

INVESTIGATION OF THE MINERAL RESOURCES OF ALASKA IN 1910.

By ALFRED H. BROOKS and others.

ADMINISTRATIVE REPORT.

By ALFRED H. BROOKS.

PREFACE.

This volume is the seventh¹ of the series issued annually by the Geological Survey, each of which summarizes for the year both the conditions of the mining industry and the most important results obtained by the investigations of the mineral wealth. The purpose of these reports is to furnish a convenient handbook for those interested in the mining industry of Alaska and to make available the more important economic results of the year's surveys in advance of the publication of complete reports, which usually require at least six months for office preparation by the author and then, because each must await its turn, from two or three months to a year for publication. In a region like Alaska, where developments are going on rapidly, such a delay after the completion of the field work may seriously impair the value of the publication to the prospector. On the other hand, the publication of the advance statements in these progress reports implies hasty preparation and in some cases the presentation of conclusions which may be changed by the more exhaustive office study. Therefore those interested in any particular district are urged to procure a copy of the more complete report as soon as it is issued.

The same arrangement will be maintained in this volume as in those previously issued. First will be presented papers of a general character, followed by those referring to special districts, which will be arranged geographically from south to north. This bulletin contains 15 papers by 11 authors, of which 2 deal with administrative

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.

matters, 3 are summaries of some features of the mining industry, and the remainder deal more specifically with problems of economic geology.

In the preparation of the summaries of the mining industries the writer, as in previous years, has in part been dependent on information gleaned from various sources, for it is impossible with the small force available to have a representative of the Survey visit each of the many Alaska mining districts. These summaries could not be prepared were it not for the cordial cooperation of the residents of the Territory, including mine operators, Federal officials, officers of banks and of transportation and commercial companies, mining engineers, and many prospectors. It would be impossible to enumerate all those who have contributed information, but special acknowledgment should be made to the following: The Director of the Mint; S. Irvine Stone, of Kodiak; Melvin Dempsey, of Dempsey; H. S. Ferris and H. P. Gallagher, of Susitna; W. M. Harrison, of Cache Creek; E. R. Stivers, of Fortymile; J. J. Hillard, of Eagle; Ralph Donaldson, of Rampart; Benjamin F. Baker and Joseph H. Eglar, of Tofty; William A. Fitzpatrick, of Chena; D. H. Boyer, Alaska Pacific Express Co., First National Bank, and Washington, Alaska & Fairbanks Banking Co., of Fairbanks; F. J. Marsh, of Caro; John A. Dexter, of Chenik; C. W. Thornton, of Solomon; and J. W. J. Reed, of Nome.

During the season of 1910, 12 parties were engaged in Alaskan surveys for varying lengths of time between April 1 and October 17. In addition to these the geologist in charge did some field work. The personnel of these parties included 12 geologists, 4 topographers, 2 engineers, and 27 packers, cooks, etc. In addition to these some gage readers were employed who gave only part of their time to the work. Four of the parties were engaged in geologic work, two in both geologic and topographic surveys, four in topographic surveys, and two in investigating water resources.

The areas covered by geologic reconnaissance surveys, on a scale of 1 : 250,000 (4 miles to the inch), amount to 8,635 square miles; by detailed geologic surveys, on a scale of 1 : 62,500 (1 mile to the inch), 321 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. Some 13,815 square miles of topographic reconnaissance surveys, on a scale of 1 : 250,000 (4 miles to the inch), and 36 square miles of detailed topographic surveys, on a scale of 1 : 62,500 (1 mile to the inch), were completed.

In 1910, 54 gaging stations were maintained in the Yukon-Tanana region for an average of 143 weeks each, furnishing data on the water resources of about 4,700 square miles. Fifteen gaging stations

were also maintained for 170 weeks in Seward Peninsula, yielding data on the run-off of some 1,800 square miles.

To state the work geographically, two parties were in southeastern Alaska, three in the Copper River and Susitna basins, one in the Matanuska Valley, three in the upper Yukon basin, two in the Innoko-Iditarod region, and one in the Kobuk region.

