with the different railway routes

already described will next be noted. The routes will be considered in geographic order from south to north. If a later and more comprehensive publication has supplanted an earlier one, only the later will be listed. References will be made not only to publications relating directly to railway location, but to those which contain data on climate, mineral resources, agriculture, forests, navigation, statistics of commerce, and population—subjects which must be considered in making choice of railway routes.

GENERAL REPORTS.

The general routes of approach to the Pacific seaboard of Alaska are indicated by the charts and publications of the United States Coast and Geodetic Survey, which has for many years been surveying the coast line of the Territory. Specific reference should here be made to Chart T, a general map of Alaska published by the Coast and Geodetic Survey. Directions for navigating the shore line, together with description of harbors, are contained in the publication entitled "United States Coast Pilot: Pacific Coast, Alaska," issued by the Coast and Geodetic Survey.

The United States Geological Survey began systematic surveys and investigations of Alaska in 1898. This Survey has made some investigation of every railway route now under consideration and has published reconnaissance and detailed maps showing topography and distribution of mineral resources. In 1905 the Director of the Geological Seuvey made specific recommendations for an appropriation to be expended for the survey and investigation of railway routes in Alaska.[1] Although no specific appropriation was made for this purpose, the Survey has directed its investigations to the end of obtaining information in regard to the topography and the resources along the different routes as rapidly as means permitted. As a consequence the publications of the Survey contain a large amount of information bearing on railway routes. General information on the character of the country and the distribution of mineral resources and statistics of mineral production are also contained in the Survey publications.

The larger topographic features of Alaska are discussed in a report entitled "The geography and geology of Alaska," by Alfred H. Brooks (Prof. Paper U. S. Geol. Survey No. 45, 1906). This report also contains a topographic map of Alaska on a scale of 1:2,500,000, which was not issued separately and is now out of date. The problems of railway location are more specifically discussed in articles entitled "Railway routes" (Bull. U. S. Geol. Survey No. 284, 1906, pp. 10–17) and "Transportation" (Bull. U. S. Geol. Survey No. 379, 1909, pp. 23–26), both by Alfred H. Brooks. A more popular account of the

[1] Twenty-sixth Ann. Rept. U. S. Geol. Survey, 1905, pp. 76-80.

same subject by Mr. Brooks has been published under the title "Railway routes in Alaska," in the National Geographic Magazine, March, 1907. Mr. Brooks has also discussed the present cost of transportation in Alaska under the heading "Transportation," in Survey Bulletin 442 (1910, pp. 23–31), and the relation of railway transportation to the coal fields in an article on "Alaska coal and its utilization" (Bull. U. S. Geol. Survey No. 442, pp. 47–100). This article considers the distribution, quality, and availability of Alaska coal.

The general coal situation has been discussed by the Hon. Walter L. Fisher in a report entitled "Alaskan coal problems" (Bull. Bureau of Mines No. 36, 1911). This subject has also been treated from another point of view by the Hon. James Wickersham, Delegate from Alaska, in a speech entitled "A national coal monopoly in Alaska" (speech delivered Feb. 23, 1911, in the House of Representatives; published Washington, 1911). There are many other public documents relating to the question of public policy toward the coal lands of Alaska, but these will not here be considered.

The general distribution of the mineral resources of Alaska is shown on a map published as Plate I in Survey Bulletin 345. A revised edition of this map is published herewith (Pl. I, in pocket). Statistics for mineral production of Alaska up to and including the year 1910 are contained in the Survey's Bulletin 480 (1911), and preliminary estimates of mineral production for 1911 are given in this report (p. 20).

The General Land Office has issued a map of Alaska on which the boundaries of the judicial divisions as well as of the national forests and other Government reservations are indicated. Information about the laws relating to the acquisition of public lands in Alaska is contained in the publications of the General Land Office.

A large number of plats and profiles of proposed railways based on surveys made under private auspices are on file in the General Land Office. These are more pertinent to the individual routes to be described below than to the general problem of railway location. A statement of the data filed in the General Land Office previous to November 28, 1908, is contained in a letter of the Secretary of the Interior of that date, printed as House Document 1201, Sixtieth Congress, second session. This document is accompanied by a map showing the location of the principal routes surveyed.

