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DEPARTMENT OF COMMERCE AND LABOR

REPORT OF THE SUPERINTENDENT

OF THE

COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

FROM

JULY 1, 1907, TO JUNE 30, 1908

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National Oceanic and Atmospheric Administration

Annual Report of the Superintendent of the Coast Survey

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LETTER OF TRANSMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
OFFICE OF THE SECRETARY,
Washington, September 11, 1908.

SIR: In compliance with the requirements of section 4690, Revised Statutes, I have the honor to transmit herewith, for the information of Congress, a report submitted to this Department by Mr. O. H. Tittmann, Superintendent of the Coast and Geodetic Survey, showing the progress made in that work during the fiscal year ended June 30, 1908. It is accompanied by maps illustrating the general advance in the operations of the Survey up to that date.

Respectfully,

OSCAR S. STRAUS,
Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
COAST AND GEODETIC SURVEY,
Washington, September 11, 1908.

SIR: In conformity with law and with the regulations of the Department of Commerce and Labor, I have the honor to submit herewith, for transmission to Congress, the Annual Report of progress in the Coast and Geodetic Survey for the fiscal year ended June 30, 1908. It is accompanied by maps illustrating the general advance in the field work of the Survey up to that date.

Respectfully,

O. H. TITTMANN,
Superintendent.

To Hon. OSCAR S. STRAUS,
Secretary of Commerce and Labor.

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CONTENTS.

REPORT OF THE SUPERINTENDENT.

		Page.
REPORT OF THE SUPERINTENDENT		7
I.	Office of Assistant in Charge	12
II.	Office of Inspector of Hydrography and Topography	13
III.	Office of Inspector of Geodetic Work	15
IV.	Office of Inspector of Magnetic Work	15
V.	Office of Disbursing Agent	17
VI.	Office of Editor of Publications	18
APPENDIX 1.	Details of field operations	19
2.	Details of office operations	59
3.	Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1907, and June 30, 1908	69

ILLUSTRATIONS.

1.	Distribution of the principal astronomic stations occupied to June 30, 1908	In pocket
2.	Positions and connections of telegraphic longitude stations to June 30, 1908	In pocket
3.	Routes of geodetic spirit leveling and positions of gravity and tide stations to June 30, 1908	In pocket
4.	Positions of magnetic stations occupied to June 30, 1908	In pocket
A.	Sketch of general progress, Eastern sheet	In pocket
B.	Sketch of general progress, Western sheet	In pocket
C.	Sketch of general progress, Alaska	In pocket
D.	Sketch of general progress, Hawaii and Porto Rico	In pocket
E.	Sketch of general progress, Philippine Islands	In pocket

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THE REPORT OF THE SUPERINTENDENT.

THE WORK OF THE YEAR.

FIELD WORK.

An important feature of the work of the year is the completion of the reconnaissance for the extension of the primary triangulation from the ninety-eighth meridian in central Texas across New Mexico, Arizona, and California to the triangulation of the same class which extends along the Pacific coast across California, Oregon, and Washington. This reconnaissance extends along an arc of the parallel for a distance of nearly 2 000 kilometers (1 200 miles), and the work was begun and completed during the year.

The triangulation when completed will connect with the international boundary between the United States and Mexico in many places and will make it possible to replace this boundary exactly in position even if the monuments which now mark the boundary were removed or destroyed. Several detached schemes of triangulation done by the United States Geological Survey will be connected and numerous geographic positions will be determined in the States and Territories through which the triangulation passes.

In addition to the importance of the work as a contribution to geographical knowledge it will also furnish important data for a better determination of the figure of the earth.

The completion of the triangulation along the ninety-eighth meridian is an interesting feature of the work of the year. This triangulation now extends across the country from Canada to Mexico and furnishes numerous geographic positions in Minnesota, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas.

The work also forms an important meridional arc which this country has contributed to the International Geodetic Association for the study of the figure of the earth.

The extension of this arc in Mexico has made good progress under the patronage of the Mexican Government, and the Dominion of Canada has begun a geodetic survey as a permanent basis for all future geographic and economic surveys in which great accuracy is desirable.

The principal governments of the world have joined in advancing the work of the International Geodetic Association for the study of the figure of the earth and other interesting physical problems which concern all mankind more or less directly, and it is most gratifying to know that the Dominion of Canada is following the home country and her other colonies in extending geodetic work gradually over their territory as demanded by their economic development. In this connection it is hoped that the

triangulation along the ninety-eighth meridian will be extended northward in the Dominion as rapidly as the economic conditions will admit.

It gives me great satisfaction to report this substantial progress in the work of covering the country with fundamental geographic positions which form the base of all geographic maps and may be used in all geographic investigations for the material development and improvement of the country.

The work of opening and remonumenting the boundary line between the United States and Canada west of the Rocky Mountains was continued and the monuments were finally inspected and numbered from the summit of the Rocky Mountains to the east side of Lake Osoyoos, a distance of 387 kilometers (242 miles). This work is now in progress and will probably be completed during the present year.

The work of surveying and remarking the boundary east of the Rocky Mountains was begun north of the State of Montana and similar work was continued and completed north of the State of Vermont. Work on the Maine-New Brunswick boundary was begun and was in progress on June 30. The surveys along the boundary include triangulation and a topographic survey of the region adjacent to the boundary on both sides.

The demarcation of the Alaska-Canada boundary in southeastern Alaska has made steady progress whenever the climatic conditions were suitable, and gratifying progress was made along the one hundred and forty-first meridian. South of the Yukon River, sites for 19 monuments were selected and the line was opened for a distance of 86 kilometers (54 miles).

In this work a representative of the British Commissioner accompanies the United States parties and a representative of the United States Commissioner accompanies the Canadian parties.

In connection with the survey of the Alaska boundary along the one hundred and forty-first meridian special attention is called to the fact that the triangulation which is being extended along this meridian, as a fundamental part of the proper demarcation of the line, will furnish geographic positions from Mount St. Elias to the Arctic Ocean that can be used for all future surveys which the economic development of the region may demand. This boundary is intersected near its center by the Yukon River, one of the great rivers of the world, and its extensive valley has never been surveyed.

It is important that provision should be made for the extension of a triangulation from the initial point of the boundary on the one hundred and forty-first meridian near where it crosses the Yukon to its mouth near St. Michaels. Congress has already authorized various economic investigations and surveys in this region and the work is in progress by the United States Geological Survey. A connected line of geographic positions is needed along the Yukon to correlate detached portions of the work mentioned and to form a basis for all future surveys.

Work at the latitude observatories at Gaithersburg, Md., and at Ukiah, Cal., maintained by the International Geodetic Association under my direction, was continued during the year.

One officer continued on duty as a member of the Mississippi River Commission and another was continuously employed in cooperation with the Maryland State Board of Shell Fish Commissioners in making a survey of the natural oyster bars and rocks in

the State of Maryland. The work in Somerset County was completed and a report covering the county was prepared. The charts necessary to accompany this report were prepared and published.

The triangulation of the city of New York by the corporation under the direction of an officer of the Coast and Geodetic Survey was continued during the year.

Astronomic observations to determine latitude, longitude, or azimuth were made in Alabama, California, Florida, Georgia, Indiana, Kansas, Maine, Maryland, Michigan, Minnesota, Missouri, Nebraska, New Jersey, New York, Oklahoma, Oregon, South Dakota, Tennessee, Texas, Vermont, and Washington. The standard levels were extended in Montana, Nevada, and Utah.

A careful search was made for a shoal reported by the steamship *Mongolia* as existing 17 miles southwesterly from the Farallon Light-house, and it was shown that no shoal exists in the position indicated.

Topographic surveys were made along the shores of Chesapeake Bay and adjacent waters, along the shore of Juan de Fuca Strait from New Dungeness to Crescent Bay, and in Puget Sound from Skagit River to Deception Pass.

Two additional connections were made between the primary triangulation along the Coast Range of mountains in Oregon with the tertiary triangulation along the coast, and this work was in progress on June 30.

Incidentally the geographic positions of all recent aids to navigation in the region covered by work were determined.

The recovery of old triangulation stations with supplementary triangulation, including the determination of the geographic positions of aids to navigation, was continued on the coast of Connecticut, North Carolina, and Florida.

Hydrographic examinations with a long wire drag were continued on the coast of Maine and in the vicinity of Key West, Fla.

A supplemental survey was made of Georges Bank and Shoal, in the Atlantic Ocean off the coast of Massachusetts, and hydrographic work was continued in Chesapeake Bay.

The offshore hydrography along the north coast of the island of Porto Rico was practically completed.

The collection of information necessary for a revision of the Coast Pilot volume covering the coast of the Gulf of Mexico from Key West to the Rio Grande was completed in the field and a revised edition was published. Similar information was collected for a revised edition of the Coast Pilot volume covering the coasts of California, Oregon, and Washington.

The magnetic survey of the country was continued by making observations in Alabama, Alaska, Arkansas, California, District of Columbia, Florida, Georgia, Hawaii, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, Nebraska, New Jersey, New York, North Carolina, North Dakota, Oregon, Pennsylvania, Porto Rico, South Carolina, South Dakota, Tennessee, Texas, Vermont, Washington, and Wisconsin.

A continuous record of the changes in the earth's magnetic condition was obtained with self-registering instruments at magnetic observatories located at Cheltenham, Md.; Baldwin, Kans.; Sitka, Alaska; Honolulu, Hawaii, and Vieques, P. R.

Continuous records with seismographs were also obtained at these observatories, except at Baldwin, Kans., where there is no seismograph. Meteorological observations were made in connection with the regular work.

Magnetic observations were made at sea, in the Atlantic and Pacific oceans, on board the vessels of the Survey on their voyages to and from their field of work.

Self-registering tide gauges were maintained at the following stations: Fort Hamilton, N. Y.; Philadelphia, Pa.; Baltimore, Md.; Fernandina, Fla.; Weeks, La.; Galveston, Tex.; San Diego, Cal.; Presidio of San Francisco, Cal.; Seattle, Wash., and Honolulu, Hawaii. In January a gauge was established at Wilmington, N. C.

The tide indicators at Fort Hamilton, N. Y.; Reedy Island, Delaware River, Delaware, and Alcatraz Island, San Francisco Bay, California, have been continued and the electric tide indicator in the rooms of the Maritime Association of New York continued to give satisfaction. A similar apparatus in the Bourse Building, at Philadelphia, was discontinued, as it was found to be impracticable to operate it after the overhead wires, which had been used, were removed by the city authorities.

ALASKA.

The survey of Iliamna Bay, Cooks Inlet, was completed and surveys were made of Chiniak and Marmot bays, and Kupreanof Strait, Kodiak Island. Topographic work was done in the Barren Islands, off the entrance to Cooks Inlet, and the triangulation in this vicinity was continued.

In Prince William Sound a survey was made along the west shore of Knight Island.

Triangulation was extended along the west side of Prince of Wales Island, connecting the work in Summer Strait and in Cordova Bay. A topographic reconnaissance was made along the channels used in extending the triangulation. A reconnaissance of Dixon Entrance for triangulation was completed and observations were made at several stations.

The work on the Alaska-Canada boundary and at the magnetic observatory at Sitka was continued and is referred to elsewhere in this report.

The information necessary for a revision of the Coast Pilot volume covering the coast from Dixon Entrance to Yakutat Bay and for the preparation of sailing directions covering the coast from Yakutat Bay to Cooks Inlet was collected in the field.

PHILIPPINE ISLANDS.

Gratifying progress was made in the important work of charting the waters of the archipelago, and the results of the field work were promptly made available in the form of drawings for charts, which were forwarded to Washington for review and publication.

The statistics of the work done during the year show that the triangulation covered 13 800 square miles and the hydrography 9 600 square miles. A topographic survey was made along 1 573 miles of general coast line.

The Coast and Geodetic Survey steamer *Pathfinder* and insular government steamers *Fathomer*, *Romblon*, *Marinduque*, and *Research* were engaged in the work, and in addition to the parties afloat several parties living on land were also at work. The expenses of the work were divided between the United States Government and the insular government in accordance with the agreement under which the work was done in previous years.

Survey work was done in the following localities during the year:

East coast of Luzon.—On the east and west coast of Polillo Island and on the main land opposite the island; in Lamon Bay; along the coast between St. Miguel Bay and Maqueda channel, and along the whole coast of Cantanduanes Island.

North and east coasts of Samar.—Between San Bernardino Strait and Laguan and from Napia Bay to and around Point Sungi, the southeast point of the island.

West coast of Leyte.—On the west coast of Biliran Island and along the west coast of Leyte to the Camotes Islands.

East and west coasts of Cebu.—From the north point of the island along the east coast to the vicinity of Borbon and along the west coast to the vicinity of Tuburan; also on the west coast from the south point of the island to Point Gorda.

North coast of Mindanao.—Along the west shore of Iligan Bay.

North, east, and west coasts of Negros.—Along the north coast of the island; in the Strait of Tanon from the south end to the vicinity of Guijulugan, and along a portion of the west shore of Guimaras Strait.

North, east, and west coasts of Panay.—From Capiz around to the vicinity of Concepcion and along the whole of the west coast.

The connection of the islands of Panay, Masbati, Negros, Cebu, and Leyte by triangulation was completed.

Tide observations were made in connection with the hydrographic work, and a continuous tide record was obtained with self-registering gauges at Manila and Iloilo.

The organization of the work in the Philippine Islands remains unchanged, except that the personnel is increasing in response to the demands upon the suboffice for information and for the prompt issue of charts. The suboffice performs all the work necessary for chart construction, and drawings for new charts and new editions are prepared and sent to Washington for completion and publication. New editions of the sailing directions for the islands are prepared as they become necessary, and a monthly Notice to Mariners was issued.

OFFICE WORK.

In the Office the current work was kept up to date and progress was made in the various branches of the work, including computation, plotting, and discussion of results of field work, and the preparation of the data for publication by chart or otherwise. Gratifying evidence of the continued usefuless of the work of the Bureau is afforded by the numerous requests received for information from its archives. A great deal of information has been published and is distributed in printed form, and it is the policy of the Survey to print data as rapidly as it can be prepared for publication.

The computation of the results of the investigation of the earth movements in the California earthquake of 1906, as shown by triangulation, was completed and an exhaustive report was prepared and published in the Annual Report.

The computation of the main scheme of triangulation along the ninety-eighth meridian was completed from northern Nebraska to the Mexican boundary.

The United States standard datum was extended through the main scheme of triangulation southward from Port Royal, S. C., along the coast and around Florida to Mobile, thus making numerous geographic positions in this region available for use in this final form.

A volume was prepared for publication under the title "United States Magnetic Tables and Magnetic Charts," which gives the results of magnetic observations previous to January 1, 1908, reduced to the epoch January 1, 1905.

The tables and charts contain better values than heretofore published for the three elements of terrestrial magnetism in the United States at numerous stations covering the country.

Tide tables containing the predicted tides for numerous ports on the coasts of the United States and in foreign countries were prepared and published.

Tables of the predicted tides for Wellington and Auckland, New Zealand, were furnished to the New Zealand authorities, upon request, in advance of publication.

The Manual of Tides, an exhaustive treatise on the subject, was completed during the year, and the concluding part was published in the Annual Report.

The Annual Report of the Survey for 1907 was prepared for transmission to Congress. Several interesting appendices were published as a part of the report. These include an account of the earth movements in the California earthquake of 1906, as measured by the trigonometrical work of the Survey, an account of the successful use of nickel steel or invar tapes in the measurement of primary base lines, and a detailed account of a long wire drag which has been constructed and successfully used by the Survey in definitely determining whether dangers to navigation escaped detection when hydrographic surveys have been made by the usual method of sounding.

The amount appropriated for the Coast and Geodetic Survey for the fiscal year ended June 30, 1908, was $991 290, of which $245 000 was for manning and equipping the vessels of the Survey, $40 000 for repairs and maintenance of vessels, and $50 000 for office expenses. The remainder of the appropriation was divided between expenses of parties in the field ($320 400) and salaries of field and office forces ($335 890). In addition to the above sums, the appropriations for marking the United States and Canada boundary and for locating and marking the Alaska boundary, made to be expended by the Secretary of State, are disbursed under my direction, as Commissioner, by the Disbursing Agent of the Coast and Geodetic Survey as special disbursing officer of the Department of State.

OFFICE OF ASSISTANT IN CHARGE.

ANDREW BRAID, *Assistant in Charge.*

The Assistant in Charge has direct supervision of the work of the divisions of the Office, as follows: Computing Division; Division of Terrestrial Magnetism; Tidal Division; Drawing and Engraving Division; Chart Division; Instrument Division; Library and Archives Division. He also has charge of the purchase of supplies and of all other expenditures for Office expenses, the care of the public property at the Office, the distribution of the publications of the Survey issued free, and of the sale of the charts, Coast Pilots, and Tide Tables published by the Survey.

Details of the Office operations are given in Appendix 2.

OFFICE OF INSPECTOR OF HYDROGRAPHY AND TOPOGRAPHY.

J. J. GILBERT, *Inspector.*

The routine work in connection with the enlistments of crews for the vessels and the administrative examination of the accounts of the vessels was kept up to date.

Numerous short trips were made by the Inspector in connection with the repair and maintenance of the surveying vessels.

COAST PILOT.

The work in the Office included the preparation of the following publications: Supplements to United States Coast Pilot, Atlantic Coast, Parts IV and VII; United States Coast Pilot, Atlantic Coast, Part VIII; United States Coast Pilot, Pacific Coast, Alaska, Part I, and Coast Pilot Notes, Yakutat Bay to Cook Inlet. Proof of these publications was read, except the last two, which were not completed at the close of the year.

THE VESSELS AND THEIR WORK.

THE STEAMER BACHE.

At the beginning of the year this vessel was at Baltimore completing repairs and outfitting for the next season's work. She left Baltimore on July 8 for Georges Bank, off the coast of Massachusetts. She reached Boston on July 12 and began work on the 16th. The work assigned included a resurvey of Georges Shoal and a system of lines to be sounded extending approximately southward from the general crest of the bank to the 50-fathom curve. The soundings covered that portion of the bank east of longitude 68° 30′. Tide observations were made by using a manometer. The work closed September 28, and examinations were then made for reported dangers to navigation in Buzzards and Narragansett bays and off New London, Conn. The vessel reached Baltimore in November, and necessary repairs were made.

On January 6 the vessel sailed for Porto Rico, and on the next day, in a sudden and violent squall, she dragged her anchor in Hampton Roads, Va., and collided with the hospital ship *Jamestown*, resulting in serious damage to the *Bache*, which necessitated repairs at Norfolk.

She sailed for Porto Rico on March 16 and reached San Juan on April 3. The hydrographic work off the north and west coasts of the island of Porto Rico was practically completed, and the vessel sailed for Baltimore on May 30. Repairs were being made to the vessel on June 30.

THE STEAMER HYDROGRAPHER.

This vessel was engaged in coast pilot work in the Gulf of Mexico at the beginning of the fiscal year. The work was completed and the vessel returned to Baltimore early in September.

In June repairs were made, and the vessel sailed for New London, Conn., on June 21, and was on coast pilot work at the close of the year.

THE SCHOONER MATCHLESS.

This vessel was engaged in the resurvey of Chesapeake Bay during the whole year except during the period May 9 to June 30, when repairs were being made at Baltimore. Work was done in Pocomoke Sound, Patuxent River, and Smith Creek.

THE STEAMER EXPLORER.

On July 1 this vessel was in the Pacific Ocean en route from Baltimore, Md., to Seattle, Wash. She reached San Diego, Cal., on July 3, and arrived at Seattle on July 15. Minor repairs were made and the vessel sailed August 17 for Dixon Entrance, Alaska. Triangulation work was done in this vicinity until the latter part of October, and the ship returned to Seattle on November 4.

From November 19 to February 20 work was done in Juan de Fuca Strait, and the vessel then returned to Seattle. She sailed for Alaska April 4, and reached Kodiak on April 16.

At the close of the year work was in progress in the vicinity of Cook Inlet.

THE STEAMER GEDNEY.

This vessel was at work on July 1 making a survey along the west coast of Prince of Wales Island, Alaska. The work continued until October, and the vessel reached Seattle November 1. From November 29 to February 15 work was done in Skagit Bay, Washington, and April 4 the vessel sailed for Alaska, and was at work in Dixon Entrance at the close of the fiscal year.

THE STEAMER M'ARTHUR.

On July 1 work was in progress in Iliamna Bay, Alaska. The survey was completed on July 11, and the work of surveying the Chugack Islands was then begun and continued until October, when the vessel returned to Seattle, reaching there October 29. Repairs were made, and the vessel sailed for Cook Inlet April 5. She reached Seldovia, Alaska, on April 21, and was at work in that vicinity during the remainder of the year.

THE STEAMER PATTERSON.

Survey work was in progress on July 1 in the vicinity of Kodiak, Alaska, and the work was continued until October, when the vessel sailed for Seattle, and arrived November 3. During the winter repairs were made, and the vessel left Seattle for Kodiak on March 9. A shore party was landed and the vessel went to Dutch Harbor, where the steamer *Yukon* was repaired and taken to Kodiak. The *Patterson* was at work in that vicinity at the close of the fiscal year.

THE STEAMER YUKON.

Repairs were made to this vessel at Dutch Harbor, Alaska, in April and May, and she then proceeded to Kodiak, Alaska, for survey work in the vicinity of Cook Inlet. The work was in progress at the close of the year.

THE STEAMER TAKU.

The survey of Prince William Sound, Alaska, was in progress on July 1, and the work was continued until October, when the vessel was laid up at Orca, Alaska.

In May the vessel was put in commission, and continued the survey of Prince William Sound during the remainder of the year.

The steamer *Endeavor* was laid up at Washington, D. C., and the schooner *Transit* at Morgan City, La., during the whole of the year.

The steamer *Pathfinder* and the steamers *Fathomer*, *Marinduque*, *Romblon*, and *Research*, belonging to the Philippine government, were engaged during the year in general survey work in the Philippine Islands.

OFFICE OF INSPECTOR OF GEODETIC WORK.

J. F. HAYFORD, *Inspector.*

The duties of the Inspector were performed at the Office in Washington, except as noted below, where the records of the field parties were examined as they were received from the field, and an effective supervision of the work was maintained in this way.

A visit was made to a party engaged in making astronomic observation and the work was found to be making rapid progress.

The triangulation along the ninety-eighth meridian was completed.

The most important event of the year in the field work was the completion of a reconnaissance for primary triangulation from northern Texas to California, a distance of more than 1 200 miles. This involved the selection of 92 primary and 38 secondary stations. The work conformed admirably to the specified requirements for primary triangulation and is a very remarkable accomplishment, even when the very favorable conditions encountered are taken into consideration.

OFFICE OF INSPECTOR OF MAGNETIC WORK.

R. L. FARIS, *Inspector.*

The instructions for magnetic work and the information required by the parties in the field were prepared by the Inspector.

The duties of the Inspector were performed at the Office, except that one visit was made to the magnetic observatory at Cheltenham, Md.

The activity of the Survey in magnetic work may be summarized as follows:

OBSERVATORY WORK.

The magnetic observatories at Cheltenham, Md.; Baldwin, Kans.; Honolulu, Hawaii; Sitka, Alaska; and Vieques, P. R., were kept in continuous operation, and observations were obtained with a self-registering magnetograph and a seismograph at each observatory, except at Baldwin, Kans., where there was no seismograph. The facilities for standardizing magnetic instruments at Cheltenham, Sitka, and Honolulu were used by the Department of Research in Terrestrial Magnetism of the Carnegie Institution, of Washington.

Twenty-four earthquakes were recorded at Cheltenham and 121 at Honolulu.

MAGNETIC WORK ON LAND.

The magnetic elements, declination, dip, and intensity were determined at 322 stations, distributed over 34 States and Territories, including Porto Rico, as summarized in the following table:

State.	Localities.	Stations.	Old localities reoccupied.	Declinations observed.	Dips observed.	Intensities observed.
Alabama	3	4	3	4	4	4
Alaska	48	49	4	53	21	22
Arkansas	2	2	2	2	2	2
California	8	8	3	9	8	8
District of Columbia	1	1	1	1	1	1
Florida	3	3	3	3	3	3
Georgia	3	4	3	4	4	4
Hawaii	1	1	1	1	1	1
Illinois	27	28	3	28	28	28
Indiana	24	24	5	24	24	24
Iowa	9	9	3	8	9	9
Kansas	1	1	1	3	4	3
Louisiana	4	5	4	5	5	5
Maine	2	2	1	2	2	2
Maryland	3	3	3	12	6	12
Michigan	41	41	2	41	41	41
Minnesota	21	21	3	21	21	21
Mississippi	3	3	3	3	3	3
Missouri	1	1	0	1	1	1
Nebraska	2	2	0	2	2	2
New Jersey	1	1	1	1	1	1
New York	36	37	4	37	36	37
North Carolina	1	2	1	2	2	2
North Dakota	15	15	2	15	15	15
Oregon	2	2	1	2	2	2
Pennsylvania	3	3	3	3	3	3
Porto Rico	3	3	3	3	3	3
South Carolina	3	4	3	4	4	4
South Dakota	7	7	2	7	7	7
Tennessee	3	3	1	3	3	3
Texas	3	3	3	3	3	3
Vermont	1	1	1	1	1	1
Washington	4	5	3	8	7	7
Wisconsin	20	20	3	21	21	21
Foreign countries	4	5	4	5	5	5
Total	313	322	82	342	303	310

MAGNETIC WORK AT SEA.

The magnetic work done on board the vessels of the Survey is approximately shown in the following table:

Vessel.	General region.	Results from swings.			Results from course observations.		
		Declination.	Dip.	Intensity.	Declination.	Dip.	Intensity.
Bache	Atlantic Ocean	15	16	16	19	0	0
Explorer	Pacific Ocean	15	15	15	13	5	5
Patterson	do	6	6	6	0	0	0
Total		36	37	37	32	5	5

The series of observations made at sea on board the steamer *Explorer*, en route from Baltimore, Md., to Seattle, Wash., was completed at Seattle on July 19, and the results from these observations are published in Appendix 3 to this report.

Observations were made on the Atlantic Ocean along the north Atlantic coast of the United States, on Georges Bank, and on special courses to and from Porto Rico. Observations were also made at sea along the coast of Alaska.

OFFICE OF DISBURSING AGENT.

SCOTT NESBIT, *Disbursing Agent.*

The Disbursing Agent of the Coast and Geodetic Survey has charge of all of the appropriations made for the service, and the appropriations made to the State Department for the survey and marking of the boundary between the United States and Canada and of the boundary between Alaska and Canada. The extremely wide field of work covered by these appropriations compel payments to be made in all parts of the United States proper and in the most remote regions of the possessions under the jurisdiction of the United States, especially in Alaska, Porto Rico, Hawaii, and the Philippine Islands. The services of more than 70 bonded chiefs of party are required to make these payments at the remote points occupied by the working parties of this Survey, both on land and sea. All of the public funds used by these officers are advanced from the central Disbursing Office of the Survey, and the resulting bookkeeping and auditing are done in that office. Necessarily a very extensive line of correspondence results, as, in addition to all pay and salary accounts, the manning, equipping, outfitting, and repairing of the vessels of the Survey, the purchase and sale of clothing and small stores, the system of allotments made by seamen and other employees, and the entire expense of the field work of the service, which is both extensive and varied, and the survey and marking of the two boundary lines mentioned, are financed entirely from the central Disbursing Office. The above-mentioned chiefs of party are bonded in the sums of from $2,000 to $10,000 each, and while acting as chiefs of party these officers receive from time to time such advances of public funds from the Disbursing Agent as are approved by the Superintendent and are required to meet the necessary current expenses of the work in hand. A ledger account is kept in the office of the Disbursing Agent, with each chief of party receiving an advance made to him, and in which such sums are charged and in which he is given credit for all proper expenditures made by him, when presented on regularly supported vouchers, after such accounts have been audited in the office of the Disbursing Agent, found to be correct, and approved by the Superintendent of the Survey. All of these accounts, after they have received the administrative examination required by law in the Office of the Superintendent of the Coast and Geodetic Survey, are, with their supporting vouchers, sent through the Department of Commerce and Labor to the Auditor for the State and other Departments for examination and audit by him. This system has met the needs of this Survey and results, in the main, in economy and good order in its expenditures. A very large proportion of the appropriations named is now being expended in the survey of the most remote waters of Alaska and the Philippine Islands, and, in the survey and

marking of the boundary between Alaska and Canada, far in the interior of that territory. An itemized statement of receipts and expenditures is submitted to Congress each year, as required by law, and is printed as a Congressional document.

OFFICE OF EDITOR OF PUBLICATIONS.

The Annual Report of the Superintendent (pp. 1–565), covering the progress of the work of the Survey during the fiscal year 1907, was completed and sent to the Public Printer through the Secretary of Commerce and Labor on September 18, 1907, and the last proof was read and returned to the printer on January 27, 1908. Copies of the report were received for distribution on March 21.

The publications of the Coast and Geodetic Survey during the fiscal year are given in the following list:

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1906, to June 30, 1907, 565 pages, with the following appendices also published as separates:
- No. 3. The Earth Movements in the California Earthquake of 1906. Reprint, 38 pp.
- No. 4. Six Primary Bases Measured with Steel and Invar Tapes. Reprint, 53 pp.
- No. 5. Results of Magnetic Observations made by the Coast and Geodetic Survey between July 1, 1906, and June 30, 1907. Reprint, 75 pp.
- No. 6. Manual of Tides, Part V: Currents, Shallow-Water Tides, Meteorological Tides and Miscellaneous Matters. Reprint, 217 pp.
- No. 7. Long Wire Drag. Reprint, 19 pp.

Tide Tables for the year 1908. 524 pp.

Tide Tables for the Atlantic Coast of the United States, including Canada and the West Indies, for the year 1908. Reprint from the Tide Tables for 1908. 186 pp.

Tide Tables for the Pacific Coast of the United States, together with a number of foreign ports in the Pacific Ocean. Reprint from the Tide Tables for 1908. 168 pp.

United States Coast Pilot, Atlantic Coast. Part VIII: Gulf of Mexico from Key West to the Rio Grande. Third edition. 177 pp.

United States Coast Pilot, Atlantic Coast. Part IV: From Point Judith to New York. Supplement to fourth edition. 9 pp.

United States Coast Pilot, Atlantic Coast. Part VII: From Chesapeake Bay Entrance to Key West. Supplement to third edition. 12 pp.

Tables of Depths for Channels and Harbors, Coasts of the United States, including Porto Rico, the Hawaiian Islands, and the Philippine Islands. Bulletin No. 36. Third edition. 150 pp.

Catalogue of Charts, Coast Pilots, and Tide Tables, 1907. 230 pp.

List of Publications of the Coast and Geodetic Survey Available for Distribution May 1 1908. Reprint from Departmental List. 25 pp.

Notices to Mariners Nos. 353–359. [This publication was consolidated with the Weekly Notice to Mariners published by the Light-House Board on January 1, 1908, by order of the Secretary of Commerce and Labor, and the issue for December, 1907, concluded the Coast and Geodetic Survey series.]

The publications named below were prepared and published in Manila, P. I., and are issued from the suboffice at that place. A small number of each is kept at the Office in Washington.

Philippine Island Sailing Directions. Section IV: Coast of Samar and Leyte, and the East Coast of Luzon. Third edition. 168 pp.

Philippine Islands Sailing Directions. Section V: Coast of Mindanao and Adjacent Islands. Supplement. 5 pp.

Philippine Islands Notices to Mariners, Nos. 6 to 12 of 1907 and Nos. 1 to 4 of 1908.

APPENDIX 1

REPORT 1908

DETAILS OF FIELD OPERATIONS

CONTENTS.

	Page.
United States	20
Alaska	36
Outlying Territory	41
Special Duty	55

DETAILS OF FIELD OPERATIONS.

UNITED STATES.

TEXAS.

[HENRY L. BECK.]

The selection of a more suitable location for the self-registering tide gauge at Galveston was assigned to Assistant Beck. He made a careful inspection of the water front and located the gauge on the wharf at the foot of Twentieth street, on the property of the Galveston Wharf Company. The officials of the company facilitated the work by extending all the aid in their power, and the Survey acknowledges their kindness in permitting the use of their wharf free of charge. A small house was erected to protect the gauge, and the tide staff was connected by leveling with three old bench marks and two new ones which were established in the vicinity.

In connection with the work mentioned above, topographic details were collected and revised by personal inspection for the purpose of bringing the chart of the harbor up to date by adding the improvements made since the last survey was made. The work of this party began on April 10 and was completed on April 23.

MARYLAND.

[J. B. BOUTELLE.]

SUMMARY OF RESULTS.—Topography: 6 square miles of area covered, 3 miles of shore line surveyed, 17 miles of roads surveyed, and 18 miles of shore line of creeks surveyed.

The continuation of the topographic resurvey of a portion of the shores of Chesapeake Bay was assigned to Assistant Boutelle. He began work south of Chesapeake Beach on April 27, and the work was in progress at the close of the fiscal year. The survey was completed to the vicinity of Port Republic, and it extends about 1½ miles inland to the first public road running approximately north and south. The country in this locality is very rugged and is intersected in all directions by deep ravines. The hills are from 100 to 180 feet in height and all wooded.

ARIZONA, CALIFORNIA, ILLINOIS, INDIANA, MICHIGAN, MINNESOTA, NEW MEXICO, AND TEXAS.

[WILLIAM BOWIE.]

SUMMARY OF RESULTS.—Astronomic observations: 4 latitudes determined and 4 azimuths measured. Magnetic observations: 4 stations occupied. Reconnaissance: 48 400 square miles of area covered, 130 triangulation stations selected, and 2 base lines selected. Triangulation: 480 square miles of area covered, 9 stations occupied, and 57 geographic positions determined.

The completion of the triangulation along the ninety-eighth meridian in Minnesota from the vicinity of Stephen to the United States and Canada boundary was assigned to Assistant Bowie. The work began on July 1, and was completed on the 31st. Observations were made at 9 triangulation stations in 19 days (July 5 to 23). Two of the stations in this triangulation are on the United States and Canada boundary, and each of these is near a boundary monument which was connected with the station.

After completion of the work in Minnesota, Assistant Bowie made preparations for a reconnaissance from the triangulation along the ninety-eighth meridian in the vicinity of Weatherford, Tex., across Texas, New Mexico, Arizona, and California, to a junction with the Pacific coast triangulation. The work in Texas began on August 25, under Mr. Bowie's direction, and he took personal charge of the party on September 24.

The selection of stations began on September 17, 1907, and continued without interruption until February 8, when the last station was located. The party consisted of one man and a driver, besides the chief. The route follows the Texas Pacific Railway to El Paso, and thence along the Southern Pacific to California. The officials of these two companies greatly facilitated the work by their courtesy in authorizing the party to obtain water at the railway water tanks.

The actual time occupied by the field work was 4 months and 21 days. During this period the locations of 92 primary and 38 secondary stations were selected, covering a distance of 1 224 miles along the axis of the main triangulation.

Arrangements were made for 5 connections with the monuments or triangulation stations along the United States and Mexican boundary and one connection with the triangulation along the California-Nevada boundary, and these subsidiary schemes amounted to a total distance of 79 miles. Two base lines were selected and connections with the main scheme were provided for. A number of triangulation stations established by the United States Geological Survey were used in the main scheme.

The average length of the lines east of Sierra Blanco, Tex., is 17 miles and west of that place 62 miles, and the longest line is 151 miles long, while many of the stations have elevations from 3 000 to 11 000 feet above sea level. Many of the conditions under which the work was done were favorable, but the work is remarkable for the rapid progress made and for its small cost. The report on the work is unusually complete and interesting.

After the completion of the reconnaissance a signal building party was organized in Texas under Mr. Bowie's direction with a signalman in charge, and signals were erected at the triangulation stations (36 in number) in the region between the vicinity of Gordon, Tex., and Midland, Tex. This work began on February 17 and was completed on May 31.

In May Mr. Bowie selected a station for use in determining the telegraphic longitude of Detroit, and then made observations to determine the latitude and an azimuth at 4 stations in the triangulation of the Great Lakes by the United States Lake Survey. Two of these stations were in Michigan, 1 in Indiana, and 1 in Illinois. This astronomic work was in progress on June 30.

Magnetic observations were made at the 4 stations mentioned above.

ILLINOIS, INDIANA, MARYLAND, NEW YORK, OHIO, PENNSYLVANIA, AND WISCONSIN.

[J. E. BURBANK.]

STATIONS OCCUPIED.—*Illinois:* Albion, Decatur, Kankakee, Lincoln, Newton, Peoria, Pontiac, Shelbyville, Springfield, Taylorville, Urbana, and Waukegan. *Indiana:* Angola, Bedford, Bluffton, Fort Wayne, Frankfort, Goshen, Indianapolis, Lafayette, Logansport, Newport, Plymouth, Rensselaer, Shelbyville, Shoals, Sullivan, Terre Haute, Vernon, Vincennes, Washington, Williamsport, and Winamac. *Maryland:* Cheltenham. *New York:* Au Sable Forks, Balston Spa, Batavia, Bath, Binghamton, Blue Mountain Lake, Canton, Cooperstown, Cortland, Geneseo, Helena, Herkimer, Lake Placid, Lake Pleasant, Lowville, Lyons, McKeever, Morrisville, Newton Falls, North Creek, Northville, Oswego, Owego, Penn Yan, Plattsburg, Rochester, Santa Clara, Schoharie, Syracuse, Ticonderoga, Watertown, and Watkins. *Pennsylvania:* Lewisburg, Tunkhannock, and Williamsport. *Wisconsin:* Waukesha.

The work of the magnetic observatory at Cheltenham, Md., was continued without interruption during the year. A continuous record of the relative force of the three elements of terrestrial magnetism was obtained and observations to determine absolute values for the three elements were made at regular intervals.

A special building was constructed for seismograph observations, and the instrument was transferred to this building on October 5. It is now possible to maintain a high degree of sensitiveness in both components of the seismograph, and excellent results have been obtained. Twenty-four earthquakes were recorded during the year, and an investigation of the micro-seismic tremors recorded by the seismograph in connection with barometric pressure shows that a relation exists between the occurrence of these tremors and the passage of low barometric areas over the coast line.

During the year observations were made to determine the value of the three elements of terrestrial magnetism at the stations named above by observers detailed to work under Mr. Burbank's direction.

Various instruments were compared with the observatory standards for use in the field work and for the Department of Terrestrial Magnetism of the Carnegie Institution, of Washington.

CALIFORNIA, MAINE, MARYLAND, NEW JERSEY, NEW YORK, OREGON, AND VERMONT.

[W. H. BURGER.]

SUMMARY OF RESULTS.—Astronomic observations: 11 azimuths measured and 12 latitudes determined. Magnetic observations: 19 stations occupied.

During the year astronomic and magnetic observations were made at various places by Assistant Burger. The work was done during the periods July 6 to November 4, February 2 to March 20, and May 1 to June 30. Observations to determine an azimuth were made at 2 stations in California, 3 in Maine, 1 in New Jersey, 3 in New York, and 2 in Vermont. Latitude was determined at 6 stations in California, 1 in Maine, 1 in New Jersey, 2 in New York, 1 in Oregon, and 1 in Vermont.

Advantage was taken of the presence of the observer in the various localities mentioned to have magnetic observations made at 19 stations, distributed as follows: 8 in California, 2 in Maine, 1 in Maryland, 1 in New Jersey, 4 in New York, 2 in Oregon, and 1 in Vermont.

Several of the stations occupied for observations were old triangulation stations, and delay occurred in transporting the instrumental outfit to these stations. Unfavorable weather also caused considerable delay. In connection with the work, a search was made for 34 old triangulation stations, and 25 were recovered.

In California work was done on Catalina, San Clemente, and San Nicolas islands. Local triangulation was done at several stations to make a connection with the old work in cases where a triangulation was not occupied. This work covered an aggregate area of 400 square miles, with 24 stations occupied and 39 geographic positions determined.

IOWA, KANSAS, MINNESOTA, MISSOURI, NEBRASKA, NORTH DAKOTA, SOUTH DAKOTA, AND WISCONSIN.

[S. A. DEEL.]

STATIONS OCCUPIED.—*Iowa:* Centerville, Des Moines, Dubuque, Independence, Knoxville, Marshalltown, Vinton, and Waterloo. *Kansas:* Baldwin. *Minnesota:* Albert Lea, Bemidji, Duluth, Fairmount, Faribault, Glencoe, Greenbush, Heron, Lake Hibbing, Luverne, Marshall, Mora, Ortonville, Preston, Red Wing, St. Paul, Swan River, Thief River Falls, Warren, Wheaton, and Wilmar. *Missouri:* Milan. *Nebraska:* Niobrara and West Point. *North Dakota:* Balfour, Bismarck, Cooperstown, Fessenden, Forman, Glen Ullin, Grafton, Hillsboro, Jamestown, Lansford, Mercer, Minnewaukon, Steele, Towner, and Valley City. *South Dakota:* Aberdeen, Brookings, De Smet, Foulton, Huron, Salem, and Webster. *Wisconsin:* Baraboo, Barron, Dodgeville, Glidden, Hayward, Iron River, Janesville, Jefferson, La Crosse, Ladysmith, Madison, Medford, Monroe, Phillips, Solon Springs, Sparta, Viroqua, and Whitehall.

The work of the magnetic observatory at Baldwin, Kans., was continued during the year under the direction of Magnetic Observer Deel. A practically continuous record of the relative force of the three elements of terrestrial magnetism was obtained and observations were made once each week to determine the absolute values of these elements.

Meteorological observations were made daily during the year.

In addition to the work at the observatory, magnetic observations were made at the stations named above by observers detailed to work under Mr. Deel's direction.

WASHINGTON.

[R. B. DERICKSON, Commanding, Steamer *Gedney*.]

SUMMARY OF RESULTS.—Topography: 21 square miles of area covered, 40 miles of general shore line surveyed, 1 mile shore line of creeks surveyed, 6 miles of roads surveyed, and 1 topographic sheet completed. Triangulation: 40 square miles of area covered, 35 stations occupied, and 46 geographic positions determined.

On November 27 the *Gedney* proceeded to the vicinity of La Conner, Wash., and began the topographic survey of the northeast coast of Whidbey Island. A survey was made of the shore line on Whidbey Island from a point near Utsalady to Deception Pass, and of Fidalgo Island from the entrance to La Conner to Deception Pass.

The triangulation was extended over the region mentioned, and a topographic survey was made along the shores of the two islands to cover the portion of the coast in this locality which had not been previously surveyed.

WASHINGTON.

[W. C. DIBRELL, Commanding, Steamer *Explorer*.]

SUMMARY OF RESULTS.—Magnetic work: 3 stations occupied on land and 1 station occupied at sea. Topographic work: 8 square miles of area covered, 30 miles of general coast line surveyed, 4 miles of shore line of creeks surveyed, 4 miles of roads surveyed, and 3 topographic sheets completed. Triangulation: 75 square miles of area covered, 5 stations occupied, and 4 geographic positions determined.

The topographic survey of the unsurveyed portion of the south shore of Juan de Fuca Strait was assigned to Assistant Dibrell.