Among the important results of the year were the completion of the detailed survey of that part of the Juneau gold belt which lies between Salmon Creek and Berners Bay and of the part of the Matanuska coal field lying west of Chickaloon River and the completion of the geologic and topographic reconnaissance mapping of the Bonni-field district, the Valdez Creek region, and the most important part of the Innoko and Iditarod region. The accumulation of data on the water resources of the Yukon-Tanana region and of Seward Peninsula is yielding results of importance to the placer-mining industry.

The following table shows the allotment, including both field and office expenses, of the total appropriation of \$90,000 to the districts investigated:

Allotment to Alaskan surveys and investigations in 1910.

Southeastern Alaska.....	\$5,100
Copper River region.....	27,000
Matanuska region.....	9,600
Upper Yukon basin.....	23,800
Innoko-Iditarod region.....	14,100
Northwestern Alaska, including Seward Peninsula.....	10,400
	<hr/>
	90,000

In the following table the approximate amount of money devoted to each class of investigations and surveys is indicated. It is not possible always to give the exact figures, as in some cases the same party or even the same man has 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 1910.

Geologic reconnaissance surveys.....	\$26,500
Detailed geologic surveys.....	11,500
Special geologic investigations.....	2,500
Topographic reconnaissance surveys.....	32,000
Detailed topographic surveys.....	1,600
Investigation of water resources.....	4,600
Collection of statistics of mineral production.....	1,100
Miscellaneous, including clerical salaries, administration, inspection, instruments, office supplies, and equipment.....	10,200
	<hr/>
	90,000

Allotments for salaries and field expenses, 1910.

Scientific and technical salaries.....	\$29, 330
Field expenses.....	51, 765
Clerical and other office salaries.....	8, 905
	<hr/> 90, 000

The following table exhibits the progress of the Alaskan investigations 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, 1898-1910.^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.
		<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Sq. m.</i>	<i>Miles.</i>			
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	6, 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
	871, 189. 60	60, 700	60, 535	2, 870	47, 680	99, 585	2, 811	459	72		
Percentage of total area of Alaska....		10. 35	10. 32	0. 49	8. 16	16. 98	0. 48				

^a The areas presented in this table differ somewhat from those published previously to 1909. 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 engaged in office work at Washington until August 3, when he proceeded to Alaska, reaching Valdez on August 15. A day was spent in visiting the Cliff mine, and the journey was continued to Seward and then to Knik, two days being spent en route in studying the geology in the vicinity of Kern Creek. From Knik

the writer proceeded to Mr. Martin's camp, which was reached on August 23. The following two weeks were spent in studying the geology of the Matanuska coal field, and then the writer returned to Seward. A day at Knik and several days at Seward were utilized in collecting data to be used for planning subdivisional surveys in this general region. (See pp. 15-20.) Returning, the writer reached Washington on September 30.

Of the time spent in the office the geologist in charge has devoted about 30 days to the completion of the Mount McKinley report (Professional Paper 70), about 50 days to the progress report, 15 days to subdivisional surveys (see pp. 15-20), and the rest to routine and miscellaneous matters.

R. H. Sargent continued the general supervision of the topographic surveys and map compilation, as in the previous year, but since July 1 his time has been largely devoted to the subdivisional surveys of Alaska public lands.

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 the collection of statistics of production of precious metals in Alaska.

The office study of the problems relating to the stratigraphy of Alaskan Tertiary coal measures was continued by W. W. Atwood during such time as he could spare from his college work. As the correlating of the coal measures of different parts of the Territory depends on the determination of their fossil plants, Arthur Hollick was employed for a part of the year on a systematic study of the large amount of paleobotanic material already collected.

SOUTHEASTERN ALASKA.

Adolph Knopf was employed from June 3 to September 7 in completing the detailed geologic mapping and study of the mineral resources of the Eagle River region. In this time he covered an area of 125 square miles. He then devoted 11 days to studying special mining problems near Juneau, 5 days to the Sitka mining district, and 11 days to collecting data on the mining developments in other parts of southeastern Alaska. (See pp. 94-110.)

J. W. Bagley, assisted by C. E. Giffin, spent the time from May 6 to June 6 in detailed topographic mapping of an area of 36 square miles in the vicinity of Mendenhall River, thus completing the surveying of the Eagle River district.

C. W. Wright was employed from July 6 to September 17 in continuing the work of preparing a report on the geology and mineral resources of Kasaan Peninsula and Hetta Inlet region. Unfortunately, he was called back to his professional work in Sardinia before he could complete his report, but he has promised an early completion.