The Alaska Road Commission (War Department) has made many surveys for roads and trails, the results of which are on file in the office of the commission at Valdez, Alaska. It has also published a general map of Alaska, showing position of roads, trails, telegraph and cable lines, and wireless stations and annual reports giving information about roads and trails.

Many records relating to the climate of Alaska are on file in the United States Weather Bureau, Department of Agriculture. These have in part been published in the annual reports on agriculture in Alaska and in part have been summarized in a report entitled "The geography and geology of Alaska" (Prof. Paper U. S. Geol. Survey, No. 45), already referred to.

The reports on agriculture in Alaska, by C. C. Georgeson, published annually since 1898 by the Office of Experiment Stations, Department of Agriculture, contain much data bearing on the general subject of railway location in relation to agricultural development. This phase of the subject is also treated of in a report entitled "Grass lands of the south Alaska coast," by C. V. Piper (Bull. Bureau of Plant Industry, No. 82, Dept. of Agriculture, 1905). The distribution of timber in Alaska is the subject of a report entitled "The forests of Alaska," by R. S. Kellogg (Bull. Forest Service No. 81, U. S. Dept. Agr., 1905).

The reports of the governor of Alaska, published annually since 1885, contain much general information relating to railway routes and transportation. Many of these reports are accompanied by general maps of Alaska. Statistics of the commerce of Alaska are contained in the publications of the Bureau of Statistics ("Monthly summary of commerce and finance in the United States" and "Report on the commerce and navigation of the United States", [annual]). The reports of the Tenth, Eleventh, Twelfth, and Thirteenth Censuses include information regarding the population and industries of Alaska.

Many congressional documents contain information about the general transportation situation in Alaska, only a few of which have been examined and abstracted for this report. Among these are the following:

"Railway and telegraph and telephone lines in Alaska" (H. Rept. No. 3874, 59th Cong., 1st sess.).

"Conditions in Alaska: Report of subcommittee of Committee on Territories" (S. Rept. No. 282, pt. 1, 58th Cong., 2d sess.), accompanied by general map of Alaska, scale 1:3,600,000; 1904.

"Conditions in Alaska: Hearings before subcommittee of Committee on Territories" (S. Rept. No. 282, pt. 2, 58th Cong., 2d sess., 1904).

"Railroads in Alaska: Hearings before the Committee on Territories of the House of Representatives" (59th Cong., 1st sess., 1906), accompanied by sketch map showing railroads under construction and projected.

"Bills and reports of Committee on Territories of the House of Representatives," by J. C. Hance (58th Cong., 1st and 2d sess.), 3 volumes, 1904.

"Investigations of the Department of the Interior and the Bureau of Forestry" (by joint committee of Congress); 7 volumes, 1910.

"Conditions in Alaska: Hearings before the Committee on the Territories of the House of Representatives" (62d Cong., 2d sess., Jan. 16–Feb. 6, 8, 10, 13, 15, and 27, 1912).

"Transportation in Alaska: Hearings before the Committee on the Territories of the House of Representatives" (62d Cong., 2d sess , Feb. 27, Mar. 5, Apr. 5, 6, 16, and 19, 1912).

"Railroads for Alaska: Hearings before the Committee on Territories, United States Senate," April 12, 1912.

"Government railroad in Alaska: Hearings before the Committee on Public Lands, United States Senate" (62d Cong., 2d sess., May 22, 1912).

"Coal lands in Alaska: Hearings before the Committee on Public Lands, United States Senate" (62d Cong., 2d sess., June 1 and 5, 1912).

ROUTE FROM PYRAMID HARBOR TO FAIRBANKS.