The *Explorer* sailed from Seattle on November 19 and returned on February 20. During this period several old triangulation points were recovered and some new ones were established. A topographic survey was made of Dungeness Spit, and the survey was extended to Port Angeles and westward to include Crescent Bay. Between Freshwater and Crescent bays the coast is rocky and abrupt and landing is impracticable, except when there is very little swell. This portion of the coast was surveyed by using a sextant instead of a plane table.

The magnetic work includes one swing of the ship on 16 headings, with both helms off New Dungeness and observations on shore at Dungeness, Port Angeles, and Striped Peak.

Assistant Dibrell was absent on leave from November 24 to January 3, and during this period Assistant Quillian was in command.

FLORIDA, MARYLAND, AND VIRGINIA.

[W. B. FAIRFIELD.]

SUMMARY OF RESULTS.—Astronomic observations: 1 azimuth measured. Triangulation: 52 stations occupied and 183 geographic positions determined.

The completion of the connection of the Weather Bureau station at Mount Weather, Va., with the primary triangulation in the vicinity was assigned to Assistant Fairfield. He began work on July 17 and completed the observations on September 27. During this period observations of horizontal angles were made at 3 triangulation stations, and observations to determine an azimuth were made at Mount Weather and the triangulation and astronomic stations were connected. The weather was very unfavorable and caused great delay in the work.

On November 23 the work of recovering old stations on the west coast of Florida in Tampa Bay and vicinity was begun and continued until June 23, when the work was closed for the summer. During this period a search was made for 80 old stations and only 6 recovered. These old stations were used, and a new triangulation was extended over Tampa, Hillsboro, Boca Ceiga, and Sarasota bays.

The positions of prominent objects in Tampa, Port Tampa, St. Petersburg, Palmetto, Braidentown, and on Mullet and Egmont keys were determined; also the positions of 16 aids to navigation (lighted beacons) and of 23 triangulation stations established under the direction of the Corps of Engineers, United States Army, in their work for the improvement of Tampa Bay.

Observations were made at 49 stations during the season, 6 of these being old stations, 11 United States Engineer stations, and 32 new stations.

DISTRICT OF COLUMBIA, MARYLAND, AND VIRGINIA.

[O. W. FERGUSON, Commanding, Schooner *Matchless*.]

SUMMARY OF RESULTS.—Hydrography: 118 square miles of area covered; 1 377 miles of lines sounded, 34 709 soundings made, 2 tide stations occupied, 2 current stations occupied, and 4 hydrographic sheets completed. Topography: 45 square miles of area covered, 58 miles of general coast line surveyed, 90 miles of shore line of creeks surveyed, 12 miles of shore line of ponds surveyed, 42 miles of roads surveyed, and 3 topographic sheets completed. Triangulation: 99 square miles of area covered, 41 stations occupied, and 63 geographic positions determined.

The survey of grounds of the Bureau of Standards was in progress on July 1, and it was completed on the 12th.

On August 5 Assistant Ferguson took command of the schooner *Matchless*, and continued the resurvey of portions of Chesapeake Bay until May 8, when the vessel started to Baltimore to have repairs made.

The work in Pocomoke Sound was completed September 21, and the vessel reached the mouth of the Patuxent on the 27th. A number of old triangulation stations were recovered and supplementary work was done up the river as far as Brooms Island. The resurvey of the Patuxent was continued until April 12, except for the period January 21 to February 3, when the work was suspended. From January 22 to February 2 and from April 13 to May 7 survey work was done in Smiths Creek, a tributary of the Potomac River.

The survey work in the localities mentioned included triangulation, topography, and hydrography, and it forms a part of the resurvey of Chesapeake Bay and tributaries.

VIRGINIA.

[S. FORNEY.]

SUMMARY OF RESULTS.—Topography: 92 square miles of area covered, 77 miles of shore line of rivers surveyed, 203 miles of shore line of creeks surveyed, 2 miles of shore line of ponds surveyed, and 158 miles of roads surveyed.

The topographic resurvey of the tributaries to Chesapeake Bay was continued by the party under the direction of Assistant Forney during the fiscal year.

The work on the Piankatank River was completed from the mouth to the head of navigation. A topographic survey was made of Gwynns Island, and a plane table triangulation of Rappahannock River was completed up to Carters Creek. A survey was made of the interior topographic details as far back as the main county road. A resurvey was also made of the shores of the Rappahannock River from its mouth to Rogues Point, and of the Carrotoman River to the head of steamboat navigation.

A considerable amount of territory adjacent to the rivers was also surveyed. Extensive changes were found along the shore line of the rivers.

LOUISIANA.

[O. B. FRENCH.]

A survey was made along the Lake Borgne Canal from the Mississippi River to Lake Borgne, and all information concerning it useful to mariners, was obtained by Assistant French in January (23 to 25). He also inspected the schooner *Transit* and her outfit, in storage at Morgan City, La.

NORTH CAROLINA.

[F. D. GRANGER.]

An examination was made of the triangulation along the Cape Fear River in North Carolina between Wilmington and the mouth of the river, the work of the Corps of Engineers, United States Army, in connection with the improvement of navigation in the river.

The river triangulation was in two sections. Observations were made at stations in order to join the sections and to connect the triangulation with the geographic positions already established at Wilmington by the Coast and Geodetic Survey. A similar connection exists near the mouth of the river.

The work was done while Assistant Granger was in charge of the tide station at Wilmington (January 25 to May 15).

CONNECTICUT, FLORIDA, MAINE, NEW YORK, AND RHODE ISLAND.

[N. H. HECK.]

SUMMARY OF RESULTS.—Fifty-three square miles of area covered with drag, 846 miles run while dragging, 413 soundings made, 163 shoals located, 12 tide stations occupied, and 8 hydrographic sheets completed.

Hydrographic examinations were made in various localities during the year with long wire drags under the direction of Assistant Heck. On July 8 work began on the coast of Maine and was continued in Jericho Bay between Spirit Ledge and Eggemoggin Reach until October 29. Seventeen square miles were covered with the drag and 28 shoals were located at depths ranging from 15 to 36 feet. In the region covered there is very little open water, and it was impracticable to use a drag longer than 600 feet. The strong tidal currents and numerous "lobster pots" used by the fishermen engaged in this industry, in this locality, increased the difficulty of operating the drag and the cost of the work by the delays resulting from the necessity of having these "pots" temporarily removed by their owners.

In August (26–30) an examination was made of Sugar Reef Passage, Fishers Island Sound, Conn., by a section of the party, and 2 shoals were located. Pulpit Harbor, Maine, was examined in September, and 1 shoal was located. The work also shows that a reported shoal in this harbor does not exist.

In October (1–31) the examination was extended through Merchants Row to Isle au Haut Bay, covering 6 square miles of area and locating 14 shoals.

After the close of the season in Maine the party was divided into two sections. One of these made an examination in the vicinity of City Island, N. Y., where 1 square mile of area was covered and 14 shoals were located. The other examined an area of one-fourth of a square mile in the vicinity of Coal Mines Buoy No. 16, in Narragansett Bay, R. I., and located 2 rocks, on one of which a vessel had struck.

The work closed for the season in the north on November 16, and similar work was taken up at Key West, Fla., on December 18 and continued until May 26. The area examined, 19 square miles, extends from the Southeast Channel to a line joining red buoy No. 8 and West Crawfish Key, and more than 100 shoals were located within these limits. Two shoals supposed to exist could not be found with the drag, and consequently they have been removed from the number of dangers to navigation.

A few geographic positions were determined for hydrographic purposes and an effort was made to recover a number of old triangulation stations on the keys to the east of Key West. Topographic details were secured in the vicinity of Key West for the purpose of revising the chart covering this locality.

Wire-drag work on the coast of Maine was resumed on June 26 and was in progress on June 30.

NORTH CAROLINA AND OREGON.

[J. S. HILL.]

SUMMARY OF RESULTS.—Reconnaissance: 2 600 square miles of area covered and 53 triangulation stations selected. Triangulation: 2 300 square miles of area covered, 57 stations occupied, and 79 geographic positions determined.

On July 1 a party was in the field under Mr. Hill's direction, with a foreman in charge, opening lines and preparing the stations so that the observations could be made without delay by an observing party, and this work was continued during the month of July.

During the period August 1 to September 22, 18 triangulation stations were occupied and 55 geographic positions were determined in the interior.

The primary triangulation along the mountains of the Coast Range was connected with the triangulation along the seacoast in two places, at Port Orford and at Cape Sebastian, and the geographic position of Cape Blanco light-house was determined.

The triangulation work was completed on September 22 and preparations were made for reconnaissance work along the coast from the vicinity of Umpqua River northward.

The work began at Myrtle Point, 50 miles south of Umpqua River, and was extended to Tillamook Bay, a distance of about 130 miles. Stations were selected for the purpose of determining the geographic positions of the light-houses at Umpqua River, Heceta Head, Yaquina Head, Cape Meares, and Coquille River. The work closed for the season on November 23.

The work of recovering old triangulation stations and doing supplementary work on the coast of North Carolina was begun on January 10 and was continued until April 15. During this period 71 old stations along Beaufort Inlet and Core and Bogue sounds were searched for, 21 of which were recovered and 32 determined as destroyed. A search was also made for 10 tidal bench marks, and 5 of these were recovered. Additional reference bench marks were established in 4 of these localities.

Twenty-four new stations were established and occupied, in addition to several old ones, and the geographic position of Harbor Island Bar light-house was determined. Triangulation stations now exist along practically the whole distance examined.

Work was resumed on the triangulation along the coast of Oregon on May 15, when a party began preparing the stations, opening lines, etc. On May 26 an additional party was organized to make observations, and in June 7 stations were occupied. The work of both parties was in progress on June 30.

ALABAMA, ARKANSAS, FLORIDA, GEORGIA, ILLINOIS, INDIANA, IOWA, LOUISIANA, MICHIGAN, MISSISSIPPI, NORTH CAROLINA, SOUTH CAROLINA, TENNESSEE, AND TEXAS.

[W. M. HILL.]

STATIONS OCCUPIED.—*Alabama:* Mobile and Selma. *Arkansas:* Little Rock and Searcy. *Florida:* Fernandina, Pensacola, and Tallahassee. *Georgia:* Milledgeville, Savannah, and Waycross. *Illinois:* Benton, Cairo, Cambridge, Chicago, Geneva, Harrisburg, Monmouth, Mound City, Mount Carroll, Murphysboro, Oregon, Pinckneyville, Sycamore, and Vienna. *Indiana:* Crown Point and Michigan City. *Iowa:* Maquoketa. *Louisiana:* Alexandria, Lafayette, Shreveport, and Smith. *Michigan:* Adrian, Allegan, Alpena, Bad Axe, Baldwin, Bay City, Bellaire, Benton Harbor, Caro, Cassopolis, Charlevoix, Charlotte, Cheboygan, Coldwater, Corunna, Grand Haven, Grand Rapids, Harrison, Harrisville, Hillsdale, Howell, Ionia, Ithaca, Kalamazoo, Kalkaska, Lapeer, Leland, Marshall, Midland, Mount Pleasant, Newaygo, Pontiac, Port Huron, Rogers, Sandusky, Standish, Tawas City, Traverse City, and West Branch. *Mississippi:* Brookhaven, Jackson, and West Point. *North Carolina:* Goldsboro. *South Carolina:* Aiken, Columbia, and Florence. *Tennessee:* Covington, Memphis, and Ripley. *Texas:* Austin, Groesbeck, and La Grange.

Magnetic work in the field was done by Mr. Hill during the periods July 1 to December 6 and March 1 to June 30. Observations were made to determine the value of the three elements of terrestrial magnetism at the stations named above, and the new stations were marked by stone posts. Many of the stations had been previously occupied and the observations were repeated to determine the annual change in declination. A meridian line was marked at Florence, S. C., in response to a request from the county surveyor.

NEVADA AND UTAH.

[FORD KURTZ.]

SUMMARY OF RESULTS.—Leveling: 320 kilometers of line completed and 90 bench marks established.

The work of extending the standard levels in Nevada and Utah was resumed on March 20 by Mr. Ford Kurtz, aid, and was in progress at the close of the fiscal year. The work began at Las Vegas, Nev., and was completed to the vicinity of Sahara, Utah, over the route of the San Pedro, Los Angeles and Salt Lake Railroad. The party lived in an "outfit box car," which was hired for the purpose, as the country traversed afforded nothing but the railroad to facilitate the work. This car was hauled forward by the railroad company as the work progressed and left on convenient side tracks. The officials of the company kindly granted authority to use velocipede cars as the means of transportation, which greatly facilitated the progress of the work, and the Survey is under obligation to these officials and especially to those of the engineering department for courtesies extended to the party.

MARYLAND.

[E. B. LATHAM.]

The topographic resurvey of the shore line of Chincoteague Bay, Maryland, was assigned to Assistant Latham. The work began on June 10 and was in progress on June 30.

Detached portions of the shore line needed immediately by the Maryland Shell Fish Commission were surveyed as the first work of the party, and an aggregate of 35 miles of shore line was completed during the period stated.

ALABAMA.

[J. W. MAUPIN.]

SUMMARY OF RESULTS.—Hydrography: 19 square miles of area covered, 255 miles of lines sounded, 7 661 soundings made, 1 tide station occupied, and 1 hydrographic sheet completed. Topography: 7 square miles of area covered, 35 miles general coast line surveyed, 3½ miles of roads surveyed, and 1 topographic sheet completed. Triangulation: 20 square miles of area covered, 8 stations occupied, and 6 geographic positions determined.

The resurvey of the entrance to Mobile Bay was assigned to Assistant Maupin.

The field work began in Mobile on May 12. Several days were spent in securing the necessary men and outfit, and the survey of the entrance began on the 20th and was completed on June 30. Two stations of the old triangulation were recovered and several new stations were established. A topographic survey was made of the points of land forming the entrance, including the shore line inside and outside. The area covered by the soundings includes the entrance to the bay and extends some distance offshore on the outside.

UTAH.

[H. W. MAYNARD.]

SUMMARY OF RESULTS.—250 kilometers of line completed and 71 bench marks established.

The extension of the standard levels in Utah was assigned to Aid H. W. Maynard. He arrived at Salt Lake City on April 2, and field work began on the 13th.

The line begins at Salt Lake City and follows the San Pedro, Los Angeles and Salt Lake Railroad to the vicinity of Milford, Utah, where the work was in progress on June 30. Velocipede cars were used as the means of transportation and the party lived in an outfit car hired from the railroad company, as it was impracticable to obtain living quarters for the party as required by the work.

CALIFORNIA.

[FREMONT MORSE.]

The work of locating a reported rock off Port Harford and securing data for correcting charts of this locality and of San Pedro Harbor was assigned to Assistant Morse. He left San Francisco on November 24 and returned on December 6, after completing the work.

At Oilport the wharf, ranges, and mooring buoys were located. At Port Harford the position of the reported rock was determined and the breakwater and wharves were located. At San Pedro the position of the breakwater was determined, a survey was made of the wharf line, and the buoys and beacons in the harbor were located.

CONNECTICUT, MASSACHUSETTS, NEW YORK, AND RHODE ISLAND.

[H. P. RITTER.]

The work of securing data for the revision of the charts covering the vicinity of Bridgeport, Conn., and the determination of the positions of aids to navigation, etc., in other localities was assigned to Assistant Ritter.

The work began at Bridgeport in July and was continued at intervals, when other assignments to duty permitted, until the end of the fiscal year. The work consisted in going over the area covered by the charts and correcting them to make them conform to existing conditions on land, and in a number of cases offshore, in order to show important changes since the date of the last survey. The work on 1 chart and the greater portion of the work on 3 others was completed. The triangulation stations within the area examined were recovered when possible and re-marked when necessary. Forty-six triangulation stations and 7 tidal bench marks were recovered.

The wreck of the steamer *City of Birmingham*, in Boston Harbor, was located. A magnetic range line in New York was investigated and a report was made. Several tide gauges in Boston Harbor were inspected. The deep-water channel range marks in East River, New York, were located trigonometrically.

The work of chart revision was in progress on June 30.

CALIFORNIA.

[A. F. RODGERS.]

The suboffice in San Francisco was continued in charge of Assistant Rodgers, who attended to numerous duties, many of them matters of routine, as the representative of the Superintendent on the Pacific coast.

MONTANA.

[H. M. ROY.]

SUMMARY OF RESULTS.—319 kilometers of lines completed and 87 bench marks established.

On July 1 the extension of the standard levels was in progress in Montana in the vicinity of Willow Creek, and the work was continued until September 10. The route followed the Northern Pacific Railway to Billings, where the work closed in September, as stated above. The railway authorities declined to permit the party to use velocipede cars on their tracks, and the necessity of walking long distances greatly delayed the work.

The line of levels was connected with 4 bench marks of the Missouri River Commission at Three Forks. A branch line of levels was run from Billings to Huntley to connect with the bench marks of the United States Reclamation Service at that place.

ALABAMA, CALIFORNIA, FLORIDA, GEORGIA, MINNESOTA, MISSOURI, NEBRASKA, NORTH DAKOTA, OKLAHOMA, SOUTH DAKOTA, TENNESSEE, AND WASHINGTON.

[E. SMITH; O. B. FRENCH.]

The determination of the differences of longitude between the places named below was made by Assistants Smith and French in charge of cooperating parties: Mobile and Fort Morgan, Ala.; Sacramento and Gazelle, Cal.; St. Marks and Daytona, Fla.; Daytona and Belleview, Fla.; Stephen and Minneapolis, Minn.; Dalton and Stephen, Minn.; Dalton, Minn., and Howard, S. Dak.; Howard, S. Dak., and Page, Nebr.; Page and Omaha, Nebr.; Omaha, Nebr., and Berger, Mo.; Omaha, Nebr., and Knobnoster, Mo.; Omaha, Nebr., and Howard, S. Dak.; Omaha, Nebr., and Salina, Kans.; Marlow and Pond Creek, Okla.; Marlow, Okla., and Bowie Base, Tex.; Knoxville, Tenn., and Atlanta,

Ga.; Seattle and University of Washington, Wash.; Seattle and Blaine, Wash.; Bismarck, N. Dak., and Stephen, Minn. This work extended over the periods July 1 to January 3 and April 9 to June 30.

The determination of the differences of longitude were made by the telegraphic method and transit micronometers were used in making the observations. The station at the University of Washington was connected with the triangulation in the vicinity of Seattle, and the recovery of the stations at Sacramento, Cal., and Bismarck, N. Dak., was verified by triangulation.

MARYLAND.

[C. M. SPARROW; F. L. FRANKS.]

SUMMARY OF RESULTS.—Topography: 6 square miles of area covered, 8 miles of shore line surveyed, 60 miles of roads surveyed, and 3 topographic sheets completed. Triangulation: 8 square miles of area covered, 8 stations occupied, and 9 geographic positions determined.

On July 1 the topographic resurvey of Chesapeake Bay was in progress in the vicinity of Chesapeake Beach under the direction of Assistant Sparrow. On September 1 he was relieved by his aid, F. L. Franks, who continued the work until December 12, when it was discontinued for the winter.

CALIFORNIA, FLORIDA, HAWAII, LOUISIANA, MARYLAND, NEW YORK, NORTH CAROLINA, PENNSYLVANIA, TEXAS, VIRGINIA, AND WASHINGTON.

Self-registering tide gauges were kept in operation during the year at the following places: Presidio and San Diego, Cal.; Fernandina, Fla.; Honolulu, Hawaii; Weeks, La.; Baltimore, Md.; Fort Hamilton, N. Y.; Wilmington, N. C. (February to June); Philadelphia, Pa.; Galveston, Tex.; Colonial Beach, Va., and Seattle, Wash.

MARYLAND, NEW YORK, PENNSYLVANIA, AND VIRGINIA.

[W. I. VINAL, Commanding, Schooner *Matchless*.]

SUMMARY OF RESULTS.—Hydrography: 45 square miles of area covered, 388 miles of lines sounded, 12 117 soundings made, and 1 tide station occupied.

The hydrographic resurvey of Pocomoke Sound, Chesapeake Bay, was in progress on July 1 under the direction of Assistant Vinal, and the work was continued until August 5, when he was relieved of the command by Assistant O. W. Ferguson.

During the period mentioned soundings were made over the greater portion of Pocomoke Sound between Onancock Creek and Pocomoke River. In June (15 to 26) an inspection was made of the tide gauges in operation at Baltimore, Md., Philadelphia, Pa., and Fort Hamilton, N. Y. Additional reference bench marks were established at Fort Hamilton, N. Y., and a report was made upon the condition of the gauges, tide staffs, etc., at all of the stations.

NEW HAMPSHIRE AND NEW JERSEY.

[D. B. WAINWRIGHT.]

Topographic information concerning a recently dredged harbor in the vicinity of Cape May, N. J., was obtained in the field in April for the purpose of correcting the charts covering this locality.

In the latter part of June (25 to 30) the work of making a topographic survey of Great Bay, New Hampshire, was begun, and this work was in progress on June 30.

HAWAII.

[W. F. WALLIS.]

A continuous record of the variations in the earth s magnetic condition was obtained during the year at the magnetic observatory near Honolulu, Hawaii, under the direction of Observer Wallis. Observations were made once each week to determine the absolute value of the three elements of terrestrial magnetism and once each month to determine the scale values.

The seismograph was kept in operation during the year, and a practically continuous record was obtained. Numerous earthquake shocks, including small tremors, were recorded, the total being 121 for the year.

Daily meteorological observations were made and monthly reports were made to the United States Weather Bureau observer at Honolulu.

The instruments of the magnetic survey yacht *Galilee*, sent out for work in the Pacific Ocean by the Carnegie Institution, of Washington, were compared at the observatory during the year.

CALIFORNIA, OREGON, AND WASHINGTON.

[F. WESTDAHL.]

The duty of collecting the information in the field necessary for a revision of the Coast Pilot volume covering the coasts of California, Oregon, and Washington was assigned to Assistant Westdahl. The work began on January 1, and the principal ports along these coasts were visited and notes were made of changes, and of all other information useful to mariners which could be obtained from local pilots, boatmen, and others. A good deal of information was also obtained showing what supplemental work is needed to bring the charts up to date, so that they may indicate the improvements made since the original surveys.

Assistant Westdahl returned to San Francisco on April 21 and continued the preparation of the Coast Pilot data until May 30. In April a shoal was reported by the officers of the steamship *Mongolia* about 17 miles southwest from the Farallon Light-house, and after April 23 advantage was taken of all suitable weather to search for this shoal. Soundings were made over the region, but no indication of the reported shoal was found.

CONNECTICUT, MARYLAND, MASSACHUSETTS, RHODE ISLAND, AND VIRGINIA.

[L. H. WESTDAHL, Commanding, Steamer *Bache*.]

SUMMARY OF RESULTS.—Hydrography: 27 square miles of area covered, 2 301 miles of lines sounded, 11 101 soundings made, 3 tide stations occupied, 9 current stations occupied, and 2 hydrographic sheets completed. Magnetic observations: 1 station on land and 5 stations at sea occupied.

The steamer *Bache* left Baltimore on July 8 for the purpose of making a hydrographic examination of Georges Shoal and a resurvey of Georges Bank, off the coast of Massachusetts. On the 18th the *Bache* left Provincetown in company with the light-house tender *Mayflower* and proceeded to Georges Bank, where the *Mayflower* placed buoys in selected positions on the bank as reference points in the survey, and left the bank on the 20th.

The resurvey of the shoal was completed on August 11, and the hydrographic examination was continued until September 29, when work was suspended on account of bad weather and the vessel went to New Bedford for coal. Later a rock was located off West Island, Buzzards Bay, as the result of a report that a danger to navigation existed in this locality.

An unsuccessful search was made for a rock which had been reported off spar buoy No. 16, in Narragansett Bay. The locality was thoroughly examined, but the reported danger was not found. The vessel then proceeded to New London and located a reported ledge off Black Rock Ledge, in the approach to the harbor.

During the season magnetic observations were made on land at Baltimore, Md., and on board ship in Hampton Roads, Virginia, off New London, Conn., off Provincetown, Mass., and at two stations at sea off the Massachusetts coast.

The *Bache* returned to Baltimore on November 7.

FLORIDA AND NORTH CAROLINA.

[ISAAC WINSTON.]

The recovery of old triangulation stations south of the entrance to Biscayne Bay, Florida, and the determination of the geographic positions of aids to navigation on the east coast of Florida was assigned to Assistant Winston.

En route to Florida a self-registering tide gauge was installed at Wilmington, N. C., and the record at this place began on January 25, 1908.

The field work in the vicinity of Miami, Fla., began on January 30 and was continued until May 7, 1908. During this period a search was made for all the triangulation stations along the outer coast from Cape Florida to Indian Key, a distance of 75 miles. In the inland waters a search was made for the stations in Cards Sound, Little Cards Sound, Barnes Sound, Black Water Sound, and in the northern part of the Bay of Florida.

A search was made for the marks at 100 old triangulation stations, and 44 of these were recovered, 55 were determined as lost, and 1 was not found. Seven new stations were established. The geographic positions of 22 aids to navigation (light-houses and beacons) were determined, and the steamship wharf at Knights Key, the temporary terminus of the Florida East Coast Railway, was located.

On the return trip to Washington the self-registering tide gauge at Fernandina, Fla., was inspected and necessary repairs were made. The position of the tide staff was checked by leveling to the permanent bench marks in the vicinity.

MARYLAND.

[C. C. YATES.]

SUMMARY OF RESULTS.—Triangulation: 475 square miles of area covered, 108 stations occupied, and 118 geographic positions determined.

Under authority conferred by law the Survey continued to cooperate with the Maryland Shell Fish Commission in surveying and marking the natural oyster beds, bars, and rocks in the waters within the State of Maryland. Some details in regard to this work are given in the preceding annual report.

The work of the Commission was extended during the year to include a definition of the crab and clam beds.

The field work undertaken by the Survey in Somerset and Wicomico counties was practically completed on November 6, and the work was then continued in Worcester County until late in December.

Six charts covering the area surveyed in Somerset County were prepared and published. Descriptions of the boundaries and landmarks in Somerset County were prepared for publication. The preparation of similar publications covering Wicomico and Worcester counties was begun and field work was in progress in Calvert County at the close of the fiscal year.

ALASKA.

[R. B. DERICKSON, Commanding, Steamer *Gedney*.]

SUMMARY OF RESULTS.—Reconnaissance: 200 square miles of area covered and 13 triangulation stations selected. Triangulation: 3 700 square miles of area covered, 5 stations occupied, and 7 geographic positions determined.

On April 5 the *Gedney* sailed from Seattle, Wash., for Sitka, Alaska, where the steamer *Cosmos* and launch *No. 117* were overhauled and put in commission. The vessel then proceeded to Dixon Entrance via New Metlakatla to leave the launch, and the triangulation of Dixon Entrance was begun on May 1.

Observing parties were placed on shore in camps and the work was continued during the remainder of the fiscal year. The lines to be observed were so long that heliotropes and signal lamps were both used at many of the stations. The ship was engaged most of the time in keeping up communication and in furnishing supplies to the four parties in camp on shore.

During the latter part of May and in June, rainy and stormy weather prevailed and slow progress was made.

[R. B. DERICKSON, Commanding, Steamer *Taku*.]

SUMMARY OF RESULTS.—Hydrography: 100 square miles of area covered, 273 miles of lines sounded, 2 824 soundings made, 1 tide station occupied, and 2 hydrographic sheets completed. Topography: 59 square miles of area covered, 39 miles of general shore line surveyed, 117 miles of shore line reconnaissance (using plane table), and 3 topographic sheets completed. Triangulation: 346 square miles of area covered, 15 stations occupied, and 29 geographic positions determined.

At the beginning of the fiscal year the survey of the west coast of Knight Island, Prince William Sound, Alaska, was in progress, and work continued in this vicinity until October 1, when the vessel started to Orca to be laid up for the winter.

A hydrographic and topographic survey of Drier Bay was completed. The triangulation from Latouche Passage to Naked Island was also completed, and a topographic reconnaissance was made along the shores of Knight Island Passage, including the bays and small passes. The positions of the points and headlands and of all objects of service to navigators were determined, and general hydrographic work was extended over the whole passage and reconnaissance lines of sounding wire extended into Mummy and Herring bays.

[W. C. DIBRELL, Commanding, Steamer *Explorer*.]

SUMMARY OF RESULTS.—Magnetic observations: 5 stations occupied on land and 18 stations occupied at sea. Reconnaissance: 6 381 square miles of area covered and 28 triangulation stations selected. Triangulation: 1 574 square miles of area covered, 16 stations occupied, and 6 geographic positions determined.

The *Explorer* left Seattle, Wash., on August 18 for survey work in Dixon Entrance, Alaska. The work was continued from August 22 to October 28, and the vessel returned

to Seattle on November 4. The vessel reached Dixon Entrance too late to accomplish much work, as the weather became very unfavorable in September and continued so during the remainder of the season. A reconnaissance was made for triangulation to cover the Dixon Entrance and a few stations were occupied during the progress of the work.

H. M. S. *Egeria* was at work in this locality in 1906, and the work done at that time greatly facilitated the work in hand. As many as possible of the stations established by the *Egeria* were used. Field work was closed on October 24 and the vessel proceeded to Seattle via Ketchikan.

On April 4 the *Explorer* sailed from Seattle for Kodiak, Alaska, to resume work in that locality, and from April 17 to June 30 the party was engaged in reconnaissance and triangulation in the vicinity of Cook Inlet and Shelikof Strait. This work was in progress on June 30.

[E. F. DICKINS, Commanding, Steamer *Gedney*.]

SUMMARY OF RESULTS.—Astronomic observations: 1 azimuth measured. Base measurement: 2 base lines measured. Hydrography: 13 square miles of area covered, 29 miles of lines sounded, 563 soundings made, and 1 tide station occupied. Topography: 444 miles of shore line sketched. Triangulation: 392 miles of area covered, 165 stations occupied, and 168 geographic positions determined.

On July 1 the party on the *Gedney* was at work on triangulation on the west coast of Prince of Wales Island, and the work was continued until October 12, when the field work closed and the vessel started to Sitka. A portion of the outfit was stored at Sitka for the winter and the vessel returned to Seattle on October 31.

The triangulation was extended from Iphegenia Bay to Cordova Bay and Howkan, a distance of 75 miles, through San Christoval and Portillo channels and around both sides of San Juan Bautista Island to a connection with the old work in Cordova Bay and Howkan Narrows.

A base line was measured near Fish Egg Island, at the entrance to Klawak Inlet, and another at North Bay near the head of Tlevak Strait. An azimuth was measured near the North Bay base and magnetic observations were made at various points along the line of work. A hydrographic examination was made of Balandra Shoal and a survey of Tlevak Narrows. A topographic reconnaissance of the shore line along the line of work was made by using the triangulation stations, and additional positions determined with sextant and by sketching between these positions.

[H. M. W EDMONDS.]

The work at the Sitka magnetic observatory was continued during the year. A record of the variations in the relative value of the three elements of terrestrial magnetism was obtained with self-registering instruments.

The seismograph was kept in continuous operation and meteorological observations were made. Observations were made at least once each week to determine the absolute values of the magnetic elements. Time signals were received over the cable, and observations to determine the local time were made when the cable time service was interrupted.

The instruments of the Carnegie Institution magnetic survey yacht *Galilee* were compared with the observatory instruments in July and August.

[H. C. GRAVES.]

On July 1 information was being collected in the field for a revised edition of United States Coast Pilot, Pacific Coast, Alaska, Part I, and the work was continued until October 1. Numerous localities were visited on commercial steamers and two special trips were made on the vessels of the Survey to points not reached by the regular means of transportation.

At all points visited inquiries were made of local authorities and masters and pilots of vessels, and valuable information was obtained extending over that portion of the coast between Dixon Entrance and Yakutat Bay and between Yakutat Bay and Cook Inlet and Kodiak.

[J. W. GREEN.]

The work of making magnetic observations on the Yukon River was assigned to Observer Green. He reached Dawson, Yukon Territory, Canada, on June 13 and started down the river in a small boat accompanied by 1 man on the 18th. Observations were made at 7 stations, as follows: Forty Mile, International Boundary, near Camp Davidson, Fort Egbert, Kandik River, Circle, and Fort Yukon. The work was in progress on June 30.

[W. C. HODGKINS, Commanding, Steamer *Patterson*]

On July 1 the party on the *Patterson* was engaged in making a survey of the coast of Alaska in the vicinity of Kodiak Island, and this work was continued until October 22. During this period a survey was made of the shore line of Kodiak Island from Cape Chiniak around the whole extent of Chiniak Bay, Kodiak Harbor, Usinka Passage, Kizhuyak Bay, Whale Island Passage, and Kupreanof Strait to a point about 3 miles west of Dry Spruce Bay, a distance of 178 miles from Cape Chiniak, following the shore line. A survey was also made of the islands lying offshore, including numerous small islands, Long and Woody islands, in Chiniak Bay, and Spruce and Whale islands, with a total of 140 miles of shore line. Hydrographic work was done in the channels and anchorages and on the shoals in the region mentioned. The western and northern portions of Chiniak Bay were sounded and the hydrographic surveys of Usinka Passage, Whale Island Passage, Afognak Strait, and Afognak Bay were completed, and some work was done in Marmot Bay, Kizhuyak Bay, and Dry Spruce Bay. A hydrographic examination was made along the eastern shore of Marmot Island, where dangerous reefs had been reported, and 2 ledges were found about 3 miles offshore. A dangerous pinnacle rock was found in the northern approach to Kodiak Harbor.

Magnetic observations were made during the season, and observations were made at Kodiak to determine on azimuth.

The *Patterson* returned to Seattle on November 3.

From August 6 to 25, Mr. H. C. Graves was on board engaged in Coast Pilot work, and special trips were made during this period to facilitate his work.

The *Patterson* left Seattle on March 9 and reached Kodiak, Alaska, on the 24th. A party was established on shore at Kodiak, to do topographic work and in Kupreanof Strait for general survey work, and the vessel proceeded to Dutch Harbor to put the steamer *Yukon* in condition for surveying work. This work was completed April 16 to

May 16. During the progress of this work observations were made at several magnetic stations on shore, and some topographic details of improvements at Dutch Harbor were obtained.

On May 17 the *Patterson* and the *Yukon* sailed for Kodiak, and reached there May 28. The steamer *Yukon* was turned over to Assistant H. C. Denson, and during the remainder of the fiscal year the entire party on the *Patterson* was engaged in surveying work.

A self-registering tide gauge was established and maintained at Uyak. Triangulation was completed in the western portion of Kupreanof Strait and in a portion of Shelikof Strait.

The topographic work done is shown on 5 sheets, one showing additional details at Dutch Harbor, one the town of Kodiak and its immediate vicinity, one Spruce Cape and Woody and Long islands, one Kupreanof Strait from Dry Spruce Island to Malina Point, and one the immediate vicinity of Uyak, including Harvester and Bear islands. Work was done on 2 hydrographic sheets, one covering Kupreanof Strait from Whale Island to Bay Point, the eastern point of Onion Bay, and the other Uyak anchorage and approaches.

Magnetic observations were made on shore at 1 station in British Columbia and at 12 stations in Alaska, and at sea off Union Bay, British Columbia, off Kodiak, and in Shelikof Strait.

[H. W. RHODES, Commanding, Steamer *McArthur*.]

SUMMARY OF RESULTS.—Astronomic observations: 1 azimuth measured and 1 latitude determined. Base measurement: 1 base line measured. Hydrography: 318 square miles of area covered, 572 miles of lines sounded, 12 684 soundings made, 2 tide stations occupied, and 2 hydrographic sheets completed. Reconnaissance: 4 790 square miles of area covered and 16 triangulation stations selected. Topography: 30 square miles of area covered, 48 miles of general coast line surveyed, and 2 topographic sheets completed. Triangulation: 1 437 square miles of area covered and 39 stations occupied.

On July 1 the survey of Iliamna Bay, on the west side of Cook Inlet, Alaska, was in progress, and the work was completed on July 19. Later in July a trip was made with an officer on board to collect Coast Pilot information, to examine the shore line and principal bays between Seldovia and Resurrection Bay. On August 1 the survey of Barren Islands was begun, and the work was continued until October 10, when field work closed on account of continuous stormy weather. The weather was generally unfavorable during the whole season. The vessel returned to Seattle, Wash., on October 28.

Repairs were made to the vessel during the winter, and on April 8 the vessel sailed for Cook Inlet and reached her destination on April 21.

A self-registering tide gauge was installed at Seldovia, and the topographic and hydrographic survey of the harbor was completed. A base line was measured in Port Graham, and a reconnaissance was made for a triangulation to cover that harbor. In May and June the reconnaissance was extended in Cook Inlet northward from Cape Douglas and the Barren Islands, and observations began at the stations as the joint operation of the parties on the ships *McArthur* and *Explorer*.

Sixty-seven miles of lines were sounded in Cook Inlet, a tide station was occupied in Port Graham, and the triangulation of this port was completed.

[G. T. RUDE, Commanding, Steamer *Taku*.]

SUMMARY OF RESULTS.—Hydrography: 35 square miles of area covered, 230 miles of lines sounded, 4 414 soundings made, 1 tide station occupied, 2 current stations occupied, and 2 hydrographic sheets completed. Topography: 6 square miles of area covered, 34 miles of general coast line surveyed, 4 miles of roads surveyed, and 2 topographic sheets completed.

The continuation of the survey of Prince William Sound was assigned to Assistant Rude. Preparations began at Cordova on April 4, and on the 29th the *Taku* was ready, and field work began immediately.

The hydrographic work includes a survey of Cordova Bay and Orca Inlet very nearly to its head. A topographic survey was made of the shore line in the vicinity of Cordova and Orca and along the greater portion of the shore line bounding the area covered by the hydrography and including the islands in the bay and inlet. A dangerous shoal reported in Cordova Bay southwest of Hanks Island with position marked doubtful on the chart was located with a drag and its position was determined.

On June 30 the work was in progress on the outer coast of Hinchinbrook Island.

OUTLYING TERRITORY.

PHILIPPINE ISLANDS.

[J. E. McGRATH, July 1 to March 6, E. F. DICKINS, March 7 to June 30.]

The survey of the coast of the Philippine Islands was continued under the immediate supervision of a Director, who represented the Superintendent in all matters requiring immediate action.

He made plans for field operations and issued instructions for field work at the suboffice in Manila. The observations made in the field were computed, and drawings for charts of the regions surveyed were prepared for transmission to Washington for review and publication. Sailing Directions and Notices to Mariners were prepared and published. He was aided in this work by such advice and instructions issued from Washington as became necessary.

The work was done under the same general plan of the division of expenses in force during the previous year. The National Government paid the salaries and subsistence of its technical corps detailed for duty in the Philippines, including several experts in the suboffice, furnished the instrumental equipment, paid the expenses of one large surveying steamer and for the supplies for two other surveying steamers, paid the expense of chart publication, the traveling expenses of officers to and from the Philippine Islands, and the hire of launches. The Philippine government paid the operating expenses of two surveying steamers, paid for the crew and repairs of two other surveying steamers (not including pay of officers), the party expenses of several surveying parties on shore, the salaries of the office force, and for office supplies obtained in Manila, and furnished office accommodations and printing.

There was a free exchange of information and good offices between the Survey and the various military and civil bureaus having common aims, and a gratifying interest was shown in responding to requests for information. Special mention is made of the courtesies extended to the Survey by the chief engineer of the Philippines division, the chief of the military information division, quartermaster's department, the bureau of navigation and its light-house and port works divisions, the bureau of public works, the bureau of customs, and the supervising railroad expert.

FIELD WORK.

Steamer Pathfinder.—This vessel was in Manila repairing and outfitting from July 1 to 20, when she proceeded to the east coast of Samar, and first filled in a gap in the triangulation in the vicinity of Sulat Bay and Hilabon Island, after which the work was taken up at the lower end of the operations of 1906 and continued southward. The triangulation was carried across the low peninsula which separates Matarinao and Quinapundan bays, and then extended from Gigoso Point in a southeasterly direction to include Malhon and Suluan islands.

The topography and hydrography were carried along the outside coast, around Sungi Point, including Suluan and Malhon islands, and connecting with the work of 1903.

Four triangulation stations in Sulat Bay were occupied and one uncharted rock off Guiuan and another in Panoan Strait were located. The vessel returned to Manila on October 31, and remained, repairing and outfitting, until December 14, when she sailed for the Gulf of Davao, Mindanao, to continue the general surveys in that section.

Work was carried on in that locality until the night of June 13, when the vessel sailed for Zamboanga for coal, and arrived there on the evening of the 14th, coaled ship, and sailed again on the 18th, arriving in the vicinity of Dominga Shoal on the morning of the 20th. During the day this shoal was located and developed, and late in the afternoon the vessel continued on to Manila, where she arrived in the afternoon of the 21st, and during the balance of the month the party was engaged on office work and having minor repairs made on the vessel.

The portion of the Gulf of Davao south of Samal Island is about 29 nautical miles in width in its narrowest part and about 42 miles in its widest part, necessitating long triangle sides, the stations of which had to be elevated in order to see across. All the shores and foothills are densely wooded, and required a large amount of cutting to open lines. Due to almost constant hazy weather, making it impossible to see poles or banners, heliotropes had to be used very extensively.

The triangulation was extended from Samal Island to Cape San Augustin, the southeastern point of entrance to the gulf, and station "Banos" on the western side of the gulf, and most of the mountain peaks on both sides of the gulf were located and their elevations determined. The topography was completed along the eastern side of the gulf from Mapanga Bay to Cape San Augustin, along the western side from Malalag Bay north to Santa Cruz, and south to Port Tubalan. The hydrography was extended along the eastern side, and as far out as the middle of the gulf, from Samal Island to Cape San Augustin, and on the western side the whole area between Samal Island, Santa Cruz, and Port Tubalan was completed. Three tide stations were established and used in connection with this work.

Steamer Fathomer.—At the beginning of the fiscal year this vessel was at Catanduanes Island, off the east coast of Luzon, engaged in combined operations, and the work was extended along the east coast of the island from Yog Point to Nagumbuaya Point, developing the important harbors and typhoon anchorages of Port Bagamanoc and Jimota and Kalapadan bays. By carrying this work to Nagumbuaya Point and connecting there with the work of 1903 the survey of all the shore line and adjacent waters of Catanduanes Island was completed. This is the first survey of this coast, and the results show a startling difference from the old Spanish charts.

After the completion of the above-named work the *Fathomer* proceeded to Rapurapu Strait, where she located and developed a reported shoal, then went to Batag Island and determined the position of the new light-house, and also developed Wright and Fisher banks and two small shoals in the vicinity of Palijon Island, and carried the work westward from Catarman to a junction with the work of 1902 in San Bernardino Strait. The heavy weather which makes this vicinity very unfavorable for field work in the fall of the year brought matters to a close on October 26, and the vessel reached Manila on October 31. She was repairing and outfitting until December 21, when she

sailed for Zamboanga to examine a rock reported off that town; also to locate and develop the reported dangers in Basilan Strait, and then to take up the general survey in Sibuguey Bay and extend it to the eastward.