COPPER RIVER AND SUSITNA REGION.

D. C. Witherspoon and C. E. Giffin began a topographic reconnaissance survey in the upper Chistochina region on July 1 and carried it westward into the Susitna basin, including the Valdez Creek placer district. The party was divided into two sections and continued work until September 12, covering an area of 4,980 square miles.

F. H. Moffit, assisted by B. L. Johnson, made a geologic reconnaissance survey of the southern front of the Alaska Range between the Fairbanks trail and Valdez Creek. He also made a reexamination of the Chistochina placer district, which had previously been mapped by W. C. Mendenhall. The Moffit party began work July 8 and continued until September 3. A geologic reconnaissance map of about 1,000 square miles was completed, in addition to which the topographic surveys and geologic notes furnished by the Witherspoon party furnished a general knowledge of the areal distribution of the principal formations over some 2,000 square miles. A preliminary statement of Mr. Moffit's results is presented on pages 112-126.

PRINCE WILLIAM SOUND AND KENAI PENINSULA.

No field work was done in the Prince William Sound and Kenai Peninsula regions other than that accomplished by the geologist in charge (p. 8). U. S. Grant has continued, so far as his collegiate duties permitted, the work of writing a report on the eastern part of the Kenai Peninsula.

MATANUSKA VALLEY.

G. C. Martin, assisted by F. J. Katz and Theodore Chapin, made a detailed geologic survey of that part of the Matanuska coal field lying between Moose Creek on the west and Chickaloon River on the east. An area of 196 square miles was surveyed during the period extending from June 3 to September 8. (See pp. 128-138.) At the close of the season Mr. Katz, assisted by Mr. Chapin, spent about a week in studying the mineral resources of the Willow Creek region. (See pp. 139-151.)

UPPER YUKON BASIN.

No geologic field work was done in the Yukon-Tanana region, but L. M. Prindle spent nine months of the year in preparing a detailed report on the region adjacent to Fairbanks and a more general report on the Fairbanks quadrangle. C. E. Ellsworth and G. L. Parker continued the study of the water resources of the Yukon-Tanana region which was begun in 1907. They began field work at Fairbanks on April 1 and then extended it into the Birch Creek district. Mr. Parker continued stream gaging in the Fairbanks

and Birch Creek districts until September 1, when he went to Nome (p. 12). After organizing the work in these two districts, Mr. Ellsworth went to Eagle, which he reached on June 11, and began a systematic study of the water supply of the Fortymile region. This work was continued until September 19. A summary of the results of these investigations is presented on pages 173-217 of this volume.

J. W. Bagley, topographer, and S. R. Capps, geologist, carried a topographic and geologic reconnaissance survey from the upper Nenana Valley eastward to Delta River. The area surveyed includes 3,135 square miles and is bounded on the south by the crest of the Alaska Range and on the north by the lowlands of the Tanana Valley. These surveys were begun on June 26 and completed on September 13. The area surveyed includes the Bonnifield placer district and the larger part of the Nenana coal field. (See pp. 218-235.)

INNOKO-IDITAROD REGION.

The continued interest in the placer-gold deposits of the Innoko basin, including the newly discovered Iditarod placers, led to extending the work previously done in this field. G. C. Anderson made a topographic reconnaissance survey of an area of 3,200 square miles, extending southward from Ruby Creek, on the Yukon, across the upper Innoko Valley, and including much of the Iditarod basin. A. G. Maddren, assisted by H. E. Birkner, made a geologic reconnaissance survey of about 2,000 square miles of the most important part of the same region, besides investigating the placers of the Innoko and Iditarod districts. (See pp. 236-270.) The work was begun on June 19 and continued until September 16.

NORTHWESTERN ALASKA.

P. S. Smith and H. M. Eakin carried a geologic and topographic reconnaissance survey from the Koyukuk to Kobuk River. The party landed near the mouth of Hogatza River on June 22 and traveled overland to Dahl Creek, on the Kobuk. (See pp. 271-305.) A contract had been made to have supplies delivered at this point, but an accident had prevented delivery and the party was therefore forced to abandon the original plan of extending the survey southwest to Seward Peninsula and made its way down the Kobuk by small boat. This, however, gave opportunity to pay a hasty visit to the newly discovered Squirrel River placer district (see pp. 306-319), where the field work was ended on August 21. In spite of the season's work being curtailed by loss of supplies, an area of 2,500 square miles was covered by geologic and topographic reconnaissance surveys.