The coastal terminal of the proposed roadway from Haines to Fairbanks is on Lynn Canal. (See charts Nos. 8300 and 8303 and "United States Coast Pilot, Pacific Coast, Alaska, Pt. I," 1908, published by the Coast and Geodetic Survey.) This route will follow Chilkat River, which has been surveyed by the International Boundary Commission, but the results of the survey have not yet been published. The mineral resources of the Porcupine district, tributary to this route, are described in a report entitled "The Porcupine placer district" by C. W. Wright (Bull. U. S. Geol. Survey No. 236, 1904). An account of the general character of the route is contained in publications entitled "A reconnaissance from Pyramid Harbor to Eagle City, Alaska" (Twenty-first Ann. Rept. U. S. Geol. Survey, pt. 2, 1900, pp. 425–424) and "A reconnaissance in the Tanana and White River basins, Alaska" (Twentieth Ann. Rept. U. S. Geol. Survey, pt. 7, 1900, pp. 425–494), both by Alfred H. Brooks. Topographic exploratory maps (scale 1:625,000, or 10 miles to the inch) accompany these reports. Part of this route lies in Canadian territory; and this part is indicated on a map entitled "Map of the Kluane, White, and Alsek rivers, Yukon Territory, Canada," from surveys by International Boundary Commission, 1893–95, J. J. McArthur, 1900, A. C. Talbot, 1899, and J. B. Tyrrell, 1898; scale 1:400,000, James White, geographer (published by the Canadian Department of the Interior, 1905).

The mineral resources of a part of this district are described in "Summary report of R. G. McConnell" (Ann. Rept. Geol. Survey Canada, vol. 16, 1904, pp. 1–18, 1906), illustrated by a sketch map of the Kluane mining district, Yukon Territory.

This route also traverses the upper White River basin, whose topography and mineral resources have been described in a publication entitled "Mineral resources of the Nabesna-White River district," by F. H. Moffit and Adolph Knopf (Bull. U. S. Geol. Survey No. 417, 1910). A topographic map (scale 1:250,000, or 4 miles to the inch, with 200-foot contours) accompanies this report as an illustration. Detailed surveys have been made by the Boundary Commission of the international boundary in the headwater region of White River. The maps resulting from this survey have not yet been published.

The topography and mineral resources of the Fairbanks and Yukon-Tanana region are described in the following publications of the United States Geological Survey:

"The gold placers of the Fortymile, Birch Creek, and Fairbanks regions," by L. M. Prindle (Bull. 251, 1905, 89 pp.).

"The Yukon-Tanana region: Description of Circle quadrangle," by L. M. Prindle (Bull. 295, 1906, 27 pp.).

"The Fairbanks and Rampart quadrangles, Yukon-Tanana region," by L. M. Prindle, with a section on the Rampart placers, by F. L. Hess, and a paper on the water supply of the Fairbanks region, by C. C. Covert (Bull. 337, 1908, 102 pp.).

"Occurrence of gold in the Yukon-Tanana region," by L. M. Prindle (in Bull. 345, 1908, pp. 179–186).

"Water-supply investigations in the Yukon-Tanana region, 1907 and 1908," by C. C. Covert and C. E. Ellsworth (Water-Supply Paper 228, 1909, 108 pp.).

"The Fortymile quadrangle, Yukon-Tanana region," by L. M. Prindle (Bull. 375, 1909, 52 pp.).

"The Fairbanks gold-placer region," by L. M. Prindle and F. J. Katz (in Bull. 379, 1909, pp. 181–200).

"Auriferous quartz veins in the Fairbanks district," by L. M. Prindle (in Bull. 442, 1910, pp. 210–229).

"Geologic reconnaissance of the Fairbanks quadrangle," by L. M. Prindle (in preparation).

"Mining and water supply of Fortymile, Seventymile, Circle, and Fairbanks districts in 1911," by E. A. Porter and C. E. Ellsworth (Bull. U. S. Geol. Survey No. 520–H, 1912, 63 pp.).

"Gold placers between Woodchopper and Fourth of July creeks, upper Yukon River," by L. M. Prindle and J. B. Mertie, jr. (Bull. U. S. Geol. Survey No. 520–G, 1912, 12 pp.).

"The Rampart and Hot Springs regions," by H. M. Eakin (Bull. U. S. Geol. Survey No. 520–I, 1912, 18 pp.).