The vessel arrived at Zamboanga on December 25 and was detained there by unfavorable weather until January 1, when she proceeded to the upper part of Sibúguey Bay and began field work at the limits of the former work in the vicinity of Buluan Island, and extended the triangulation, topography, and hydrography around the upper end of the bay and down the eastern side, which is very foul with dangerous reefs extending well offshore, then round the southern end of Olutanga Island and up into Dumanquilas Bay, connecting with a survey made by the U. S. S. *Yorktown* in 1903.

Six uncharted reefs and 1 bank (over 5 miles across, surmounted by a rocky patch) were found south of Sibuguey Bay, all surrounded by deep water. A reported 9-fathom bank due south of the entrance to Dumanquilas Bay in about the latitude of Lutagan Point was searched for, but no indication of it could be found.

Five tide stations were used at various times during the survey of Sibuguey Bay. The extension of the triangulation to the eastward of Sibuguey Bay involved a great deal of hard work.

During the season, while the vessel was at Zamboanga for coal, a plane-table survey of the shore-line front of the town was made, and a hydrographic survey along the water front from the eastern side of the military reservation to a point as far west of the town as any vessels are likely to approach the shore. This work was carried into the straits until depths of from 10 to 20 fathoms were reached, and a special examination was made for a shoal reported about 350 meters southeast of the long wharf, but no indications of it were found.

While this work was going on the vessel searched for two reported shoals in Basilan Strait to the southward of the eastern end of Little Santa Cruz Island. No indications of the northern shoal could be found, but the other shoal was found as reported and enough discrepancies discovered in this section of the chart to indicate that a resurvey of Basilan Strait, especially near the Basilan coast, should be made.

On June 27 the season's work in vicinity of Dumanquilas Bay was closed with the usual swinging of ship for magnetic variation, and the vessel started for Zamboanga for coal. While en route a shoal was sighted well to the southward of the work in Sibuguey Bay and a thorough examination of it was made and several soundings of 3 fathoms were obtained.

At the close of the fiscal year the vessel was at sea en route from Zamboanga to Manila.

Steamer Romblon.—At the beginning of the fiscal year the *Romblon* was on the eastern coast of Luzon, engaged in the surveys of San Miguel Bay, and on July 15, having completed that bay, the work in the vicinity of the Calagua Islands was taken up with a view of connecting it with the work in Lamon Bay. The topography of the islands was completed on August 15.

The work was making good progress when, on August 20, while sounding in the vicinity of Roses reef, the vessel struck on a pinnacle rock. Temporary repairs were made at Mercedes, but this serious accident put an end to the season's operations, and the work had to be left in an unfinished condition.

On September 1 the vessel started for Manila, but owing to her damaged condition and bad weather did not reach there until September 8. She remained in Manila undergoing repairs and outfitting until October 24. While repairs were going on a boat party was engaged on special development work and the location of buoys in the harbor.

On October 25 she sailed from Manila for Lucena, and the survey of the west coast of Luzon, Marinduque, and adjoining islands eastward from the termination of the work of 1906 was continued, and extended to the eastward between Marinduque and Luzon as far as Point Salomague and Lipata Point. The topography was extended southwest along the Luzon coast from Pitogo to the Matataha River, and from Port Banalacan to Point Salomague on the Marinduque coast, and also included the Anibayas Islands.

The inshore hydrography developed the coast of Luzon from Mabio Point to the Matataha River and the Marinduque coast from Point Santa Cruz to Point Salomague, and in addition special development was made at Pitogo and Mulanay anchorages, Catanauan Bay, Santa Cruz Harbor, and Port Banalacan. The offshore hydrography, with the ship, filled in the area in the vicinity of the inshore work above referred to, and in addition extended it south of Salomague Point to a point east of Mount Marlanga, and also filled in the space left between the hydrography executed previous to January 1 and the northwest coast of Marinduque. Current observations were made in Mompog Pass, tidal observations at Pitogo, Catanauan Bay, and Santa Cruz Harbor, and magnetic observations at Romblon.

The vessel closed field work in the vicinity of Marinduque Island on April 10, and arrived in Manila on the 12th, where she was overhauled and outfitted, and on May 18 sailed for Coal Harbor, Batan Island, to develop the inner harbor at request of the military authorities. The vessel arrived there on the 21st and reran the shore line, measured a solar azimuth, and did enough hydrography to develop the inner harbor, and also observed tides. This work was completed on the 25th, and on the following day the vessel sailed for Mercedes, where she arrived on the 27th, coaled ship, and located three new buoys recently placed in the mouth of Daet River. On May 29 the vessel proceeded to Capalonga and established a self-registering tide gauge in the estuary of the river. On the following day she proceeded to Atimonan, where the triangulation was taken up to connect the main scheme, which was brought across the divide from the west side of Luzon, connecting with the triangulation of Lamon Bay and of Calagua Islands.

Much rainy and cloudy weather interfered with the use of the heliotropes, which were required on all the lines, and a great deal of steaming was demanded of the ship to keep all parties moving.

Steamer Marinduque.—The *Marinduque* was in Manila repairing and outfitting from July 1 to 9, and on the 10th she sailed for the east coast of Luzon, where she arrived on the 14th and took up the general surveys of Lamon Bay and vicinity, in continuation of the work of the preceding year, beginning the triangulation in the vicinity of Alabat and Atimonan, and carrying it round the south end of Lamon Bay and out Calauag Bay to Pangao Point. The topographic work was extended along the shore of Luzon from Atimonan to Dagdap, and also along the shore of Alabat Island around the south end and along the eastern shore to Gerado Point, where it connects with the work of the preceding year. A survey was also made of Balesin Island. The hydrographic work includes the south end of Lamon and Calauag bays and was extended out to Dagdap

Point, Balesin, and Cabaleto Islands. The season was closed and the vessel started for Manila on October 13 and arrived on the 15th. From the 16th to the 21st she was engaged in repairing and outfitting, and on the 22d sailed from Manila for Palompon, Leyte, where she arrived on the 24th, and on the following day resumed the general surveys between Cebu and Leyte and continued it northward from the previous work in this vicinity. The triangulation was around the northern extremity of Cebu Island and into the northern entrance of Tañon Strait, and also around the north end of Leyte Island and through Biliran Strait into Carigara Bay. The topography was completed along the east coast of Cebu from Bantulin Point to Campatoc Point, along the west coast of Leyte from Villaba around Rabin Point and through Biliran Strait into Carigara Bay, and around the south and west shore of Biliran Island from Matuntun Point to Tincausan. The hydrography included the area between Cebu and Leyte from Bantulin and Duljugan points on the south to the northwest end of Biliran Island and through Biliran Strait into Carigara Bay.

Field work in this vicinity was closed on April 2 and the vessel returned to Manila to make repairs preparatory to taking up the summer's work on the east coast of Luzon. On May 18 the vessel sailed for the east coast of Luzon and arrived at Atimonan on the 22d. Field work was immediately commenced, but stormy weather prevailed during the remainder of the month and the completion of one topographic sheet and some signal building was all that could be accomplished. The month of June was much more favorable for field work and the triangulation between Polillo and Luzon and four topographic sheets were completed. At the close of the year the work was in progress.

Steamer Research.—This vessel was at Iloilo from July 1 to 6 having repairs made; on the 7th she resumed work on the north coast of Negros Island, and the triangulation, topography, and hydrography were extended until October 19, when a junction was made with the work at Danao River.

The topography includes the shore of Negros Island from Bito Point to Danao River and the outlying islands. At the Guimugahan River the topography was extended 7 miles inland to the head of navigation. The hydrography was extended 10 to 15 miles offshore, ending on a line from Baliguian Island to the southwestern extremity of the Don Islands and thence southward to Danao River.

At the close of this work the vessel returned to Iloilo and remained until October 1, when work was resumed on the northeast coast of Panay, extending the hydrography and topography from the limits of the work of last year. The hydrography was taken up on a line from Malangaban Island to Baliguian Island and thence to Macajolum shoals and extended northward to latitude 11° 27′ and eastward to longitude 123° 27′. This was all outside work extending about 15 miles offshore, in depths ranging from 3 to 30 fathoms. All the shoals indicated on the Spanish chart within this area were located and developed, and in addition four others previously uncharted were located. A very thorough search was made for "Mòlena Shoal P. D.," but no trace of it was found. The passage south of Sicogon Island is entirely clear, having not less than 17 fathoms, and the native fishermen do not know of any such shoal as that indicated on the old charts.

Field work was closed on January 11 and the vessel returned to Manila on the 20th. Assistant Miller assumed command on February 1, and remained in Manila outfitting

and repairing until March 5. While repairs were in progress, three days, February 3 to 5, inclusive, were devoted to a hydrographic examination of portions of Manila Harbor in order to locate two sunken wrecks which had been causing trouble to vessels.

After repairing and outfitting at Manila, the vessel sailed on March 5 to resume the work off the northeast coast of Panay, and by June 20 the hydrography had been extended about 15 miles to the northward and eastward. She then moved to Batangas Island and spent the remainder of the month in extending the topography.

During the season about 25 sandy and rocky shoals were carefully developed, some being shown on previous charts. The inside passage from Tagil Pass to Bulacaue Point which has been used only by small coasters, was shown to have 10 feet at low water.

To aid in the offshore work, two large bamboo buoys 25 feet square and 25 feet high were made and anchored, and they were seen with ease at a distance of 8 miles.

Launch Morven.—This party was organized to take up the survey of the southern end of Tañon Strait. She left Manila on July 2, arrived at Dumaguete, Negros Island, on the 3d, and work began on the 5th.

A base line was located and measured just north of Dumaguete and the triangulation was extended from this base to the northward through Tañon Strait as far as Guijulugano on the Negros side and Tanguil Point on the Cebu side. An azimuth was observed from the stone tower of the church at Dumaguete and connected with the triangulation.

The topography on the Cebu Island shore of the strait was completed from Tañon Point, at the southeast extremity of Cebu Island, to Tanguil Point and on the Negros Island shore from Dumaguete to the barrio of Calagcalag. The hydrography was completed from the southern entrance of Tañon Strait up the strait to Tanguil Point on the eastern side and to Calagcalag on the western side. A topographic and hydrographic survey was also made of Port Canoan, Siquijor Island, at the request of a member of the Philippine Commission.

The field work closed on December 19 and the party returned the launch to her owner at Iloilo and arrived at Manila on December 27, where it was disbanded.

At the request of the insular government for a survey of the north and west coasts of Bohol Island, Assistant C. V. Hodgson was directed to organize a party for that purpose and the launch *Morven* was again chartered for his use. The party sailed from Manila on February 12 by regular steamer for Cebu, where the launch had been ordered to meet them, and on their arrival there the instruments, outfit, and supplies were transferred to the launch and she sailed for Ubay, Bohol, on the 16th.

A base line was measured and a self-registering tide gauge was established. Hydrographic work commenced on March 1, using plane-table triangulation as a base until the triangulation could be extended from the work of the previous season. The inshore hydrography in that vicinity was extended from 10 to 14 miles offshore. Ubay was used as headquarters until May 4, on which date the party moved to Jetafe, at the northwest corner of Bohol Island. The triangulation was extended from the previous work across to Cebu Island and connected with the triangulation of 1902 in the vicinity of Cebu Harbor. The inshore hydrography, extending out to the Danajon Bank, and the topography down the west coast of Bohol Island was in progress at the close of the year.

Launch Erica.—The work assigned to this party was to close the gap between the northeast point of Panay and the former work in the vicinity of Capiz. The line Manigonigo light-house to Jintotolo light-house was used as a base, and in three figures a connection was made with a line in the triangulation of 1903 in the vicinity of Capiz. The outlying islands Zapatos and Olutaya made the laying out of a strong scheme comparatively easy, although some difficulty was experienced in locating stations in the low flat country south of Pirara Point and west of Tinagongdaget Inlet.

The topography presented no difficult features, except that it was impracticable to make a plane-table survey of Tinagongdaget Inlet on account of the fact that it was bordered on all sides by mangrove swamps and the water was too deep for setting up an instrument; therefore a sextant survey of the inlet was made, it being controlled by triangulation. The greater part of the work was the hydrography, which extended from Manigonigo light-house to Colasi Point and out to and including Cucaracha Shoal and the Zapato Islands.

Field work was closed on November 2, and on the 14th the party started for Manila on the launch *Erica*, arriving there on the 16th, when the party was disbanded.

OFFICE WORK.

The suboffice at Manila is organized to do all the work involved in chart construction. The records of observations made in the field were received as the work progressed. The necessary computations were made and the resulting data compiled in the form of drawings for charts. Eight drawings for new charts and 7 drawings for new editions of charts were prepared during the year and sent to Washington for publication.

A new edition of the Philippine Islands Sailing Directions, Section IV, was prepared and published. A supplement to Section V was published and also Philippine Island Notices to Mariners Nos. 6 to 12 of 1907 and Nos. 1 to 4 of 1908.

The Director is the disbursing agent for the Philippine work, and all expenditures, except expenditures on account of the steamer *Pathfinder*, are made by him and under his direction. He renders his accounts to the general Disbursing Agent, at Washington, for all expenses paid on the part of the General Government. This work involves a great deal of clerical labor and is increased by the accounts kept to show the disbursement of the funds furnished by the insular government, for which vouchers are rendered to the proper accounting officers of that government.

A division of map archives was formed during the year for the purpose of collecting and indexing all maps, sketches, descriptive reports, field notes, and general information from all available sources, in order to compile a new map of the archipelago and to keep such a map up to date by preparing and publishing new editions whenever new information makes this desirable. It is believed that this collection will be of great public utility, as it will be a combination of all the authoritative geographical information relating to the islands.

[H. L. BECK, Commanding, Launch *Erica*.]

SUMMARY OF RESULTS.—Hydrography: 381 square miles of area covered, 1 517 miles of sounding lines sounded, 48 038 soundings made, 1 tide station occupied, and 2 hydrographic sheets completed. Topography: 25 square miles of area covered, 74 miles of general coast line surveyed, and 1 topographic sheet completed. Triangulation: 521 square miles of area covered, 11 stations occupied, and 42 geographic positions determined.

Work along the north coast of Panay to complete the unsurveyed portion of the coast between the northeast point of the island and the vicinity of Capiz was assigned to Assistant Beck. He landed at Libas on July 25, and the work was continued until November 14, when the party started on the return trip to Manila.

The survey of the coast, including triangulation, topography, and hydrography, was extended from Manigonigo light-house to Colasi Point light-house and connects with work already completed in these localities. A self-registering tide gauge was installed at Libas, and observations were made during the progress of the work. Provision was made in the vicinity of Capiz for the extension of the triangulation with long lines across the old work to Calibo.

The area covered by the hydrographic work is comparatively shoal, the 20-fathom curve being about 8 miles offshore. The work was extended over the area between Zapatos Islands and Pilar Bay and over the Cucuracha Shoal.

The northeast monsoon began to blow steadily on November 1 and work was closed soon afterwards, as stated.

[J. B. BOUTELLE, Commanding, Steamer *Research*.]

SUMMARY OF RESULTS.—Hydrography: 557 square miles of area covered, 2 309 miles of lines sounded, and 34 255 soundings made. Topography: 38 square miles of area covered, 72 miles of general shore line surveyed, 3 miles of shore line of rivers and creeks surveyed, and 3 miles of roads surveyed. Triangulation: 34 square miles of area covered, 15 stations occupied, and 18 geographic positions determined.

On July 1 the steamer *Research* was at Iloilo having minor repairs made.

The survey of the north coast of Negros, including triangulation, topography, and hydrography, was resumed on the 7th and continued without interruption until October 19, when a junction was made with the work previously done on Danao River, thus completing the survey of the north coast of the island. The coast is low and nearly all covered with a growth of mangrove. The topographic work extends along the shore of Negros Island and 1 mile inland and includes the outlying islands. At the Guimugahan River the topographic survey was extended 7 miles inland to the head of navigation. The hydrographic work was extended from 10 to 15 miles offshore, ending on a line from Baliguian Island to the southwestern extremity of Don Islands and thence south to Danao River.

In November work on the northeast coast of Panay began and was continued until January 10, when operations were suspended and the party returned to Manila.

The hydrographic work was extended 15 miles offshore, the depths varying from 3 to 30 fathoms. All of the shoals indicated on the Spanish charts of this locality were located and developed and 4 not shown were discovered. A thorough search was made for the so-called "Moleno Shoal," but no trace of it was found. The passage south of Sicogon Island was found to be clear with 17 fathoms of water. The native fishermen were asked about the location of this shoal, but they knew nothing about it.

While the vessel was engaged on the hydrographic work, a topographic party on shore completed the survey of the Sicogon and Gigantes islands and the shore from the vicinity of Magalumbi Island to Gogo Point, including the islands to the east and northeast.

[H. C. DENSON, Commanding, Steamer *Marinduque*, July 1 to Jan. 13; D. R. JEWELL, Commanding, Steamer *Marinduque*, Jan. 14, to April 2.]

SUMMARY OF RESULTS.—Base measurement: 1 base line measured. Hydrography: 974 square miles of area covered, 2 470 miles of lines sounded, 34 856 soundings made, 4 tide stations occupied, and 11 hydrographic sheets completed. Magnetic observations: 1 station occupied. Topography: 266 square miles of area covered, 258 miles of general coast line surveyed, 12 topographic sheets completed. Triangulation: 2 450 square miles of area covered, 56 stations occupied, and 69 geographic positions determined.

[C. V. HODGSON.]

SUMMARY OF RESULTS.—Base measurements: 1 base line measured. Hydrography: 316 square miles of area covered, 2 238 miles of lines sounded, 113 290 soundings made, 3 tide stations occupied, and 2 hydrographic sheets completed. Topography: 97 square miles of area covered, 146 miles of general coast line surveyed, 12 miles of shore line of rivers and creeks surveyed, 9 miles of roads surveyed, and 1 topographic sheet completed. Triangulation: 320 square miles of area covered, 19 stations occupied, and 48 geographic positions determined.

Assistant Hodgson and his party reached Ubay, Bohol Island, on February 16, and field work began immediately. A base line was measured for temporary use in the plane table work, and the triangulation was extended to cover the north coast of Bohol Island between the work of the previous season and the triangulation of 1902.

A topographic survey was also made along this coast, including the islands along the shore, and the hydrographic work covers this region and extends offshore to a distance of 10 to 15 miles. All three classes of work were in progress at the close of the year.

[D. R. JEWELL, Commanding, Steamer *Marinduque*.]

SUMMARY OF RESULTS.—Topography: 103 square miles of area covered, 70 miles of general coast line surveyed, 3 miles of shore line of rivers and creeks surveyed, and 5 topographic sheets completed. Triangulation: 900 square miles of area covered, 13 stations occupied, and 26 geographic positions determined.

The vessel left Manila on May 18, and reached Atimonan, east coast of Luzon, on the 22d. Field work began immediately, and the triangulation and topographic work was in progress on June 30.

The triangulation extended the previous work northward along the coast of Luzon and completed the connection of Alabat, Cabalete, Balesin, and Polillo islands with each other and with the main land.

The topographic survey was extended along the shore line of Luzon and Polillo islands in the region covered by the triangulation.

[H. D. KING, Commanding, Steamer *Romblon*.]

SUMMARY OF RESULTS.—Astronomic observations: 1 azimuth measured. Hydrography: 1 602 square miles of area covered, 2 514 miles of lines sounded, 66 825 soundings made, 7 tide stations occupied, and 10 hydrographic sheets completed. Topography: 116 square miles of area covered, 205 miles of general coast line surveyed, and 7 topographic sheets completed. Triangulation: 5 812 square miles of area covered, 38 stations occupied, and 70 geographic positions determined.

On July 1 the *Romblon* was at work in San Miguel Bay, on the east coast of Luzon. The survey of the bay was completed on the 15th, and on that date the survey of the Calagua Islands was begun.

The topographic survey of the islands was completed on August 15 by a party living on shore, but the work from the vessel was greatly delayed on account of there being no harbor in the islands. A hydrographic party was placed on shore at Borocboc, and work was continued in this way until the completion of the topographic survey. Tide observations were made by using a self-registering gauge at Mercedes, supplemented by a tide staff in the islands.

The triangulation work was continued until August 20, on which date the vessel struck a pinnacle rock on Roses Reef, and this accident made immediate repairs necessary. Temporary repairs were made at Mercedes and the work on Roses Reef was completed before the vessel sailed for Manila. Unfavorable weather delayed the arrival of the vessel until September 9. The repairs were completed and the vessel sailed for Lucena, southwest coast of Luzon, on October 25. While at Manila some hydrographic work was done in the harbor and some buoys were located.

A reconnaissance was made and triangulation stations were selected to connect the work on the east and west coasts of Luzon and the islands of Marinduque, St. Cruz, Maninagan, and Mompog, on the west coast, and Alabat and Balesin, on the east coast. The triangulation was extended from the vicinity of Lucena to a point opposite Marinduque Island. A topographic survey was made along the north and east coasts of Marinduque Island to Point Salomague and along the opposite shore of Luzon.

The hydrographic survey was extended along the coast of Tayabas Province, Luzon, as far south as Matataha River, and to cover the area out to Marinduque Island. The hydrographic features of Pitogo and Mulanay anchorages, Catanauan Bay, Santa Cruz Harbor, and Port Banalacan were specially developed. Current observations were made in Mompog Pass, magnetic observations at Romblon, and tide observations at Pitogo, Catanauan, and Santa Cruz.

The work closed on April 10, and the vessel sailed next day for Manila.

The *Romblon* sailed from Manila for Daet on the coast of Luzon on May 18. En route a topographic resurvey of the shore line of Coal Harbor, Batan Island, was made, and some supplemental hydrographic work was done. The positions of three new buoys at the entrance to Daet River were determined after the work at Coal Harbor was completed.

After June 1 the triangulation was extended eastward from Lamon Bay to the Calagua Islands, connecting Polillo, Balesin, Alabat, and Jomalig islands with each other and with the Calagua Islands and Luzon.

The work was in progress on June 30.

[E. B. LATHAM.]

SUMMARY OF RESULTS.—Astronomic observations: 2 azimuths measured. Base measurement: 1 base line measured. Hydrography: 347 square miles of area covered, 1 357 miles of lines sounded, 35 355 soundings made, 4 tide stations occupied, and 8 hydrographic sheets completed. Topography: 99 square miles of area covered, 152 lines of general coast line surveyed, 22 miles of shore line of creeks surveyed, and 152 miles of roads surveyed. Triangulation: 800 square miles of area covered, 44 stations occupied, and 64 geographic positions determined.

Survey work on the coast of Negros was assigned to Assistant Latham. He reached Damaguete on July 3, and field operations began on the 5th. The astronomic station at this place was recovered, a base line was selected and measured, and an azimuth was

determined. Triangulation was extended from the base northward through Tañon Strait to a point near Guijulugan, at the western side of the strait, and to Tangil Point, Cebu, on the eastern side of the strait. Azimuth observations were also made at Canoan.

The topographic work was extended from Damaguete to Badian Bay, and on the western side of the strait it was completed to the barrio of Calagcalag. A survey was made in the vicinity of Damaguete and of North and South Bais bays. The survey was extended on the shore of Cebu from Badian Point to Tangil Point, and includes the harbor of Dumanjug, the proposed terminus of a railroad from Cebu. A survey was also made of the harbor of Canoan, Siquijor Island. The hydrographic work was extended along the shores where topographic work was done. The work closed on December 23, and the party returned to Manila.

[J. B. MILLER, Commanding, Steamer *Research*.]

SUMMARY OF RESULTS.—Hydrography: 386 square miles of area covered, 1 434 miles of lines sounded, 19 434 soundings made, 2 tide stations occupied, and 3 hydrographic sheets completed. Topography: 75 square miles of area covered, 50 miles of general coast line surveyed, 19 miles of rivers and creeks surveyed, 1 mile of roads surveyed, and 1 topographic sheet completed.

This vessel began topographic and hydrographic work on the northeast coast of Panay on March 10, and this work was continued until June 20, when the vessel proceeded to Bantayan Island, and on June 30 the work was in progress off the west coast of this island. A survey was made of the uncompleted portion of the shore line of the northeast coast of Panay and of the islands off this coast, including the Gigantes Islands, and the hydrographic work was extended 10 miles outside these islands on the north and east.

A survey was also made of the shore line of the Don Islands and along the west coast of Bantayan Island, and some hydrographic work was done in this vicinity.

In the offshore hydrographic work two large bamboo buoys, 25 feet high, were anchored and used successfully as hydrographic signals.

[W. E. PARKER, Commanding, Steamer *Fathomer*.]

SUMMARY OF RESULTS.—Hydrography: 1 999 square miles of area covered, 3 730 miles of lines sounded, 71 055 soundings made, 9 tide stations occupied, and 12 hydrographic sheets completed. Magnetic observations: 3 stations occupied. Topography: 455 square miles of area covered, 274 miles of general coast line surveyed, 71 miles of shore line of rivers and creeks surveyed, 4 miles of roads surveyed, and 6 topographic sheets completed. Triangulation: 1 189 square miles of area covered 35 stations occupied, and 56 geographic positions determined.

At the beginning of the year the *Fathomer* was at work on the survey of the east coast of Catanduanes Island, and this work was completed on September 25. The triangulation was extended from the old work on the islands, off the west coast of Catanduanes Island, across the north end of the island and down the east coast to the vicinity of Agutayan Point. From this point to the south end of the island the country bordering the coast is mountainous and heavily wooded nearly to the shore line, and there are no rocks or islands offshore available for use in triangulation; consequently a plane-table triangulation was extended along this portion of the coast and connected with a triangulation station on Lagonoy Gulf. The topographic and hydrographic

surveys along the east coast of Catanduanes Island were completed on September 24, and on the 25th magnetic observations were made off Port Anajao, and the vessel sailed the next day for Legaspi.

In passing through Rapurapu Strait a reported shoal was located, and developed by making soundings. Coal and supplies were obtained at Legaspi, and the vessel reached the north coast of Samar on September 29. Four shoals, Wright and Fisher banks, and 2 smaller shoals in the vicinity of Pelijon Island, were located and developed by soundings.

The triangulation on the north coast of Samar was completed by filling in between the work already finished along this portion of the coast. A tide staff was established in the mouth of the river below Catarman and connected with a bench mark in that place by leveling, and the inshore hydrographic work was completed along the north and east coast of Cabaun Island.

All the work was completed on October 26, including magnetic observations offshore in Biri Channel, and on the 27th the vessel sailed for Manila via Legaspi.

The *Fathomer* sailed from Manila in December and reached Zamboanga, Mindanao, on December 25. On January 1 topographic and hydrographic work began in Sibuguey Bay. The topographic survey was extended from a point on the west shore of the bay opposite Buluan Island around the head of the bay and down the east shore to the entrance, including a survey of Olutanga Island and the shores of Port Sibulan to a junction with the previous work at the entrance of Dumanquilas Bay.

The hydrographic survey covers the whole bay above Bagolibud Point (on the west shore) and the eastern half of the bay to a point about 30 miles outside Olutanga Island, including also Port Sibulan and its entrance. Five tide stations were established in this work. A triangulation was also carried across Sibuguey Bay, and extended to cover Port Sibulan. The work closed in Port Sibulan on June 27.

[J. F. PRATT, Commanding, Steamer *Pathfinder*.]

SUMMARY OF RESULTS.—Hydrography: 1 954 square miles of area covered, 2 403 miles of lines sounded, 27 044 soundings made, 3 tide stations occupied, and 8 hydrographic sheets completed. Topography: 115 square miles of area covered, 108 miles of general coast line surveyed, 16 miles of shore line of rivers and creeks surveyed, 5 miles of roads surveyed, and 5 topographic sheets completed. Triangulation: 2 729 square miles of area covered, 16 stations occupied, and 89 geographic positions determined.

The *Pathfinder* sailed from Manila on December 14, and reached Davao on the 19th, making magnetic observations at sea at four stations en route.

A self-registering tide gauge and two tide staffs were established and a reconnaissance for the triangulation of the Gulf of Davao was made. The gulf is very wide (29 nautical miles in the narrowest place) and the foothills near the shores are densely wooded.

Field work in this locality was continued until June 13, when the vessel sailed for Manila. The long lines over which the observations were made necessitated the use of heliotropes, and the heliotropers were stationed in pairs and armed on account of the hostility of the natives.

The triangulation was extended to cover the gulf from Samal Island to Point San Agustin, at the entrance. Heliotropes were used on lines more than 8 miles in length, and several of these were constructed in the field to meet the increased demand.

The lines in the main scheme of triangulation ranged from 25 to 43 miles in length, and many of the lines had to be cleared by cutting avenues through a dense tropical growth. The weather was very unfavorable until the middle of April, with heavy clouds and rainfall, and the sun was totally obscured over half the time.

A topographic survey of the shore line was made along the eastern shore from Mapanga Bay, opposite Samal Island, to Cape San Agustin and along the western shore north of Malalag Bay and of Tubalan Bay.

The hydrographic work was extended over the gulf as far south as Port Tubalan and over the eastern half of the gulf to Cape San Agustin.

The work shows the existence of several ridges in the gulf, the most prominent one having 65 fathoms of water on top and over 500 fathoms on both sides. Strong currents were found off the southern ends of Talicud and Samal islands and off Cape San Agustin. The mountain peaks were nearly always in the clouds, and could not be used in the hydrographic work. Field work in the gulf closed on June 13, when the vessel sailed for Manila. En route Dominga Shoal was located and developed by sounding.

[D. B. WAINWRIGHT, Commanding, Steamer *Pathfinder*.]

SUMMARY OF RESULTS.—Hydrography: 334 square miles of area covered, 1 450 miles of lines sounded, 12 059 soundings made, and 3 tide stations occupied. Topography: 34 square miles of area covered, 77 miles of general coast line surveyed, 1 mile of shore line of creeks surveyed, and 5 hydrographic sheets completed. Triangulation: 400 square miles of area covered, 22 stations occupied, and 34 geographic positions determined.

The work of surveying the east coast of Samar was in progress on July 1. The party on the *Pathfinder* continued this under the direction of Assistant Wainwright until October 27, when the work closed and the vessel proceeded to Manila. The principal work of the party may be summarized as follows: The completion of the unfinished portion of the survey of the coast above and also below Matarinao Bay, the extension of the surveys southward and westward from Sungi Point to and including Suluan and Malhon islands, and the connection of the triangulation work of 1903 with that of 1905–6.

Four triangulation stations were occupied in Sulat Bay and uncharted rocks were located off Guian and in Panoan Strait. The triangulation extends from Matarinao Bay across the low peninsula, which separates the bay from Quinapundan Bay and from Gigoso Point southeastward to Malhon and Suluan islands. The hydrographic work began at the north end of Iniyao Island and was extended along the coast to a point south and west of Malhon Island. Soundings were made over an area extending offshore to a distance of from 2 to 5 miles to depths varying from 140 to 680 fathoms. The topographic work included the survey of the shore line and a narrow band extending inland along the mainland of Samar and the whole of the islands of Malhon and Suluan. A small portion of the shore line and interior topography was also surveyed on Calicoan Island.

PORTO RICO.

[W. B. KEELING.]

The work of the magnetic observatory at Vieques, P. R., was continued during the fiscal year without interruption, and a record of the relative value of the three elements of terrestrial magnetism was obtained. The seismograph was in continuous operation and a record with this instrument was also obtained.

An additional building was constructed for use as an office.

[P. A. WELKER, Commanding, Steamer *Bache*.]

SUMMARY OF RESULTS.—Hydrography: 422 square miles of area covered, 1 111 miles of lines sounded, 11 514 soundings made, 2 tide stations occupied, and 6 hydrographic sheets completed. Magnetic work: 3 stations occupied on land and 10 stations occupied at sea.

The steamer *Bache* left Baltimore on January 6 for Porto Rico to complete the offshore hydrography along the north coast of the island. On the next day in a severe storm the vessel dragged her anchor in Hampton Roads and was driven into the U. S. hospital ship *Jamestown*, at anchor in Hampton Roads, causing considerable damage and making immediate repairs necessary.

While waiting for the work to be done, supplemental topographic work was completed (January 17 to February 8) along the water front in the vicinity of Norfolk to show all changes since the last survey was made. Magnetic observations were made on board ship in Hampton Roads on February 28, and on March 16 the voyage to Porto Rico began. Rough weather interfered with the magnetic work en route, but a few observations were made. Magnetic observations were made on board in the harbor of Mayaguez and at a number of stations at sea on the return voyage to Norfolk, and a special route was followed in order to obtain observations at points off the direct route. Hydrographic signals were erected at triangulation points along the north and west coast of the island from Boca Juan Point to Point Cadena, covering about 80 miles of the coast. It was necessary to place a party on shore to do this work, as the almost continuous heavy surf made regular boat landings impracticable. The work on shore was done under great disadvantage on account of the absence of facilities for proper transportation of men and material.

The hydrographic work was completed along the coast from Boca Juan Point on the north coast to Point Jiguero on the west coast, except a narrow strip of inshore work from Boca Juan Point to Point Borenquen, and the soundings were extended offshore to the 300-fathom curve without finding any indications of dangers to navigation.

The field work closed on May 23, and the vessel sailed from San Juan for Baltimore on May 30 and reached her destination on June 7.

SPECIAL DUTY.

NEW YORK.

[A. T. MOSMAN.]

The trigonometric survey of Greater New York was continued by the city authorities under the direction of Assistant Mosman, and the field work was almost completed at the close of the fiscal year.

Observations were made at 51 stations in the Borough of Queens during the year, and this work was completed except at 4 stations. The observations at these 4 stations will complete the field work of triangulation over the whole area of Greater New York.

INTERNATIONAL BOUNDARIES.

[O. H. TITTMANN.]

UNITED STATES AND CANADA BOUNDARY.

The work of re-marking this boundary west of the Rocky Mountains was continued during the year, under the direction of the joint commission, in which Messrs. O. H. Tittmann and C. D. Walcott represent the United States and Mr. W. F. King, Great Britain.

During the summer of 1907 the Commissioners made a joint personal inspection of the boundary at various points. The representatives of the Commissioners, Messrs. C. H. Sinclair and N. J. Ogilvie, inspected the monuments from the top of the Rocky Mountains to the east side of Lake Osoyoos, a distance along the boundary of 242 miles. In this section 155 boundary monuments were inspected and a plate bearing the proper number was attached to each. This work was very laborious, as it involved 1 400 miles of travel, 800 miles of which was by pack train. The work closed for the winter on October 22, 1907. It was resumed in June, and was in progress at the close of the year.

In the spring a party began the work of recovering and re-marking the boundary east of the Rocky Mountains, and on June 30 the work was in progress along the Montana boundary east of Coutts, Province of Alberta. Messrs. F. D. Granger and J. J. McArthur represented the Commissioners on this work.

On July 1 the work of recovering and re-marking the Vermont-Canada boundary was in progress under the direction of Mr. O. H. Tittmann and Mr. W. F. King, Commissioners of the United States and Great Britain, respectively. The representatives of the Commissioners, Messrs. J. B. Baylor and G. C. Rainboth, had charge of the work in the field. Field operations continued until November 9, when the work closed for the winter. During this period 55 miles of the boundary was surveyed and a vista was cut through the forest. Ninety cast-iron monuments were reset in concrete bases and 86 new granite monuments were placed in position, set in concrete bases. Four large

concrete monuments were built, 2 on the shores of Missisquoi Bay and 2 on the shores of Richelieu River. A topographic survey was made along the boundary covering a strip half a mile wide on each side, on a scale of 4 inches to 1 mile. Large scale maps (1 inch = 250 feet) were made of the immediate vicinity of the boundary, covering a strip 500 feet wide on both sides. On the date mentioned, November 9, the field work along the Vermont-Canada boundary was completed.

In the spring the monuments along the Vermont-Canada boundary were inspected to ascertain the effect of frost during the winter, and were found in good condition.

In June the recovery of the Maine-New Brunswick boundary was begun and at the end of the month 8 miles of the line had been recovered and remonumented, and the work of opening a vista along the line and of making a topographic survey in its vicinity on both sides was in progress by the joint party of surveyors representing the United States and Great Britain, on June 30.

ALASKA BOUNDARY.

The demarcation of the boundary between Alaska and Canada along the one hundred and forty-first meridian was continued as provided in the convention between the United States and Great Britain (signed April 21, 1906) by Mr. O. H. Tittmann, the Commissioner representing the United States, and Mr. W. F. King, the Commissioner representing Great Britain. Messrs. G. C. Baldwin and A. J. Brabazon, representing the Commissioners in the field, extended the line southward from the point reached on June 30, and at the close of work for the winter established a point 125 miles south of the Yukon River. Marks were left on the summits and at numerous intermediate places for the use of the surveying and monumenting party which was following.

Mr. Thomas Riggs, jr., had charge of the party engaged in making a survey along the boundary line. Triangulation along the line with points on each side was extended south from the Yukon River for a distance of 62 miles, and in this work observations were made at 43 stations. A vista 20 feet wide on the sky line was opened for a distance of 54 miles. A topographic survey was made in the vicinity of the boundary, and it was extended to cover a strip 2½ miles wide on each side. Boundary monuments were established on the banks of the Yukon River, one on each bank, and sites for monuments were selected and marked at short intervals along the line. Eighteen sites were established south of the river in a total distance of 54 miles. On June 30 Messrs. Baldwin and Riggs were in the field with their parties continuing their work of the previous season.

In southeastern Alaska several parties were at work on the demarcation of the boundary. Mr. O. M. Leland was at work in the vicinity of Lynn Canal. The triangulation was extended up the Katzehin River, and 20 stations were occupied. Nine of these were stations from which observations were made directly on boundary peaks and one was on a boundary peak. Incidentally the geographic positions of the light-houses at Eldred Rock and Point Sherman were determined. The portion of the boundary located extends from "6800," north of Katzehin River, southeastward to "8000," just north of Taku River. Boundary peak 6600 was occupied as a triangulation station, and the directions to several other boundary peaks were observed. Eight stations were occupied with topographic cameras and numerous

phototopographic negatives were obtained. This work furnishes much new information, especially concerning the Meade Glacier district.

Mr. Fremont Morse continued the triangulation in the vicinity of Glacier Bay and extended the work from the stations in the coast triangulation of Icy Strait to the head of Glacier Bay. Thirty-nine stations were occupied and 57 geographic positions were determined. A base line was measured to verify the work, and observations were made to determine the latitude of a point and an azimuth. The positions of all the boundary peaks were determined from "7450" to Mount Fairweather and thence eastward to "5300."

A party under Mr. Leland's direction resumed work in June on the survey of the boundary in the vicinity of the Unuk River, and the work was in progress on June 30. Mr. Morse began similar work in the vicinity of the Alsek River in May, and the work was in progress on June 30.

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APPENDIX 2

REPORT 1908

DETAILS OF OFFICE OPERATIONS

CONTENTS.

	Page.
OFFICE OF THE ASSISTANT IN CHARGE	61
Computing Division	61
Division of Terrestrial Magnetism	61
Tidal Division	62
Drawing and Engraving Division	63
Chart Division	66
Instrument Division	66
Library and Archives Division	67
Miscellaneous Section	68

DETAILS OF OFFICE OPERATIONS.

OFFICE OF THE ASSISTANT IN CHARGE.

ANDREW BRAID, *Assistant in Charge.*

The Assistant in Charge of the Office has direct supervision of the work of the different divisions of the Office. The Miscellaneous Section is a part of the immediate office of the Assistant in Charge.

COMPUTING DIVISION.

The reduction of the triangulation in Florida, Georgia, and South Carolina to the United States standard datum was continued. Geographic positions on this datum are now available for all points in the main scheme of triangulation from Port Royal, S. C., to Mobile, Ala., and around the coast of Florida, and for many points not in the main scheme in South Carolina and Georgia.

The triangulation along the ninety-eighth meridian in southern Texas and also the triangulation in California north of Monterey Bay has also been reduced to the standard datum. The computation of the triangulation in California done since the earthquake of April 18, 1906, to fix the new positions of the disturbed points was completed, and the results showing the earth movements have been published.

A third adjustment of the precise net in the United States was made and the results were partly prepared for publication.

About two-thirds of the energy of the Division was used in preparing data for publication, and a good deal of material is in an advanced state of preparation.

DIVISION OF TERRESTRIAL MAGNETISM.

The preparation of the results obtained by making magnetic observations on land and at sea during the fiscal year ended June 30, 1907, was completed, and they were published as an appendix to the Annual Report of the Survey for that year.

The computation of the results of the observations made on land and at sea by the party on the steamer *Explorer* while en route from Norfolk, Va., to Seattle, Wash., via the Straits of Magellan, was completed, and these results were furnished to the United States Hydrographic Office, Navy Department, at the request of that Office.

The reduction of the work at the magnetic observatories previous to 1905 is nearly completed, and the results are almost ready for publication.

The compilation of earthquake data from the seismographs at the magnetic observatories of the Survey to the end of 1907 was completed. These results and seismograms showing the principal earthquakes were transmitted to Prof. H. F. Reid, the United States representative of the International Seismological Association.

The reduction of magnetic observation made in the field during the year, as well as the usual routine work of the Division, was kept up to date.

TIDAL DIVISION.

An harmonic analysis was computed for 1 station for 1 year. Nonharmonic reductions were made for 111 stations, with a combined length of 32 years 7 months and 14 days. Mean sea level has been computed for 14 stations, with a combined length of 10 years and 8 months. High and low waters and hourly heights of the sea have been tabulated for 146 stations, with a combined length of 33 years 9 months and 14 days.

There were received, examined, and registered in this division the records from 19 automatic tide gauge stations of this Survey, with a combined length of 12 years 2 months and 4 days, together with staff gauge records from 63 stations, with a combined length of 5 years 10 months and 22 days. The total of all tide observations made by this Survey and received during the year is 18 years and 26 days at 82 stations, and from other sources about 14 years 4 months and 26 days at 28 stations, making a total of nearly 32½ years of tide observations at 110 stations.

The following is a list of the sources from which tide observations were received from outside parties during the year:

1. United States Army Engineers, tides for 1 station in Washington, with a length of 1 month and 24 days; tides for Colon and Panama, Canal Zone, with combined length of 3 months and 12 days.

2. United States Navy Engineers, tides for 3 stations in California, with a combined length of 1 year and 6 months.

3. The American embassy at Mexico, Mexico, tides for 10 Mexican ports, with a combined length of 7 years 10 months and 5 days.

4. The sewerage department of Boston, Mass., tides for 1 station in Massachusetts for 1 year.

5. The Hawaiian Territorial government, tides at Honolulu for 6 months.

6. The Philippine government, tides at Manila and Iloilo, with a combined length of 1 year and 11 months.

7. The Norwegian hydrographic office, tides at 8 Norwegian ports, with a combined length of 1 year and 2 months.

The concluding portion, Part V, of the Manual of Tides, "Currents, shallow-water tides, meteorological tides, and miscellaneous matters," was completed, printed, and the proof was read. The Tide Tables for 1909, containing the predicted tides for that year, were also completed, printed, and the proof was read.

At the request of the German ambassador in Washington, D. C., manuscript copies of the predicted tides for the year 1909 for Sandy Hook, Baltimore, Charleston, and San Francisco were sent to the hydrographic office at Williamshaven, Germany. At the request of the secretary of the marine department of New Zealand manuscript copies of the predicted tides for Wellington and Auckland for the year 1909 were sent to him.