Systematic investigations of the water supply of Seward Peninsula have been carried on each year since 1906. The need of investigations

in other parts of Alaska made it impossible to detail an engineer to continue this work in 1910. Through the cooperation of a number of mine operators it has been possible to keep up some gaging stations during the open season of 1910. In addition to the data thus obtained, G. L. Parker spent from September 15 to October 18 in Seward Peninsula in collecting the gage readings furnished by individuals and in making stream measurements. All these data are now being used in the preparation of a summary report on the water resources of Seward Peninsula.

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. There are, unfortunately, still a rather large number of placer-mine operators who 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. It is believed that a large part of those who fail to report their production ignore the request sent by schedule because of the rush of work during the short open mining season. There may be some, however, who dislike to reveal their gold production, even to the Geological Survey. Those operators who have hesitated to furnish the desired information for fear it might be used to their disadvantage are reminded of the fact that the Geological Survey has received confidential information from practically every mining corporation in the States for many years and has never been charged with betraying a confidence. The figures furnished are used only to make up totals of districts, and every precaution is taken to prevent their being published in any way to indicate the output of individuals or corporations unless permission has been explicitly granted in writing.

The attention of all those interested in the advancement of the mining industry of Alaska is directed to the fact that it will be greatly to the advantage of this industry if accurate figures of the gold output of each district are published. If funds were available for sending a representative into each district to collect the required information in person, complete and reliable figures could undoubtedly be had. As it is, the work is still largely done by correspondence, and the address list of operators is by no means complete. It is expected, however, that soon every operator in the Territory will report his production, so that accurate totals for each district can be published. Until this is done the figures of production can be only approximate. Fortunately, there are other though less exact sources of information.

The statement of placer-gold production as presented is, then, based in part on the returns from operators and in part on data furnished by bankers, express companies, Federal officials, and other residents of Alaska.

PUBLICATIONS ISSUED OR IN PREPARATION.

During 1910 the Survey published five bulletins relating to Alaska. Three bulletins, one professional paper, and two maps are in press. The authors' work on two other reports, to appear as bulletins, has been completed, and illustrations for these are being prepared. The office work on eight other reports is sufficiently advanced to make it reasonably certain that they will be ready to submit for publication on or before the 1st of July, 1911. Six other reports will probably be submitted during the year 1911. The reports in press or in preparation include 14 new topographic maps, to be published on scales of 1:500,000, 1:250,000, or 1:62,500.

REPORTS ISSUED.

The Innoko gold-placer district, Alaska, with accounts of the central Kuskokwim Valley and the Ruby Creek and Gold Hill placers, by A. G. Maddren. Bulletin 410.

Mineral resources of the Nabesna-White River district, Alaska, by F. H. Moffit and Adolph Knopf; with a section on the Quaternary, by S. R. Capps. Bulletin 417.

Geology and mineral resources of the Solomon and Casadepaga quadrangles, Seward Peninsula, Alaska, by Philip S. Smith. Bulletin 433.

Mineral resources of Alaska in 1909, by A. H. Brooks and others. Bulletin 442.

Reconnaissance of the geology and mineral resources of Prince William Sound, Alaska, by U. S. Grant and D. F. Higgins. Bulletin 443.

REPORTS IN PRESS.

The Mount McKinley region, Alaska, by A. H. Brooks; with descriptions of the igneous rocks and of the Bonfield and Kantishna districts, by L. M. Prindle. Professional Paper 70.

Geology and mineral resources of the Berners Bay region, by Adolph Knopf. Bulletin 446. [Issued February 16, 1911.]

Geology and mineral resources of the Nizina region, Alaska, by F. H. Moffit and S. R. Capps. Bulletin 448.

Geologic reconnaissance in southeastern Seward Peninsula and Norton Bay-Nulato region, Alaska, by P. S. Smith and H. M. Eakin. Bulletin 449. [Issued June 17, 1911.]