Many of these publications are illustrated by topographic maps (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours), in addition to which the Survey has issued the following separate maps,

covering areas adjacent to or near the Pyramid Harbor-Fairbanks railway route: Fortymile (No. 640); Circle (No. 641); Fairbanks (No. 642); and Rampart (No. 643), all on scale of 1:250,000, or 4 miles to the inch, with 200-foot contours. A map of the region adjacent to the town of Fairbanks on a scale of 1:62,500, or 1 mile to the inch, with 25-foot contours, has been published as the Fairbanks special (No. 642A). The region adjacent to and north of upper Tanana River has been surveyed (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours), but the map has not been published.

The agricultural resources of the Tanana Valley are discussed in the annual reports of the Alaska Experiment Station, by C. C. Georgeson (published by the Office of the Experiment Stations, Department of Agriculture), and the timber in a publication entitled the "Forests of Alaska," by R. S. Kellogg (Bull. Forest Service No. 81, U. S. Dept. of Agr., 1910).

Some private railway surveys have been run over a part of the Haines-Fairbanks route. These are probably on file in the General Land Office and in the archives of the Canadian Government, but they have not been examined by the writer.

YAKUTAT BAY-ALSEK ROUTE.

A map of Yakutat Bay has been published by the Coast and Geodetic Survey as Chart No. 8455, and the approaches are described in United States Coast Pilot, Pacific Coast, Alaska, Part I (U. S. Coast and Geodetic Survey, 1908). The geography, geology, and mineral resources of the region are discussed in reports entitled "The Yakutat Bay region," by R. S. Tarr and B. S. Butler (Prof. Paper U. S. Geol. Survey No. 64, 1909), and "Reconnaissance on the Pacific coast from Yakutat to Alsek River," by Eliot Blackwelder (in Bull. U. S. Geol. Survey No. 314, 1907, pp. 82–88).

Topographic reconnaissance surveys of the coastal slope of the mountains stretching eastward from Yakutat Bay to the Alsek were made by boundary commission surveyors in 1888–1891. These have been published on a scale of 1:160,000, with 250-foot contours (Alaska Boundary Tribunal Atlas, vol. 3, Washington, 1904). A more detailed survey of this region has recently been made by the boundary commission, but the results have not yet been published. This survey was carried up Alsek River to the Canadian boundary. There remain about 50 miles of the Alsek Valley which have not been surveyed.

ROUTES TO BERING RIVER COAL FIELDS.

Katalla Harbor and Controller Bay are shown on Coast and Geodetic Survey Chart No. 8513. The approaches and hydrography are described in "Alaska Coast Pilot Notes from Yakutat Bay to Cook

Inlet and Shelikoff Strait" (Coast and Geodetic Survey, 1910). The hydrography and approaches to Cordova are shown on Charts Nos. 8550 and 8520 (Coast and Geodetic Survey) and are described in "Alaska Hydrographic Notes, sailing directions, etc." (Bull. Coast and Geodetic Survey No. 38, 1899). There is also a voluminous literature consisting chiefly of congressional documents bearing on this subject. The titles of two of these are given below:

"Chugach National forest lands, Alaska. Letter from Secretary of the Interior, including map of Controller Bay region with proposed railways" (S. Doc. No. 12, 62d Cong., 1st sess., 1911).

"Controller Bay lands. Hearings before the Committee on Expenditures in the Interior Department of the House of Representatives, on House Resolution No. 103," 1911.

The topography, geology, and coal resources of Bering River field are described in detail in a report entitled "Geology and mineral resources of the Controller Bay region," by G. C. Martin (Bull. U. S. Geol. Survey No. 335, 1908, 141 pp.). This report is accompanied by maps showing topography, geology, and coal resources (scale 1:62,500, 1 mile to the inch, with 50-foot contours). The topographic map has also been issued as a separate sheet under the title "Controller Bay region" (No. 601A). In 1911 the Bureau of Mines investigated the conditions of coal mining in the Bering River coal field, but the report has not yet been printed. Much information regarding the Bering River coal field is also contained in the "Hearings held before the Joint Committee of Congress relative to the investigation of the Department of the Interior and the Bureau of Forestry," volumes 1–7, 1910, and in the Message from the President of the United States transmitted in response to Senate Resolution No. 112, of December 21, 1909, 1910, pages 805. The maps of the Controller Bay region by the Geological Survey, already listed (Bull. 335), are reprinted in this document.