DRAWING AND ENGRAVING DIVISION.

The Division is divided into five sections—the Drawing, the Engraving, the Printing, the Photographing, and the Electrotyping sections. Each section does the work indicated by its title, and the combined result is shown on the charts published and issued by the Survey. On November 20, 1907, the Hydrographic Section of the Chart Division was transferred to this division and after that date all the work of chart construction was done in the division. On January 1, 1908, the publication of a monthly Notice to Mariners was discontinued by the Coast and Geodetic Survey, and since that date all information obtained by the Survey has been published by the Light-House Board in the weekly Notice to Mariners, issued by that Bureau. All desired information is prepared and furnished weekly to the Light-House Board by this division.

Drawing Section.

During the year the following drawings for new charts were completed:

Chart No.	
——.	Maryland Shell Fish Commission Charts, Nos. 5–12.
283.	Hudson River.
354*a*.	Bristol Harbor.
558.	Potomac River.
4102.	Hawaiian Islands.
5145.	San Pedro Harbor.
8084.	Seal Cove and Kasaan Bay.
8162.	Lake Bay, Alaska.
8243.	Kelp, Takatz, and Warm Spring Bays.
8524.	Drier Bay.
8665.	Iliamna Bay.

New drawings were completed for new editions of charts, as follows:

Chart No.	
112.	Vineyard Sound and Buzzards Bay.
135.	Chesapeake Bay.
204.	Galveston Bay.
249.	Buzzards Bay.
9380.	Norton Sound, Alaska.

Extensive corrections were made to the drawings for 57 charts in preparing them for the issue of new editions. Eleven drawings for charts were received from Manila and prepared for publication.

The usual work of making corrections on charts, verifying proofs, constructing projections on paper and on copper plates, inking, plotting, and verifying topographic and hydrographic sheets was done, and the illustrations for the Annual Report of the Survey were prepared.

The two Filipino students attached to the Division for instruction in drawing were relieved from duty October 1, 1907.

Engraving Section.

The following original engraved plates were completed:

Chart No.	
196.	Barataria Bay.
901.	West Coast of Porto Rico.
903.	North Coast of Porto Rico.
950.	Colon Harbor.
3133.	District of Columbia (map).
4711.	Northern part of Luzon.
5533.	San Pablo Bay.
5534.	Suisun Bay.

Seven of these plates represent charts already published by photolithography.

The following original etched plates were completed:

Chart No.	
4108.	Hanapepe Bay.
4454.	Harbors on Burias and Ticao Islands.
6023.	Siuslaw River.
8285.	Killisnoo Harbor.
8665.	Iliamna Bay.

Four of these plates represent charts already published by photolithography.

The following new bassos were completed:

Chart No.	
108.	Wells to Cape Ann.
125.	Delaware River.
133.	Chesapeake Bay.
143.	Pamlico Sound.
152.	Murrell Inlet to Cape Romain.
153.	North Island to Isle of Palms.
155.	Hunting Island to Ossabaw Island.
156.	Savannah to Sapelo Island.
157.	Sapelo Island to Amelia Island.
158.	St. Marys Entrance, etc.
166.	Key Biscayne to Carysfort Reef.
167.	Elbow Key to Matecumbe Key.
177.	Tampa Bay.
189.	Mobile Entrance.
210.	Aransas Pass and Corpus Christi Bay.
309.	East Penobscot Bay.
331.	Newburyport Harbor.
388.	Potomac River.
400.	Hampton Roads to Norfolk.
401*a*.	James River.
401*b*.	James River.
420.	Beaufort Harbor.
428.	Winyah Bay.
440.	Tybee Roads, etc.
453.	Fernandina Entrance.
541.	New York Harbor.
927.	Ponce Harbor.
5143.	Wilmington and San Pedro Harbors.
6100.	Cape Lookout to Grays Harbor.
6400.	Waters of Washington
6460.	Puget Sound
8800.	Alaska Peninsula to Seguam Pass.

The following plates were corrected for new editions of charts:

Chart No.	
120.	New York Harbor.
169.	Newfound Harbor Key, etc.
190.	Round Island to St. Josephs Sound.
197.	Barataria Bay to Terrebonne Bay.
198.	Caillou Bay to Ship Shoal.
205.	Galveston Bay to Oyster Bay.
250.	Nantucket Sound.
362.	New Haven Harbor.
410.	Port Newbern.
469.	Key West Harbor.
542.	Jamaica Bay and Rockaway Inlet.
908.	Port San Juan.
8000.	Dixon Entrance to Cape St. Elias.
8100.	Clarence Strait, etc.

SUMMARY.

Plates for new charts finished	1	Plates for new editions completed	14
Plates for former lithograph charts finished	7	Bassos completed	32
Plates (etched) for new charts finished	1		
Plates (etched) for former lithograph charts finished	4		

Extensive corrections were made on 83 plates and minor corrections on 806.

Printing Section.

New prints:		Charts printed from stones (impressions, 95 901)	37 817
Number of different charts from stones	67	Charts printed from plates (impressions, 65 581)	57 887
Number of different charts from plates	683		

The following charts were printed from stones:

NEW CHARTS.

Chart No.	
354*a*.	Bristol Harbor.
558.	Potomac River.
559.	Potomac River.
903.	North Coast of Porto Rico.
4210.	Dasol Bay to Iba.
4223.	San Miguel and Lamit Bays.
4267.	Lucena Anchorage, Pagbilao Bay, and Port Laguimanoc.
4416.	Iloilo and Guimaras Straits.
4421.	Catarman to Oras Bay.
4422.	Oras to Matarinao Bay.
4426.	Ormoc Bay to Maasin.
4462.	Matarinao Bay.
4640.	Port Misamis.
4648.	Vicinity of Davao and Pakiputan Strait
4716.	Palawan Island.
5145.	San Pedro Harbor.
5530.	San Francisco Bay.
6380.	Washington Sound, Washington.
8084.	Seal Cove and Head of Kasaan Bay.
8162.	Lake Bay and Approaches.
8243.	Kelp, Takarz, and Warm Spring Bays.
8502.	Cape St. Elias to Shumagin Islands.
8515.	Prince William Sound, Western Entrance.
8524.	Drier Bay.
8665.	Iliamna Bay.
8821.	Harbors and Bays, Southwest Alaska.
9196.	Anchorages and Harbors, Southwest Alaska

NEW EDITIONS.

Chart No.	
112.	Vineyard Sound and Buzzards Bay.
249.	Buzzards Bay.
261.	Guilford to Blackstone Rocks.
264.	Milford to Bridgeport.
266.	Fairfield to Georges Rock.
565.	Passaic River, etc.
577.	Fernandina to Jacksonville.
901.	West Coast of Porto Rico.
4100.	Hawaiian Islands.
4209.	Lingayen Gulf.
4220.	San Bernardino Strait.
4221.	Albay Gulf and part of Lagonoy Gulf.
4222.	Lagonoy Gulf to Sisiran Bay.
4237.	Tabaco Bay to Legaspi.
4266.	Ports Masinloc and Matalvi and Palanig Bay.
4343.	Puerto Princesa.
4447.	Harbors of Balabac Island.
4460.	Iloilo Strait and part of Guimaras Strait.
4641.	Murcielagos Bay.
4714.	Mindoro.
4718.	Panay, Negros, and Cebu.
4722.	Jolo Archipelago.
4723.	Western Mindanao.
5832.	Humboldt Bay.
5971.	Coquille River Entrance, Oregon.
6112.	Tillamook Bay, Oregon.
6400.	Waters of Washington.
7000.	Cape Flattery to Dixon Entrance.
8000.	Dixon Entrance to Cape St. Elias.
8074.	Harbor Charts of Dixon Entrance and Clarence Strait.
8075.	Revillagigedo Channel.
8077.	Harbors in Prince of Wales Island.
8100.	Clarence Strait, etc.
8513.	Controller Bay, Alaska.
8520.	Prince William Sound, Eastern Entrance.
8881.	Islands and Harbors off Alaska Peninsula.
9380.	Norton Sound.

Photographing Section.

The following etched plates were made:

Chart No.	
411.	Appamattox River.
517.	Sabine Pass and Lake.
4107.	Pearl Harbor.
4109.	Honolulu Harbor.
4246.	San Fernando Harbor.
4267.	Lucena Anchorage, etc.
4543.	Isabella Channel.
4645.	Masinloc Anchorage to Caldera Bay.
4647.	Agusan River Entrance.
4649.	Malalog Bay.
5984.	Coos Bay.
6023.	Siuslaw River.
8160.	Zarembo Island.
8242.	Harbors in Chatham Strait.
8285.	Killisnoo Harbor.
8513.	Controller Bay.
8538.	Resurrection Bay.
8665.	Iliamna Bay.

Negatives of 71 charts were made for use in reproducing them by lithography.

Electrotyping Section.

	Number.
Altos completed	51
Bassos completed	36
Copper deposited (kilograms)	1 410

CHART DIVISION.

A new edition of the chart catalogue was prepared. The total issue of charts was 4 per cent larger than during the previous year, and the correspondence shows an increase of 13 per cent.

The charts were sold by 170 agents and at the office in Washington.

Charts were received as follows from the Drawing and Engraving Division:

	Number.
Prints from plates	57 887
Prints from stone	37 815

In addition to the above 8 562 copies of special charts Nos. 5, 6, 7, 8, 9, 10, and 12, prepared for the Maryland Shell Fish Commission and printed by contract, were received for distribution.

Charts were issued as follows:

Sales agents	44 310	Executive Departments	4 740
Sales at the office	2 409	Foreign governments	636
Congressional account	4 678	Miscellaneous	677
Hydrographic Office, U. S. Navy	30 908		
Light-House Board	3 520	Total	107 917
Coast and Geodetic Survey Office	6 892		
Coast and Geodetic Survey suboffice at Manila, P. I.	9 147		

All the work in connection with the sale of charts is done in this Division.

The corrections necessary to keep the charts up to date were indicated and the monthly Notice to Mariners was prepared in the Division previous to November 20, 1907, the date on which all the work of chart construction was brought together under the Drawing and Engraving Division by the transfer to that Division of the work previously done in the Hydrographic Section of the Chart Division and the employees engaged on the work.

INSTRUMENT DIVISION.

In this Division an account was kept of all instruments and general property owned by the Survey or purchased during the year, except articles on the inventory of the Office at Washington.

All necessary repairs were made to instruments used by the Survey. Minor repairs were made to the Office buildings and furniture.

Considerable progress was made in constructing a new tide-predicting machine. The superstructure was received and the machine was assembled. The gearing connecting the two main parts of the machine was made and mounted. The main driving gear was constructed and put in place. A test was made for flexure with a satisfactory result.

A design based upon the ordinary interferometer was made for an apparatus to measure the movement of pendulum cases such as used by the Survey, caused by the

swinging of the pendulum, when gravity observations are being made. The construction of duplicate sets of this apparatus was well advanced during the year.

A number of monuments to be used in marking the Alaska boundary were inspected.

Four duplicates of the leveling instrument devised and adopted by the Coast and Geodetic Survey, made for the East Indian government by private parties subject to inspection and approval by the Superintendent, were carefully examined and recommended for approval.

The machine for engraving soundings was modified so that it can be operated by one man instead of two when the soundings are placed on a plate in their proper position by a photographic-transfer process.

LIBRARY AND ARCHIVES.

The current routine work was kept up to date. The records of observations made in the field were indexed as they were received. Progress was made in the preparation of a complete author and subject catalogue.

The following tables show the accessions and issues during the year:

Accessions.

	Purchased.	Donated.	Exchanged.	Total.
Books and pamphlets	137	141	869	1 147
Maps and charts	1	7	1 454	1 462

Issued for temporary use.

	Number.
Books and pamphlets	1 615
Serials	940
Records	6 758
Original sheets	4 443
Maps and charts	5 634

The following list shows the original records received:

Subject.	Volumes.	Cahiers.	Sheets or rolls.
Astronomy	66	65	39
Geodesy	147	150	2
Hydrography	712	28	90
Hypsometry	77	2	2
Log books	52		
Magnetism	1	1 873	167
Tides	162	14	197
Topography	6	26	38
Totals	1 323	2 158	535

Photographic prints	1 037
Photographic negatives	1 002

MISCELLANEOUS SECTION.

All purchases under the appropriation for Office expenses were made through this Section, and this work involved a great deal of correspondence. The mailing list for the Notice to Mariners numbered 1 650, and 4 200 copies were distributed to these addresses every month from July to December, inclusive. On January 1, 1908, this monthly Notice to Mariners was consolidated with and made a part of the weekly Notice to Mariners issued by the Light-House Board, and has been issued by that Bureau since the date stated.

The following publications were received from the Public Printer:

	Number.
Report of the Superintendent of the Coast and Geodetic Survey for 1907	2 000
Appendices to Report for 1907 published as separates	2 593
Bulletins Nos. 1 to 41, inclusive	1 023
Catalogue of Charts, 1907	1 550
United States Coast Pilots, Atlantic Coast	2 000
Supplements to Coast Pilots	1 900
Tide Tables, complete	2 200
Tide Tables, Atlantic Coast	2 710
Tide Tables, Pacific Coast	10 505
List of Publications Available for Distribution	400
Notices to Mariners	32 950

The following publications were received from the suboffice at Manila:

	Number.
Sailing Directions for Philippine Islands, sections 1–7	120
Supplements to same	75
General Instructions for Coast Surveys, Philippine Islands, 1906	45
Notices to Mariners, Philippine Island	546

The following publications were issued by the Office:

	Number.
Annual Reports, 1851–1907	3 007
Appendices to Annual Reports	3 038
Bulletins, Nos. 1 to 41	972
Catalogue of Charts, 1907	1 300
United States Coast Pilots, Atlantic Coast	2 365
United States Coast Pilots, Pacific Coast, Alaska, Part I	137
United States Coast Pilot, Pacific Coast, California, Washington, and Oregon	489
United States Coast Pilot, Porto Rico	35
Supplements to Coast Pilots	3 429
United States Magnetic Declination Tables	134
Sailing Directions, Philippine Islands	348
Supplements to same	61
Special Publications Nos. 1 to 7	260
Tide Tables, complete	1 031
Tide Tables, Atlantic Coast	1 381
Tide Tables, Pacific Coast	9 420
Administration and Work of Coast and Geodetic Survey	3
Air Contained in Sea Water	3
Conversion Tables	12
Field Catalogue of 983 Transit Stars	2
General Instructions for Coast Surveys, Philippine Islands, 1906	35
Geodetic Operations in United States, 1900–1903	2
Geodetic Operations in United States, 1903–1906	10
Historical Sketch, 1884	5
Laws and Regulations, 1887	5
List and Catalogue	216
List of Publications Available for Distribution, 1908	39
Report on Nicaragua Route	3
Original Hydrographic and Topographic Sheets, 1883	2
Standard Mean Places of C. & T. Stars	1
Star Factors, A B C	4
Survey of Oyster Bars, Anne Arundel County, Md	304
Table of Coefficients	11
Table of Factors (in feet)	13
Table of Factors (in meters)	1
Table of Heights (in meters)	10
Tidal Researches	5
Tides and Tidal Action in Harbors	1
Treatise on Projections	30
Work of the Coast and Geodetic Survey	64
Notice to Mariners	32 364
Notice to Mariners, Philippine Islands	351

APPENDIX 3

REPORT 1908

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1907, AND JUNE 30, 1908

By

R. L. FARIS

Inspector of Magnetic Work; Assistant, Coast and Geodetic Survey

CONTENTS.

	Page.
Introduction	71
Observations on land and their distribution	71
Secular change of the magnetic declination	72
Observations at sea and their distribution	75
Methods of observing	76
Accuracy of results	76
Comparison of instruments	77
Reduction of observations	84
Arrangement of tables	84
Magnetic observations on land July 1, 1907, to June 30, 1908	85
Magnetic observations at sea July 1, 1907, to June 30, 1908	96
Results of magnetic observations made by the *Explorer* on a cruise from the Atlantic to the Pacific	98
Descriptions of stations	
Alabama	107
Alaska	108
Arkansas	109
California	110
Florida	112
Georgia	112
Hawaii	113
Illinois	113
Indiana	118
Iowa	123
Kansas	125
Louisiana	125
Maine	126
Maryland	126
Michigan	127
Minnesota	136
Mississippi	138
Missouri	139
Nebraska	139
New Jersey	140
New York	140
North Carolina	148
North Dakota	148
Oregon	150
Pennsylvania	151
Philippine Islands	152
Porto Rico	153
South Carolina	154
South Dakota	154
Tennessee	155
Texas	156
Vermont	156
Washington	157
Wisconsin	158
Foreign countries	161

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1907, AND JUNE 30, 1908.

By R. L. FARIS,

Inspector of Magnetic Work, Assistant, Coast and Geodetic Survey.

INTRODUCTION.

The present publication contains the results of magnetic observations made on land and at sea by officers of the Coast and Geodetic Survey in the prosecution of the magnetic survey of the United States and outlying territories during the fiscal year ended June 30, 1908. There are also included the results obtained by the party on the Coast and Geodetic Survey steamer *Explorer* during the cruise from the Atlantic to the Pacific coast in the spring of 1907.*

Five magnetic observatories † have been in continuous operation throughout the year—at Cheltenham, Md.; Baldwin, Kans.; Sitka, Alaska; near Honolulu, Hawaii, and on Vieques Island, Porto Rico. In April, 1907, the instruments at Vieques were moved from old Fort Isabel, where they had been in operation since February, 1903, and installed in a building especially constructed for use as a magnetic observatory, about half a mile west of the fort. There will be found in the tables the values of the magnetic elements at each of the observatories, as based on the observations of December and January.

OBSERVATIONS ON LAND AND THEIR DISTRIBUTION.

The distribution of the stations on land is shown in the following table, from which it will be seen that observations were made during the year in 35 States and Territories. Especial attention was directed to increasing the density of distribution of stations in the northern part of the country from New York to the Dakotas and to securing secular change data in the South Atlantic and Gulf States.

* For previous results see: United States Magnetic Declination Tables and Isogonic Chart for 1902; Appendix 1, Report for 1897; Appendix 6, Report for 1902; Appendix 5, Report for 1903; Appendix 3, Report for 1904; Appendix 3, Report for 1905; Appendix 3, Report for 1906; Appendix 5, Report for 1907.

† For description of observatories see Appendix 5, Report for 1902.

Summary of results on land.

State	Localities	Stations	Old localities reoccupied	Declinations observed	Dips observed	Intensities observed
Alabama	3	4	3	4	4	4
Alaska	12	39	4	44	13	14
Arkansas	2	2	2	2	2	2
California	8	8	3	9	8	8
District of Columbia	1	1	1	1	1	1
Florida	3	3	3	3	3	3
Georgia	3	4	3	4	4	4
Hawaii	1	1	1	1	1	1
Illinois	25	26	2	26	26	26
Indiana	24	25	5	25	24	24
Iowa	9	9	3	9	9	9
Kansas	1	1	1	3	4	3
Louisiana	4	5	4	5	5	5
Maine	2	2	1	2	2	2
Maryland	3	3	3	15	6	15
Michigan	41	41	2	41	41	41
Minnesota	21	21	3	21	21	21
Mississippi	3	3	3	3	3	3
Missouri	1	1	0	1	1	1
Nebraska	2	2	0	2	2	2
New Jersey	1	1	1	1	1	1
New York	36	37	4	37	36	37
North Carolina	1	2	1	2	2	2
North Dakota	15	15	2	15	15	15
Oregon	2	2	1	2	2	2
Pennsylvania	3	3	3	3	3	3
Philippine Islands	7	7	3	7	7	7
Porto Rico	3	3	3	3	3	3
South Carolina	3	4	3	4	4	4
South Dakota	7	7	2	7	7	7
Tennessee	3	3	1	3	3	3
Texas	3	3	3	3	3	3
Vermont	1	1	1	1	1	1
Washington	5	6	4	9	7	8
Wisconsin	19	19	2	20	20	20
Foreign countries	5	5	2	5	5	5
Total	283	319	83	343	299	310

SECULAR CHANGE OF THE MAGNETIC DECLINATION.

In Appendix 3, Report for 1905, attention was called to the fact that since about 1898 the change in the direction of the compass needle from year to year has been different from what would be expected from a study of the observations made prior to 1898. In 1906 a new discussion was made of all the available data, and the results were published in Appendix 4, Report for 1906, in the form of tables showing the secular change of the magnetic declination in different parts of the country from 1750 to 1905. Since that time a large number of old magnetic stations have been reoccupied in order to follow as closely as possible the secular change in the magnetic elements. A comparison of the results for declination is presented in the following table. It will be seen that the resulting values of annual change do not in general differ materially from those given in Appendix 4 for 1906. The letters after the names of stations indicate (*a*) that the old station was reoccupied exactly, (*b*) that the two stations were

very near together, and (*c*) that the new station was some distance (quarter of a mile or more) from the old one. A tabulated value of annual change refers approximately to the middle of the period from which it is deduced. A plus sign indicates increasing east declination or decreasing west declination and a minus sign the reverse.

Comparison of declination results at repeat stations.

State and station	Former observation		Last observation		Average annual change
	Date*	Declination	Date*	Declination	
		° ′		° ′	′
Vermont: Hyde Park (*b*)	1905 Se	14 19.8 W	1907 Se	14 26.4 W	−3.3
Rhode Island: Newport (*b*)	1904 Au	12 07.2 W	1906 Au	12 20.9 W	−6.9
New York: Plattsburg (*a*)	1905 Au	11 48.0 W	1907 Au	11 58.8 W	−5.4
New Jersey: Barnegat Lighthouse (*a*)	1903 Au	7 58.8 W	1907 Oc	8 21.6 W	−5.5
Pennsylvania:					
Harrisburg (*c*)	1901 Oc	6 25.0 W	1907 Je	6 40.7 W	−2.8
Allegheny (*a*)	1902 Jy	3 50.2 W	1907 Je	4 08.9 W	−3.8
Williamsport (*a*)	1901 Oc	6 48.4 W	1907 Jy	7 06.2 W	−3.1
Lewisburg (*c*)	1900 Je	6 15.1 W	1907 Jy	6 39.3 W	−3.4
Tunkhannock (*a*)	1902 Oc	7 51.6 W	1907 Jy	8 07.0 W	−3.2
Maryland:					
Cheltenham (*a*)	1905 Ap	5 16.5 W	1908 Ap	5 29.7 W	−4.4
Baltimore (*a*)	1904 Ja	5 44.8 W	1906 No	5 53.6 W	−3.1
Davis (*c*)	1896 Se	5 27.5 W	1907 No	6 05.2 W	−3.4
Virginia:					
Cape Henry (*b*)	1895 Je	3 56.5 W	1906 Jy	4 41.1 W	−4.0
Bristol (*a*)	1898 My	0 21.2 W	1906 Au	0 33.0 W	−1.4
Charlottesville (*b*)	1901 Se	3 37.2 W	1906 Au	3 50.0 W	−2.6
North Carolina:					
Halifax (*a*)	1899 Ap	2 00.0 W	1906 Jy	2 19.7 W	−2.7
Goldsboro (*a*)	1899 My	1 50.3 W	1908 Mh	2 18.6 W	−3.2
Newbern (*a*)	1898 Jy	2 46.6 W	1906 Jy	3 13.6 W	−3.4
Southport (*a*)	1898 Au	1 50.4 W	1906 Jy	2 14.0 W	−3.0
Raleigh (*a*)	1899 Je	2 27.1 W	1906 Au	2 54.2 W	−3.8
Chapel Hill (*a*)	1898 Mh	1 28.6 W	1906 Au	1 54.0 W	−3.0
Morganton (*a*)	1900 Se	0 27.7 W	1906 Au	0 38.8 W	−1.9
South Carolina:					
Florence (*a*)	1903 My	0 36.3 W	1908 Mh	0 51.8 W	−3.2
Columbia (*a*)	1905 De	0 00.2 E	1908 Mh	0 07.4 W	−3.4
Aiken (*a*)	1904 Fe	0 35.0 E	1908 Mh	0 26.3 E	−2.2
Georgia:					
Milledgeville (*a*)	1900 Mh	2 41.9 E	1908 Mh	2 31.2 E	−1.3
Savannah (*b*)	1903 My	0 42.5 E	1908 Mh	0 30.2 E	−2.5
Waycross (*c*)	1905 Fe	1 12.2 E	1908 Mh	1 05.8 E	−2.1
Florida:					
Fernandina (*a*)	1900 Ap	1 21.1 E	1908 Ap	1 12.2 E	−1.1
Tallahassee (*b*)	1900 My	2 21.3 E	1908 Ap	2 17.2 E	−0.5
Pensacola (*b*)	1900 My	4 27.2 E	1908 Ap	4 30.3 E	+0.4
Alabama:					
Huntsville (*c*)	1900 Je	4 02.2 E	1906 De	3 57.3 E	−0.8
Mobile (*a*)	1905 Mh	4 30.5 E	1908 Ap	4 33.4 E	+0.9
Selma (*a*)	1903 Fe	2 57.8 E	1908 Ap	2 58.8 E	+0.2
Livingston (*a*)	1903 Ja	4 39.3 E	1908 Ap	4 37.5 E	−0.3
Mississippi:					
West Point (*a*)	1901 Mh	4 42.3 E	1908 Ap	4 45.0 E	+0.4
Jackson (*a*)	1901 Mh	5 57.0 E	1908 Ap	6 06.2 E	+1.3
Brookhaven (*a*)	1901 Mh	5 32.5 E	1908 My	5 39.7 E	+1.0
Brookhaven (*a*)	1905 Fe	5 40.8 E	1908 My	5 39.7 E	−0.4

* See page 84 for a key to abbreviations of months.

Comparison of declination results at repeat stations—Continued.

State and station	Former observation		Last observation		Average annual change
	Date	Declination	Date	Declination	
		° ′		° ′	
Louisiana.					
Amite (*b*)	1903 Ja	5 43.4 E	1908 My	5 48.8 E	+1.0
Lafayette (*b*)	1904 Fe	6 32.4 E	1908 My	6 35.4 E	+0.7
Alexandria (*a*)	1904 Fe	6 38.0 E	1908 My	6 46.0 E	+1.9
Shreveport (*a*)	1904 Ja	6 59.1 E	1908 My	7 07.8 E	+2.0
Tennessee:					
Knoxville (*a*)	1903 Au	0 18.1 W	1906 Au	0 11.0 W	+2.4
Knoxville (*a*)	1906 Au	0 13.6 W	1907 Mh	0 12.8 W	+1.3
Memphis (*a*)	1905 De	5 29.5 E	1908 My	5 29.6 E	0.0
Ohio:					
Marietta (*a*)	1898 Je	2 01.4 W	1907 Je	2 31.2 W	−3.3
Cincinnati (*a*)	1903 My	1 05.2 E	1907 Je	0 57.4 E	−1.9
Cleveland (*c*)	1900 Jy	3 08.5 W	1907 Je	3 32.7 W	−3.5
Toledo (*b*)	1903 Jy	1 00.0 W	1907 Je	1 10.9 W	−2.8
Indiana:					
Richmond (*a*)	1900 Se	1 39.2 E	1907 Je	1 34.1 E	−0.8
Fort Wayne (*a*)	1900 Oc	0 12.8 E	1907 Jy	0 05.1 E	−1.1
Indianapolis (*a*)	1900 Se	1 21.1 E	1907 Jy	1 15.1 E	−0.9
Vincennes (*a*)	1905 No	3 08.8 E	1907 Jy	3 07.5 E	−0.8
Terre Haute (*a*)	1900 Se	2 44.0 E	1907 Au	2 43.3 E	−0.1
Michigan City (*b*)	1900 No	1 45.6 E	1907 Oc	1 38.1 E	−1.1
Illinois. Chicago (*a*)	1900 No	3 57.8 E	1907 No	3 46.0 E	−1.7
Michigan:					
Detroit (*a*)	1900 No	1 12.0 W	1907 Je	1 29.0 W	−2.6
Kalamazoo (*c*)	1900 No	1 05.3 E	1907 Oc	1 15.8 E	+1.5
Wisconsin:					
La Crosse (*a*)	1900 Oc	5 31.8 E	1907 Au	5 22.2 E	−1.4
Madison (*a*)	1905 Je	4 54.6 E	1907 Jy	4 52.9 E	−0.8
Minnesota:					
Heron Lake (*a*)	1900 Oc	8 58.2 E	1907 Au	8 58.0 E	0.0
St. Paul (*c*)	1900 Oc	8 41.4 E	1907 Au	8 45.0 E	+0.5
Duluth (*b*)	1902 Oc	8 40.0 E	1907 Au	8 41.0 E	+0.2
Iowa: Waterloo (*a*)	1900 Jy	7 14.0 E	1907 Jy	7 23.7 E	+1.4
Missouri:					
Kansas City (*a*)	1900 No	8 58.2 E	1907 Je	9 12.1 E	+2.1
Chillicothe (*a*)	1903 Jy	7 11.4 E	1907 Je	7 15.1 E	+0.9
Arkansas:					
Little Rock (*a*)	1901 My	6 37.4 E	1908 My	6 47.4 E	+1.4
Searcy (*a*)	1905 No	6 03.7 E	1908 My	6 07.0 E	+1.3
Texas:					
La Grange (*a*)	1902 Jy	8 07.1 E	1908 My	8 24.6 E	+3.0
Austin (*a*)	1906 Ja	8 19.8 E	1908 My	8 26.6 E	+2.9
Groesbeck (*b*)	1901 Ap	8 27.1 E	1908 My	8 43.2 E	+2.3
Oklahoma. Guthrie (*a*)	1905 Ja	9 29.5 E	1906 Oc	9 37.5 E	+4.6
Kansas:					
Baldwin (*a*)	1905 Ja	8 26.9 E	1908 Ja	8 32.2 E	+1.8
Salina (*a*)	1904 Oc	11 09.1 E	1906 Oc	11 10.6 E	+0.8
Hutchinson (*a*)	1904 Au	9 52.7 E	1906 Oc	9 55.5 E	+1.3
Anthony (*a*)	1902 No	9 08.4 E	1906 Oc	9 09.9 E	+0.4
Nebraska:					
O'Neill (*a*)	1900 Au	11 29.2 E	1906 Se	11 48.4 E	+3.2
Chadron (*c*)	1896 My	13 58.2 E	1906 Se	14 21.8 E	+2.4
North Dakota:					
Williston (*c*)	1896 Jy	16 57.7 E	1906 Jy	17 20.3 E	+2.3
Dickinson (*b*)	1896 Je	16 11.7 E	1906 Jy	16 33.7 E	+2.2
Jamestown (*b*)	1896 Je	12 27.5 E	1907 Se	12 19.7 E	−0.7
Fargo (*a*)	1905 Je	11 31.5 E	1906 Se	11 33.9 E	+2.0

Comparison of declination results at repeat stations—Continued.

State and station	Former observation		Last observation		Average annual change
	Date	Declination	Date	Declination	
		° ′		° ′	
South Dakota:					
Watertown (*b*)	1900 Se	10 02.3 E	1906 Au	10 18.0 E	+2.6
Rapid City (*a*)	1905 Au	15 16.3 E	1906 Au	15 18.9 E	+2.6
Pierre (*a*)	1896 My	12 44.4 E	1906 Se	13 03.1 E	+1.8
Belle Fourche (*a*)	1905 Au	15 46.2 E	1906 Se	15 46.6 E	+0.4
Huron (*a*)	1900 Se	11 08.2 E	1907 Jy	11 11.9 E	+0.6
Aberdeen (*b*)	1896 My	12 17.8 E	1907 Jy	12 15.0 E	−0.3
Montana:					
Glendive (*a*)	1896 Je	16 43.9 E	1906 Jy	17 05.8 E	+2.2
Missoula (*a*)	1905 Au	21 17.4 E	1906 Se	21 22.0 E	+4.1
Billings (*c*)	1896 Je	17 29.0 E	1906 Oc	18 02.5 E	+3.3
California:					
Ukiah (*b*)	1897 Se	17 45.0 E	1906 Jy	18 23.7 E	+4.4
Stockton (*a*)	1897 Mh	16 57.8 E	1906 Jy	17 35.4 E	+4.0
Barstow (*b*)	1897 Ja	14 52.8 E	1906 Jy	15 30.1 E	+4.0
San Diego (*a*)	1905 Au	*14 42.7 E	1908 Fe	14 55.9 E	+5.0
Placerville (*b*)	1897 Oc	18 20.4 E	1908 My	18 58.1 E	+3.6
Redding (*b*)	1897 De	18 31.5 E	1908 My	19 16.6 E	+4.3
Oregon:					
Pendleton (*a*)	1905 Au	21 48.8 E	1906 Jy	21 51.2 E	+2.6
Jacksonville (*b*)	1906 Je	19 59.6 E	1908 Je	20 10.3 E	+5.4
Washington:					
Seattle (*a*)	1904 Mh	23 09.2 E	1907 No	23 29.0 E	+5.5
Port Angeles (*a*)	1904 Ap	23 40.7 E	1908 Ja	23 56.6 E	+4.2
Port Orchard (*a*)	1906 Fe	22 39.0 E	1907 My	22 42.8 E	+3.0

*Observations by Department of Terrestrial Magnetism of the Carnegie Institution.

OBSERVATIONS AT SEA AND THEIR DISTRIBUTION.

Magnetic observations have been made at sea as often as the regular surveying work of the ships of the Bureau would permit. Observations were made on the *Bache* during her cruises from Hampton Roads, Virginia, to Georges Bank and return, and to Porto Rico and return; on the *Explorer* on her cruise from Seattle, Wash., to Ketchikan, Alaska, and return in 1907, and from Seattle to Kodiak, Alaska, in 1908, and on the *Patterson* between Seattle and Kodiak in 1907. In the progress of the survey of Georges Bank, course observations were made on the *Bache* at 19 places, but the results showed such a wide range that they have been combined to a single mean value. The results of observations at sea, including those made by the party on the *Explorer* during her cruise from the Atlantic to the Pacific, are distributed as follows:

Summary of results.

Vessel	General region	Results from swings			Results from course observations		
		Declination	Dip	Intensity	Declination	Dip	Intensity
Bache	Atlantic Ocean	15	16	16	1	0	0
Explorer	Pacific Ocean	15	15	15	13	5	5
Patterson	Pacific Ocean	12	15	15	0	0	0
Explorer	Atlantic to Pacific	29	30	30	85	46	46
Total		71	76	76	99	51	51

METHODS OF OBSERVING.

LAND WORK.

The methods of observing have been the same as those followed in previous years. Observers engaged exclusively in magnetic work are supplied with a complete outfit, consisting of theodolite magnetometer, dip circle, half-second pocket chronometer, observing tent, and small accessories, while those who are expected to get magnetic results incidental to other work are supplied with more or less complete outfits, according to circumstances. Where only declination results can be secured under the conditions involved, a compass declinometer is supplied, but to those who can attempt more a dip circle with compass attachment is furnished, with which compact outfit, knowing the azimuth of some reference mark from triangulation or other source, the declination, dip, and total intensity (by Lloyd's method) can be obtained with a fair degree of accuracy.

SEA WORK.

The *Bache*, *Explorer*, and *Patterson* are each provided with a Lloyd-Creak dip circle and accompanying gimbal stand, by means of which dip and total intensity can be determined on board ship. The *Explorer* and *Patterson* are also provided with a magnetometer, so that the "intensity constant" of the dip circle may be determined at each place where shore observations are made. Observations for declination are made with the usual standard liquid compass and an azimuth circle of Ritchie or Negus pattern. A value of declination, dip, or intensity usually depends upon the mean of observations made on 8 or 16 equidistant headings while steaming in a circle, once with port and once with starboard helm. In some cases, however, observations are made on three headings and the results are corrected for the effect of the ship's magnetism by comparison with the observations made while swinging ship.

ACCURACY OF RESULTS.

The endeavor in general is to secure, on land, declination and dip observations whose absolute error (including everything involved—error of observation and reduction) shall not exceed 2′, and to determine the horizontal intensity within 1 part in 1 000. As stated in previous reports, the experience of the Coast and Geodetic Survey has been that, under all of the conditions involved in a campaign of field work covering a large area, including the standardization of instruments and the determination of reduction errors, this accuracy can not be much increased. In observatory work with special instruments, or when special investigations are made under the best conditions by special observers, there is no difficulty of reducing these limits of error, but in a large organization, where results must be secured from all kinds of observers, under all conditions, and at times under great physical difficulties, and when all sources of error are considered, the degree of accuracy stated must be regarded as satisfactory and sufficient. It happens, of course, that these limits, for one reason or another, are occasionally exceeded, and there may be a few isolated cases in which the errors are two or three times the amounts given.

COMPARISON OF INSTRUMENTS.

At the beginning of the systematic magnetic survey of the United States, in 1899, the importance was recognized of an intercomparison of the various absolute instruments used in the prosecution of the work. The results of some of the earlier comparisons were presented in a paper published in the journal "Terrestrial Magnetism" for May, 1901.

These results emphasized the fact that the differences between different dip circles are sometimes too great to be neglected, especially where the observations may involve the determination of the secular change. The most reliable dip circle was selected as a provisional standard, and the results with other instruments were corrected to reduce to that standard. Since that time numerous comparisons of dip circles have been made, and with each publication of results there has been given a table showing the corrections applied to the different dip circles to reduce to the standard instrument, which, since November, 1903, has been the large Wild-Edelmann earth inductor at the Cheltenham Magnetic Observatory. These repeated comparisons have led to the conclusion that the correction required by a particular needle of a particular dip circle can not be considered constant even for the same magnetic latitude, and the practice has been adopted of revising the table of corrections each year to correspond to the latest comparisons. It has been recognized for some time that the correction required by a dip needle changes with a change in the magnetic latitude, and in the case of two circles requiring large corrections, which were used through a large range in dip, this fact has been taken into account and the corrections have been derived by means of a formula of the form $F\ \Delta I = x + y \sin I + z \cos I$. For the other instruments a constant correction has been used for each season's work, since the range in dip involved has usually been small.

The differences in declination and horizontal intensity indicated by the results referred to in the article in "Terrestrial Magnetism" were not greater than might be ascribed to errors of observation in magnetometers having wooden deflection bars and horizontal circles reading only to minutes. In 1901 the wooden deflection bars were replaced by bars of brass, and beginning with 1904, as fast as circumstances would permit, the older magnetometers have been supplied with new theodolites having horizontal circles reading directly to 20″ and by estimation to 10″, and the errors of observation have been much reduced. As the instrumental comparisons were continued from year to year with an increasing degree of accuracy, it soon became apparent that some of the magnetometers required corrections in horizontal intensity too great to be neglected. Beginning with April, 1901, an effort has been made to reduce horizontal intensity results to the same standard, at first taking account only of corrections which amounted to as much as 1/500 of the horizontal intensity. Up to June, 1907, the same practice was adopted as for the dip circles, namely, to modify more or less, from year to year, the corrections used, to make them conform to the latest comparisons. The large Wild-Edelmann magnetometer at Cheltenham has been adopted as the standard instrument, and the corrections adopted for other magnetometers have depended largely upon direct comparisons with it.

The first occasion for applying a correction to declination with a magnetometer was in 1904, when a tabulation of numerous comparisons of magnetometer No. 19 with other magnetometers brought out the fact that results by it differed systematically from others by about 1′.5. An examination of the instrument revealed the presence of a piece of impure brass, and after the substitution of a new piece no correction was required.

In 1907 the reduction of the work of the various magnetic observatories of the Coast and Geodetic Survey had progressed so far that it became important to determine definitely the relation between the various absolute instruments, in order that the published observatory results might be all referred to the same standard. This need was emphasized by the not infrequent standardization of magnetic instruments at the observatories of this Bureau by other organizations of this and other countries. With the exception of Baldwin, each observatory is now supplied with an earth inductor, which has been compared either directly or indirectly with the standard earth inductor at Cheltenham, the correction in no case exceeding 1′.0. The magnetometers at present in use at the other observatories (except Honolulu) have all been compared directly with the standard instrument at Cheltenham, and there have been numerous indirect comparisons by means of different field magnetometers.

The results of the comparisons of various magnetometers at the observatories and in Washington (including also the results of some comparisons by means of simultaneous observations at other places) have been adjusted by the method of least squares. Weights have been assigned equal to the number of sets of observations, except that a set of observations away from an observatory is given half as much weight as one at an observatory. The observations at the two stations in Washington have been utilized by assuming constant differences between the two stations and Cheltenham. The results of declination comparisons with magnetometer No. 10 showed such a large range that they were not included in the general adjustment. Subsequent observations at Cheltenham failed to reveal any cause for such variation and the correction given below was adopted, being the mean of 35 sets in 1908. A few other observations were thrown out for one reason or another. The results for some magnetometers were divided into two groups on account of change to the instrument or to the instrumental constants. The resulting corrections to reduce to magnetometer No. 26, the standard instrument at Cheltenham, are given in the following table. The declination correction is given the proper sign for east declination. The horizontal intensity correction is expressed in parts of H.

It is the practice of the Coast and Geodetic Survey to determine the instrumental constants for each magnetometer: The deflection distances by direct measurement; the moment of inertia by means of oscillations alternately with and without an auxiliary inertia bar or ring of known dimensions and mass; the temperature coefficient from observations at high and low temperatures; the distribution coefficients from deflection observations at two or three distances; the induction coefficient according to Lamont's deflection method. Hence the observed difference in horizontal intensity between two magnetometers, aside from the errors of observation, may be due to error in the determination of the instrumental constants or impurity in the metal entering into the

construction of the instruments. In either case the correction required would be proportional to the observed value of horizontal intensity.

Magnetometer	Correction to east declination	Correction to H, in parts of H
	′	
1 C. I.	−1.7	[+0.0017]
4 C. I.	+0.4	+ .0010
8	[0.0]	[− .0004]
10_1 1902–1905	[−2.1]	+ .0011
10_2 1906–1907	[−2.1]	[+ .0021]
10_3 1908	[−2.1]	[+ .0032]
11	−0.4	− .0002
17	−0.3	+ .0020
18	[+0.1]	[+ .0016]
19_1 to end of 1905	+1.3	− .0002
19_2 1906–1907	+0.1	− .0010
20	+0.3	+ .0021
21_1 to Jan. 1904	−0.3	+ .0073
21_2 since Dec. 1904	−1.4	[+ .0054]
22	+0.9	+ .0016
25	−0.2	+ .0016
29	[+1.0]	+ .0002
30	0.0	+ .0003
31	[−0.2]	[+ .0010]
36_1 to end of 1906	−0.7	+ .0019
36_2 1907	−0.7	+ .0013
37	−0.4	+ .0022

The quantities inclosed in brackets were derived independently and not from the general adjustment. The corrections applied to the results of declination and horizontal intensity observations made during the fiscal year 1908 are the ones given in the above table, but no correction to declination has been applied if less than 0′.5, nor to horizontal intensity if less than 0.001 H.