REPORTS IN PREPARATION.

The Yakutat Bay earthquake of September, 1899, by R. S. Tarr and Lawrence Martin. Professional Paper 69.

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

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

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.
- Geology and mineral resources of the Eagle River region, by Adolph Knopf; including detailed geologic and topographic maps.
- Preliminary report on mineral deposits of Sitka region, by Adolph Knopf.
- The headwater region of the Gulkana and Susitna rivers, with an account of the Chistochina and Valdez Creek placers, by F. H. Moffit, including geologic and topographic reconnaissance maps.
- Geology and mineral resources of the southern part of Kenai Peninsula, by U. S. Grant and D. F. Higgins, including geologic reconnaissance maps.
- The coal fields of the lower Matanuska Valley, by G. C. Martin.
- Geology and mineral resources of the Fairbanks district, by L. M. Prindle and F. J. Katz; including detailed topographic and geologic maps.
- The Fairbanks quadrangle, by L. M. Prindle; including geologic and topographic reconnaissance maps.
- The Bonnifield region of the Tanana Valley, by S. R. Capps; 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 and Philip S. Smith; including detailed geologic map.
- The water supply of Seward Peninsula, by F. F. Henshaw and P. S. Smith; including topographic reconnaissance map.

REPORT ON PROGRESS OF SURVEYS OF PUBLIC LANDS IN ALASKA DURING 1910.

By ALFRED H. BROOKS.

INTRODUCTION.

An item in the sundry civil act approved June 25, 1910, provided "for the survey of the lands in the United States in the District of Alaska, \$100,000." In accordance with instructions, the Director of the Geological Survey, on June 25, 1910, submitted plans for the surveys authorized by this item to the Secretary through the Commissioner of the General Land Office. These were approved by the Commissioner and by the Secretary on June 29. In a letter dated June 29 the Director instructed the geologist in charge of the division of Alaskan mineral resources to put the plans into execution.

OUTLINE OF PLANS.

The approved plans authorized the following surveys:

1. The astronomic determination of the latitude, longitude, and azimuth in the vicinity of the initial point of the proposed surveys near Fairbanks.

2. Time permitting, the astronomic determination of latitude, longitude, and azimuth at another point near the mouth of Tanana River which might be used as a reference point for future land surveys in this district.

3. The inauguration of a triangulation system in the vicinity of Fairbanks by which the accurate location of land lines and corners could be determined and which could also be developed so as to permit extensions into other areas where subdivisional surveys are needed.

4. The extension of a base and meridian from the initial point near Fairbanks.

5. The surveying of such township exteriors as were deemed advisable.

6. Time permitting, the subdivision of these townships.

7. The making of reconnaissances in the Copper River, Seward, and Matanuska regions for the sake of obtaining information on which to plan surveys in these provinces.

METHODS OF SURVEY.

The surveys provided for three classes of work—astronomic determination of positions, triangulation, and linear measurement.

The astronomic work was performed by the Coast and Geodetic Survey in accordance with its long-established standards and methods.

The triangulation, including measurement of base, was executed in accordance with the standards and methods of the Geological Survey.

The approved plans authorized the making of linear measurements either by stadia or with steel tape, depending on the physical character of the country to be surveyed. In either method the standard set for accuracy was to be maintained. In practice it was found that the lines actually run could be best measured by steel tape. There is no doubt, however, that under favorable conditions the stadia is applicable and advisable.

The plans approved also provided that the township corners should be tied to triangulation points so far as practical, thus giving an entirely independent check on the line work. It is worthy of note that this is the first time that any subdivisional surveys made by the United States Government have been checked by triangulation. The United States is the only country in the world which does not use geodetic methods in making its land surveys.

Soon after reaching the field the engineers satisfied themselves that in this latitude and under existing climatic conditions the old method of controlling the azimuth of linear surveys by means of solar transit was not practical for the following reasons:

1. Observations on Polaris through the small telescopes of the transits are impracticable before the 10th of August.

2. The altitude of Polaris, about 65° in this latitude, increases the difficulty of accurate observations.

3. The sun's path in this high latitude is such that solar observations for a good part of the day are very unreliable.

4. During the season of 1910, owing to climatic conditions, the sun was visible for solar observations only about one-fifth of the time.