Many private railway surveys have been made from Controller Bay, Katalla, and Cordova, the results of which are on file in the General Land Office. Among these are the surveys of the Alaska Pacific Railway & Terminal Co., the Copper River & Northwestern Railroad, the Controller Bay Railway & Navigation Co., the Controller Bay & Bering Coal Railway, the Catalla & Carbon Mountain Railway, the Bering River Railroad, and the Kusktaka & Southern Railway.

ROUTE FROM CORDOVA TO FAIRBANKS.

The publications relating to Cordova, the coastal terminal of this route, have been referred to above. The mineral resources of the region around Cordova are discussed in a report entitled "Reconnaissance of the geology and mineral resources of Prince William

Sound," by U. S. Grant and D. F. Higgins (Bull. U. S. Geol. Survey No. 443, 1910, 89 pp.). The geology and mineral resources of the lower Copper River and Chitina regions are described in a report entitled "Mineral resources of the Kotsina-Chitina region," by F. H. Moffit and A. G. Maddren (Bull. U. S. Geol. Survey No. 374, 1909, 103 pp.). This report is accompanied by a topographic map of the lower Copper River region (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours). The United States Geological Survey has also investigated and surveyed the Bremner River-Hanagita Valley region, which is tributary to this route. The maps based on these surveys are being drawn on a scale of 1:250,000 (4 miles to the inch) and a report is being prepared. A preliminary statement of the results of this survey has been published under the title "The Taral and Bremner River regions," by F. H. Moffit (in Bull. U. S. Geol. Survey No. 520–B). A detailed account of the Nizina district has been published under the title "Geology and mineral resources of the Nizina district," by F. H. Moffit and S. R. Capps (Bull U. S. Geol. Survey No. 448). This is accompanied by a detailed topographic map (scale, 1:62,500, or 1 mile to the inch, with 50-foot contours).

A statement of the topography and mineral resources of the central Copper River region, including that part of the route lying between Copper Center and Delta River, has been published as "Geology of the central Copper River region," by W. C. Mendenhall (Prof. Paper U. S. Geol. Survey No. 41, 1906, 133 pp.). This paper is accompanied by a topographic map (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours). The region tributary to the upper Delta was surveyed and investigated in 1910, and a report published entitled, "Headwater regions of Gulkana and Susitna rivers," by F. H. Moffit (Bull. U. S. Geol. Survey No. 498). This report is accompanied by a topographic map (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours). In 1910 surveys and investigations were also made in the region lying west of Delta River and forming part of the Tanana River basin. The results are printed in a report entitled, "The Bonnifield region," by S. R. Capps (Bull. U. S. Geol. Survey No. 501), which is accompanied by a topographic map (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours). The publications relating to the Tanana Valley and to the Fairbanks district have already been listed (pp. 81–82).

A number of private surveys for railways over the Cordova-Fairbanks route have been filed in the General Land Office, a complete list of which is not at hand. These include those of the Copper River & Northwestern Railway Co., the Copper River Railway Co., and the Alaska Pacific Railway & Terminal Co.

ROUTES FROM VALDEZ TO FAIRBANKS.

Coast Survey charts Nos. 8519, 8520, 8521, and 8550 cover Port Valdez and its approaches. Sailing directions and descriptions of hydrography for this region are contained in "Alaska Coast Pilot Notes from Yakutat Bay to Cook Inlet" (Coast and Geodetic Survey, 1910).