It will be seen that the horizontal intensity corrections are nearly all positive, the average value, excluding magnetometer No. 21, being +0.0012 H. This would indicate that the adopted standard is a little too high. The same conclusion was reached by Dr. L. A. Bauer, Director of the Department of Terrestrial Magnetism of the Carnegie Institution, as a result of the comparisons of the instruments of the *Galilee* at the observatories of the Coast and Geodetic Survey and at various foreign observatories during her cruises in the Pacific. It has been decided, however, to continue to use the Cheltenham Observatory magnetometer as the standard of the Coast and Geodetic Survey.

A comparison between the observed and adjusted differences of declination and horizontal intensity is presented in the following table. In general, the agreement is very good—much better, in fact, than was anticipated. The tabulated differences in horizontal intensity are in parts of H multiplied by 10 000.

Observed and adjusted differences of declination and horizontal intensity.

CHELTENHAM, MD.

Declination					Horizontal intensity				
Date [a]	Magnetometers	Sets	Difference		Date [a]	Magnetometers	Sets	Difference	
			Observed	Adjusted				Observed	Adjusted
			′	′					
1901—Oc	26–22	6	−0.6	+0.9	1901—Oc	26–22	7	+18	+16
No	26–25	6	+0.2	−0.2	No	26–25	5	+15	+16
De	26–11	6	−1.0	−0.4	De	26–11	3	+ 3	− 2
De	26–21_1	12	−0.1	−0.3	1902—Je	26–21_1	6	+82	+73
1902—Je	26–21_1	6	+0.3	−0.3	Au	26– 8	6	0	− 4
Se	26–30	7	−0.7	0.0	Se	26–30	3	+ 8	+ 3
No	26–21_1	2	−0.4	−0.3	No	26–21_1	3	+72	+73
1903—Mh	26–21_1	2	−1.7	−0.3	1903—Mh	26–21_1	1	+64	+73
Je	26–20	4	+1.1	+0.3	Je	26–20	1	+27	+21
Oc	26–31	18	−0.1	−0.2	Oc	26–31	8	+ 6	+10
De	26–19_1	3	+1.5	+1.3	De	26–19_1	3	− 7	− 2
De	26–21_1	6	−0.8	−0.3	De	26–21_1	6	+70	+73
1904—Ja	26–21_1	2	−0.2	−0.3	1904—Mh–Jy	26– 8	14	− 3	− 4
Jy	26–11	2	−0.4	−0.4	Jy	26–11	3	− 9	− 2
1905—Ja–My	26–36_1	7	−0.7	−0.7	Se–De	26– 8	16	− 4	− 4
Ja–Fe	26–37	4	+0.2	−0.4	1905—Ja–Fe	26–36_1	6	+21	+19
Je	26–29	3	+0.4	+1.0	Ja–Fe	26–37	5	+21	+22
1906—Mh	26–11	2	0.0	−0.4	Ja–Ap	26– 8	14	− 4	− 4
Je	26–10_1	3	−2.4	−2.1	Je	26–29	6	+ 4	+ 2
Oc	26–Cl1	4	−2.5	−1.7	My–Au	26– 8	17	− 8	− 4
1907—Ja	26–17	10	+0.1	−0.3	1906—Mh	26–11	1	−10	− 2
Ja–My	26–19_2	59	−0.1	+0.1	Je	26–10_2	3	+28	+21
Mh–Je	26–36_2	24	−0.3	−0.7	Oc	26–Cl1	2	+16	+17
Ap–Je	26–Cl4	8	+1.1	+0.4	1907—Ja	26–36_2	10	+12	+13
Je	26–10_2	4	−0.1	−2.1	Ap–My	26–19_2	5	−12	−10
Je	26–20	4	−0.4	+0.3	My–Je	26–36_2	5	+12	+13
Se	26–11	3	−3.6	−0.4	Je	26–Cl4	4	+ 5	+10
Se	26–10_2	4	−3.4	−2.1	Je	26–20	4	+20	+21
De	26–10_2	6	−2.6	−2.1	Je	26–10_2	2	+18	+21
					Se	26–10_2	2	+14	+21
					Se	26–11	3	−17	− 2
					De	26–10_2	2	+24	+21

[a] For key to abbreviations of months see page 84.

Observed and adjusted differences of declination and horizontal intensity—Continued.

WASHINGTON, D. C. (OFFICE OBSERVATORY).

Declination

Date	Magnetometers	Sets	Difference	
			Observed	Adjusted
			′	′
1900—Mh	26–17	8	[a] −0.2	−0.3
Mh	26–18	8	[a] +0.4	+0.1
Mh	26–19$_1$	8	[a] +1.6	+1.3
Mh	26–20	8	[a] −0.3	+0.3
1901—Ap	26–20	2	0.0	+0.3
My	26–19$_1$	4	+0.8	+1.3
Je	26–18	6	−0.2	+0.1
Je	26–21$_1$	4	+0.7	−0.3
Se	26–11	2	+0.8	−0.4
No	26–22	1	+0.3	+0.9
1902—Ja	26–21$_1$	8	−0.9	−0.3
Fe	26–10$_1$	7	+1.6	−2.1
Ap	26–21$_1$	3	+1.3	−0.3
My	26–21$_1$	2	−0.5	−0.3
My	26–11	6	−3.1	Rej.
Je	26–10$_1$	3	0.0	−2.1
Jy	26–19$_1$	2	+1.6	+1.3
Au	26–11	4	−1.2	−0.4
Se	26–30	1	−0.8	0.0
De	26–20	4	+0.6	+0.3

Assuming a difference between Cheltenham (magnetometer No. 26) and Office Observatory of 4′.5 in 1901 and 2′.8 in 1902.

Horizontal intensity

Date	Magnetometers	Sets	Difference	
			Observed	Adjusted
1901—Ap	26–20	1	+29	+21
My	26–19$_1$	1	− 3	− 2
My	26–17	1	+18	+20
Je	26–18	3	+16	+16
Se	26–11	1	+ 9	− 2
No	26–22	4	+17	+16
1902—My	26–11	3	− 2	− 2
Je	26–10$_1$	2	+36	+21
Jy	26–19$_1$	1	+ 2	− 2
Au	26–11	2	+ 2	− 2
Se	26–30	1	+ 8	+ 3
De	26–20	2	+15	+21
1903—Ap–Je	26–20	9	+24	+21
Ap–My	26–11	3	+ 2	− 2
Je	26–19$_1$	1	− 8	− 2
Oc	26–31	1	+17	Rej.
De	26–19$_1$	1	−22	Rej.

Assuming a difference from Cheltenham of 150γ in 1901, 160γ in 1902, and 170γ in 1903.

WASHINGTON, D. C. (STATION NEAR ZOOLOGICAL PARK).

			′	′
1904—Jy	26–10$_1$	4	−2.4	−2.1
1905—Ja	26–19$_1$	3	+1.5	+1.3
Fe	26–17	6	−1.4	−0.3
Je	26–37	2	+0.2	−0.4
Je	26–21$_2$	3	−0.3	−1.4
Jy	26–29	10	+1.4	+1.0
1906—Ja	26–20	2	+0.4	+0.3
Je	26–CI1	2	+4.6	Rej.
Je	26–37	8	+1.1	−0.4
Oc	26–CI1	2	+0.2	Rej.

Assuming a constant difference between Cheltenham (magnetometer No. 26) and Station near Zoo of 47′.6.

1904—Je	26– 8	3	− 2	− 4
Jy	26–10$_1$	3	+15	+21
1905—Ja	26–19$_1$	1	− 6	− 2
Fe	26–17	3	+19	+20
Je	26–37	1	+25	+22
Je	26–21$_2$	1	+64	+54
Jy	26–29	5	− 2	+ 2
1906—Ja	26–21$_2$	1	+59	+54
Je	26–CI1	2	+22	+17
Je	26–37	3	+24	+22
Oc	26–CI1	2	+14	+17

Assuming a constant difference between Cheltenham (magnetometer No. 26) and Station near Zoo of 15γ.

[a] These differences refer to the mean of Nos. 17, 18, and 20.

Observed and adjusted differences of declination and horizontal intensity—Continued.

BALDWIN, KANS.

Declination					Horizontal intensity				
Date	Magnetometers	Sets	Difference		Date	Magnetometers	Sets	Difference	
			Observed	Adjusted				Observed	Adjusted
			′	′					
1902—Jy	30–21$_1$	9	−0.7	−0.3	1902—Jy	30–21$_1$	2	+60	+69
Au	30–21$_1$	8	+0.3	−0.3	Au	30–21$_1$	1	+68	+69
Oc	30–21$_1$	4	−0.4	−0.3	Oc	30–21$_1$	2	+58	+69
Oc–No	30–20	9	0.0	+0.3	Oc–No	30–20	3	+16	+18
Se	30–11	3	−0.1	−0.4	Se	30–11	2	− 4	− 5
Oc	30–11	2	−1.1	−0.4	Oc	30–11	2	+ 8	− 5
Oc	30–10$_1$	6	+0.5	−2.1	Oc	30–10$_1$	2	+15	+ 8
De	30–10$_1$	4	+0.5	−2.1	De	30–10$_1$	2	− 1	+ 8
1903—Ja	30–10$_1$	4	−3.0	−2.1	1903—Ja	30–10$_1$	2	+ 9	+ 8
Jy	30–10$_1$	3	−2.2	−2.1	Jy	30–10$_1$	4	0	+ 8
Se	30–10$_1$	8	−2.0	−2.1	Se	30–10$_1$	4	+ 7	+ 8
1904—Oc	30–10$_1$	8	−4.1	−2.1	1904—Oc	30–10$_1$	2	+16	+ 8
Oc	30–11	4	−2.1	−0.4	Oc	30–11	3	− 4	− 5
De	30–10$_1$	4	−4.2	−2.1	De	30–10$_1$	2	+11	+ 8
De	30–21$_2$	6	−1.2	−1.4	De	30–21$_2$	6	+49	+51
1905—Au	30–10$_1$	4	−1.8	−2.1	1905—Au	30–10$_1$	2	+ 7	+ 8
Oc	30–11	4	+0.6	−0.4	Oc	30–11	2	− 6	− 5
Oc	30–17	8	−1.2	−0.3	Oc	30–17	4	+19	+16
De	30–17	4	0.0	−0.3	De	30–17	2	+16	+16
De	30–36$_1$	4	+0.5	−0.7	De	30–36$_1$	2	+18	+16
1906—Je	30–19$_2$	6	+0.6	+0.1	1906—Je	30–19$_2$	7	−12	−13
Au	30–37	8	−0.8	−0.4	Au	30–37	5	+25	+19
Se	30–19$_2$	4	+1.8	Rej.	Se	30–19$_2$	2	−10	−13
Oc	30–17	2	+1.6	Rej.	Oc	30–17	2	+11	+16
1907—Je	30–36$_2$	6	−2.2	−0.7	1907—Je	30–36$_2$	2	+ 7	+10
Se	30–36$_2$	4	−1.3	−0.7	Se	30–36$_2$	2	+19	+10
Se	30–21$_2$	4	−1.5	−1.4	Se	30–21$_2$	2	+52	+51
Oc	30–20	4	+1.7	+0.3	Oc	30–20	2	+20	+18

HONOLULU, HAWAII.

			′	′					
1902—Ja–Je	22–19$_1$	54	+0.6	+0.4	1902—Ja–Je	22–19$_1$	29	−16	−18
1904—Oc	22–20	2	−1.0	−0.6	1904—Oc	22–20	1	− 6	+ 5
1905—Se	22–36$_1$	2	−2.5	−1.6	1905—Se	22–36$_1$	2	− 3	+ 3
1906—Fe	22–17	8	−1.6	−1.2	1906—Fe	22–17	2	− 1	+ 4
Je	22–17	5	−1.9	−1.2	Je	22–17	2	+ 1	+ 4
1907—Se	22–CI4	13	−0.8	−0.5	1907—Se	22–CI4	10	− 3	− 6

SITKA, ALASKA.

			′	′					
1902–1903	25–17	86	0.0	−0.1	1902–1903	25–17	77	+ 4	+ 4
1903—Jy	25–21$_1$	4	−0.2	−0.1	1906—Se–Oc	25–37	8	+ 3	+ 6
1906—Se–Oc	25–37	10	−0.7	−0.2	1907—Ap	25–37	4	+ 7	+ 6
1907—Ap	25–37	3	−0.3	−0.2	Jy	37–CI4	6	−12	−12
Jy	37–CI4	13	+0.7	+0.8					
Jy	37–CI1	4	−1.2	−1.3					
Au	37–CI1	6	−0.8	−1.3					
Au	37–21$_2$	5	−1.6	−1.0					

Observed and adjusted differences of declination and horizontal intensity—Continued.

VIEQUES, P. R.

Declination					Horizontal intensity				
Date	Magnetometers	Sets	Difference		Date	Magnetometers	Sets	Difference	
			Observed	Adjusted				Observed	Adjusted
			′	′					
1905—Mh–Ap	31–17	12	0.0	−0.1	1905—Mh–Ap	31–17	8	+ 8	+10
Se	31–17	8	0.0	−0.1	Se	31–17	4	+ 9	+10

COMPARISONS IN THE FIELD.

			′	′					
1902—Oc	10_1–21_1	2	+0.8	+1.8	1902—Oc	10_1–21_1	1	+71	+61
1903—Ja	19_1–11	8	0.0	−1.7	1903—Ja	19_1–11	3	+ 6	0
1904—Au	8 –19_1	2	+1.5	+1.3	1904—Au	8 –19_1	1	− 5	+ 3
1905—Jy	10_1–29	13	+2.1	+3.1	1905—Jy	10_1–29	3	−13	− 9

DIP INSTRUMENTS.

The various dip circles used and the corrections which have been applied to the results are given in the following table. The figures after the decimal point in the fourth column indicate the particular needles to which the correction applies.

Corrections to dip circles.

Number	Pattern	Needles	Designation	Correction
				′
15	Kew-Casella	5 and 6	15.56	−0.8
18	Kew-Casella	5 and 6	18.56	−1.6
23	Kew-Casella	2C and 2D	23.22	−3.7
23	Kew-Casella	3 and 4	23.34	−3.7
25	Tesdorpf	IV and VIII	25.48	−2.0
28	L. C.-Casella	1 and 2	28.12	−2.0
30	Kew-Dover	1 and 2	30.12	+1.0
31	Kew-Dover	1 and 2	31.12	+2.1
31	Kew-Dover	3 and 4	31.34	.0
32	L. C.-Dover	1 and 2	32.12	−2.3
33	L. C.-Dover	1 and 2	33.12	−3.3
[a] 34	L. C.-Dover	5 and 6	34.56	[a]
36	Kew-Dover	1 and 2	36.12	− .6
4655	Kew-Casella	3 and 4	55.34	.0
5676	Kew-Casella	1 and 2	76.12	−3.4
5678	Kew-Casella	1 and 2	78.12	−2.3

[a] For corrections to dip circle No. 34, see discussion of observations made in 1907 by the party on the steamer *Explorer*.

Corrections to earth inductors.

Number	Pattern	Observatory	Correction
			′
1	Wild-Eschenhagen	Porto Rico	−1.0
2	Wild-Eschenhagen	Sitka	−0.9
22	Wild-Edelmann	Honolulu	−0.2
26	Wild-Edelmann	Cheltenham	0.0

REDUCTION OF OBSERVATIONS.

A first computation is made by the observer in the field, and he is instructed to carry it far enough before he leaves a station to assure himself that the desired degree of accuracy has been attained. This computation is carefully revised in the Office, in the Division of Terrestrial Magnetism, and the necessary corrections are applied to reduce the results to the standard instruments, as indicated in the foregoing section.

Each value of the magnetic declination is then corrected to reduce it to the mean of the particular month in which the observation was made, with the aid of the continuous observations at the nearest magnetic observatory, allowance being made for the change in diurnal variation with change in magnetic latitude. No attempt has been made to correct the dip and horizontal intensity for diurnal variation.

ARRANGEMENT OF TABLES.

LAND OBSERVATIONS.

The values of declination, dip, and horizontal intensity presented in Table I are arranged by States alphabetically, the results for each State being given in the order of increasing latitudes. The latitudes and longitudes are in most cases the result of solar observations made with the small theodolite which forms a part of the magnetometer. In default of observations the geographic coordinates were scaled from the best available map, either the United States Geological Survey topographic sheets, a post-route map, or some other State map. In such cases only the nearest whole minute of latitude and longitude is given. The horizontal intensity is expressed as heretofore in terms of the one hundred thousandth part of a C. G. S. unit of intensity of magnetic force, termed a *gamma*, and designated by the letter γ.

In order to include the desired amount of information in the available space the following abbreviations were adopted. Only the month and day of the date are given, since the observations were all made between July 1, 1907, and June 30, 1908, except when otherwise stated in footnote. The names of the months have been abbreviated as follows:

January	Ja	May	My	September	Se
February	Fe	June	Je	October	Oc
March	Mh	July	Jy	November	No
April	Ap	August	Au	December	De

In the column headed "Instruments" M stands for "magnetometer" and D. C. for "dip circle." Italicised numbers in the magnetometer column indicate that the

declination was determined with a compass declinometer of the number given. When the declination was determined with the compass attachment of the dip circle the letter C is placed in the magnetometer column. The dip circles have been given the designations indicated on page 83, the figures after the decimal point denoting the needles used. Values of horizontal intensity printed in italics were obtained by combining the observed dip with the total intensity determined by Lloyd's method.

The observer is indicated by the initials of his name. The names of the observers are as follows:

W. Bowie	W. M. Hill	J. H. Simpson
J. E. Burbank	C. V. Hodgson	C. C. Stewart
W. H. Burger	W. B. Keeling	W. M. Steirnagle
C C. Craft	H. D. King	S. W. Tay
A. Crowell	W. D. Lambert	S. G. Townshend, jr
S. A. Deel	T. J. Mayer	W. F Wallis
H. M. W. Edmonds	F. A. Molby	P. C. Whitney
J. W. Green	E. Mueller	C. F. Woodyard
E. R. Hand	C. G. Quillian	

Sea Observations.

The results obtained at sea are presented in Table II. The general arrangement is indicated by the headings. Unless otherwise indicated the ship was swung with both port and starboard helms. In the column headed "Sea," sm means smooth; sw, swell; lt, light; mod, moderate. The names of the ships taking part in the work and their commanding officers are as follows:

Bache	P. A. Welker and L. H. Westdahl
Explorer	W. C. Dibrell
Patterson	W. C. Hodgkins

Intensity results are expressed in C. G. S. units. The horizontal intensity has been computed from the dip and total intensity.

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908.*

ALABAMA.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		*East* ° ′	° ′	*γ*			
Mobile	30 41.0	88 09.2	Ap 17	4 33.4	61 23.0	26669	19	23.34	WMH
Selma (old)	32 26.7	87 02.8	Ap 20, 21	2 58.8	63 03.3	25860	19	23.34	WMH
Selma (new)	32 27.5	87 01.1	Ap 21, 22	2 57.8	63 10.8	25726	19	23.34	WMH
Livingston	32 35.4	88 10.7	Ap 24, 25	4 37.5	63 22.9	25473	19	23.34	WMH

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

ALASKA.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
Prince of Wales Island, west coast:	° ′	° ′		East ° ′	° ′	γ			
Breeze	54 54.4	132 39.2	Se 27	28 52	-- ----	-----	15	-----	TJM
Nice	54 57.8	132 46.6	Se 24	29 13	-- ----	-----	15	-----	TJM
Cent	54 59.3	132 53.5	Se 30	29 02	-- ----	-----	15	-----	TJM
Boreas	55 03.7	132 58.3	Se 20	29 17	-- ----	-----	15	-----	TJM
Jump	55 07.4	133 00.7	Au 30	29 05	-- ----	-----	15	-----	TJM
Side	55 08.2	132 56.2	Se 18	29 38	-- ----	-----	15	-----	TJM
Time	55 08.6	132 56.4	Se 17, 18	29 32	-- ----	-----	15	-----	TJM
Lap	55 09.9	132 53.2	Oc 7	29 52	-- ----	-----	15	-----	TJM
Mac	55 10.7	133 01.5	Au 29	29 00	-- ----	-----	15	-----	TJM
Flat	55 12.1	133 05.1	Au 19	29 13	-- ----	-----	15	-----	TJM
Guide	55 12.9	133 04.3	Au 26	29 56	-- ----	-----	15	-----	TJM
South Base	55 13.0	133 06.4	Oc 10	28 05	-- ----	-----	15	-----	TJM
North Base	55 13.2	133 06.1	Oc 10, 11	27 33	-- ----	-----	15	-----	TJM
Gone	55 14.5	133 06.1	Au 24	28 30	-- ----	-----	15	-----	TJM
Cabin	55 16.2	133 07.8	Au 22, Se 14	29 03	-- ----	-----	15	-----	TJM
Pin	55 16.4	133 12.2	Au 16	29 13	-- ----	-----	15	-----	TJM
Stone	55 16.7	133 12.2	Au 16	28 54	-- ----	-----	15	-----	TJM
Mud	55 16.8	133 13.4	Se 14	30 14	-- ----	-----	15	-----	TJM
Antonio	55 17.3	133 14.5	Au 15	30 25	-- ----	-----	15	-----	TJM
Ketchikan 1	55 20.2	131 39.5	Au 23	29 08.2	74 02.5	[a]16145	C	34.56	CGQ
Ketchikan 2	55 20.2	131 39.5	Au 24	28 57.4	-- ----	15948	IIII	-----	CGQ
Do.	55 20.2	131 39.5	Se 10	28 59.8	74 11.5	16000	IIII	34.56	CGQ
Do.	55 20.2	131 39.5	Oc 16	29 01.2	74 18.1	15955	IIII	34.56	CGQ
Prince of Wales Island, west coast.									
Flores	55 21.1	133 17.5	Se 13	29 06	-- ----	-----	15	-----	TJM
Ignace	55 23.1	133 25.0	Au 10	29 16	-- ----	-----	15	-----	TJM
Clam	55 28.2	133 24.7	Se 10	29 45	-- ----	-----	15	-----	TJM
Fish	55 29.0	133 11.3	Se 5	29 45	-- ----	-----	15	-----	TJM
S. W. Base	55 29.7	133 11.5	Se 4	29 36	-- ----	-----	15	-----	TJM
N. E. Base	55 29.8	133 10.9	Jy 29	29 20	-- ----	-----	15	-----	CVH
Port	55 32.2	133 27.8	Se 11	29 37	-- ----	-----	15	-----	TJM
Philip Rock	55 38.2	133 26.0	Se 12	29 42	-- ----	-----	15	-----	TJM
Twin	55 41.5	133 37.8	Au 2	29 11	-- ----	-----	15	-----	TJM
Sitka Magnetic Observatory	57 03.0	135 20.1	De-Ja	30 08.0	74 38.0	15550	37	?. EI	HMWE
Do.	57 03.0	135 20.1	My 19–25	30 07.0	74 36.6	15539	25	25.48	JWG
Kodiak	57 47.5	152 23.8	Je 5[b]	24 05.8	71 58.2	17389	8	32.12	AC
Do.	57 47.5	152 23.8	Oc 17	24 08.0	71 58.1	17388	8	32.12	AC
Do.	57 47.5	152 23.8	Ap 18, 20	24 11.5	71 57.9	17414	IIII	34.56	SWT
Uzinki Pass	57 55	152 31	Au 5	23 52.4	72 04.9	17304	8	32.12	AC
Ushagat, Barren Islands	58 55.6	152 17.6	Se 1	23 30.5	-- ----	-----	737	-----	ERH
Iliamna Bay	59 37.1	153 37.3	Jy 12	22 58.8	-- ----	-----	737	-----	ERH
Fort Egbert	64 47.3	141 12.5	Je 20	35 55.5	78 20.5	12006	25	25.48	JWG
Island	65 21.6	143 05.8	Je 24	34 56.4	78 57.6	11304	25	25.48	JWG
Circle	65 49.6	144 04.4	Je 25	34 10.6	78 48.5	11409	25	25.48	JWG
Fort Yukon	66 33.8	145 18.0	Je 30	34 01.6	79 05.5	11073	25	25.48	JWG

[a] Computed from the total intensity, determined by Lloyd's method, and the dip.
[b] Observations in June, 1907, not heretofore published.

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

ARKANSAS.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		East ° ′	° ′	γ			
Little Rock	34 47.0	92 17.9	My 26, 27	6 47.4	64 58.7	24409	19	23.34	WMH
Searcy	35 15.8	91 44.9	My 28	6 07.0	65 49.0	24022	19	23.34	WMH

CALIFORNIA.

	° ′	° ′		East ° ′	° ′	γ			
San Diego	32 42.7	117 11.7	Jy 5	14 54.9	58 07.2	27760	IIII	34.56	CGQ
Do.	32 42.7	117 11.7	Fe 6	14 55.9	58 09.3	27666	29	30.12	WHB
San Clemente	33 00.3	118 33.2	Mh 9	14 23.0	59 03.0	26852	29	30.12	WHB
San Nicolas	33 16.5	119 30.6	Mh 15	15 23.5	58 22.9	27378	29	30.12	WHB
Catalina Peak	33 23.2	118 24.0	Fe 28	15 12.6	-- ----	-----	C30	-----	WHB
Placerville	38 43.8	120 52.2	My 13	18 58.1	62 59.2	25003	29	30.12	WHB
Corning	39 55.4	122 10.6	My 16	18 51.7	64 23.8	24163	29	30.12	WHB
Redding	40 35.5	122 24.3	My 25	19 16.6	64 50.6	23688	29	30.12	WHB
Gazelle	41 31.6	122 31.1	My 30	20 10.0	65 38.8	23182	29	30.12	WHB

FLORIDA.

	° ′	° ′		East ° ′	° ′	γ			
Pensacola	30 20.9	87 15.9	Ap 11, 13	4 30.3	61 11.1	26771	19	23.34	WMH
Tallahassee	30 26.0	84 17.7	Ap 7, 8	2 17.2	61 38.5	26312	19	23.34	WMH
Fernandina	30 40.1	81 27.2	Ap 3	1 12.2	62 12.8	25809	19	23.34	WMH

GEORGIA.

	° ′	° ′		East ° ′	° ′	γ			
Waycross	31 14.4	82 21.4	Mh 30, 31	1 05.8	62 35.2	25772	19	23.34	WMH
Savannah	32 05.7	81 04.7	Mh 27	0 30.2	63 42.7	24914	19	23.34	WMH
Milledgeville (old)	33 04.5	83 15.0	Mh 19, 20	2 31.2	64 59.7	24238	19	23.34	WMH
Milledgeville (new)	33 04.5	83 15.0	Mh 21, 23	2 37.1	64 49.5	24230	19	23.34	WMH

HAWAII.

	° ′	° ′		East ° ′	° ′	γ			
Honolulu Magnetic Observatory	21 19.2	158 03.8	De–Ja	9 25.0	40 55.9	29196	22	22 EI	WFW

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

ILLINOIS.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		East ° ′	° ′	γ			
Cairo	37 00.8	89 11.6	Je 11, 12	4 37.2	67 49.6	22336	19	23.34	WMH
Mound City	37 06.2	89 10.0	Je 17, 18	4 40.1	67 57.9	22236	19	23.34	WMH
Vienna	37 25.1	88 53.8	Je 19, 20	4 18.5	68 06.4	22170	19	23.IV	WMH
Harrisburg	37 43.7	88 32.8	Je 22, 23	4 44.4	68 30.6	22089	19	23.IV	WMH
Benton	38 00.2	88 55.4	Je 25	4 00.5	68 52.3	21717	19	23.34	WMH
Pinckneyville	38 03.3	89 23.2	Je 27, 29	5 19.2	68 39.7	22073	19	23.34	WMH
Albion	38 22.4	88 03.7	Jy 26	3 29.9	69 29.7	21173	10	18.56	CCC
Newton	39 00.4	88 09.5	Jy 27	3 34.7	69 59.3	20702	10	18.56	CCC
Shelbyville	39 24.7	88 49.5	Au 23, 24	4 07.9	70 08.4	20619	10	18.56	CCC
Taylorville	39 32.5	89 18.2	Au 20, 21	4 08.0	70 08.6	20556	10	18.56	CCC
Decatur	39 49.8	88 59.9	Au 25	3 27.3	70 29.2	20474	10	18.56	CCC
Springfield (old)	39 50	89 39.0	Au 17	4 15.3	70 23.8	20406	10	18.56	CCC
Springfield (new)	39 50	89 39.0	Au 18	4 17.2	70 24.5	20379	10	18.56	CCC
Urbana	40 07	88 15.4	Au 27	3 26.3	70 48.6	20033	10	18.56	CCC
Lincoln	40 08.1	89 24.3	Au 16	4 07.8	70 36.8	20235	10	18.56	CCC
Peoria	40 44.7	89 35.8	Au 13	5 14.7	71 20.6	19691	10	18.56	CCC
Pontiac	40 53.2	88 37.3	Au 11	3 50.9	71 30.1	19515	10	18.56	CCC
Monmouth	40 53.7	90 39.3	No 30, De 1	5 41.0	71 17.1	19715	19	23.22	WMH
St. Anne	41 01.3	87 43.3	Je 29	3 08.8	72 05.6	19087	20	78.12	WB
Kankakee	41 07.0	87 49.9	Au 9, 10	3 18.7	71 56.6	19076	10	18.56	CCC
Cambridge	41 18.7	90 11	No 26	5 02.2	71 50.5	19153	19	23.22	WMH
Geneva	41 53.3	88 17.2	No 8	2 50.3	72 29.1	18569	19	23.22	WMH
Chicago	41 55.8	87 37.2	No 5, 6	3 46.0	72 37.2	18410	19	23.22	WMH
Sycamore	41 59.3	88 41	No. 10–12	3 37.4	72 44.7	18370	19	23.22	WMH
Oregon	42 02.6	89 20	No 14	4 45.2	72 33.9	18632	19	23.22	WMH
Mount Carroll	42 05.6	89 59	No 18	5 08.4	72 33.8	18595	19	23.22	WMH

INDIANA.

	° ′	° ′		East ° ′	° ′	γ			
Vincennes	38 40.2	87 31.3	Jy 25	3 07.5	69 43.2	20921	10	18.56	CCC
Shoals	38 40.3	86 45.4	Jy 23	2 31.5	69 50.4	20824	10	18.56	CCC
Washington	38 40.5	87 12.9	Jy 24	2 55.2	69 51.0	20793	10	18.56	CCC
Bedford	38 51.4	86 28.7	Jy 22	2 52.0	70 07.4	20524	10	18.56	CCC
Vernon	38 58.7	85 36.1	Jy 19	1 36.5	70 18.8	20200	10	18.56	CCC
Vernon, N. Mer.	38 58.7	85 36.1	Jy 20	1 07.5	-- ----	-----	10	-----	CCC
Sullivan	39 05.8	87 24.5	Jy 30, 31	3 07.9	70 06.1	20602	10	18.56	CCC
Terre Haute	39 29.6	87 23.4	Au 1, 2	2 43.3	70 22.0	20340	10	18.56	CCC
Shelbyville	39 32.7	85 45.2	Jy 17	2 03.1	70 33.9	20100	10	18.56	CCC
Indianapolis	39 47.4	86 11.9	Jy 16	1 15.1	70 51.4	19848	10	18.56	CCC
Newport	39 53.5	87 24.9	Au 3	2 31.9	70 40.0	20031	10	18.56	CCC
Williamsport	40 17.0	87 17.9	Au 5	2 37.1	71 03.8	19832	10	18.56	CCC
Frankfort	40 18.2	86 33.8	Jy 13	2 12.7	71 27.6	19482	10	18.56	CCC
La Fayette	40 22.7	86 53.7	Jy 12	1 27.1	71 24.9	19487	10	18.56	CCC
Bluffton	40 45.0	85 10.5	Jy 2	1 03.2	71 40.4	19200	10	18.56	CCC
Logansport	40 45.8	86 19.0	Jy 9	1 48.5	71 35.4	19267	10	18.56	CCC
Renssalaer	40 56.1	87 09.7	Au 7, 8	1 54.7	71 40.1	19339	10	18.56	CCC
Winamac	41 03.5	86 34.7	Jy 10	1 16.8	71 43.4	19190	10	18.56	CCC
Fort Wayne	41 06.0	85 08.2	Jy 3	0 05.1	72 10.1	19088	10	18.56	CCC
Plymouth	41 18.7	86 18.8	Jy 8	1 36.1	71 56.2	19046	10	18.56	CCC
Crown Point	41 25.0	87 22.2	No 3	2 19.4	72 12.0	18782	19	23.22	WMH
Goshen	41 34.7	85 48.6	Jy 6	1 21.2	72 20.4	18689	10	18.56	CCC
Angola	41 38.2	84 58.6	Jy 4	0 17.5	72 43.2	18268	10	18.56	CCC
Carlisle	41 40.1	86 29.6	Je 12, 13	1 47.3	72 15.9	18760	20	78.12	WB
Michigan City	41 42.8	86 54.8	Oc 28, 29	1 38.1	72 23.3	18612	19	23.22	WMH

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

IOWA.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		East ° ′	° ′	γ			
Centerville	40 43.6	92 52.0	Jy 3, 4	7 32.1	70 48.8	20235	36	28.12	CFW
Knoxville	41 19.1	93 07.4	Jy 6	7 49.2	71 04.1	19978	36	28.12	CFW
Des Moines	41 35.8	93 34.0	Jy 8, 9	7 53.7	71 31.6	19494	36	28.12	CFW
Marshalltown	42 02.6	92 53.7	Jy 11, 12	7 22.9	72 05.6	19203	36	28.12	CFW
Maquoketa	42 04	90 41.6	No 21, 22	4 59.6	72 35.3	18476	19	23.22	WMH
Vinton	42 09.2	92 01.6	Jy 16, 17	6 55.9	72 35.4	18577	36	28.12	CFW
Independence	42 28.0	91 54.2	Jy 19	7 27.4	72 13.1	18782	36	28.12	CFW
Dubuque	42 29	90 40	Jy 20	5 27.5	73 02.8	18061	36	28.12	CFW
Waterloo	42 29.3	92 22.1	Jy 13	7 23.7	72 47.1	18350	36	28.12	CFW

KANSAS.

	° ′	° ′		East ° ′	° ′	γ			
Baldwin	38 47.0	95 10.0	Se 16, 17	8 32.8	68 46.4	21686	36	28.12	CFW
Do.	38 47.0	95 10.0	Oc 22, 23	8 30.3	68 48.8	21718	20	36.12	CCS
Do.	38 47.0	95 10.0	De–Ja	8 32.2	68 47.4	21740	30	55.34	SAD

LOUISIANA.

	° ′	° ′		East ° ′	° ′	γ			
Lafayette (old)	30 13	92 00	My 8, 9	6 35.4	60 25.2	27312	19	23.34	WMH
Lafayette (new)	30 13	92 00	My 9, 11	6 37.6	60 25.2	27305	19	23.34	WMH
Amite	30 44.3	90 30.0	My 4, 6	5 48.8	61 04.7	26839	19	23.IV	WMH
Alexandria	31 19.8	92 25.1	My 12, 13	6 46.0	61 24.7	26727	19	23.34	WMH
Shreveport	32 31.0	93 45.9	My 23, 25	7 07.8	62 34.9	26108	19	23.34	WMH

MAINE.

	° ′	° ′		West ° ′	° ′	γ			
Farmington	44 39.8	70 09.0	Au 7, 10	15 51.6	74 46.0	15831	29	30.12	WHB
Pole Hill	45 57.3	67 47.0	Jy 18	19 27.5	75 23.5	15103	29	30.12	WHB

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

MARYLAND.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		West ° ′	° ′	γ			
Davis	38 20.5	75 06.4	No 1	6 05.2	70 08.1	20118	29	30.12	WHB
Cheltenham	38 44.0	76 50.5	De–Ja	5 28.1	70 30.3	19964	26	26.EI	JEB
Do.	38 44.0	76 50.5	Se 3	5 25.5	70 29.4	19987	10	18.56	CCC
Do.	38 44.0	76 50.5	Se 5–8	5 23.1	70 29.2	19997	11	31.IV	JEB
Do.	38 44.0	76 50.5	De 10, 25	5 27.9	-- ----	19960	10	-----	SGT
Do.	38 44.0	76 50.5	Ja 10, 15	5 27.7	-- ----	19955	19	-----	SGT
Do.	38 44.0	76 50.5	Ja 21–29	5 27.7	-- ----	19954	11	-----	JEB
Do.	38 44.0	76 50.5	Fe, Ap, My	5 29.7	-- ----	19954	10	-----	SGT
Do.	38 44.0	76 50.5	Ap 29, 30	5 30.8	-- ----	19959	20	-----	JEB
Do.	38 44.0	76 50.5	Je 4	5 30.2	-- ----	19953	10	-----	JEB
Do.	38 44.0	76 50.5	Je 5, 6	5 29.8	-- ----	19960	11	-----	JEB
Do.	38 44.0	76 50.5	Je 10–14	5 30.4	-- ----	19943	36	-----	JEB
Do.	38 44.0	76 50.5	Je 16, 18	5 30.2	-- ----	19959	18	-----	JEB
Baltimore, Patterson Park IV.	39 17.4	76 34.9	No 12, 13	6 08.1	70 54.4	*a19534*	C	33.12	JHS
Do.	39 17.4	76 34.9	Je 9	6 10.9	70 55.2	*a19501*	C	33.12	JHS

MICHIGAN.

	° ′	° ′		° ′	° ′	γ			
Sherman	41 50.8	85 27.2	Je 1	0 26.8E	72 39.7	18302	20	78.12	WB
Adrian	41 54.3	84 01.7	Jy 18, 19	1 37.6W	72 48.9	18165	19	23.22	WMH
Hillsdale	41 55.0	84 36.8	Jy 20	0 05.3E	72 46.7	18307	19	23.22	WMH
Cassopolis	41 56.0	86 03.8	Oc 19, 20	1 02.0E	72 46.5	18282	19	23.22	WMH
Coldwater	41 57.2	84 58.8	Jy 22, 23	0 12.0E	72 50.9	18205	19	23.22	WMH
Bunday	42 03.3	84 27.7	My 19	0 26.2W	72 59.8	18036	20	78.12	WB
Benton Harbor	42 08.9	86 29.1	Oc 24, 25	1 31.0E	72 52.2	18163	19	23.22	WMH
Marshall	42 16.5	84 56.9	Jy 24, 25	0 22.7W	73 06.1	17929	19	23.22	WMH
Kalamazoo	42 17	85 36.6	Oc 15, 16	1 15.8E	73 06.7	17972	19	23.22	WMH
Allegan	42 32.7	85 55.0	Oc 10, 11	0 01.0E	73 12.6	17762	19	23.22	WMH
Charlotte	42 33.0	84 48.7	Jy 26, 27	0 03.7E	73 17.1	17792	19	23.22	WMH
Howell	42 34.8	'83 59.3	Jy 29, 30	0 42.4W	73 40.5	17499	19	23.22	WMH
Pontiac	42 35.7	83 22.1	Jy 15, 16	2 10.5W	73 11.6	17790	19	23.22	WMH
Grand Rapids	42 57.8	85 42.2	Oc 1, 2	1 47.8E	73 57.8	17445	19	23.22	WMH
Ionia	42 58.9	85 06.0	Oc 5	0 27.0W	73 34.5	17509	19	23.22	WMH
Corunna	42 59.0	84 10.1	Jy 31, Au 1	1 29.0W	73 48.5	17277	19	23.22	WMH
Port Huron	43 00.4	82 24.8	Jy 2	2 50.2W	73 48.5	17179	19	23.22	WMH
Lapeer	43 03.0	83 20.2	Jy 12	2 08.4W	73 55.2	17201	19	23.22	WMH
Grand Haven	43 04.3	86 12.0	Oc 8, 9	0 45.1E	73 32.5	17654	19	23.22	WMH
Ithaca	43 17.4	84 37.0	Au 2, 3	1 04.6W	74 13.3	16962	19	23.22	WMH
Newaygo	43 25.8	85 46.0	Se 29, 30	0 38.0W	74 11.3	16885	19	23.22	WMH
Sandusky	43 26.5	82 49.1	Jy 4, 5	2 33.8W	74 15.8	16954	19	23.22	WMH
Caro	43 29.4	83 23.7	Jy 9, 10	1 25.8W	74 08.1	16964	19	23.22	WMH
Bay City	43 36.4	83 50.9	Au 14	1 33.0W	74 11.8	16959	19	23.22	WMH
Midland	43 37.2	84 15.8	Au 10, 12	0 51.4W	74 08.9	16943	19	23.22	WMH
Mount Pleasant	43 37.2	84 47.5	Au 6	0 55.8W	74 09.8	16925	19	23.22	WMH
Bad Axe	43 47.5	83 00.4	Jy 7	2 45.2W	74 28.7	16666	19	23.22	WMH
Baldwin	43 54.8	85 50.7	Se 24–26	0 01.1E	74 17.9	16843	19	23.22	WMH
Standish	43 59.0	83 58.2	Au 15, 16	1 45.3W	74 31.7	16574	19	23.22	WMH
Harrison	44 00.9	84 48.3	Au 8, 9	0 49.8W	74 37.1	16697	19	23.22	WMH
Tawas City	44 17.4	83 32.0	Au 21, 22	1 57.6W	74 53.9	16234	19	23.22	WMH

[a] For the values in italics the total intensity determined by Lloyd's method was combined with the observed dip.

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

MICHIGAN—Continued.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		° ′	° ′	γ			
West Branch	44 17.4	84 17.3	Au 17, 19	1 20.0W	74 51.2	16296	19	23.22	WMH
Harrisville	44 40.2	83 19.4	Au 23, 24	2 50.0W	75 20.4	15869	19	23.22	WMH
Kalkaska	44 45.0	85 08.7	Se 13, 14	0 38.1W	75 19.3	15747	19	23.22	WMH
Traverse City	44 45	85 38	Se 17	0 44.8W	75 37.7	15594	19	23.22	WMH
Bellaire	44 59.9	85 13	Se 11, 12	0 10.0W	75 36.3	15462	19	23.22	WMH
Leland	45 01.4	85 46.0	Se 19, 20	0 01.1W	75 37.5	15522	19	23.22	WMH
Alpena	45 04.5	83 29.0	Au 26, 28	3 04.5W	76 00.9	15305	19	23.22	WMH
Charlevoix	45 18.4	85 15.2	Se 6, 7	0 42.8W	75 34.1	15490	19	23.22	WMH
Rogers	45 25.8	83 49.4	Au 29, 30	3 31.6W	76 00.1	15116	19	23.22	WMH
Cheboygan	45 39.2	84 27.9	Se 3, 4	0 56.4W	76 09.8	15036	19	23.22	WMH

MINNESOTA.