Accordingly the lines were run as plain transit lines on the basis of the azimuth determination made at the astronomic station and transferred to the different lines by the triangulation system. This not only saved time but yielded results of a higher degree of accuracy than could be obtained in this latitude by the old method.

PERSONNEL.

As provided for in the plans submitted, the Superintendent of the Coast and Geodetic Survey detailed the necessary engineers to make the latitude, longitude, and azimuth determinations at Fairbanks and at the mouth of the Tanana.

R. H. Sargent, topographer, was put in charge of the field parties at Fairbanks. C. L. Nelson, W. N. Vance, and S. G. Lunde, topographers, were detailed to assist Mr. Sargent. In addition to these four engineers, who were detailed from the permanent staff of the Geological Survey, four chainmen and one recorder accompanied the party from Seattle. At Fairbanks 21 other men were engaged as rodmen, axmen, packers, cooks, etc.

The personnel of the two line parties and the triangulation party were as follows:

Line parties:

1 engineer in charge.
4 chainmen.
2 flagmen.
3 axmen.
1 cook.
1 teamster.

Triangulation party:

1 engineer in charge.
1 axman.
1 packer.
1 cook.
1 recorder.

Mr. Sargent was directed, after inaugurating the work at Fairbanks, to proceed by trail to Valdez and make the necessary investigations along this route to procure information needed for planning future work in this field.

Mr. Brooks undertook similar investigations in the northeastern part of Kenai Peninsula and in the Matanuska region.

DISTRIBUTION OF TIME OF FIELD PARTIES.

To attain efficient and economic administration, the Fairbanks parties should have gone inland over the winter trail; and had this been done, some field work might have been begun by the 1st of May. As a matter of fact, the money was not available until July 1, and therefore the parties could not leave for the field until that date. Mr. Sargent, Mr. Nelson, and Mr. Lunde, with four chainmen and one recorder, sailed from Seattle on July 5 and arrived at Fairbanks, by way of the White Pass route, on July 22. The field parties were at once organized and the measurement of a base line was begun the following day. Mr. Vance, whose departure from Seattle had been unavoidably delayed, reached Fairbanks on August 8. On August 9 line work was begun by two parties and continued until about October 7. Meanwhile the third party had been engaged in triangulation. Topographic surveys along the surveyed lines was begun about October 10 and continued until about October 20, when stormy weather necessitated the disbanding of the field parties.

Mr. Sargent organized the work at Fairbanks and continued with the parties until September 15. He then spent 14 days in investigating conditions which would affect future surveys in the region traversed by the Valdez-Fairbanks trail.

Mr. Brooks was detained in Washington by office duties until August 3. He sailed from Seattle on August 8 and arrived at Seward

on August 18. Continuing his journey, he arrived at Knik on August 20. From August 21 until September 9 he spent in the Knik Arm and Matanuska region. Returning, he sailed from Seward for Seattle on September 17.

The combined time of Mr. Vance and Mr. Lunde, chiefs of the line parties, from the dates of their leaving the office to their return, was 281 days, a detailed account of which follows:

	Days.
Travel to field and return.....	113
Measuring triangulation base line and constructing astronomic stations.....	14
Line work.....	85
Topographic surveying.....	21
Field computations and office work.....	5
Outfitting.....	3
Stormy weather.....	14½
Moving camp.....	12½
Days observed as Sundays.....	13
	<hr/> 281

Upon Mr. Sargent's departure, Mr. Nelson was left in charge of the field work and thereafter devoted the larger part of his time to administrative duties. He was employed 43 days on field work in connection with the triangulation, 48 days on supervision and computation, 50 days in traveling, and 10 days in outfitting.

RESULTS.

Astronomic determinations.—An astronomic determination of latitude, longitude, and azimuth was made at a station near Fairbanks by the Coast and Geodetic Survey. A similar determination was made at Tanana, a settlement on the west bank of the Yukon, at the mouth of Tanana River. This was in accordance with the approved plans and an agreement made between the Secretary of the Interior and the Secretary of Commerce and Labor under date of July 5, 1910. The Superintendent of the Coast and Geodetic Survey transmitted the results of the final computations of these observations on February 6, 1911.