The mineral resources of the vicinity of Valdez are discussed in "Reconnaissance of the geology and mineral resources of Prince William Sound," by U. S. Grant and D. F. Higgins (Bull. U. S. Geol. Survey No. 443, 1910, 89 pp.), and in "Gold deposits near Valdez," by Alfred H. Brooks (Bull. U. S. Geol. Survey No. 520–D, 1912). A detailed topographic survey of the Valdez mining district has been made, and the map is now being prepared (scale, 1:62,500, or 1 mile to the inch, with 100-foot contours). The Marshall Pass route from Valdez has not been mapped by the Geological Survey, though several private surveys of it have been made. The Thompson Pass route is shown on the topographic map of the lower Copper River region, published as an illustration (Pl. I) in Bulletin 374 (U. S. Geol. Survey) and not issued separately. Both these routes are described by Edward Gillette in a report to Capt. W. R. Abercrombie, United States Army, contained in "Copper River Exploring Expedition, 1899, Capt. W. R. Abercrombie, Second United States Infantry, commanding," Washington, 1900 (pp. 139–149). There are also references to this route in "Hearings of Committee on Territories of the House of Representatives on Transportation in Alaska" (62d Cong., 2d sess., Feb. 27 and Apr. 6, 1912). Beyond the coastal barrier the Valdez-Fairbanks route is identical with the Cordova-Fairbanks route. (See pp. 83–84).

No complete list is at hand of the numerous private railway surveys extending inland from Valdez on file in the General Land Office. Among these are those of the Alaska Central Railway Co., the Akron, Sterling & Northern Railroad Co., the Alaska Home Railway Co., the Copper River & Northwestern Railway Co., the Valdez-Yukon Railroad Co., the Valdez, Copper River & Tanana Railroad Co., the Valdez & Northern Railroad Co., and the Valdez, Marshall Pass & Northern Railroad Co.

ROUTE FROM SEWARD TO FAIRBANKS.

Seward is located on Resurrection Bay, which is shown on Chart No. 3538 of the Coast and Geodetic Survey. Sailing directions for this part of coast are included in "Alaska Coast Pilot Notes from Yakutat Bay to Cook Inlet" (Coast and Geodetic Survey, 1910).

The approaches to Seward on Resurrection Bay are shown on Chart No. 8538 of the Coast and Geodetic Survey. A discussion of the

mineral resources in the vicinity of Seward has been published under the title "Preliminary report on the mineral resources of the southern part of the Kenai Peninsula," by U. S. Grant and D. F. Higgins (in Bull. U. S. Geol. Survey No. 442, pp. 166–176, 1910). A general account of the topography and resources of the Kenai Peninsula has been published as "Mineral resources of Kenai Peninsula," by F. H. Moffit and R. W. Stone (Bull. U. S. Geol. Survey No. 277, 1906, 88 pp.). This is accompanied by a map (scale, 1:250,000, or 4 miles to the inch), which shows the main drainage lines and the chief features of the topography of the northeastern part of the peninsula.

A study of the gold deposits of the northeastern part of Kenai Peninsula was made in 1911, the preliminary results of which have been published as "Gold deposits of the Seward-Sunrise region, Kenai Peninsula," by B. L. Johnson (Bull. U. S. Geol. Survey No. 520–E, 1912). In 1911 a topographic survey was carried over the northern part of the peninsula, including the route of the Alaska Northern Railway as far as Turnagain Arm. The map based on these surveys is now being prepared, to be published on a scale of 1:250,000, or 4 miles to 1 inch, with 200-foot contours.

The topography and mineral resources of the region traversed by the railway route from Turnagain Arm to Talkeetna River are discussed in a publication having the title "Geologic reconnaissance in the Matanuska and Talkeetna basins," by Sidney Paige and Adolph Knopf (Bull. U. S. Geol. Survey No. 327, 1907, 71 pp.). A topographic map (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours) accompanies this report.

The Matanuska coal fields, which are tributary to this route, have been described in a report entitled "A reconnaissance of the Matanuska coal field in 1905," by G. C. Martin (Bull. U. S. Geol. Survey No. 289, 1906, 36 pp.). A more detailed account is contained in "Geology and coal fields of the lower Matanuska Valley," by G. C. Martin and F. J. Katz (Bull. U. S. Geol. Survey No. 500, 1912). A detailed topographic map (scale, 1:62,500, or 1 mile to the inch, with 100-foot contours) and a detailed geologic map, showing distribution of coal, accompany this report. In 1911 the Bureau of Mines investigated the conditions of coal mining in the Matanuska field, but the report on this investigation has not yet been issued. A study of the gold-bearing lodes of the Willow Creek district, which lies adjacent to this railway route, was made in 1910 and the results were published as "A reconnaissance of the Willow Creek gold region," by F. J. Katz (in Bull. U. S. Geol. Survey No. 480, 1911, pp. 139–152).