					East					
	° ′	° ′			° ′	° ′	γ			
Luverne	43 39.0	96 16.1	Jy	18	10 17.6	73 01.2	18174	20	36.12	CCS
Fairmont	43 39.1	94 28.0	Au	7	6 43.6	73 14.9	17847	20	36.12	CCS
Preston	43 39.9	92 05.3	Au	9	7 49.2	73 27.9	17823	20	36.12	CCS
Albert Lea	43 40.6	93 20.1	Au	8	6 45.1	73 36.8	17821	20	36.12	CCS
Heron Lake	43 48.9	95 18.0	Au	5	8 58.0	73 18.6	17867	20	36.12	CCS
Faribault	44 17.0	93 16.7	Au	15	7 28.9	74 20.5	17134	20	36.12	CCS
Marshall	44 24.3	95 51.0	Au	3	9 21.9	73 49.4	17408	20	36.12	CCS
Red Wing	44 33.8	92 33.1	Au	13	6 04.6	74 09.6	17047	20	36.12	CCS
Glencoe	44 46.4	94 10.8	Au	17	9 26.6	74 18.7	16892	20	36.12	CCS
St. Paul	44 56.9	93 04.7	Au	16	8 45.0	74 45.1	16582	20	36.12	CCS
Willmar	45 09.6	95 03.7	Au	1	8 31.3	74 53.4	16500	20	36.12	CCS
Ortonville	45 18	96 27.9	Jy	30	10 40.8	74 34.4	16777	20	36.12	CCS
Wheaton	45 47.3	96 27.9	Jy	31	10 43.8	74 52.1	16402	20	36.12	CCS
Mora	45 53.4	93 17.1	Au	20	9 22.8	75 26.5	15803	20	36.12	CCS
Duluth (Minnesota Point)	46 44	92 03	Au	21	8 41.0	76 13.5	15127	20	36.12	CCS
Swan River	47 05.2	93 10.2	Au	23	6 46.2	76 19.0	15027	20	36.12	CCS
Hibbing	47 26.9	92 56.4	Au	24	7 39.8	77 12.2	13854	20	36.12	CCS
Bemidji	47 27.5	94 52.2	Au	27	9 11.4	76 43.5	14596	20	36.12	CCS
Thief River Falls	48 04.7	96 11.8	Au	31	10 34.2	76 42.7	14543	20	36.12	CCS
Warren	48 11.4	96 45.9	Se	2	11 16.8	76 43.0	14601	20	36.12	CCS
Greenbush	48 44.2	96 10.0	Au	29	10 36.2	77 07.8	14257	20	36.12	CCS

MISSISSIPPI.

					East					
	° ′	° ′			° ′	° ′	γ			
Brookhaven	31 35.4	90 26.8	Ap 30, My 1		5 39.7	62 06.8	26294	19	23.34	WMH
Jackson	32 20.0	90 11.1	Ap	29	6 06.2	63 26.7	25333	19	23.34	WMH
West Point	33 36.3	88 39.0	Ap	27	4 45.0	64 23.9	24842	19	23.34	WMH

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

MISSOURI.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		East ° ′	° ′	γ			
Milan	40 11.8	93 07.5	Jy 1	7 22.6	70 21.5	20445	36	28.12	CFW

NEBRASKA.

	° ′	° ′		East ° ′	° ′	γ			
West Point	41 49.7	96 41.8	Jy 11	11 06.2	71 04.0	19903	20	36.12	CCS
Niobrara	42 47.3	98 02.4	Jy 13	10 55.3	71 38.7	19510	20	36.12	CCS

NEW JERSEY.

	° ′	° ′		West ° ′	° ′	γ			
Barnegat light-house	39 45.8	74 06.4	Oc 21, 22	8 21.6	71 24.1	19080	29	30.12	WHB

NEW YORK.

	° ′	° ′		West ° ′	° ′	γ			
Gardiners Id.	41 06.1	72 06.4	Oc 12	10 51.0	72 12.1	18221	29	30.12	WHB
Fishkill	41 30.2	73 59.0	Oc 2, 3	9 53.6	72 53.3	17844	29	30.12	WHB
Binghamton	42 05.4	75 56	Jy 15	9 18.2	73 03.6	17844	11	31.34	FAM
Owego	42 06.2	76 16.6	Jy 13	7 44.2	73 27.8	17451	11	31.34	FAM
Bath	42 21.0	77 18.3	Je 24	7 46.5	73 42.0	17328	10	31.34	FAM
Watkins	42 22.2	76 50.5	Jy 3	8 36.8	73 19.3	17560	11	31.12	FAM
Cortland	42 36.9	76 11.8	Jy 16	8 39.8	73 42.0	17195	11	31.34	FAM
Penn Yan	42 39.4	77 03.8	Jy 1, 2	8 38.6	73 40.7	17222	11	31.12	FAM
Schoharie	42 40.3	74 18.0	Jy 25	10 33.5	73 38.9	17020	11	31.34	FAM
Cooperstown	42 41.6	74 55.3	Jy 22, 23	9 51.3	73 33.2	17194	11	31.IV	FAM
Geneseo	42 48.3	77 49.4	Je 25, 26	6 51.1	74 18.5	16626	10	31.34	FAM
Morrisville	42 54.3	75 39.1	Jy 19	8 30.8	73 39.9	17183	11	31.34	FAM
Ballston Spa	43 00.6	73 51.8	Au 8	10 37.0	-- ----	16792	11	-----	FAM
Do.	43 01.2	73 51.5	Au 9	10 50.4	73 53.4	16755	11	31.34	FAM
Herkimer	43 01.2	74 59.2	Jy 31	10 13.4	73 49.4	16908	11	31.34	FAM
Batavia	43 01.2	78 12.3	Je 29, 30	6 28.6	74 25.0	16542	18	15.56	FAM
Syracuse	43 01.8	76 10.3	Jy 18	8 55.7	73 57.8	16867	11	31.34	FAM
Lyons	43 04.5	76 58.0	Au 29	8 30.4	74 08.7	16658	11	31.34	FAM
Rochester	43 08.4	77 34.7	Au 30, 31	7 26.9	74 03.2	16813	11	31.34	FAM
Northville	43 13.5	74 09.2	Jy 26	11 13.4	73 59.9	16755	11	31.34	FAM
Oswego	43 28.1	76 28.7	Au 28	8 38.8	74 13.3	16560	11	31.34	FAM
Lake Pleasant	43 28.6	74 23.9	Jy 29	11 17.0	74 25.0	16258	11	31.34	FAM
McKeever	43 37	75 05.9	Au 1	10 30.6	74 26.8	16442	11	31.34	FAM
North Creek	43 41.9	73 58.9	Au 5, 6	12 08.7	74 13.7	16478	11	31.34	FAM
Mannsville	43 42.9	76 03.2	Se 24, 26	8 12.0	74 54.7	16085	29	30.12	WHB
Lowville	43 47.8	75 29.3	Au 24	10 23.4	74 32.4	16452	11	31.34	FAM

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

NEW YORK—Continued.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		*West* ° ′	° ′	γ			
Ticonderoga	43 51.4	73 25.0	Au 10, 12	12 09.8	74 03.9	16636	11	31.34	FAM
Blue Mount'n Lake	43 51.8	74 26.0	Au 3	12 42.6	75 05.3	15678	11	31.34	FAM
Watertown	43 57.8	75 53.5	Au 26	10 32.1	74 28.0	16178	11	31.34	FAM
Newton Falls	44 12.9	74 59.2	Au 22, 23	11 39.8	74 55.0	15882	11	31.34	FAM
Lake Placid	44 18.3	73 58.6	Au 15, 16	11 06.2	74 50.7	15843	11	31.34	FAM
Au Sable Forks	44 27.1	73 39.0	Au 13, 14	11 21.2	74 00.7	16765	11	31.34	FAM
Canton	44 36.6	75 10.1	Au 21	10 57.7	75 11.8	15608	11	31.34	FAM
Santa Clara	44 38.3	74 26.5	Au 17	10 08.6	74 53.3	15845	11	31.34	FAM
Plattsburg	44 40.4	73 27.1	Au 13	11 58.8	74 07.3	16853	11	31.34	FAM
Dannemora	44 42.9	73 43.7	Se 18, 19	8 14.8	76 12.0	14957	29	30.12	WHB
Helena	44 55.8	74 41.8	Au 19	12 37.6	75 03.7	15820	11	31.34	FAM

NORTH CAROLINA.

	° ′	° ′		*West* ° ′	° ′	γ			
Goldsboro (new)	35 22.5	77 58.3	Mh 4, 5	2 13.3	67 14.1	22354	19	23.IV	WMH
Goldsboro (old)	35 23.0	77 59.0	Mh 2	2 18.6	67 07.8	22439	19	23.22	WMH

NORTH DAKOTA.

	° ′	° ′		*East* ° ′	° ′	γ			
Forman	46 04.1	97 41.4	Se 18	11 10.1	74 53.5	16323	20	36.12	CCS
Bismarck	46 48.4	100 47.0	Se 16	14 29.4	74 53.9	16450	20	36.12	CCS
Glen Ullin	46 48.7	101 52.6	Se 14	15 33.0	74 41.3	16546	20	36.12	CCS
Steele	46 52.0	99 55.4	Se 12	13 35.4	75 02.0	16275	20	36.12	CCS
Jamestown	46 53.0	98 46.4	Se 10	12 19.7	75 34.8	15766	20	36.12	CCS
Valley City	46 56.8	97 59.9	Se 9	11 39.4	75 33.3	15699	20	36.12	CCS
Hillsboro	47 22.7	97 03.3	Se 5	11 22.4	76 05.4	15176	20	36.12	CCS
Cooperstown	47 26.4	98 06.8	Se 6	12 35.1	75 58.5	15305	20	36.12	CCS
Mercer	47 29.7	100 45.0	Se 26	14 10.2	75 29.8	15785	20	36.12	CCS
Fessenden	47 36.4	99 37.0	Se 30	13 15.0	75 46.4	15517	20	36.12	CCS
Balfour	47 55.5	100 32.4	Oc 3	14 25.8	75 45.9	15535	20	36.12	CCS
Minnewaukon	48 03.5	99 15.3	Se 24	14 06.8	76 02.8	15175	20	36.12	CCS
Towner	48 19.5	100 26.6	Oc 8	14 47.4	76 14.1	15032	20	36.12	CCS
Grafton	48 25.3	97 25.2	Se 4	12 14.8	76 50.2	14462	20	36.12	CCS
Lansford	48 36.1	101 23.6	Oc 5	14 59.9	76 31.9	14769	20	36.12	CCS

OREGON.

	° ′	° ′		*East* ° ′	° ′	γ			
Jacksonville	42 18.0	122 59.6	Je 5	20 10.3	65 58.9	22896	29	30.12	WHB
Roseburg	43 12.6	123 21.2	Je 13	19 19.6	66 46.2	22769	29	30.12	WHB

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

PENNSYLVANIA.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		*West* ° ′	° ′	γ			
Lewisburg	40 57.0	76 52.8	Jy 6, 8	6 39.3	72 12.2	18476	11	31. IV	FAM
Williamsport	41 14	77 02	Jy 5	7 06.2	72 11.7	18558	11	31. IV	FAM
Tunkhannock	41 32.0	75 55.4	Jy 9, 10	8 07.0	72 41.9	18024	11	31. IV	FAM

PHILIPPINE ISLANDS.

	° ′	*East* ° ′			*East* ° ′	° ′	γ			
Zamboanga	6 52.3	122 03.8	My	7[a]	1 58.5	−0 09.2	38814	18	37.2	WMS
Davao	7 04.0	125 38	My	10[a]	2 06.2	−0 02.5	38397	18	37.2	WMS
Cauit Island	10 16.2	123 52.8	No	18	1 33.9	6 46.2	38364	18	37.2	EM
Cebu	10 17.5	123 54.3	De	18	1 40.3	6 45.0	38658	18	37.2	EM
Matarinao Bay	11 14.0	125 34.6	Au	6	1 15.8	8 53.5	38151	18	37.2	WMS
Romblon	12 34.7	122 16.1	Mh	16–23	1 04.4	11 41.1	38462	18	37.2	HDK
Atimonan	14 00.0	121 55.3	Se.	23–26	0 46.0	14 34.6	37797	18	37.2	EM

PORTO RICO.

	° ′	° ′			*West* ° ′	° ′	γ			
Porto Rico Magnetic Observatory	18 08.8	65 26.9	De–Ja		1 57.7	49 31.9	29107	31	1. EI	WBK
Mayaguez	18 12.0	67 08.5	My	16	1 44.8	49 36.6	[b]29241	C	33. 12	JHS
San Juan, South Base	18 27.2	66 08.3	Mh	26	1 46.9	50 18.4	[b]29111	C	33. 12	JHS

SOUTH CAROLINA.

	° ′	° ′			° ′	° ′	γ			
Aiken	33 33.9	81 43.8	Mh	17	0 26.3E	65 21.7	23847	19	23. IV	WMH
Columbia	34 00.0	81 02.0	Mh	13, 14	0 07.4W	65 43.1	23637	19	23. 34	WMH
Florence (new)	34 11.2	79 45.0	Mh	10, 12	0 46.8W	66 10.5	23104	19	23. 34	WMH
Florence (old)	34 11.3	79 45.4	Mh	7–9	0 51.8W	66 08.1	23100	19	23. IV	WMH

SOUTH DAKOTA.

	° ′	° ′			*East* ° ′	° ′	γ			
Brookings	43 17.0	96 48.3	Jy	20	10 47.2	73 16.2	17929	20	36. 12	CCS
Salem	43 43.7	97 24.6	Jy	16	10 26.0	72 59.3	18113	20	36. 12	CCS
Huron	44 21.1	98 09.7	Jy	23	11 11.9	73 09.7	18082	20	36. 12	CCS
De Smet	44 22.5	97 33.0	Jy	22	11 12.7	73 31.0	17616	20	36. 12	CCS
Faulkton	45 02.8	99 07.8	Jy	24	12 43.8	73 47.2	17361	20	36. 12	CCS
Webster	45 18.6	97 31.7	Jy	27	11 30.7	74 20.1	16901	20	36. 12	CCS
Aberdeen	45 30.4	98 28.3	Jy	26	12 15.0	74 06.8	17162	20	36. 12	CCS

[a] Observations in 1907 not heretofore published.
[b] Computed from total intensity determined by Lloyd's method, and the dip.

TABLE I—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

TENNESSEE.

Station	Latitude	Longitude	Date.	Declination.	Dip	Horizontal intensity	Instruments		Observer
							M	D C	
	° ′	° ′		*East* ° ′	° ′	γ			
Memphis	35 07.8	90 04.3	My 30, Je 1	5 29.6	65 52.0	23902	19	23.34	WMH
Covington	35 34.1	89 39.5	Je 5	5 02.8	66 21.9	23633	19	23 34	WMH
Ripley	35 44.8	89 34.1	Je 8, 9	5 09.3	66 34.0	23327	19	23.34	WMH

TEXAS.

	° ′	° ′		*East* ° ′	° ′	γ			
Lagrange	29 52.1	96 49.4	My 14, 15	8 24.6	59 05.2	27919	19	23.IV	WMH
Austin	30 16.0	97 46.3	My 18	8 26.6	59 27.7	27863	19	23.34	WMH
Groesbeck	31 31.5	96 31.0	My 20, 21	8 43.2	60 55.4	27101	19	23.34	WMH

VERMONT.

	° ′	° ′		*West* ° ′	° ′	γ			
Hyde Park	44 35.6	72 35.3	Se 10, 11	14 26.4	74 44.3	15928	29	30.12	WHB

WASHINGTON.

	° ′	° ′		*East* ° ′	° ′	γ			
Port Orchard	47 32.1	122 38.2	My 17, 24[a]	22 41.7	70 51.6	19434	8	32.12	PCW–AC
Seattle	47 39.6	122 18.4	Jy 18, 19	23 26.0	70 51.4	19379	IIII	34.56	CGQ
Do.	47 39.6	122 18.4	No 7, 8	23 29.0	70 47.0	19352	IIII	34.56	CGQ
Do.	47 39.6	122 18.4	No 26, 27	23 13.2	70 49.2	19377	8	32.12	AC
Do.	47 39.6	122 18.4	Mh 16–18	23 27.6	70 49.9	19369	IIII	34.56	SWT
Port Angeles (new)	48 08.4	123 26.0	Ja 21	24 00.0	70 44.7	19437	IIII	34.56	CGQ
Port Angeles (old)	48 08.4	123 26.0	Ja 24	23 56.6	-- ----	-----	IIII	-----	CGQ
Striped Peak	48 09.6	123 41.1	Fe 20	23 51.6	71 44.9	18515	IIII	34.56	CGQ
Dungeness	48 10.9	123 06.7	No 21	24 05.0	70 40.9	19299	IIII	34.56	CGQ

[a] 1907.

TABLE I.—*Magnetic observations on land, July 1, 1907, to June 30, 1908*—Cont'd.

WISCONSIN.

Station	Latitude	Longitude	Date	Declination.	Dip	Horizontal intensity.	Instruments		Observer
							M	D C	
	° ′	° ′		East ° ′	° ′	γ			
Monroe	42 35.8	89 37.7	Jy 29	5 42.9	72 57.4	18257	36	28.12	CFW
Janesville	42 42.4	89 02.5	Au 1	4 19.5	73 33.2	17996	36	28.12	CFW
Dodgeville	42 57.6	90 07.9	Jy 23	5 09.1	73 30.4	17680	36	28.12	CFW
Waukesha	43 00.0	88 14	Je 24–30	2 48.9	73 38.2	17482	36	76.12	CFW
Jefferson	43 00.1	88 48.4	Au 3	3 18.4	73 55.6	17321	36	28.12	CFW
Madison	43 04.5	89 25.3	Jy 26	4 52.9	73 50.8	17646	36	28.12	CFW
Baraboo	43 28.8	89 44.4	Au 7	4 43.2	73 51.8	17367	36	28.12	CFW
Viroqua	43 33.7	90 53.0	Au 12	6 17.1	73 20.8	17943	36	28.12	CFW
La Crosse	43 49.2	91 14.0	Au 12	5 22.2	73 59.0	17155	20	36.12	CCS
Sparta	43 56.6	90 49.2	Au 9	5 17.5	74 00.5	17165	36	28.12	CFW
Whitehall	44 21.7	91 18.7	Au 15	5 23.5	74 20.2	16883	36	28.12	CFW
Medford	45 08.5	90 18.4	Au 22	4 09.2	75 02.2	16186	36	28.12	CFW
Barron	45 24.7	91 51.7	Au 31	6 20.7	75 21.2	15969	36	28.12	CFW
Ladysmith	45 27.9	91 05.3	Au 28	4 30.9	75 03.1	16297	36	28.12	CFW
Phillips	45 41.9	90 23.7	Au 24	5 38.5	75 38.9	15477	36	28.12	CFW
Hayward	46 00	91 28.7	Se 4	6 05.3	75 07.6	16259	36	28.12	CFW
Glidden	46 06.8	90 37.8	Oc 14	3 48.2	75 45.7	15551	20	36.12	CCS
Solon Springs	46 21.0	91 48.8	Se 6	7 06.5	76 22.2	15063	36	28.12	CFW
Iron River	46 34.1	91 23.8	Se 11	6 45.5	76 21.2	14942	36	28.12	CFW

FOREIGN COUNTRIES.[a]

British Columbia:	° ′	° ′		East ° ′	° ′	γ			
Union	49 35.6	124 54.0	Oc 31 No 2	26 15.4	71 20.6	19039	8	32.12	AC
Union 2	49 35.8	124 54.0	Ap 7, 8	26 30.2	71 24.2	19080	IIII	34.56	SWT
Yukon Territory:									
Whitehorse	60 43.5	135 01.7	Je 2, 3	32 05.6	77 36.2	12791	25	25.48	JWG
Dawson	64 03.6	139 26.0	Je 15	35 04.0	77 54.7	12522	25	25.48	JWG
Forty Mile	64 25.0	140 34.2	Je 19	34 41.2	78 09.0	12147	25	25.48	JWG
Camp Davidson	64 40.8	140 54.5	Je 19	35 36.2	78 39.3	12080	25	25.48	JWG

[a] For observations in other foreign countries, see discussion of observations made in 1907 by the party on the steamer *Explorer*.

TABLE II.—*Magnetic observations at sea, July 1, 1907, to June 30, 1908.*

ATLANTIC OCEAN.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Total intensity	Ship	Headings	Sea
	° ′	° ′		West ° ′	° ′	c. g. s.	c. g. s.			
Mayaguez Harbor	18 13	67 10	My 9	1 27	49 25	0.2944	0.4525	Bache	16	Sm.
At sea	19 50	66 13	My 30	2 09	51 20	.2920	.4673	Do.	8	Lt. sw.
Do.	23 30	66 37	My 31	4 11	55 22	.2781	.4894	Do.	8	Mod. sw.
Do.	26 48	71 12	Mh 19	3 42	58 50	.2696	.5210	Do.	8	Sm.
Do.	27 12	67 05	Je 1	5 26	59 17	.2616	.5122	Do.	8	Lt. sw.
Do.	30 47	68 00	Je 2	6 32	62 53	.2440	.5354	Do.	8	Mod. sw.
Do.	33 00	71.15	Je 3	5 59	65 05	.2344	.5564	Do.	8	Mod. sw.
Hampton Roads	36 56	76 05	Jy 9	4 34	68 52	.2129	.5906	Do.	16	Sm.

TABLE II.—*Magnetic observations at sea, July 1, 1907, to June 30, 1908*—Cont'd.

ATLANTIC OCEAN—Continued.

Station	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Total intensity	Ship	Headings	Sea
	° ′	° ′		*West* ° ′	° ′	*c. g. s.*	*c. g. s.*			
Hampton Roads	36 57	76 21	Je 6	4 59	68 49	0. 2118	0. 5861	Bache	16	Sm.
Do.	36 58	76 21	Fe 28	4 29	68 47	. 2125	. 5873	Do.	16	Sm.
Do	36 58	76 21	Mh 16	4 49	68 43	. 2122	. 5847	Do.	16	Sm.
At sea	38 21	74 21	Jy 10	6 44	69 47	. 2050	. 5931	Do.	8	Sm.
Georges Bank	41 07	67 59	Au–Se	15 15	-- --	-----	-----	Do.	21	
New London Harbor	41 18	72 04	Oc 31	10 16	72 18	. 1822	. 5994	Do.	8	Sm.
At sea	41 28	70 01	Au 19	13 08	72 26	. 1804	. 5977	Do.	8	
Provincetown Harbor	42 02	70 09	Jy 16	13 36	73 05	. 1730	. 5945	Do.	16	Sm.

PACIFIC OCEAN.

				East ° ′	° ′	*c. g. s.*	*c. g. s.*			
Port Orchard	47 33	122 38	My 18[a]	-- --	71 44	0. 1857	0. 5926	Patterson	16	Sm.
Seattle Harbor	47 36	122 22	No 4	23 25	70 42	. 1942	. 5876	Explorer	16	Sm.
Do.	47 36	122 22	Ap 2	23 20	70 48	. 1949	. 5926	Do.	16	Sm.
Do.	47 37	122 26	De 24	23 22	70 43	. 1947	. 5896	Patterson	16	Sm.
Port Townsend	48 06	122 45	My 26[a]	24 17	71 12	. 1907	. 5916	Do.	16	Sm.
Dungeness	48 11	123 06	No 20	23 57	70 37	. 1943	. 5854	Explorer	16	Sm.
Haro Strait	48 35	123 13	Au 18	23 01	-- --	-----	-----	Do.	3	Sm.
Gulf of Georgia	48 52	122 58	My 27[a]	24 52	71 35	. 1877	. 5940	Patterson	16	Sm.
Do.	49 28	124 28	Au 18	24 42	-- --	-----	-----	Explorer	3	Sm.
Do.	49 30	124 31	My 28[a]	24 45	71 36	. 1863	. 5901	Patterson	16	Sm.
Baynes Sound	49 35	124 52	No 2	25 40	71 33	. 1876	. 5929	Do.	16	Sm.
Union Bay	49 36	124 52	Ap 7	25 50	71 26	. 1906	. 5986	Explorer	16	Sm.
Gulf of Georgia	49 48	124 54	Oc 31	24 54	71 38	. 1863	. 5913	Patterson	16	Sm.
Discovery Passage	50 09	125 22	Au 19	25 46	-- --	-----	-----	Explorer	3	Sm.
Do.	50 13	125 24	Au 19	-- --	69 56	. 2042	. 5952	Do.	3	Sm.
Do.	50 30	126 24	Ap 9	-- --	70 59	. 1933	. 5932	Do.	8	Sm.
Johnstone Strait	50 32	126 41	Oc 31	26 05	-- --	-----	-----	Do.	3	Sm.
Hecate Strait	51 03	128 32	My 30[a]	25 34	72 00	. 1822	. 5895	Patterson	16	Mod. sw.
At sea	51 58	131 47	My 31[a]	27 01	71 19	. 1849	. 5773	Do.	8	Rough
Lama Passage	52 04	128 06	Au 20	27 00	-- --	-----	-----	Explorer	3	Sm.
Grenville Channel	53 26	129 25	Ap 11	-- --	73 23	. 1686	. 5897	Do.	8	Sm.
At sea	54 15	130 30	Oc 28	28 22	-- --	-----	-----	Do.	8	Sm.
Chatham Sound	54 25	130 36	Ap 12	29 07	73 51	. 1634	. 5876	Do.	8	Sm.
Off north end Dundas Island	54 41	130 54	Oc 25	28 23	74 05	. 1616	. 5894	Do.	8	Sm.
At sea	55 14	140 22	Je 2[a]	-- --	72 38	. 1704	. 5709	Patterson	8	
Near Ketchikan	55 17	131 36	Au 22	28 55	74 07	. 1627	. 5944	Explorer	16	Sm.
Do.	55 17	131 36	Oc 16	29 11	74 15	. 1591	. 5863	Do.	16	Sm.
Ketchikan	55 18	131 36	Ap 12	29 00	74 13	. 1593	. 5858	Do.	8	Sm.
At sea	56 23	145 59	Je 3[a]	-- --	72 14	. 1732	. 5677	Patterson	8	Rough
Sumner Strait	56 24	133 35	Ap 13	29 59	-- --	-----	-----	Explorer	3	Sm.
At sea	57 14	144 18	Ap 15	28 59	-- --	-----	-----	Do.	1	Rough
Do	57 15	144 31	Ap 15	28 52	-- --	-----	-----	Do.	1	Rough
Do.	57 23	149 35	Ap 16	26 00	72 26	. 1749	. 5794	Do.	8	Mod. sw.
Do.	57 36	151 36	Ap 16	23 51	-- --	-----	-----	Do.	3	Mod. sw.
Shelikof Strait	57 38	154 31	Au 10	23 47	71 58	. 1735	. 5603	Patterson	16	Sm.
Kodiak Harbor	57 46	152 26	Je 10[a]	24 12	72 04	. 1736	. 5637	Do.	16	Sm.
St. Paul Harbor	57 48	152 20	Ap 17	24 24	71 54	. 1744	. 5613	Explorer	16	Lt. sw.
St. Paul Roadstead	57 48	152 21	Oc 21	24 15	71 53	. 1736	. 5582	Patterson	16	Sm.
Marmot Bay	57 57	152 33	Au 15	24 14	72 04	. 1734	. 5633	Do.	16	Sm.

[a] Observations in May and June, 1907, not heretofore published.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE EXPLORER ON HER CRUISE FROM THE ATLANTIC TO THE PACIFIC.

Mention was made in last year's Appendix of the magnetic observations made by the *Explorer* on her cruise from the Atlantic to the Pacific, but the records were not available in time to include the results in that publication. In view of the large number of observations and the wide range of latitude covered by the cruise, it will be of interest, in connection with a summary of the results, to give some account of the methods adopted to determine the instrumental constants of the ship dip circle and to allow for the effect of the ship's magnetism.

The *Explorer*, in command of Assistant W. C. Dibrell, left Baltimore, Md., on February 20, 1907, and arrived at Seattle, Wash., on July 15, 1907. In addition to the usual equipment of compasses and azimuth circles, she was provided with a magnetometer and an L. C. dip circle and accompanying gimbal stand. Just before the beginning of the cruise the dip circle was remodeled in the manner explained on page 112, Appendix 3 for 1906, so as to permit using a greater distance for the deflection observations in equatorial regions, where the intensity of the earth's magnetic force is small. It was also provided with a new set of needles and was restandardized at the Cheltenham Magnetic Observatory.

The instructions for magnetic work during the cruise provided for (1) shore observations at each port where a stop was made for coal; (2) observations on board ship near these ports while swinging ship on 8 or 16 equidistant headings; (3) observations at sea while swinging ship on 8 equidistant headings, once a day, weather and coal supply permitting; (4) observations on the course and 2 points to port and starboard of the course as often as possible between swings. These instructions were executed in a very satisfactory manner, as will be seen by the following summary:

Summary of results.

	Declination	Dip	Intensity
Shore observations	14	14	14
Swings near port	13	14	14
Swings at sea	16	16	16
Course observations	85	46	46

In addition to the determination of declination and horizontal intensity with the magnetometer and dip with the dip circle, the work at each shore station included observations with the dip circle to determine the relative total intensity by Lloyd's method. For the loaded dip observations, the same weight was used throughout the cruise, but it was changed from the south end of the needle to the north end at Rio de Janeiro and back to the south end at Chatham Island on the way north. At each of these places care was taken to make observations with the weight in each of the two positions, in order to determine the effect of the change. The deflection observations were made at two distances whenever it was possible.

The observations on shipboard while swinging ship comprised standard compass bearings of the sun for declination and compass deviations, during both port and star-

board swings, deflection observations with dip circle while swinging to port and loaded dip observations while swinging to starboard. The arrangement of the observations is explained in greater detail in Appendix No. 3 for 1904. The course observations usually involved the same number of readings as a swing on 8 points, beginning with observations on the course, then 2 points to port, 2 points to starboard, and finally on the course again. The compass observations were made by Assistant Dibrell, the dip circle and shore observations by C. G. Quillian, assistant, and A. L. Giacomini, first watch officer.

The results of the shore observations are presented in the following table. Descriptions of the stations occupied will be found at the end of this Appendix. Old stations were reoccupied whenever it was possible to do so.

Results of shore observations.

[Magnetometer No. IIII. Dip circle No. 34, needles 5 and 6.]

	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity
	° ′	° ′		° ′	° ′	γ
Port Castries, Santa Lucia	14 01.0 N	60 59.4	Mar. 9, 10	2 15.0 W	45 28.7	29427
Pernambuco, Brazil	8 02.8 S	34 52.1	Mar. 27, 28	15 57.8 W	4 34.9	27950
Rio de Janeiro, Brazil	22 54.5 S	43 10.7	Apr. 6, 7	9 03.6 W	−14 04.2	24747
Montevideo, Uruguay	34 52.5 S	56 12.4	Apr. 15, 16	4 49.2 E	−27 45.8	25016
Punta Arenas, Chile	53 08.7 S	70 53.0	Apr. 25, 27	19 05.3 E	−50 29.4	27480
Coronel, Chile	37 01.9 S	73 09.6	May 8, 9	16 05.8 E	−35 56.1	26851
Callao, Peru	12 05.4 S	77 13.5	May 20, 21	9 19.6 E	− 3 32.7	29920
Chatham Island, Ecuador	0 54.0 S	89 36.7	June 1, 2	8 09.6 E	12 40.0	32977
Panama, Canal Zone	8 54.6 N	79 31.7	June 8, 9	4 36.8 E	33 39.2	32789
Acapulco, Mexico	16 50.9 N	99 55.4	June 21, 22	8 08.8 E	41 24.7	33513
Magdalena Bay I, Mexico	24 38.4 N	112 08.9	June 29	11 12.0 E	48 46.9	31654
Magdalena Bay II, Mexico	24 39.6 N	112 08.9	June 30	11 17.3 E	49 24.5	31471
San Diego, Cal.	32 42.7 N	117 11.7	July 5	14 54.9 E	58 07.2	27760
Seattle, Wash.	47 39.6 N	122 18.4	July 18, 19	23 26.0 E	70 51.4	19379

The first difficulty encountered in the reduction of the observations was the determination of the correction to be applied to the dip results. The observations at Cheltenham showed that needles 5 and 6 of dip circle No. 34 required corrections at that place amounting to $-7'.9$ and $-11'.6$, respectively. Now, it is well known that the correction to a dip needle varies with change of dip, and this becomes an important consideration where the range is so great, as in the cruise of the *Explorer*, from 71° north to 50° south. Theoretically, the correction may be represented by an analytical expression of the form $\Delta I = x + y \sin I + z \cos I$. For the evaluation of the three unknowns in this equation, observations are required at not less than three places where the correct value of the dip is known from observations with some other instrument, and, moreover, these places should cover approximately the range of dip for which the formula is to be used. Although magnetic observations had been made a number of times by other parties at most of the ports where the *Explorer* stopped for coal, it was impossible to get the data required for the solution of the above formula except at a few places. Either it was not possible to reoccupy the old station or the means were

lacking for correcting the earlier results for secular change or the results were not sufficiently accurate. In the United States the dip at San Diego and Seattle is well determined as the result of observations with several other dip circles. At Rio de Janeiro the observations were made in the magnetic observatory connected with the meteorological department of the Brazilian Hydrographic Office, where magnetic observations are made regularly (dip about once a week) by naval officers, and their results were used for determining the correction to the *Explorer* dip circle. At Port Castries the observations were made at the station established by the Department of Terrestrial Magnetism of the Carnegie Institution in July, 1905, and the *Explorer* station at Callao was also occupied by the officers of the Carnegie Institution yacht *Galilee* in March, 1908. It was thus possible to obtain the corrections required by the needles of the *Explorer* dip circle at six places, and therefrom to compute the unknown coefficients in the above equation by the method of least squares. As there appeared to be no systematic difference between the results with the two needles, a single expression was derived from which to determine the mean of the corrections required by the two needles, namely,

$$F\Delta I = -8'.0 - 1'.1 \sin I + 8'.6 \cos I$$

This gave corrections ranging from $+2'.4$ at Rio de Janeiro to $-10'.5$ at Seattle.

No regular dip observations were made on board ship, but the dip was derived from the deflection observations involved in the determination of total intensity, needle No. 7 being deflected by No. 8. The corrections required by needle No. 7 were determined by means of comparisons with the regular dip needles on shore, as follows:

Place	Long distance	Short distance	Place	Long distance	Short distance
	′	′		′	′
Cheltenham	− 3.9	− 1.2	Callao	0.0	------
Port Castries	− 5.0	− 7.1	Chatham Island	+31.9	+21.2
Pernambuco	− 1.4	------	Panama	+34.0	+24.4
Rio de Janeiro	+24.4	------	Acapulco	+35.8	+25.0
Do.	+23.0	------	Magdalena Bay	+34.7	+23.5
Montevideo	+26.2	------	Do.	+34.3	+21.9
Do.	+23.0	------	San Diego	+ 7.4	+22.2
Punta Arenas	+20.3	−33.2	Do.	+ 5.5	+18.8
Coronel	+24.8	−25.0	Seattle	+ 5.5	+26.3

It will be seen that, in general, a different correction is required according as the deflection observations are made at the long or the short distance. In the observations on board ship the short distance was used between Baltimore and Port Castries and between San Diego and Seattle. For the remainder of the cruise the deflection observations were made at the longer distance. An inspection of the tabular quantities shows little evidence of a systematic variation in the correction to needle No. 7. Instead, the indications are that it remained nearly constant for a considerable period and then changed abruptly, and this has been adopted as a basis for deriving the corrections for the dip results on board ship.

For the determination of the intensity constant to be used in computing the total intensity from observations by Lloyd's method special observations were made at

Cheltenham in February, 1907. In addition, total intensity observations with the dip circle formed a part of the regular shore observations, thus furnishing an additional value of the intensity constant for each place. The resulting values are as follows:

Place	Date	Log C_L	Log C_S
Cheltenham	Feb. 5	9.51664	9.58957
Do.	Feb. 6	9.51673	9.58982
Do.	Do.	9.51704	9.59029
Port Castries	Mar. 9	9.51876	9.59263
Pernambuco	Mar. 28	9.52070	-------
Rio de Janeiro	Apr. 7	9.52164	-------
Changed weight from south end to north end			
Rio de Janeiro	Apr. 7	9.51934	-------
Montevideo	Apr. 16	9.51848	-------
Do.	Do.	9.51852	-------
Punta Arenas	Apr. 26	9.52595	9.59560
Coronel	May 9	9.52180	9.59416
Callao	May 20	9.52456	-------
Chatham Island	June 2	9.52088	9.59611
Changed weight from north end to south end			
Chatham Island	June 2	9.51980	9.59503
Panama	June 9	9.52388	9.59655
Acapulco	June 22	9.52142	9.59477
Magdalena Bay	June 29	9.52187	9.59564
San Diego	July 3	9.51978	9.59384
Do.	July 5	9.51945	9.59358
Seattle	July 19	9.52006	9.59281

There appears to have been some change in the constants after the observations at Cheltenham. The subsequent results show considerable range, but in general not more than is to be expected, when the large number of possible sources of error is considered. The change of the weight from one end of the loaded needle to the other had no well-defined effect. It was therefore decided to use a mean value of log C for each distance for the whole cruise, omitting the Cheltenham results but including the values obtained during the season's work in Alaska, which followed immediately after the completion of this cruise.

Up to this point attention has been directed to the determination of what may be called the "instrumental constants" of the L. C. dip circle. There remains the more difficult problem of finding what corrections must be applied to the results of observations made on board ship in order to eliminate the effect of the ship's magnetism. A complete analysis of the magnetic effect of the iron entering into the composition of the *Explorer* has not been attempted, as the observations while swinging ship and the shore observations are so well distributed throughout the cruise that a simpler treatment of the subject serves to obtain the required corrections with sufficient accuracy. The general theory of the analysis of the deviations due to the ship's magnetism has been treated so often that only a few points need be mentioned here. The deviation in declination, dip, or total intensity on any heading—that is, the effect of the ship's magnetism—may be represented approximately by an equation of the form

$$\Delta = A + B \sin \zeta + C \cos \zeta + D \sin 2\zeta + E \cos 2\zeta$$

in which ζ is the magnetic heading of the ship, counted from north around by east. The second member of this equation may be divided into three parts: A, which is constant for all headings; ($B \sin \zeta + C \cos \zeta$), called the semicircular deviation, the values on two headings 180° apart being equal, but of opposite sign; ($D \sin 2\zeta + E \cos 2\zeta$), called the quadrantal deviation, the values on two headings 90° apart being equal, but of opposite sign. It is apparent that when observations are made on 8 or 16 equidistant headings the mean result is affected only by A, the constant part of the deviation. For incomplete swings or course observations, the values of the coefficients B, C, D, E,

must be known in order to compute the deviation. Wherever observations during a complete swing are made near land in connection with shore observations, a value of A is obtained, which, in addition to errors of observation, is subject to the error which may arise from a difference in the earth's magnetism at the two points of observation. Observations during a complete swing, whether near land or at sea, furnish data for computing B, C, D, E. In the following table will be found the values of these approximate deviation coefficients for each of the three series of observations, declination, dip, and total intensity, together with the probable error of an observation on a single heading, as deduced from a comparison of the observed and computed deviations. The declination and dip coefficients are expressed in minutes, those for total intensity in units of the fourth decimal place of the C. G. S. system.

Summary of deviation coefficients.

Date	Number of points	Declination						Dip						Total intensity					
		A	B	C	D	E	r	A	B	C	D	E	r	A	B	C	D	E	r
1907		′	′	′	′	′	′	′	′	′	′	′	′						
Feb. 21	8	+19	−151	−85	+53	− 7	7	+ 40	+31	−246	+ 4	+36	3	+133	−24	+221	− 4	− 32	1
Mar. 1	8	----	−125	−50	+46	− 5	18	-----	− 4	−230	+10	+54	8	----	+ 7	+299	0	− 59	24
11	8	+36	− 85	−37	+33	+17	12	+125	+ 6	−128	0	+57	7	+102	− 7	+298	−18	− 78	18
18	8	----	− 46	−11	+64	− 8	11	-----	− 9	− 77	+10	+45	18	-----	−22	+302	+ 6	− 86	12
28	8	+15	− 31	−29	+79	−33	14	+192	− 1	+105	+19	+20	9	+ 10	−30	+215	+12	− 74	17
Apr. 1	8	----	− 68	−12	+41	− 3	20	-----	+18	+147	+12	−33	8	-----	−38	+146	0	− 75	6
8	8	----	----	----	----	----	--	+131	+ 4	+153	+ 9	−28	2	− 19	−10	+116	− 4	− 77	6
10	8	----	− 35	−44	+43	+ 9	16	-----	−17	+164	+10	−24	10	-----	−33	+ 91	+ 2	− 84	13
12	8	----	− 49	−40	+56	+16	14	-----	− 3	+131	− 3	−30	11	-----	−24	+ 74	+ 1	− 61	8
13	16	−22	− 28	−59	+49	− 2	8	+113	−14	+135	+12	−36	6	− 55	−11	+ 57	− 3	− 62	6
19	8	----	----	----	----	----	--	-----	+18	+112	−18	−47	13	-----	−36	+ 51	−14	− 68	35
24	8	+14	+ 6	−25	+56	− 6	8	+ 18	+ 8	+ 30	+ 3	−48	4	+ 6	− 2	− 65	− 7	− 57	5
May 4	8	----	+ 14	−60	+19	+35	5	-----	+12	+ 40	+ 7	−43	7	-----	+ 8	− 70	−13	− 36	6
12	8	− 2	− 6	−49	+57	− 2	7	+ 93	+ 1	+ 79	+ 5	−38	12	+ 49	−27	− 9	− 2	− 60	8
14	8	----	+ 54	+89	+ 7	−89	16	-----	+14	+ 84	− 1	−51	13	-----	−24	− 2	−15	− 63	12
18	8	----	+ 22	+ 4	+47	−23	14	-----	+22	+115	+27	+ 3	18	-----	+ 1	+ 60	+ 2	− 74	14
24	8	+ 4	− 21	−20	+69	−10	6	+ 73	−11	+121	+26	+16	12	+ 67	+ 4	+111	+ 5	− 60	11
31	8	----	+ 1	−41	+47	−25	16	-----	+ 9	+ 90	+ 6	+26	5	-----	−30	+128	− 5	− 85	20
June 1	8	−17	− 3	−44	+48	−24	7	+ 54	+24	+ 66	+11	+19	12	+ 25	−45	+192	+12	−124	20
3	8	----	− 4	− 4	+60	−17	11	-----	+19	+ 53	+ 5	+31	4	-----	− 6	+168	− 9	− 88	10
5	8	----	− 10	−20	+44	−10	6	-----	+29	+ 19	+14	+48	5	-----	− 1	+185	− 6	−104	12
6	8	----	− 19	−23	+58	+ 7	7	-----	+24	− 7	+15	+52	5	-----	−28	+203	−24	−118	8
14	[a]	----	− 31	−16	+45	−13	10	-----	-----	-----	----	----	--	-----	-----	-----	-----	-----	--
14	[b] 16	+ 3	− 25	−38	+55	−25	14	+ 81	− 1	− 56	+ 8	+50	8	+111	−30	+240	−10	− 96	11
17	8	----	− 33	−17	+34	+ 4	9	-----	-----	-----	----	----	--	-----	-----	-----	-----	-----	--
19	8	----	− 26	−16	+46	−25	8	-----	+31	− 44	+ 7	+42	17	-----	−15	+239	+11	−115	16
20	8	----	− 35	−43	+54	− 3	8	-----	+28	− 63	+ 4	+42	8	-----	−43	+278	0	− 83	16
21	16	+21	− 49	−36	+57	− 5	5	+ 61	+24	−101	+11	+51	9	+ 95	−32	+268	− 7	− 80	9
26	8	----	− 26	−30	+56	− 2	11	-----	+25	− 88	+ 7	+76	6	-----	−47	+302	+20	−106	23
29	16	+25	− 50	−49	+58	+ 2	4	+ 43	+25	−139	+15	+52	9	+126	−29	+279	−20	− 81	8
July 3	16	+ 5	− 70	−47	+67	+ 2	6	+ 31	+21	−190	+17	+46	6	+103	−12	+283	−19	− 54	12
15	16	+ 9	−136	−80	+58	− 1	6	+ 7	+22	−235	+16	+37	7	+124	− 7	+207	−14	− 32	9

[a] Incomplete sun observations. [b] Reciprocal bearings.