Triangulation.—A base line was measured and a system of triangulation inaugurated, the geodetic position of which was based on the astronomic observations. This triangulation not only checked the line surveys but can also be extended into adjacent parts of the Tanana Valley to provide points from which land surveys of important areas may be executed in the future. By this means the projection of long standard parallels and guide meridians through areas of no commercial importance will be avoided.

The primary triangulation stations are marked by bronze tablets, furnished by the General Land Office, firmly set in concrete or solid

rock. Preparatory to the future expansion of the triangulation system six signals have been constructed on prominent hills in the Tanana Valley.

Summary of triangulation.

Base line measured.....	feet..	13,876.674
Primary stations occupied.....		12
Secondary stations occupied.....		15
Points intersected.....		3
Signals constructed.....		6

Line work.—The line work consisted chiefly of extending base and meridian lines and the survey of township exteriors. Some section lines and a few meanders were also run. The geodetic position of the initial point was determined by triangulation. It seemed desirable not to attempt the sectionizing of the townships until the matter of the rights of the homesteaders had been settled.

Summary of line surveys.

	Miles.
Principal meridians.....	23.7
Base line.....	18
Township exteriors.....	43.7
Section lines.....	11.8
Meanders.....	11.7
	<hr/>
	108.9

It was impossible to ship iron posts to Fairbanks in time to make them available for the season's work. Wooden posts were therefore set, properly inscribed and witnessed in accordance with the regulations of the General Land Office.

The number of corners set was as follows:

Initial point.....	1
Township corners.....	7
Standard township corners.....	3
Closing township corners.....	3
Section corners.....	76
Quarter corners.....	88
Meander corners.....	8
Witness corners.....	8

COST OF SURVEYS.

The expenditures for public-land surveys in Alaska to and including May 15, 1911, were as follows:

Geological Survey.....	\$32,591.02
Coast and Geodetic Survey.....	2,013.06

The estimated liabilities are \$528.19. The total cost of these surveys is therefore \$35,132.27.

OFFICE WORK.

Mr. Nelson was furloughed on January 12, thus leaving Messrs. Sargent, Vance, and Lunde to work upon the notes and plats.

The following data were transmitted to the Commissioner of the General Land Office on May 15, 1911: Notes and plats of land lines; results of astronomic observations; notes and results of triangulation base measurements, all corrections being computed; notes and results of the triangulation with least-square adjustment applied.

RECOMMENDATION FOR CONTINUATION OF SURVEYS.

If the policy established last year of surveying the arable lands, especially those which are now being taken up as homesteads, is to be continued, there are three general provinces in which work should be done—the Tanana Valley, the Cook Inlet region, and the Copper River valley.

In the Tanana Valley the subdivision of townships whose exteriors have already been surveyed should be completed and the surveys should be extended by means of the triangulation system into adjacent areas where homesteads have been taken up.

In the Copper River region the positions of the base and meridian lines already surveyed should be astronomically determined, so that the township surveys in this field can be accurately tied to other Alaskan surveys. To obtain an accurate datum for elevations, a line of primary levels should be run from Cordova to Fairbanks. A triangulation should be carried up the Chitina Valley, so as to provide a tie point for subdivisinal surveys, which will soon be needed in this field because of the demands of settlers now being attracted by the railway that is under construction. Plans should be made to subdivide the arable lands in the Chitina Valley.

In the Cook Inlet region it seems desirable to subdivide the flats and floors of tributary valleys adjacent to Resurrection Bay. These surveys should be tied to triangulation points of the Coast and Geodetic Survey. It is also desirable to begin township surveys at Knik and at Seward, covering the arable lands of the vicinity. These surveys should also be tied to the Coast and Geodetic Survey triangulation.

If the coal fields are to be subdivided, work should be begun in the Bering River, Matanuska, and Nenana fields. The surveys in the Bering River field should be tied by triangulation to points of known position on the coast. The Matanuska surveys should be tied by triangulation to Coast Survey points on Knik Arm. The Nenana field can readily be reached by extending the Fairbanks triangulation southward.

It is furthermore recommended that authority be obtained, by legislation if necessary, to permit the boundaries of bona fide homesteads to stand as recorded. All the members of the Geological Survey who are conversant with the conditions are agreed that if the rights to lands as recorded by homesteaders are not recognized grave injustice may be done.