The general features and resources of the Susitna Valley are described in "The Mount McKinley region," by Alfred H. Brooks (Prof. Paper U. S. Geol. Survey No. 70, 234 pp.). A topographic map, which includes that part of the route lying between Turnagain

Arm and Fairbanks, accompanies this report (scale, 1:625,000, or 10 miles to the inch, with 200-foot contours).

The auriferous deposits of the Yentna basin were investigated in 1911 and a preliminary statement of results has been published as "Gold placers of the Yentna district," by S. R. Capps (Bull. U. S. Geol. Survey No. 520–F, 1912, 31 pp.).

In 1910 a survey and investigation was made of the region east of and adjacent to that part of this route lying north of the Alaska Range. A report on this work, called "The Bonnifield region," by S. R. Capps (Bull. U. S. Geol. Survey No. 501), is in print. It is illustrated by a topographic map (scale, 1:250,000, or 4 miles to the inch, with 200-foot contours). The publications relating to resources and topography of the Tanana Valley have already been listed elsewhere (pp. 81–83).

The following congressional committee hearings pertain largely to the Seward-Fairbanks Railway route:

Hearings before the Committee on Territories of the House of Representatives on S. 2534, "An act to extend the time of completion of the Alaska Northern Railway, and for other purposes," December 9, 1911.

Hearings of the Committee on the Territories of the House of Representatives on Conditions in Alaska, February 10, 1912.

Hearings before the Committee on the Territories of the House of Representatives on Transportation in Alaska, March 5 and April 6.

"Government Railroad in Alaska": Hearing before the Committee on Public Lands, United States Senate, Sixty-second Congress, second session, May 22, 1912.

The Alaska Central Railway Co. and its successor, the Alaska Northern Railway Co., have made numerous surveys along this railway route. These are probably for the most part on file in the General Land Office.

ROUTE FROM COOK INLET TO KUSKOKWIM.

The upper part of Cook Inlet is shown on chart No. 8553 and Iliamna Bay on chart No. 8665 of the Coast and Geodetic Survey. Sailing directions for this part of the coast are contained in "Alaska Coast Pilot Notes from Yakutat Bay to Cook Inlet" (Coast and Geodetic Survey, 1910). The geography, geology, and mineral resources of the region lying between Cook Inlet and Lake Clark are described in "A geologic reconnaissance of Iliamna region," by G. C. Martin and F. J. Katz. This is accompanied by a topographic map on a scale of 1:250,000 (4 miles to the inch), with 200-foot contours.

No surveys have been made between Lake Clark and the Kuskokwim. Some account of the geography of the Mulchatna Valley is included in "A biological reconnaissance of the base of the Alaska Peninsula" (North American Fauna No. 24, Dept. of Agriculture, 1904), which is accompanied by a sketch map. The Middle Kuskokwim Valley and the Innoko placer district, which are tributary to this route, are described in "The Innoko gold placer district, Alaska," by A. G. Maddren (Bull. U. S. Geol. Survey No. 410). This is accompanied by a map (scale 1:625,000, or about 10 miles to the inch). A more recent account of the gold placers of this region has been published under the title "Gold placer mining developments in the Innoko-Iditarod region," by A. G. Maddren (Bull. U. S. Geol. Survey No. 480, 1911, pp. 236–370). The topographic survey of the Innoko-Iditarod region has been made (scale 1:250,000, or 4 miles to the inch, with 200-foot contours), but the resulting map has not yet been published.

The Alaska Short Line Railway Co. has made preliminary surveys of a route from Iliamna Bay to the Yukon. Its plats and notes are undoubtedly on file in the General Land Office, but the writer has not examined them.