It will be seen that in general the coefficients show a systematic variation; but there is evidently much irregular variation also, probably due more to errors of observation

than to change in the magnetic condition of the ship, so that for computing the deviations for the course observations it is desirable to have suitable interpolation formulæ, which will eliminate, at least partially, this irregular variation.

For declination, the coefficients A, D, and E should be practically constant, according to theory, and they have been so considered. B and C are composed of two parts, one of which varies as the tangent of the dip and the other as the reciprocal of the horizontal force. By dividing the cruise into two parts formulæ were deduced which represent very closely the variations in B and C.

Chesapeake Bay to Punta Arenas	Punta Arenas to Seattle
$A = +\ 8'$ $B = +12' - 36' \tan I - 16'/H$ $C = +80' -\ 7' \tan I - 30'/H$ $D = +52'$ $E = -\ 5'$	$A = +\ 8'$ $B = +64' - 31' \tan I - 24'/H$ $C = +56' + 10' \tan I - 29'/H$ $D = +52'$ $E = -\ 5'$

For dip and total intensity, the A coefficients are not constant, but are represented by equations of the form

$$\alpha_I = \sin A_I = \frac{\lambda - \mu}{2} \sin 2I \qquad \alpha_F = \frac{A_F}{F} = 1 - \frac{\lambda + \mu}{2} - \frac{\lambda - \mu}{2} \cos 2I$$

in which λ and μ are factors of the ship's magnetism, the former being a constant, or nearly so, and the latter being a function of the vertical force: $\mu = K + 1 + \frac{R}{Z}$. Each swing near a port furnishes the data for computing a value of λ and μ, and from the different values of μ the values of K and R can be computed. Here again it was necessary to divide the cruise into two parts in order to get satisfactory results. The following values of λ and μ were used to compute the A coefficients for dip and total intensity:

Chesapeake Bay to Punta Arenas	Punta Arenas to Seattle
$\lambda = 1.0045$ $\mu = 0.9871 - .0111/Z$	$\lambda = 0.9933$ $\mu = 0.9848 - .0056/Z$

In the case of the other dip coefficients, B shows no systematic variation. The average value for the first part of the cruise is $+3'$ and for the last part $+18'$. The variation in C appears to be quite systematic, though not according to theory. Graphical interpolation was resorted to, plotting the values of C as a function of the dip and drawing a smooth curve through the plotted points. D appears to be constant for the whole series, the average value being $+10'$. $E = 5' + 50' \sin 2I$.

For total intensity the mean values, $B = -20'$ and $D = -4'$, were used for the whole cruise. Graphical interpolation was used for C and E, treating them as functions of the dip.

By the methods indicated above, the A coefficient was computed for each result for declination, dip, and total intensity, and the B, C, D, E coefficients for each course observation, after which the proper deviation correction was computed by the formula

$$\Delta = A + B \sin \zeta + C \cos \zeta + D \sin 2\zeta + E \cos 2\zeta.$$

The resulting values of declination, dip, and total intensity are given in the following table, together with the corresponding values of horizontal intensity computed from the dip and total intensity:

Results of magnetic observations at sea made on the Explorer during the cruise from Baltimore, Md., to Seattle, Wash.

Place	Latitude	Longitude	Date 1907	Declination	Dip	Total intensity	Horizontal intensity	Headings	Sea
	North ° ′	° ′		° ′	° ′	*c. g. s.*	*c. g. s.*		
Chesapeake Bay	38 02	76 22	Feb. 21	5 09 W	69 38	0.5930	0.2064	8	Sm.
	35 25	74 43	Feb 26	4 27 W	67 43	.5814	.2205	3	Mod. sw.
	30 01	70 23	Feb 28	4 06 W	61 56	.5431	.2555	3	Mod. sw.
	27 09	68 46	Mar 1	4 20 W	59 36	.5180	.2621	8	Lt. sw.
	23 55	66 43	Mar 2	3 50 W	56 08	.4966	.2767	3	Mod. sw.
	21 02	64 57	Mar 3	4 10 W	52 46	.4699	.2843	3	Mod. sw.
	17 57	63 20	Mar 4	3 06 W	49 15	.4463	.2913	3	Lt. sw.
Off Port Castries	14 02	61 02	Mar 11	1 47 W	44 58	.4192	.2966	8	Sm.
	10 40	56 10	Mar 13	5 32 W	41 02	.3903	.2944	3	Hvy. sw
	9 39	54 50	Mar 14	4 41 W	-- --	-----	-----	3	Mod. sw.
	5 10	46 47	Mar 17	9 33 W	-- --	-----	-----	3	Mod. sw.
	4 15	45 08	Mar 18	-- -----	30 59	.3405	.2919	8	Mod. sw.
	4 00	44 46	Mar 18	10 39 W	-- --	-----	-----	8	Mod. sw.
	1 12	40 25	Mar 20	13 29 W	-- --	-----	-----	3	Lt. sw.
	1 05	40 13	Mar 20	-- -----	24 00	.3179	.2904	3	Lt. sw.
	South								
	0 50	37 31	Mar 21	13 51 W	-- --	-----	-----	3	Mod. sw.
	1 01	37 19	Mar 21	-- -----	19 11	.3071	.2900	3	Mod. sw.
	2 40	35 47	Mar 22	15 07 W	-- --	-----	-----	3	Mod. sw.
	3 34	35 06	Mar 22	15 18 W	-- --	-----	-----	3	Mod. sw.
	5 01	34 00	Mar 23	17 15 W	-- --	-----	-----	3	Mod. sw.
	5 26	33 54	Mar 23	-- -----	9 14	.2914	.2876	3	Mod. sw.
	7 54	33 55	Mar 24	18 01 W	- --	-----	-----	2	Mod. sw.
Off Pernambuco	8 05	34 50	Mar 28	15 51 W	3 43	.2790	.2784	8	Lt. sw.
	9 48	35 04	Mar 29	16 18 W	- --	-----	-----	3	Lt. sw.
	9 58	35 06	Mar 29	-- -----	1 41	.2730	.2729	3	Lt. sw.
	13 21	36 16	Mar 30	15 10 W	- --	-----	-----	3	Lt. sw.
	13 33	36 20	Mar 30	-- -----	— 3 35	.2673	.2668	3	Lt. sw.
	16 47	37 33	Mar 31	-- -----	— 7 48	.2601	.2577	3	Lt. sw.
	16 54	37 36	Mar 31	13 38 W	- --	-----	-----	3	Lt. sw.
	18 18	38 06	Mar 31	13 28 W	- --	-----	-----	3	Lt. sw.
	20 14	39 04	Apr 1	12 53 W	—13 24	.2554	.2484	8	Lt. sw.
	21 33	39 46	Apr 1	11 57 W	-- --	-----	-----	3	Mod. sw.
	23 02	41 46	Apr 2	[a] 10 15 W	—15 26	.2539	.2447	3	Lt. sw.
Rio de Janeiro	22 54	43 09	Apr 8	-- -----	—14 04	.2534	.2458	8	Sm.
	23 53	43 46	Apr 8	7 59 W	-- --	-----	-----	1	Lt. sw.
	25 19	45 03	Apr 9	8 01 W	-- --	-----	-----	3	Mod. sw.
	25 35	45 15	Apr 9	- -----	—17 08	.2512	.2401	3	Mod. sw.
	26 33	46 01	Apr 9	6 27 W	-- --	-----	-----	3	Lt. sw.
	28 22	47 22	Apr 10	5 27 W	—20 57	.2583	.2412	8	Lt. sw.
	29 29	48 18	Apr 10	4 21 W	-- --	-----	-----	3	Lt. sw.
	31 31	49 55	Apr 11	1 46 W	—23 45	.2623	.2401	3	Lt. sw.
	32 47	50 51	Apr 11	0 32 W	-- --	-----	-----	3	Lt. sw.
	33 57	52 55	Apr 12	0 59 E	—26 57	.2740	.2442	8	Lt. sw.
	34 46	54 06	Apr 12	2 30 E	-- --	-----	-----	3	Lt. sw.
Off Montevideo	34 58	56 09	Apr 13	4 19 E	—28 04	.2828	.2495	16	Sm.
	36 08	56 28	Apr 17	5 43 E	-- --	-----	-----	3	Lt. sw.
	38 27	57 09	Apr 18	6 41 E	-- --	-----	-----	3	Lt. sw.
	38 38	57 15	Apr 18	- ----	—31 46	.2969	.2524	3	Lt. sw.
	39 41	57 56	Apr 18	7 44 E	-- --	-----	-----	3	Lt. sw.
	41 55	59 13	Apr 19	[b] 9 18 E	—36 51	.3213	.2571	8	Hvy. sw.

[a] On 1 heading only.

[b] On 5 headings with port helm and 8 headings starboard helm.

Results of magnetic observations at sea made on the Explorer during the cruise from Baltimore, Md., to Seattle, Wash.—Continued.

Place	Latitude	Longitude	Date 1907	Declination	Dip	Total intensity	Horizontal intensity	Headings	Sea
	South ° ′	° ′		° ′	° ′	*c. g. s.*	*c. g. s.*		
	43 00	59 56	Apr 19	10 35 E	-- --	-----	-----	3	Mod. sw.
	44 57	61 05	Apr 20	12 07 E	-- --	-----	-----	3	Mod. sw.
	45 09	61 12	Apr 20	-- ----	−39 18	0.3394	0.2626	3	Mod. sw.
	46 06	61 53	Apr 20	12 42 E	-- --	-----	-----	3	Mod. sw.
	47 52	63 48	Apr 21	-- ----	−42 41	.3758	.2763	1	
	49 52	65 30	Apr 22	15 22 E	−45 19	.3876	.2726	3	Mod. sw.
	50 38	65 54	Apr 22	16 24 E	-- --	-----	-----	3	Mod. sw.
	52 37	67 35	Apr 23	18 54 E	-- --	-----	-----	3	Hvy. sw.
Magellan Straits	52 34	69 40	Apr 24	-- ----	−49 14	.4127	.2695	1	Sm.
Do.	52 42	70 04	Apr 24	19 11 E	-- --	-----	-----	3	Sm.
Do.	53 00	70 33	Apr 24	19 33 E	-- --	-----	-----	3	Sm.
Off Sandy Point (Punta Arenas)	53 08	70 48	Apr 24	19 11 E	−50 34	.4321	.2745	8	Sm.
Magellan Straits	53 49	70 56	Apr 28	19 20 E	-- --	-----	-----	3	Sm.
Do.	53 48	71 48	Apr 28	20 02 E	-- --	-----	-----	3	Sm.
Do.	53 38	72 14	Apr 29	19 58 E	-- --	-----	-----	1	Sm.
Do.	53 14	73 19	Apr 29	20 43 E	-- --	-----	-----	1	Sm.
Do.	53 00	73 44	Apr 30	21 04 E	-- --	-----	-----	3	Sm.
Do.	52 15	73 38	Apr 30	20 21 E	-- --	-----	-----	3	Sm.
Patagonian Channels	51 52	73 41	May 1	19 44 E	-- --	-----	-----	3	Sm.
Do.	51 49	73 47	May 1	20 45 E	-- --	-----	-----	9	Sm.
Do.	51 42	73 58	May 1	-- ----	−51 02	.4320	.2717	1	Sm.
	47 45	76 42	May 3	-- ----	−48 24	.4139	.2748	3	
	44 29	76 36	May 4	19 19 E	−45 20	.3837	.2697	8	Lt. sw.
	43 32	76 22	May 4	19 48 E	-- --	-----	-----	3	Lt. sw.
	41 13	75 43	May 5	-- ----	−41 40	.3652	.2728	3	Lt. sw.
	41 05	75 42	May 5	18 15 E	-- --	-----	-----	3	Lt. sw.
	39 59	75 27	May 5	17 42 E	-- --	-----	-----	3	Sm.
	37 35	74 49	May 6	16 10 E	-- --	-----	-----	3	Lt. sw.
	37 19	74 45	May 6	-- ----	−37 41	.3425	.2711	3	
Coronel Bay	37 02	73 12	May 12	15 56 E	−36 56	.3267	.2611	8	Sm.
	36 00	73 28	May 12	15 50 E	-- --	-----	-----	3	Lt. sw.
	33 47	73 54	May 13	15 32 E	-- --	-----	-----	3	Lt. sw.
	33 35	73 58	May 13	-- ----	−33 37	.3207	.2671	3	Lt. sw.
	32 26	74 14	May 13	15 13 E	-- --	-----	-----	3	Lt. sw.
	30 24	74 32	May 14	14 17 E	-- --	-----	-----	3	Lt. sw.
	30 17	74 33	May 14	14 28 E	−29 53	.3120	.2705	8	Mod. sw.
	27 13	74 59	May 15	-- ----	−27 05	.3065	.2729	3	Lt. sw.
	26 00	75 07	May 15	13 09 E	-- --	-----	-----	3	Lt. sw.
	23 48	75 28	May 16	-- ----	−22 09	.3037	.2813	3	Lt. sw.
	20 40	76 04	May 17	-- ----	−17 34	.2991	.2852	3	Lt. sw.
	19 15	76 17	May 17	11 00 E	-- --	-----	-----	3	Lt. sw.
	17 12	76 38	May 18	-- ----	−12 14	.2960	.2893	3	Mod. sw.
	15 59	76 44	May 18	10 15 E	−10 30	.2934	.2885	8	Mod. sw.
	13 52	77 08	May 19	9 45 E	-- --	-----	-----	3	Lt. sw.
	13 40	77 14	May 19	- ----	− 6 29	.2999	.2980	3	Lt. sw.
Callao Bay	12 04	77 13	May 24	9 16 E	− 3 44	.2947	.2941	8	Sm.
	10 32	79 13	May 28	- ----	− 2 15	.3026	.3024	3	
	8 12	81 54	May 29	- ----	1 08	.3077	.3076	3	
	5 54	84 34	May 30	- ----	3 39	.3173	.3167	3	
	5 50	84 36	May 30	8 23 E	-- --	-----	-----	3	Lt. sw.
	3 28	86 57	May 31	8 02 E	8 00	.3250	.3218	8	Lt. sw.
	2 32	87 56	May 31	8 15 E	-- --	-----	-----	3	Lt. sw.
	0 59	89 22	June 1	7 45 E	12 47	.3391	.3307	8	Lt. sw.
	0 44	89 31	June 3	7 48 E	-- --	-----	-----	3	Sm.

Results of magnetic observations at sea made on the Explorer during the cruise from Baltimore, Md., to Seattle, Wash.—Continued.

Place	Latitude	Longitude	Date 1907	Declination	Dip	Total intensity	Horizontal intensity	Headings	Sea
	North ° ′	° ′		° ′	° ′	c. g. s.	c. g. s.		
	0 08	88 41	June 3	7 51 E	15 00	.3413	.3297	8	Lt. sw.
	1 35	87 09	June 4	7 06 E	-- --	-----	-----	3	Lt. sw.
	1 42	86 58	June 4	- ----	18 27	.3499	.3319	3	Lt. sw.
	3 26	84 16	June 5	6 11 E	22 43	.3581	.3311	8	Lt. sw.
	4 12	83 05	June 5	6 30 E	-- --	-----	-----	3	Sm.
	5 54	81 32	June 6	- ----	27 57	.3713	.3280	3	Sm.
	5 58	81 28	June 6	5 49 E	-- --	-----	-----	3	Sm.
	6 53	80 32	June 6	5 10 E	29 44	.3799	.3299	8	Sm.
	7 09	81 48	June 15	5 01 E	-- --	-----	-----	1	Sm.
	7 53	83 34	June 16	- ----	29 55	.3871	.3355	3	Mod. sw.
	7 56	83 41	June 16	5 39 E	-- --	-----	-----	3	Mod. sw.
	8 00	79 38	June 7	4 32 E	-- --	-----	-----	3	Lt. sw.
	8 16	79 34	June 7	- ----	32 27	.3851	.3250	3	Sm.
Panama Roads	8 55	79 30	June 14	4 32 E	33 12	.3865	.3259	16	Sm.
	8 35	84 55	June 16	5 59 E	-- --	-----	-----	3	Lt. sw.
	9 38	86 51	June 17	6 03 E	-- --	-----	-----	8	Lt. sw.
	9 41	86 56	June 17	- ----	32 27	.3978	.3357	3	Lt. sw.
	10 16	87 58	June 17	5 56 E	-- --	-----	-----	3	Lt. sw.
	11 15	90 01	June 18	- ----	34 10	.4071	.3368	3	Lt. sw.
	11 19	90 04	June 18	6 54 E	-- --	-----	-----	3	Lt. sw.
	11 57	91 27	June 18	6 59 E	-- --	-----	-----	3	Lt. sw.
	13 07	93 14	June 19	6 50 E	36 21	.4180	.3367	8	Sm.
	13 53	94 29	June 19	8 47 E	-- --	-----	-----	3	Mod. sw.
	14 53	96 17	June 20	7 33 E	-- --	-----	-----	3	Lt. sw.
	15 06	96 38	June 20	- ----	38 37	.4329	.3382	3	Lt. sw.
	15 35	97 42	June 20	8 01 E	39 29	.4353	.3360	8	Sm.
	16 11	99 22	June 21	7 49 E	-- --	-----	-----	3	Lt. sw.
Acapulco Harbor	16 51	99 55	June 21	8 22 E	41 10	.4457	.3355	16	Sm.
	16 56	100 21	June 24	8 45 E	-- --	-----	-----	3	Mod. sw.
	17 36	102 24	June 25	8 44 E	-- --	-----	-----	3	Mod. sw.
	17 39	102 30	June 25	- ----	41 14	.4425	.3328	3	Mod. sw.
	18 13	103 49	June 25	9 28 E	-- --	-----	-----	3	Mod. sw.
	19 24	105 39	June 26	9 11 E	43 45	.4538	.3278	8	Mod. sw.
	20 10	106 40	June 26	9 42 E	-- --	-----	-----	3	Lt. sw.
	21 11	108 01	June 27	- ----	45 53	.4640	.3230	3	Lt. sw.
	22 16	109 26	June 27	10 53 E	-- --	-----	-----	3	Lt. sw.
	24 25	112 01	June 28	10 32 E	-- --	-----	-----	3	Sm.
Magdalena Bay	24 38	112 07	June 29	11 32 E	49 03	.4792	.3141	16	Sm.
	24 46	112 20	June 30	11 07 E	-- --	-----	-----	3	Lt. sw.
	26 20	114 11	July 1	-- ----	51 35	.4913	.3053	3	Lt. sw.
	30 26	116 33	July 2	-- ----	55 48	.5096	.2864	3	
	32 25	117 26	July 3	14 27 E	-- --	-----	-----	3	Sm.
San Diego Harbor	32 43	117 12	July 3	14 52 E	58 08	.5267	.2781	16	Sm.
	34 05	119 16	July 7	-- ----	59 16	.5311	.2714	3	Lt. sw.
	34 24	120 19	July 7	15 35 E	-- --	-----	-----	3	Lt. sw.
	36 18	121 56	July 8	15 40 E	-- --	-----	-----	3	Lt. sw.
	45 48	124 17	July 13	-- ----	-- --	-----	-----	1	Hvy. sw.
	48 16	123 39	July 14	24 05 E	-- --	-----	-----	3	Sm.
	48 14	123 30	July 14	-- ----	71 23	.5930	.1893	3	Sm.
Seattle Harbor	47 36	122 22	July 15	23 27 E	71 03	.5911	.1920	16	Sm.

DESCRIPTIONS OF STATIONS.

Magnetic observers are instructed to mark every station in as permanent a manner as possible, either with a stone or a post of some durable wood, so that it may be available for future occupation. They are also required to furnish a sufficiently detailed description to locate the station, even if the marking should be destroyed, and to determine the bearing of two or three prominent objects in addition to the one used as reference mark in the azimuth and declination observations. The information is given in abridged form on the following pages for each of the stations occupied during the year. Further details can usually be obtained upon application to the Superintendent of the Coast and Geodetic Survey. The usual method of marking a station is by a stone post about 3 feet long and 6 or 8 inches square, set so as to project an inch or two above ground, and lettered on top U. S. C. & G. S., with a drill hole in the center to mark the exact point. Whenever the local authorities desired, and were willing to bear the expense, a second stone was set to denote the true meridian.

The descriptions are arranged alphabetically by States and by names of stations.

ALABAMA.

Livingston, Sumter County.—The station of 1903 was reoccupied. To reach the station proceed 1 block southeast from the court-house square and then turn one-half block northeast; the station is in the street. It is 27.6 feet from the fence on the northwest, 54.2 feet from the fence on the southeast, and is about midway between the nearest intersecting streets. The station is marked by a limestone post 11 by 11 by 34 inches, set flush with the ground and roughly lettered on top U. S. C. S. The following true bearings were determined in 1903:

	° ′	
Spire on colored Methodist Church	37 51.4	east of north
Spire of Baptist Church	6 09.3	west of north
Dome of court-house	77 21.9	west of north

Mobile, Mobile County.—The station of 1905 was reoccupied. It is on the grounds of the Spring Hill College (Jesuit), 7 miles west of the Mobile court-house. It is near the southwest corner of the athletic grounds of the college and is 59.0 and 53.6 feet, respectively, from the picket fences on the south and west lines of the grounds. It is also 230.2 feet from the lower left-hand corner of the west steps of the west wing of the main building. The station is marked by a limestone post 6 by 6 by 30 inches, set flush with the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined in 1905:

	° ′	
Cross on north end of college chapel (mark)	57 51.1	east of north
Rod on south gable of east wing of main hall	54 41.3	east of north
Base of cross on main hall	44 37.9	east of north

Selma, Dallas County.—The station of 1903 was reoccupied. It is on the ground adjoining the colored Presbyterian Church and near the intersection of Robinson and Sylvan streets. It is 70.8 feet from the southwest corner and 82.3 feet from the northwest corner of the church building.

As the station of 1903 would not be suitable for future magnetic observations, a new station was established in the northeast corner of the county fair grounds, about 1½ miles north of the center of the town and about three-fourths of a mile northwest of the old station. It is 84.5 feet west and 86.3 feet south of the fence around the grounds, and 140 feet northeast of the fence around the inside of the race track. It is marked by a limestone post 6 by 8 by 33 inches, projecting about 12 inches above ground and lettered U. S. C. & G. S., 1903. The following true bearings were determined:

	° ′	
Cupola on court-house (mark)	9 38.2	west of south
Baptist Church spire	11 48.4	west of south
Spire of Methodist Episcopal Church	13 29.3	west of south
East edge at top of town water tank	2 47.0	east of south

Descriptions of stations—Continued.

ALASKA.

Circle.—The station is on the west bank of the Yukon River, about one-half mile north of the town of Circle, just beyond the Indian village. It is 56 feet from the bank of the river, 67.5 feet from the northeast corner and 67.0 feet from the northwest corner of an unused log cabin. The following true bearings were determined:

	° ′	
Left edge of top platform of wireless telegraph tower	4 02.6	east of south
Mountain peak to westward	67 43.1	west of south

Fort Egbert (Eagle).—The station of 1905 was reoccupied as nearly as could be determined. It is 57 feet north of the astronomic station and in the meridian line marked by the astronomic station and a post on the mountain north of the town. The mark used was the north monument of the meridian line, which is due north of the magnetic station. The astronomic station is marked by a 1-inch copper pipe set in the center of a cement block, which is set almost flush with the surface of the ground. The following true bearing was determined:

	° ′	
South gable of west wing of adjutant's house	51 09.2	east of north

Fort Yukon.—The station is on the grounds of the Episcopal Mission, just in front and a little to the left of the new log church. It is 60 feet from the front left-hand corner of the church and about 150 feet from the river bank. The station is marked by a spruce post 4 inches in diameter, lettered U. S. and having a Winchester rifle shell as a center mark; the post projects 4 inches above the ground. The following true bearings were determined:

	° ′	
Mission warehouse No. 1, north gable	43 19.2	east of south
McInroy's warehouse, south gable	45 10.3	west of north
Beaumont's store, north gable	53 39.4	west of north

Iliamna Bay.—The station is about 1 650 feet south of Drift Point, about 50 feet back from high-water mark and about 5 feet above it. A post 10 inches in diameter and 8 feet long was set 4 feet in the ground as an observing stand for the astronomic observations.

Island, Yukon River.—The station is located on the north shore of an island, about one-fourth of a mile from its upstream or eastern end. About 1 mile upstream from this point there is a bluff some 300 feet high on the left bank of the river. On the right bank of the river opposite the island there is a line of bluffs. As the banks of the island change rapidly the station was not marked. The reference mark used in the observations was a point on the bluff across the river to the northward. This point has an inverted V-shaped apex, and bears 21° 25′.6 east of true north from the magnetic station. A little to the right of this point is a somewhat larger projecting point having a flat top, the true bearing of which is 21° 34′.4 east of true north. The apex of an angular-shaped wall of rock three-quarters of a mile downstream and just to the right of a small depression bears 55° 13′.8 west of true north.

Ketchikan.—The station is on the northeastern end of Pennock Island, in front of and a little north of the northern Indian burial ground. It is about 60 yards from the end of the island and about 5 yards from high-water mark. It is marked by a cement block about 1 foot square, projecting about 3 inches above the surface and lettered U. S. C. & G. S. 1907. The following true bearings were determined:

	° ′	
Flagpole on schoolhouse cupola mark)	45 35.1	east of north
Sharp peak south of Ketchikan	80 01.1	east of north
East end of wharf on Pennock Island	72 44.4	east of south

On August 23 observations were made about 200 feet farther to the west at a place which is covered at extreme high water.

Kodiak.—The station of 1907 was reoccupied. It is on a bluff on the north side of St. Paul roadstead and about three-fourths of a mile east of Kodiak. East of the bluff is a small bight. The bluff is about 15 feet high and 200 feet long, and slopes back about 100 feet to low ground, where are some

Descriptions of stations—Continued.

ALASKA—Continued.

huts. A small stream comes down behind the bluff. The station is marked by a green bottle set in cement, with the neck about 3 inches below the turf. On the bluff are two spruce trees and the stub of a third, marked with a blazed triangle of nails. The distance to the easterly one is 28.6 feet; to the northerly one 43.4 feet; to the westerly one 94 feet, and to the east end of the bluff 75.5 feet. The station is about 6 feet from the south side of the bluff. The following true bearings were determined in 1907:

	° ′	
Spire of Greek Church (mark)	36 00.3	east of south
Spire of Baptist Church	29 43.0	east of south
Middle gable of large building on Woody Island	28 35.5	east of south
Northeast gable of left North American Commercial Company building on Woody Island	25 54.0	east of south
Northwest gable of North American Commercial Company ice house	24 48.6	east of south
Inner Humpback rock	15 18.9	east of south

Prince of Wales Island, west coast.—During the season of 1907 magnetic observations were made with compass declinometer at or near 29 triangulation stations along the west coast of Prince of Wales Island. The instrument was usually set up a short distance from one station in line to another, which was used as an azimuth mark.

Sitka Magnetic Observatory, Sitka.—In the absolute building. For description of the observatory see Appendix 5, Report for 1902.

Ushagat Island, Barren Islands.—Magnetic observations were made about 130 feet west of camp.

Uzinki Pass.—Magnetic observations were made at triangulation station Pass. . It is on the point at the southwestern extremity of Spruce Island, north of Uzinki Pass. It is on the south slope of a hill, about 50 feet above high water, halfway from the edge of the cliff to the summit of the point. It is the only point in the vicinity from which can be seen Course Rock, the summit of Spruce Island, and the south point of Hog Island. It is marked by a square drill hole and 6-inch triangle on a rock buried flush with the turf.

ARKANSAS.

Little Rock, Pulaski County.—The station of 1901 was reoccupied. It is on the parade ground of Fort Logan H. Roots, about 3 miles northwest of Little Rock. It is about 700 feet southwest of the west end of the barracks and about 125 feet due east of the drive. It is marked by a gray limestone post 7 by 7 by 36 inches, sunk flush with the surface of the ground and lettered U. S. C. & G. S. This stone marks the north end of a meridian line established in 1901. The south end is marked by a similar stone set 444.5 feet distant. The following true bearing was determined in 1901:

	° ′	
Tip of tower on Maddox Female Academy (mark)	4 29.5	east of south

Searcy, White County.—The station of 1905 was reoccupied. It is about 1 mile west of town on the east campus of the Spear Langford Military Academy. It is the north end of a meridian line 460 feet long, marked by a stone post 7 by 7 by 42 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S. Some of the letters are missing, one corner of the stone having been broken off. It is 77 feet from the east fence and 76.8 feet from a tree to the southwest. The following true bearings were determined in 1905:

	° ′	
Court-house spire (mark)	83. 33.6	east of south
West Searcy Methodist Church spire	53 31.7	east of south
Langford's house (tower tip)	67 03.4	east of south

Descriptions of stations—Continued.

CALIFORNIA.

Catalina Peak, Catalina Island.—The triangulation station of 1904 was occupied as nearly as could be determined. It is on the next to the highest peak on Catalina Island, near what is known as Whites Cove. The pile of stones which were around the old signal pole were found, but the brickbat marking the station could not be found. Magnetic observations were made over the point where the pile of stones were found. The following true bearing was determined:

	°	′	
Signal pole, Cactus Peak triangulation station (mark)	37	00.6	west of south

Corning, Tehama County.—The station is in the southeast corner of the Corning Union High School grounds, 152.8 feet from the southeast corner of the building, 16.4 feet from a row of trees to the east, 34.8 feet from a row of trees to the south, and 560 feet east of the Southern Pacific Railway tracks. The station is marked by a piece of 3-inch sewer tile, 12 inches long, with top 4 inches below the ground, the center of the top marking the station. The following true bearings were determined:

	°	′	
Spire on the tower of the Maywood Colony building (mark)	19	27.4	west of north
Spire of Maywood Packing Company's water tank	16	55.2	west of north
Baptist Church spire	0	25.9	west of north
Corning Union High School spire	52	23.7	west of north

Gazelle, Siskiyou County.—The Gazelle astronomic station is located on top of a prominent knoll bearing about 250 yards north by east from the Gazelle railway station, and almost due east and across the track from the stock pens. It is marked by a circular brass disk cemented in rock about 8 inches below the surface of the ground. East of the station and distant 28.6 feet is a concrete latitude and longitude pier.

The magnetic station is 490.5 feet from the astronomic station on the flat at the southeast side of the knoll. It is 20 paces from the fence on the south, 197 paces from the fence on the west, and 247 paces from the railway track. The magnetic station is marked by a rough stone 6 by 6 by 16 inches, projecting about 1 inch above the ground and lettered U. S. The following true bearings were determined:

	°	′	
Upright bar of letter F on the I. O. O. F. Hall (mark)	33	51.2	west of south
Small spire at east end of ornamental ridge of railway station	47	12.3	west of south
Gazelle astronomic station	67	21.2	west of north

Placerville, Eldorado County.—Observations were made within a short distance of the station of 1897. It is a little over one-fourth of a mile south of the county court-house, on top of the hill southeast of the Chinese quarter. It is southwest of the reservoir, near a mine shaft, and about three-fourths of a mile southeast of the fair grounds. It is 22.1 feet due south of the south stone of the meridian line established in 1897, said stone being the magnetic station of 1897. This stone is lettered U. S. C. & G. S. on its south face, Mag. Sta. on its north face, and 1897 on its west face. The north stone is 1 000 feet due north and lettered on its south face U. S. C. & G. S., on its east face 1897, and on its west face Mer. Mark. The following true bearings were determined in 1908:

	°	′	
North Meridian mark (mark)	0	01.6	east of north
Cross on Episcopal Church	36	21.6	west of north
Schoolhouse spire	22	55.8	west of north

Redding, Shasta County.—The station of 1897 was recovered and the north and south meridian stones found in apparently good condition. The old station is no longer suitable for magnetic work, and hence a new station was established in line between the north meridian stone and the head of the statue of Justice on the dome of the court-house, distant 140 feet from the north meridian stone. It is also 75.5 feet from the southeast corner of the fence of the house lot of Mr. Emmet Moss and 19 paces north of the road along Tellurium avenue. The north meridian stone is about 18 inches west of the

Descriptions of stations—Continued.

CALIFORNIA—Continued.

west fence of Mr. Moss's lot, near the southwest corner of this lot. The south meridian stone is near a large oak tree at the north side of the timber on the side hill and near the house of Mr. Kieth. A telephone pole now stands exactly on the meridian line, about midway from the north and south meridian stones. About one-fourth the distance from the south to the north stone a small shed has been built on the line. The following true bearings were determined in 1908:

	°	′	
Center of the head of the statue of Justice (mark)	38	10.1	east of south
Bally triangulation station	86	13.8	west of north
Southeast corner of Emmet Moss's house	8	47.2	west of north

San Clemente, Los Angeles County.—The station is located on the point at the east side of Wilsons Cove (or Gallaghers Bay) on San Clemente Island, and about three-eighths mile from the ranch house of Mr. Charles E. Howland, who leases the island from the United States. It is near the eastern part of the sheep pasture on the point, 8 paces from the bluff overlooking the ocean, and 123 paces from a large rock of peculiar shape, about 8 feet in diameter and 10 feet high, and very noticeable. The station is marked by a nail in the top of a 4 by 4 inch wooden post, projecting 4 inches above the ground. The following true bearings were determined:

	°	′	
Flag pole on north face of Mr. Howland's house (mark)	79	19.1	west of south
Harbor triangulation station, on top of hill	43	57.9	west of south
Cross on top of large rock	51	49.8	west of south
Catalina Peak triangulation station ("Blackjack")	18	34.8	east of north

San Diego, San Diego County.—The station called San Diego No. 1, established in 1905 by the officers of the magnetic survey yacht *Galilee*, of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, was reoccupied. It is near the north point of North Coronado Beach Island, about 10 feet above the sea. It is marked by a spruce-wood post 6 by 6 inches, lettered C. I., 1905, and projecting 1 foot above the surface. The station is about 320 yards west of the west corner of the engine house at Spreckel's marine railway. Harbor Beacon No. 10, in the bay, bears approximately NNW. from the station. Coronado Island is low, the highest point being at an elevation of probably 20 feet, with sandy soil covered with low bush. The following true bearings were determined in 1908:

	°	′	
Flag pole on south tower of Coronado Hotel	21	19.8	east of south
Center of dome of School of Theosophy	83	10.4	west of north
Bennington monument	61	35.5	west of south
Smoke stack, power house	85	36.9	east of north

San Nicolas Island, Ventura County.—The station is on the north shore of the island, 9 paces back from the edge of the bluff overlooking the east end of the rocky reef extending eastward from Corral Harbor. It is about 15 feet above mean tide, on a flat shelf dotted with sand dunes covered with grass. It is also 16 paces from the point of shore bluff to the eastward. Between the shore bluff to the north and the outlying reef is a small cove with a sandy beach which affords a good boat landing, and the station is south of that part of the sandy beach, which is about 50 feet west of water at low tide. It is 98.6 feet north of the latitude station. The subsurface mark consists of a drill hole in an irregular 7 by 11 by 11 inch stone, and the surface mark consists of a drill hole in an irregular 5 by 12 by 13 inch stone flush with the top of the ground and lettered U. S., the two stones being about 2 inches apart. The following true bearings were determined:

	°	′	
Stake on sand ridge about 300 yards distant (mark)	84	26.0	west of north
Canyon triangulation station	22	48.6	east of south
Latitude station	2	51.5	east of south
Corral triangulation station	63	39.4	west of south

Descriptions of stations—Continued.

FLORIDA.

Fernandina, Nassau County.—The station of 1900 was reoccupied. It is on the Indian Mound about 1 200 feet north of the main street, and three-fourths of a mile west of the Amelia Island Light-house. It is 52 feet south of the remains of a hedge, 300 feet north of the second street north of the main street and about the same distance east of the street running north by the waterworks. The station is marked by a limestone post, 5 by 8 by 30 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′	
Top of Amelia Island Light-house (mark)	86 43.8	east of south
West edge of standpipe	20 41.0	west of south
Cupola of county court-house	63 21.3	west of south
Cupola of small wooden church	75 40.8	west of south

Pensacola, Escambia County.—The station of 1900 was reoccupied as nearly as could be determined. The station is in the Pensacola Navy-Yard, 249 feet east of the dispensary, 226 feet south of the low cement wall on the south border of the grounds of the officers' houses, and 21.7 feet northeast of a live oak tree. It is marked by a limestone post, 5 by 8 by 30 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′	
Town Point Light (mark)	71 04.8	east of north
Northeast corner of the mess room and gymnasium building	48 53.3	east of south
Northeast corner of building No. 14	30 21.4	west of south
South edge of base of navy-yard flag pole	67 33.1	west of north

Tallahassee, Leon County.—The station of 1900 was reoccupied as nearly as could be determined. The station is in the northern part of the grounds of the West Florida Seminary, 262 feet northwest of the northwest corner of the main college building and 216 feet southwest from the southwest corner of the white college building to the north. It is about 350 feet west of North Corpland street and about 50 feet from the stakes marking the street to the north. It is marked by a limestone post, 5 by 8 by 30 inches, projecting about 5 inches above the ground and lettered U. S. C. & G. S., 1900. The following true bearings were determined:

	° ′	
Spire of Trinity Methodist Episcopal Church (mark)	83 31.4	east of north
Presbyterian Church spire	83 49.1	east of north
Northeast corner of the main seminary building	46 19.2	east of south

GEORGIA.

Milledgeville, Baldwin County.—The station of 1900 was reoccupied as nearly as could be determined, probably within a few inches. It is upon the old capitol grounds, now the grounds of the Georgia Military College. The following measurements were taken in 1900: To a fence on the east 81 feet 4 inches; to the street on the south 124 feet; to the center of a tree to the northwest 26 feet 5 inches; to the corner of the capitol 275 paces; to the corner of the gateway 140 paces.

As the station of 1900 was considered unsuitable for future observations, a new station was established 129 feet northwest of the station of 1900, 18 feet south of an elm tree and 198 feet southwest of the southwest corner of the college building, and 174 feet west of a board fence. It is marked by a limestone post, 6 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′	
Spire on Methodist Episcopal Church (mark)	63 24.2	west of south
Northwest corner of college building	8 04.3	east of north
Dome on State Insane Asylum	5 31.3	east of south

Savannah, Chatham County.—The station of 1903 was reoccupied as nearly as could be determined. The station is on Hutchinson Island on the second bank from the river running approximately north and south (near a chinaberry tree). This tree is nearly in line with the cupola on the city hall and the

Descriptions of stations—Continued.

GEORGIA—Continued.

spire of the Presbyterian Church. It is also in line with two church steeples. The station is in the center of a path 18 feet from the center of this tree. The station is marked by a hard-wood stake, 3 by 3 by 30 inches, projecting about 3 inches above the ground, with one side beveled near the top. The following true bearings were determined:

	° ′	
Presbyterian Church spire (mark)	21 22.7	west of south
Spire of post-office	22 45.9	west of south
Spire of Sailors' Home	10 29.4	west of south
Southern of two church spires almost in line	14 40.5	west of south

Waycross, Ware County.—The station of 1905 being no longer suitable for magnetic work a new station was established about one-half mile northeast of the old one and about 1½ miles northeast of the center of the town. It is in the northeastern corner of the grounds of the new Baptist College. The station is about 11 feet northwest of a line between the northeast corner of the college building and a large pine tree at the northeast corner of the grounds. It is 87.7 feet southwest from the center of this pine tree and 190.6 feet northeast of the northeast corner of the college building. It is marked by a marble slab, 2 by 6 by 28 inches, projecting about 2 inches above the ground and lettered U. S. on the top and 1908 on one side. The following true bearings were determined:

	° ′	
Court-house spire (mark)	72 22.4	west of south
Spire of First Methodist Church	50 34.9	west of south
Presbyterian Church steeple	47 41.4	west of south
Cupola of colored Baptist Church	41 30.2	west of south

HAWAII.

Honolulu Magnetic Observatory, Oahu Island.—The observatory is about 12½ miles west of Honolulu and about three-fourths of a mile south of the station Sisal, on the Oahu Railway. The observatory is described in Appendix 5, Report for 1902.

ILLINOIS.

Albion, Edwards County.—The station is in Graceland Cemetery, near the center of a driveway south and west from a large tool house. It is 19.0 feet from the base of a small tombstone marked Clarie Arine, 55.7 feet from the base of a large one marked Utley, and 66.2 feet from the base of one marked Jones. The station is marked by a Bedford limestone post, 6 by 6 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Weather vane on court-house cupola (mark)	85 15.5	west of south
Spire of Congregational Church	78 53.2	west of south
Spire of Christian Church	88 52.2	west of south

Benton, Franklin County.—The station is in the northeastern part of the grounds of the Benton High School, about one-half mile northwest of the center of the town. It is 68 feet from the north fence and 213 feet northeast from the northeast corner of the high school building. It is marked by a cement post, 6 by 6 by 30 inches, projecting about 7 inches above the ground, and having a cross in the top to mark the exact spot. The following true bearings were determined:

	° ′	
Methodist Church spire (mark)	19 25.3	east of south
Northwest corner of high school, just under the roof	64 54.7	west of south

Cairo, Alexander County.—The station is on the new city levee, between the Illinois Central and the Mobile and Ohio Railroad tracks, west of the west end of West Thirty-third street. This levee

Descriptions of stations—Continued.

ILLINOIS—Continued.

extends northeast from an iron post which was set by the river survey as a bench mark, and which is 250 feet southeast of the Mobile and Ohio signal station. The magnetic station is about 705 feet northeast along the city levee from this bench mark and 12 feet north of the center of the levee on the slope. The station is marked by a Bedford limestone post, 5 by 5 by 30 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Steeple of St. Joseph's Catholic Church (mark)	64	25.8	east of south
A cupola	65	06.8	east of south
Base of flagstaff on Redman & Magee Company elevator	15	09.1	east of north
Bench mark of river survey	52	30.7	west of south

Cambridge, Henry County.—The station is in the west part of the county fair grounds, about three-fourths of a mile northeast of the center of the town. It is 65.7 feet west of the fence around the outside of the race track, 159.4 feet a little east of north from the northeast corner of the building marked "Dining Hall," and 120.3 feet southeast of the southeast corner of the south wing of the exhibition building, north of the dining hall. It is also 72 paces north of the northwest corner of the grandstand. The station is marked by a glass bottle filled with dust and sunk 7 inches below the ground. The following true bearings were determined:

	°	′	
Church steeple (mark)	35	30.9	west of south
West corner of water tower	36	15.2	west of south
Flagstaff on judges' stand	19	11.5	east of south

Chicago, Cook County.—The station of 1900 was reoccupied. It is near the south end of Lincoln Park, between the athletic field and the lake. It is 123 feet from the southeast end of the lagoon (measured from the topmost stone of the embankment) and 123½ feet southwest from the lake-shore driveway. It is marked by a post of Bedford stone, 6 inches square, lettered on top U. S. C. & G. S., and sunk 6 inches below the surface of the ground. The mark or range was a church spire, and bears 87° 35′.3 west of true south.

Decatur, Macon County.—The station is in the cemetery in the southern portion of the town, northwest of the city waterworks and north of the Sangamon River. It is in an alley on the side of the hill in the only clear space in this part of the cemetery. It is 24.3 feet from the southwest corner of the base of the Bourne monument, 24.0 feet from the northwest corner of the base of the Erickson monument, and 23.2 feet from the northwest corner of the base of the Furguson monument. The station is marked by a Bedford limestone post, 5 by 7 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Southwest corner of top of waterworks chimney (mark)	8	47.6	east of south
Southeast edge of small tombstone on the side of hill across small valley	1	23.7	west of south
Tip of Strolun monument	24	03.5	east of north

Geneva, Kane County.—The station is about 1¼ miles southeast of the center of the town, in the southwest part of the grounds of the State Training School for Girls, about 356 feet west of the southwest corner of the main building. It is 96 feet east of the fence bounding the grounds on the west, 80 feet north of a row of telephone poles to the south, and 88.5 feet south of a row of telephone poles to the north. It is marked by a Bedford limestone post, 6 by 6 by 30 inches, projecting about 5 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on steeple of Swedish Church (mark)	25	38.6	west of north
Rod on the cupola of the public school	25	18.8	west of north
Congregational Church spire	22	29.0	west of north
Weather vane on the cupola of a green house	67	25.8	west of south

Descriptions of stations—Continued.

ILLINOIS—Continued.

Harrisburg, Saline County.—The station is in the northeast corner of the grounds of the high school, about 1¼ miles southwest of the center of the town, and about 300 feet northeast of the school building. It is 85.6 feet from the north fence and 112 feet from the east fence. It is marked by a Bedford limestone post, 8 by 8 by 30 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′	
Cross on steeple of Christian Church (mark)	10 01.1	west of north
Upper southeast edge of school building	71 41.4	west of south
Spire on northeast cupola of school building	84 52.3	west of south

Kankakee, Kankakee County.—The station is in the northeastern part of the Protestant cemetery about three-fourths of a mile north and east of the court-house. The station is north of and in line with the row of trees bordering the west side of the driveway east of the windmill and water tank. It is about 50 feet from the southwest corner of the Catholic cemetery, 57.4 feet from the base of a tombstone marked Lilly Anna Elizabeth Fiedler, and 65.5 feet from the southwest corner of a stone square just inside of the Catholic cemetery. This stone square is not marked, but is just west of a similar square surrounding a tombstone marked Menard. The station is marked by a Bedford limestone post, 6 by 6 by 30 inches, projecting about 1 inch above the surface of ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Rod on south end of stock-yard pavilion (mark)	82 41.0	west of north
Bradley Church spire	49 22.5	west of north
Cross on white dome in Bradley	48 01.8	west of north
Flag pole of Bradley public school	43 22.9	west of north

Lincoln, Logan County.—The station is in the northwest corner of the Chatauqua grounds, or Brainerd Park. It is in the only clear space in that part of the grounds and is about northeast of a circular briar patch. Two small thorn trees are just south of the station, while to the south and east are three large walnut trees growing from one stump. The station is marked by a stone which projects about 4 inches above the surface of the ground and can be seen as soon as the open space is reached. The stone is lettered U. S. C. & G. S., 1907. The following true bearing was determined:

	° ′	
Northwest corner of annex to small white house (mark)	75 09.1	east of south

Monmouth, Warren County.—The station is in the northwest corner of the Driving Association Park, about 1¼ miles southwest of the center of the town. This ground is owned by Mr. Irwin. It is 172.8 feet south and 88 paces east of the fence around the park, and 133 feet northwest of the fence around the outside of the race track. The station is marked by a Bedford limestone post, 6 by 6 by 30 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Weather vane on the cupola of the county court-house (mark)	14 25.9	east of north
Top of the town water tank	21 07.6	east of north
Rod on the top of the Chicago, Burlington and Quincy Railroad water tank	6 28.6	west of north

Mound City, Pulaski County.—The station is in the southeastern corner of the intersection of the West city levee with the Meridian road, about three-fourths of a mile north of the center of the town. The levee runs north and south, and the Meridian road runs east and west; but the latter at this point turns and runs due north. The station is 66 feet west of a stone 5 by 6 inches on top and projecting 5 inches above the ground and marked "92" with a cross. This stone is under a fence on a section line. The station is also 19 feet east of a large, dead tree about 4½ feet in diameter, and 43 feet south of the center of the Meridian road. It is marked by a Bedford limestone post 5 by 5 by 30 inches,

Descriptions of stations—Continued.

ILLINOIS—Continued.

projecting 8 inches above the ground, and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Cupola of Lovejoy School (mark)	25	15.2	west of south
North corner of window gable of Metal-Bound Package Company factory	44	49.2	east of south

Mount Carroll, Carroll County.—The station is near the center of a circle inclosed by a wire fence in the field within the race track at the county fair grounds, about 2 miles southwest of the center of the town. It is 163 feet east and 198 feet north of the fence inclosing this circle. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on the town water tank (mark)	31	45.7	east of north
Spire of First Lutheran Church	32	47.9	east of north
Spire of tallest tower on Methodist Church	30	53.4	east of north
West gable of grand stand	52	24.6	east of south

Newton, Jasper County.—The station is in the roadway leading into the old Catholic cemetery. The cemetery property extends from Embarras River on the east to Church street on the west, though at present the cemetery is confined to a small space on the banks of the river. When the property between the fence marking western boundary of old cemetery and Church street is included in the cemetery, the roadway in which station is located will then be the main street of cemetery. The center of a large hickory tree about southeast from the station is 72.7 feet distant. A large jack oak tree south and west from station is 50.0 feet distant. The station is marked by a limestone post 6 by 6 by 24 inches, set about an inch below the surface of ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on cupola of city drug store (mark)	23	13.3	east of south
Tip of city water tank	28	32.3	east of south
Head of figure on cupola of court-house	18	05.7	east of south

Oregon, Ogle County.—The station is in the northwest corner of the field within the race track at the county fair grounds, about three-fourths of a mile northwest of the center of the town. It is 86 feet east and 147 feet south of the fence around the inside of the race track. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on the steeple of the Catholic Church (mark)	23	49.6	east of south
Flagstaff on the judges' stand	42	30.9	east of south

Peoria, Peoria County.—The station is about 3 miles north of the court-house, in the northwest corner of the center field of the race track owned by Mr. C. J. Off. Standing at the station, the east side of a lone white house south of the race track is directly in line with the cupola of St. Francis Hospital, and an electric light tower is seen a little to the east of the south gable of a brown house near the entrance to the race track. The station is marked by a Bedford limestone post 6 by 6 by 29 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flag pole on the south stable (mark)	10	53.2	west of south
Center of cross on cupola of St. Francis Hospital	3	36.3	west of south
Most westerly of two church spires seen in eastern part of city	3	16.5	east of south

Pinckneyville, Perry County.—The station is on the grounds of the county poor farm, about 1¼ miles southeast of the center of the town. It is in a field which is bounded by the road to Pinckneyville on the west and the drive to the farmhouse on the north. It is in the northwest corner of this field, 101 feet from the west fence and 85.2 feet from the north fence. It is marked by a cement post 8 by

Descriptions of stations—Continued.

ILLINOIS—Continued.

8 by 27 inches, flush with the ground. A cross in the top of the post indicates the exact spot. The following true bearings were determined:

	° ′	
Point at top of Illinois Central Railroad water tank (mark)	14 20.7	west of north
Base of rod on top of the White Walnut Colliery	24 27.6	west of north

Pontiac, Livingston County.—The station is in a small pasture belonging to Mr. Samuel Earp. It is about 1 mile west of the court-house, being separated from the west end of Washington street by a small hay field, and is about one-fourth of a mile west of the Chicago and Alton Railroad depot. It is north of Vermillion River, between the river and West Madison street. It is 165.0 feet from the center of a walnut tree almost due north of the station, and 135.2 feet from the center of a thorn tree on the bank of the river to the south. A maple tree just south of this thorn tree is distant 149.4 feet. The station is marked by a Bedford limestone post 5 by 5 by 29 inches, projecting about 2 inches above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Temporary pole on cupola of court-house (mark)	84 19.2	east of north
Tip of Chicago and Alton Railroad water tank	87 24.2	east of north

St. Anne, Kankakee County.—The station is in the high school grounds, southwest of the high school building. It is 59.8 feet north of a cut in a catalpa tree, 241.1 feet from the northwest corner of the high school building and 218.4 feet from the southwest corner. It is marked by a 4-inch terra-cotta draintile set in cement. The following true bearings were determined:

	° ′	
St. Anne triangulation station (mark)	88 55.5	east of south
Northwest corner of high school	61 17.0	east of north
Southwest corner of high school	76 07.0	east of north
Presbyterian Church spire, center of ball	83 24.3	east of north

Shelbyville, Shelby County.—The station is near the center of Glenwood Cemetery, in the southeast corner of the portion at present used for graves. It is in the south edge of a roadway 16.9 feet from the northwest corner of the base of the Hickey monument, 47.4 feet from the southwest corner of the base of the Warthman monument, and 25.8 feet from the southeast corner of the base of the Ragan monument. It is marked by a Bedford limestone post 6 by 6 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Rod on cupola of public school (mark)	64 00.2	west of south
Court-house flag pole	40 24.2	west of south
Tip of city water tower	31 25.4	west of south

Springfield, Sangamon County.—The station of 1891 was reoccupied, but on account of changed surroundings will not be suitable for future work. A new station was therefore established on a circular lawn south of the Lincoln monument. It is 82 paces northeast of the station of 1891. A large oak tree is 105.2 feet a little north of east from station, while a small tree on the circular lawn is 90.1 feet a little west of south from the station. It is marked by a Bedford limestone post 6 by 6 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined.

	° ′	
Tip of ear of horse on cavalry group on monument (mark)	16 00.1	west of north
Tip of spear, infantry group	20 01.9	west of north

Sycamore, Dekalb County.—The station is in the southwest corner of the pasture immediately east of the ground surrounding the Waterman Hall School, about one-half of a mile southwest of the center of the town. This pasture belongs to the school. The station is 158.8 feet north and 119.2 feet east of the fence around the pasture. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting

Descriptions of stations—Continued.

ILLINOIS—Continued.

about 3 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on the steeple of the Swedish Lutheran Church (mark)	84	45.9	west of north
Corner of main school building	73	57.6	west of north
Cross on the cupola of the Waterman School building	75	48.0	west of north
Steeple on the Ohio Grove Church	29	20.9	east of south

Taylorville, Christian County.—The station is on a hill in the southwest part of the cemetery, to the south and in the first alley east of the large Vandeveer monument. It is 102.5 feet from the southeast corner of the base of the Goodrich monument and 97.8 feet from a small pine tree. The station is marked by a Bedford limestone post 5 by 5 by 30 inches, set flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Only telegraph pole to the west of a large tree (mark)	27	01.1	east of south
West gable of red barn with white cupola	35	47.6	east of south
Tip of the Ellen Brewer monument	51	22.8	east of north

Urbana, Champaign County.—The station is in new Mount Hope Cemetery, south of the university grounds, and is reached by going south on Fourth street. It is in an alley on block E between lots 19 and 20, 21 and 22. It is 130.1 feet from the southwest corner of the base of the Strong monument and 19.0 feet from a small tree in the center of the alley, next to the roadway. The station is marked by a Bedford limestone post 7 by 7 by 25 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on cupola of farm building to the south (mark)	8	05.2	east of south
Rod on cupola of West End Park pavilion	63	36.6	west of north

Vienna, Johnson County.—The station is in the western part of the county fair grounds and about three-fourths of a mile northwest of the center of town. It is 132.2 feet east of the northeast corner of cattle barn No. 1, 103 feet west of the fence on the outside of the race track, and 210.8 feet northeast of the nearest wall of a cistern over which is an iron pump. It is marked by a cement block 6 by 6 by 30 inches, projecting about 5 inches above the ground. The following true bearings were determined:

	°	′	
Steeple of Baptist Church (mark)	18	57.7	east of south
Spire on Miss Simpson's house	48	03.6	east of south
Base of rod on cupola of Art Building	73	44.5	east of south

INDIANA.

Angola, Steuben County.—The station is in the northern part of Circle Hill or Odd Fellows' Cemetery It is in the center of a driveway, 29.0 feet from the base of a small stone marked Anes Ermina Greenlee and 68.7 feet and 79.4 feet from the bases of large tombstones marked James A. Perfect and Osfall, respectively. It is marked by a limestone post 6 by 6 by 30 inches, set about 2 inches beneath the surface of the ground and lettered on the side U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Court-house flag pole (mark)	67	28.8	west of north
Cupola of Steuben County Bank building	63	12.6	west of north

Bedford, Lawrence County.—The station is in the northwest corner of Green Hill Cemetery, west of the sexton's house, on a portion of ground not yet laid out. It is 78.1 feet from a small tree, the fourth tree from the northwest corner along the northern fence, and 75.7 feet from a small cherry tree.

Descriptions of stations—Continued.

INDIANA—Continued.

It is marked by a Bedford limestone post 5 by 6 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on west end of Mr. Desard's summer kitchen mark)	60	21.4	east of north
Tip of Mathews monument	16	52.8	east of south

Bluffton, Wells County.—The station is in the southeast part of Fairview Cemetery, 81.0 feet from the fence on the east, 148.7 feet from the base of a large tombstone marked Rinear, and 87.6 feet from the base of one marked Fisher. It is marked by a marble post 6 by 6 by 20 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Lightning rod on Mr. Dunn's house (mark)	89	41.5	east of north
Baptist Church spire	58	51.8	west of south

Carlisle, Sullivan County.—The station is about 2½ miles southeast of New Carlisle on the prominent wooded hill just south of the residence of Mr. Clark Rodgers. It is about 164 feet south-southeast of the dwelling of Mr. Rodgers, 2 yards inside the north edge of the woods, and 6.6 feet east of an old wood road leading south up the hill. It is 57.3 feet south of a cross mark on a stone just south of the garden fence, 11.9 feet northwest of a triangle cut in a small elm tree, and 17.5 feet east-southeast from a cut on another small elm tree. The station is marked by a stone buried 15 inches below the ground and a dressed stone 6 by 6 by 12 inches, projecting 3 inches above the ground and lettered U. S. The following true bearings were determined:

	°	′	
Magnetic azimuth mark	3	17.2	west of north
South gable of red barn	45	43.2	east of north
South gable of yellow house	47	00.5	east of north
Windmill	48	35.1	east of north

Crown Point, Lake County.—The station is in the southwest corner of the county fair grounds, about 1 mile southwest of the center of the town. It is 30 feet southwest of the fence around the outside of the race track and 130.5 feet east of the fence bounding the fair grounds on the west. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on grand stand (mark)	41	52.2	east of north
Flagstaff on judges' stand	42	43.7	east of north
Center of shaft at top of windmill tower	40	23.4	east of north

Fort Wayne, Allen County.—The station of 1900 was reoccupied. It is in a pasture owned by Mr. Christian F. Pfeiffer, about 1½ miles north of the court-house. It is reached by going out the Goshen road past the Catholic Orphans' Home. It is 405 feet from the north fence of the pasture, in line with two trees to the west and the Catholic Orphans' Home to the east. It is 205 feet from the nearer of the two trees and 33.6 feet from a large stump to the southwest. The pasture is north of Archer avenue. The station is marked by a stone post 6 by 6 by 36 inches, projecting about 5 inches above the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Spire of St. John's Lutheran Church mark)	0	05.4	east of south
Spire on State Institution for the Feeble-Minded	81	37.8	east of north

Frankfort, Clinton County.—The station is in the south part of the new addition to Bunnel Cemetery, about 2 miles northwest of the court-house. It is in an alley just north of the second driveway and west of the center driveway, 136 8 feet from the base of a bronze monument marked Maish, and 56.2 feet, 38.7 feet, 30.8 feet, respectively, west, northwest, and east from three small trees. The

Descriptions of stations—Continued.

INDIANA—Continued.

station is marked by a limestone post 5 by 6 by 30 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
South lightning rod on S. A. Clark's barn (mark)	12 12.6	east of north
East edge of chimney on Mr. Parson's house	21 03.9	west of south
East lightning rod on house of William Boys	6 51.6	west of south

Goshen, Elkhart County.—The station is on the grounds of the Goshen Golf Club, owned by the Egbert & Sanders Lumber Company. It is about one-half of a mile southwest of the town. The station is in an open space just west of an embankment across the golf course, and is distant 56.3 feet, 46.2 feet, 60.3 feet, and 77.0 feet from trees to the east, southeast, south, and west, respectively. The station is marked by a Bedford limestone post 5 by 7 by 28 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Lightning rod on west end of barn (mark)	28 10.2	east of south
Edge of Mennonite School building	38 05.3	west of south

Indianapolis, Marion County.—The station of 1900 was reoccupied. It is in Riverside Park, about 5 miles northwest of the court-house. It is near the break of the hill in the western part of the park, about 200 yards north of Thirtieth street. It is 45, 42, and 18 feet, respectively, from three trees and northwest of the bear cage. It is marked by a stone post 6 by 6 by 36 inches, projecting 12 inches above the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′	
Center of head of figure on soldiers' monument (mark)	37 06.5	east of south
Steeple of small church	73 51.6	west of south

La Fayette, Tippecanoe County.—The station is on the property of Mrs. Pauline Erudee. It is about 4 miles southeast of the court-house, and is reached by going south on the La Fayette and Concord road to the Fink Cemetery. Mrs. Erudee's house is on the opposite side of the road from the cemetery. The station is in an open space about 200 feet north and west from the residence of Mrs. Erudee, 76 feet from the center of a large hickory tree to the northwest, and 57.8 feet from a large walnut tree to the northeast. It is marked by a limestone post 6 by 6 by 30 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Middle lightning rod on Mr. Fink's residence (mark)	11 50.9	west of north
Rod on Mr. Aker's residence	33 01.9	east of south

Logansport, Cass County.—The station is in the southern portion of the Spencer Park race-track grounds, 175.8 and 94.6 feet, respectively, from the centers of two large trees, one to the northeast and the other to the northwest. The station is marked by a Bedford limestone post 5 by 6 by 28 inches, projecting about 1 inch above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
East gable on cupola on Mr. Murdock's barn (mark)	80 34.9	west of south
Rod on east cupola of large red barn	40 28.3	west of north
Flag pole on judges' stand	52 37.0	west of north

Michigan City, Laporte County.—The station of 1900 could not be definitely located and a new station was established very near to the old one in the park to the south of Marsh Schoolhouse, to the south of the town. It is 93.2 feet north of the nearest edge of the sidewalk on the south side of Barker avenue and 47 feet east of the line of the east wall of the schoolhouse. It is marked by a Bed-

Descriptions of stations—Continued.

INDIANA—Continued.

ford limestone post 4 by 8 by 30 inches, projecting about 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Spire on church at East Port School (mark)	72	15.2	east of north
Spire on Swedish Church	42	16.9	west of south
Northeast corner of old part of school building	6	15.6	west of north

Newport, Vermilion County.—The station is in the cemetery about 2 miles west of the court-house. It is in the third driveway from the south at its intersection with the fourth alley from the west. The station is 37.9 feet from the base of a tombstone marked Fannie White, 23.3 feet from the base of one marked Elizabeth White, 26.0 feet from the base of one marked Clara Bell Harvey, and 30.8 feet from the base of a small one marked Bessie Place. The center of a small marble post on the corner of the lot northeast from the station is distant 6.0 feet. The station is marked by a round pint bottle set neck upward and buried about 2 inches beneath the surface. The following true bearings were determined:

	°	′	
Tip of David A. Hall monument (mark)	7	05.5	west of north
North edge of chimney on small church just outside of cemetery	14	47.6	west of north
South edge of chimney on house across a field	67	19.9	west of south

Plymouth, Marshall County.—The station is in the cemetery, at the intersection of the main driveway and the third alley (running east and west) from the north. It is 37.0 feet from the base of a stone marked Sherwood, 40.8 feet from one marked Seltenright, 26.6 feet from one marked Lovell, 28.8 feet from one marked Hossler, and 32.5 feet from one marked Weaver. The station is marked by a marble slab 2 by 4 by 18 inches, set 1 inch beneath the surface of the ground. The following true bearings were determined:

	°	′	
North gable of Mr. John Susland's house (mark)	56	17.2	east of south
Tip of large monument about the center of the cemetery	54	24.9	west of south

Rensselaer, Jasper County.—The station is in the southwest part of Weston Cemetery, at the intersection of two walks, 77.2 feet from the southwest corner of the base of the Garriott monument. It is 6.9, 27.4, and 23.4 feet from small trees to the northwest, northeast, and southeast, respectively. It is marked by a marble post 4 by 4 by 29 inches, set flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Court-house flag pole (mark)	87	03.0	east of north
Tip of cupola on Mr. Robinson's barn	1	19.6	east of north
Tip of ornament on north gable of court-house	86	03.8	east of north

Shelbyville, Shelby County.—The station is in the southwest part of Forest Hill Cemetery. It is in section 8 in an alley between two posts marking the corners of lots 221, 222, 208, and 209. These posts are of Bedford limestone, set flush with the surface of the ground. The center of the post marking the station is 1 foot from the edge of the post marking the corner of lots 208 and 209 and 1.5 feet from the edge of the post marking the corner of lots 221 and 222. The station is marked by a Bedford limestone post 6 by 6 by 20 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flag pole on city hall (mark)	61	46.0	west of south
Spire of Methodist Church	60	37.0	west of south
Spire of Catholic Church	58	23.2	west of south

Sinoats, Martin County.—The station is in the northwest part of the cemetery about the center of an old road leading from the north entrance. This old road is in the space intended for the main street of the cemetery. The station is 66.2 feet from the center of a large tree in the north fence just west

Descriptions of stations—Continued.

INDIANA—Continued.

of the west gatepost, 63 feet from the center of another large tree south and west from the stations and 36.7 feet northwest from the northwest corner of a stone square surrounding some graves. The station is marked by a Bedford limestone post 5 by 8 by 24 inches, projecting about 1 inch above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Tip of court-house cupola (mark)	79	00.1	west of south
Tip of Teney monument	37	58.0	east of south

Sullivan, Sullivan County.—The station is in the southwest part of the cemetery, about three-fourths of a mile west of the court-house. It is at the intersection of two paths between lots 109, 115 (marked), 110, and 116 (not marked), 24.8 feet from the base of the Price monument, 16.1 feet from the base of the Walls monument, 28.0 feet from the base of the Eaton monument, and 26.7 feet from the base of the Bell monument. It is marked by a Bedford limestone post 6 by 6 by 24 inches, set flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
North edge of chimney on Mr. Woodard's house (mark)	76	27.6	west of north
Tip of Herbert Hudson monument	15	02.1	west of north
Tip of Martha J. Stratton monument	1	07.1	east of north

Terre Haute, Vigo County.—The station of 1900 was reoccupied. It is on a small plot of ground now cut up into lots, on the property of Mr. McKeen, a dairyman, just east of his residence. It is about 3 miles northeast of the court-house, at the corner of Maple avenue and Twenty-fifth street. The station is about 393 feet south of the edge of Maple avenue and about 156 and 204 feet, respectively, from the south and west fences of the grounds. It is marked by a stone post 6 by 6 by 36 inches, projecting 10 inches above the ground. The top of the stone is chipped. The following true bearing, were determined in 1907:

	°	′	
Spire of Orphans' Home (mark)	9	06.0	east of south
Tip of cupola on Union railroad station	42	35.1	west of south
Center of west cross on Catholic Church	33	46.3	west of south

Vernon, Jennings County.—The station is in the main driveway of the Vernon Cemetery, about halfway between the entrance and a large sycamore tree, near the north border of driveway. It is 19.3 feet from the base of a small stone marked Isaac Doll, 22.0 feet from base of a small stone marked Staton, and 22.7 feet from base of a larger tombstone marked Pennington. The station is marked by a Bedford limestone post 6 by 6 by 24 inches, projecting about 1 inch above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Baptist Church spire (mark)	5	52.1	east of north
West edge of the east chimney on Mr. Bemish's house	0	05.4	east of north

Observations for declination were also made over the north monument of a meridian line in the court-house yard.

Vincennes, Knox County.—The station of 1905 was reoccupied. It is in the Catholic cemetery, which is one-half to three-fourths of a mile southwest of the court-house. It is on a high ridge in a lot southwest of the main southeast-northwest driveway. It is 38.4 feet from the northeast corner of the foundation of the Berry monument and 38.8 feet from the northwest corner of the foundation of the Caney monument. It is marked by a Bedford stone post 6 by 6 by 36 inches, set flush with the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined in 1905:

	°	′	
East gable on strawboard works	12	30.3	west of north
Court-house tower	56	46.9	east of north
Tall steeple of Catholic Church (mark)	64	50.0	east of north
Small steeple of Catholic Church	65	33.6	east of north
Tip of water tank at Star Foundry	79	02.7	east of south

Descriptions of stations—Continued.

INDIANA—Continued.

Washington, Daviess County.—The station is at the northern extremity of the main street of Oak Grove Cemetery. The ground north of this point, however, has been purchased by the cemetery board, and will be laid out in lots. Southwest of the station is the lot of W. W. Barnett, surrounded by a stone square. The northeast corner of square is 9.9 feet from the station. Southeast from the station is the lot of W. A. Williams, also surrounded by a stone square and having a tombstone near the center of the square. The northwest corner of this square is 9.0 feet from station, while the northwest corner of the base of the tombstone is distant from the station 18.7 feet. The station is marked by a Bedford limestone post 7 by 8 by 24 inches, set about 2 inches beneath the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Boxtown schoolhouse flag pole (mark)	73	02.1	east of south
South edge of south chimney of house	56	16.3	east of south

Williamsport, Warren County.—The station is in a pasture belonging to Mrs. Swank. It is about one-fourth of a mile west of the court-house, and about 170 feet a little west of south of the west end of Midway street. A large fence post marking the corner of fences is distant 150.0 feet a little east of north, and the center of a large tree, a little west of north, is distant 167.3 feet. The station is marked by a marble slab 2¼ by 6 by 29 inches, projecting about 5 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Spire of Presbyterian Church (mark)	63	43.2	east of south
Flag pole of public school building	77	49.5	east of south

Winamac, Pulaski County.—The station is in a pasture, the property of the county surveyor, Mr. J. W. Cox. It is about 1 mile northeast of the court-house and is reached by going east on, and to the end of, the first street north of the city standpipe and power house. A gate marking the extremity of the street opens into a lane which leads to the pasture. The station is 150.5 feet from the southeast corner of a fence surrounding a field to the west, and 109.3 feet a little north of east from the twelfth fence post (corner post being 1) of this fence. The station is marked by a limestone post 5 by 6 by 30 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Spire of Catholic Church (mark)	65	38.4	west of south
Spire of court-house	44	39.2	west of south

IOWA.

Centerville, Appanoose County.—The station is situated in the northwest corner of a small park on the west side of Oakland Cemetery. It is 59 feet from the fence along the west side of the park, 63 feet from the north fence, and about 8 feet from the edge of the drive east of the station. It is marked by a gray sandstone post 6 by 6 by 26 inches, projecting about 1 inch above the surface of the ground and lettered U. S. C. & G. S. The following true bearing was determined:

	°	′	
Left edge of red barn on hill (mark)	15	07.1	west of north

Des Moines, Polk County.—As the station of 1888 could not be recovered, a new station was established in the State fair grounds, to the east of the city. It is about 200 feet west of the west end of the amphitheater, 59 feet south of the fence along the race track, and 117 feet northeast of a box-elder tree, which is almost in line with the station and the State Capitol building. The station is marked by a marble post projecting about 1½ inches above the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Central rod on Capitol dome	82	14.4	west of south
Center of tower on Webster School building	88	10.2	west of south
Highest rod on old Drake Sanitarium	25	28.6	west of north

Descriptions of stations—Continued.

IOWA—Continued.

Dubuque, Dubuque County.—The station of 1900 was reoccupied. It is in the grounds of Mr. J. V. Rider, on Seminary Hill, in the southwest corner of the yard near the limestone bluff. It is marked with a marble post lettered U. S. and sunk flush with the surface of the ground. The following true bearings were determined in 1900:

	°	′	
Spire of Presbyterian Church	6	04.8	east of south
North spire on Catholic Sisters' school	86	16.7	west of north
South spire on Catholic Sisters' school	87	01.3	west of north
Tip of cupola on Mr. Rider's house	11	26.8	west of north

Independence, Buchanan County.—The station is in Oakland Cemetery, at the south edge of town, near the center of the south side of the cemetery. It is in an almost unused driveway, at the corner of four lots, 13 feet south and slightly west of the large monument marked Merritt and Cilley, and 17 feet north, and slightly west of the large monument marked Lillie. It is marked by a Vermont marble post 6 by 6 by 24 inches, set almost flush with the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Right edge of Ross monument (mark)	59	16.2	east of north
Right edge of S. A. Pierce monument	74	36.6	west of north

Knoxville, Marion County.—The station is in a driveway toward the southwest corner of the Knoxville Cemetery. It is 12.3 feet east of a monument lettered John Kerr and about 175 feet from the fences along the west and south sides of the cemetery. The station is marked by cement poured in a hole in the ground about 8 inches deep and 7 inches square on top, roughly lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Court-house flagstaff (mark)	87	27.3	east of south
Extreme right edge of Porter monument	37	42.8	east of north

Maquoketa, Jackson County.—The station is in the south end of the field within the race track at the county fair grounds, about 1 mile east of the center of the town. It is 148 feet north, 156 feet east, and about 225 feet west of the fence around the inside of the race track. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on the cupola of the high school (mark)	78	04.4	west of south
Spire on the town-clock cupola	74	50.2	west of north
Top of belfry	71	58.4	west of north

Marshalltown, Marshall County.—The station is in the county fair grounds, almost directly south of the entrance to the grounds, which is close to the stables. It is in the field inside of the race track, but outside of the baseball field. The station is 131 feet from the nearest point of the fence along the race track and 117 feet from the nearest point of the fence around the baseball field. It is marked by a Bedford limestone post 6 by 6 by 24 inches, projecting about 1 inch above the ground and lettered on top U. S. C. & G. S. and on the south side 1907. The following true bearings were determined:

	°	′	
Left edge of left smokestack on glucose factory (mark)	33	19.4	west of south
Right edge of right smokestack on Lenox Machine Shops	38	33.6	west of south

Vinton, Benton County.—The station is just inside the Vinton fair grounds, near the entrance and outside of the race track. It is 57 feet from the building on the north and 51 feet from a maple tree almost due west of station and close to the township hall. It is marked by a cement post about 5 by 5 by 21 inches, set flush with the surface of the ground and roughly lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Rod on vegetable and fruit hall (mark)	7	16 4	east of south
Rod on judges' stand	80	36.9	east of north

Descriptions of stations—Continued.

IOWA—Continued

Waterloo, Blackhawk County.—The station of 1900 was reoccupied. It is in a triangular field or park in front of Elmwood Cemetery, on the west side of the Cedar River. It is 59.8 feet from the edge of Elmwood Cemetery road and 67.4 feet from the edge of Locust street. The following true bearing was determined in 1907:

	°	′	
Right edge of large smokestack on electric power house (mark)	36	47.6	west of north

KANSAS.

Baldwin Magnetic Observatory, Baldwin, Douglas County.—Observations were made in the absolute house of the magnetic observatory. The mark used is the flagstaff on Science Hall, Baker University, and bears 48° 20′ 6 west of true north.

LOUISIANA.

Alexandria, Rapides Parish.—The station of 1904 was reoccupied. It is in the national cemetery at Pineville, on the east side of Red River. It is marked by a marble post 6 inches square, projecting 3 inches above the ground. This post is 135.0 feet from the brick fence on the southeast side of the cemetery and 223.8 feet from the brick fence on the northeast side. The following true bearings were determined in 1904:

	°	′	
Top of well house at the superintendent's lodge	46	27.0	west of south
Southwest corner of brick stable	24	14.9	west of south

Amite, Tangipahoa Parish.—The station is in the northeast corner of the grounds of the old county court-house, southwest of the station of 1903, which could not be reoccupied on account of a fallen tree. The new station is 13.5 feet northeast of the northwest corner of the shed for horses, 20.0 feet from the east fence, and 38.7 feet from the north fence. The north fence had been moved to the south between 1903 and 1908. It is marked by the neck of a brown glass bottle buried 5 inches underground. The following true bearings were determined:

	°	′	
Cupola of slate-colored house with a red roof (mark)	54	55.6	east of north
Base of court-house flagstaff	55	11.0	west of south

Lafayette, Lafayette Parish.—Observations were made as near to the station of 1904 as could be determined, but as this station is no longer suitable for magnetic observations a new station was also established. It is 429 feet west of the southwest corner of the main school building of the Industrial School and 342 feet south of the southwest corner of the kitchen on the west side of the boys' dormitory. The observations were made over a glazed earthen pipe filled with cement, which also marks the northern point of a meridian line.

Shreveport, Caddo Parish.—The station of 1904 was reoccupied. It is in the northeast part of the space inside the Caddo Downs race track, which is about 3 miles southwest of the court-house. The inner fence about the race track is distant from the station 38.1 feet measuring due north, and 34.4 feet measuring in the direction of Mr. Mulkaupt's house. There is a small pear orchard about 15 rods north and west of the station and across the race track. The station is marked by a Bedford limestone post, 5 inches square, projecting 5 inches above the general surface, and having a hole filled with lead to mark the center. Two other similar stones mark the meridian, the south stone being 600 feet south of the magnetic station and 6 feet inside the inner fence of the race track, while the north stone is 940 feet north of the magnetic station and is 6 feet inside the high board fence surrounding the race-track grounds. The following true bearing was determined in 1904:

	°	′	
Spire of Jewella Christian Church	76	59.4	west of south

Descriptions of stations—Continued.

MAINE.

Farmington, Franklin County.—The station of 1905 was not reoccupied. A new station was established on low ground in a lot known as the "Abbott Interval," 31 paces east of the bank of Sandy River, and 165.4 feet from the fence line bordering the road leading from Farmington to West Farmington. It is directly opposite the south end of the second large billboard from the river, which end is 202 paces from the stone abutment of the bridge. The station is marked by a large bottle buried 1 inch below the sod, center of mouth marking the station. The station is on slightly higher ground than that just near it. The following true bearings were determined:

	°	′	
Spire of Baptist Church, West Farmington (mark)	68	30.2	west of south
Spire of Congregational Church, Farmington	1	20.0	east of north
Spire of court-house, Farmington	10	36.1	west of north
Spire of cupola on Normal School, Farmington	2	57.5	east of north

Pole Hill, Aroostook County.—The triangulation station is in the northeast part of Amity Township, on the summit of Pole Hill, some 230 feet west from the international boundary line at a point three-fourths of a mile north of the initial monument. It is marked by a 1-inch drill hole in a large rock in a cultivated field belonging to John Friel, living one-quarter of a mile south of the station and 2 miles east of North Amity post-office. The magnetic station is in pasture land of John Friel north-northeast of the triangulation station, and is marked by a small wooden stub. The three cedar stubs on which the tripod legs rested were also left in position. It is 19.7 feet northwest of the center of the top of the largest rock in vicinity, 59.4 feet east of the west fence of pasture, and 383.5 feet from triangulation station. The following true bearings were determined:

	°	′	
Triangulation station (mark)	18	54.2	west of south
Center of chimney of Robert Anderson's house (½ mile distant)	60	18.6	east of north
Center of chimney on house of G. Bustard (1 mile distant)	66	33.8	east of south
Center of chimney on house of C. Friel (½ mile)	5	47.0	east of south

MARYLAND.

Baltimore, Patterson Park IV, Baltimore City County.—The station established in January, 1907, was reoccupied. It is in the northeastern part of the park, in the open field, about 600 feet northeast of a large stone building formerly used as a casino. It is 63.7 feet north-northwest from a sycamore tree near a driveway and 23 feet south of a small maple tree 6 inches in diameter. It is also in range with an elm tree about 250 feet to the eastward and the center of Lombard street, Highlandtown. The station is marked by a marble post, 6 by 6 by 30 inches, set 2 inches below the surface of the ground, with top lettered U. S. C. & G. S. The following true bearings were determined in January, 1907:

	°	′	
Dome of Insane Asylum (mark)	87	19.3	east of south
Sacred Heart Church spire	55	01.8	east of south
Cross on St. Elizabeth's Church	41	56.1	east of north
Weather vane on park shelter house	7	23.8	east of south

Cheltenham, Prince George County.—The station is at the Coast and Geodetic Survey magnetic observatory, on the grounds of the State Reform School.

Davis, Worcester County.—The magnetic station is near triangulation station Davis, where magnetic observations were made in 1853. It is in the eastern and broader part of the prominent knoll in a cultivated field, 395 paces north of the house of Mr. W. E. Gantt and 74.9 feet west of the wire fence running along the east side of said field and is about 1½ miles northwest of Ocean City, Md. The station is marked by a beer bottle, buried with the top 18 inches below the surface. Around it and forming a triangle are 3 other similar bottles, inverted, each about 1 foot from the center bottle and with tops about 16 inches below the surface. The following true bearings were determined:

Descriptions of stations—Continued.

MARYLAND—Continued.

	°	′	
North gable of sharp-ridged barn of Mr. W. E. Gantt (mark)	6	21.0	west of south
Water tower, Ocean City	47	55.3	east of south
Spire of Episcopal Church	65	49.7	east of south
Water tower, Sisters' Academy	84	09.3	east of north

MICHIGAN.

Adrian, Lenawee County.—The station is in the northeast corner of the county fair grounds, about three-fourths of a mile northeast of the center of the town. It is 60.4 feet west of the line of stables bordering the grounds on the east and 160.8 feet south of the line of stables bordering the grounds on the north. It is also 62 feet northeast of the fence on the outside of the race track. It is marked by a Bedford limestone post, 6 by 6 by 30 inches, projecting about 5 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple of the Roman Catholic Church (mark)	54	23.6	west of south
The southwest one of four crosses on the academy chapel tower	5	40.6	east of north
Flagstaff on judges' stand	32	50.3	west of south
Large flag pole north of the grand stand	49	45.4	west of south

Allegan, Allegan County.—The station is in the south part of the oval within the race track of the county fair grounds, about 1½ miles north of the center of the town. It is 160 feet west and 284 feet north of the fence on the inside of the race track and 267 feet east of the northeast corner of the judges' stand. It is marked by a limestone post, 5 by 6 by 30 inches, set about flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple on Presbyterian Church (mark)	29	38.8	east of south
Southeast corner of large exhibition building with cupola	14	40.2	east of south
Northwest gable of grand stand	49	38.0	west of south

Alpena, Alpena County.—The station is in the southwest part of the oval within the race track at the county fair grounds, about 1½ miles southwest of the center of the town. It is 120.2 feet north of the fence around the inside of the race track at the south end, 106.5 feet east of the inside fence on the west, and 232.4 feet west of the fence on the east. The station is marked by a Bedford limestone post, 5 by 6 by 36 inches, projecting about 6 inches above the ground, and lettered U. S. C. & G. S., 1907 The following true bearings were determined:

	°	′	
Spire of only church steeple in sight (mark)	45	20.4	east of south
Flagstaff on cupola of Garfield School	30	15.4	east of south
Flagstaff on grand stand	49	47.1	east of north

Bad Axe, Huron County.—The station is in the southwest corner of the county fair grounds, about three-fourths of a mile southwest of the center of the town. It is 89.8 feet north of the fence bounding the grounds on the south and 96.4 feet east of the fence bounding the grounds on the west. It is marked by a Bedford limestone post, 6 by 6 by 30 inches, projecting about 3 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on steeple of Catholic Church (mark)	53	33.7	east of north
Center of iron ornament at top of cupola of county court-house	58	23.1	east of north
Flagstaff on cupola of the school	55	26.0	east of north
The cupola of the Methodist Church	50	57.3	east of north

Baldwin, Lake County.—The station is in the northwest corner of the ground surrounding the county court-house, about one-half of a mile north of the center of the town. It is 62.2 feet east and 71.0 feet south of the fence bounding the grounds on the west and north, respectively, and 186.9 feet

Descriptions of stations—Continued.

MICHIGAN—Continued.

northwest of the northwest corner of the court-house. It is marked by a Bedford limestone post, 5 by 6 by 30 inches, projecting about 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Top of northwest corner of the Messenger Building (mark)	4	04.1	east of south
Southwest corner of court-house	12	33.7	east of south

Bay City, Bay County.—The station is in the northwest corner of the county fair grounds, about 1 mile northeast of the center of the town It is 377 feet east of the fence bounding the grounds on the west and 362 feet south of the fence on the north. The station is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 6 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on steeple of Catholic Church at Essexville (mark)	50	42.2	east of north
Flagstaff on sugar factory	21	52.4	east of north
South side at base of chimney of sugar factory	21	35.5	east of north
Cupola on house at the northwest corner of the fair grounds	29	42.3	west of north

Bellaire, Antrim County.—The station is in the southwestern part of the oval within the race track at the county fair grounds, about 1 mile east of the center of the town. It is 115.0 feet north and 128.6 feet east of the fence on the inside of the race track and 275.6 feet a little west of south of the nearest point on the judges' stand. It is marked by a Bedford limestone post 5 by 6 by 36 inches, projecting about 4 inches above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Ball on steeple of Methodist Episcopal Church (mark)	72	35.2	west of north
Flagstaff on cupola of court-house	88	56.2	west of south
Cupola on public school	69	03.4	west of north

Benton Harbor, Berrien County.—The station is on the western side of the golf links at Higman Park, about 1½ miles northwest of the center of the town. It is on the southeastern edge of a group of apple trees, about 360 feet a little east of north from the northeast corner of the golf clubhouse, and about 210 feet east of a steep bank down to a road on the western side of the golf links. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Top of the water tank at Higman Park (mark)	42	36.8	west of south
East edge of the top of the tower on Mr. Higley's house just under tower roof	52	02.4	west of south
East gable of golf clubhouse	43	58.6	west of south

Bunday, Hillsdale County.—The astronomic station of the same name is about 2 miles west of Somerset Center, on a hill known as Bundays Hill, in a field of Alfred Sutfin. It is marked by a stone 8 by 8 by 12 inches, projecting about 1 inch above the ground. The magnetic station is 201.4 feet east of the astronomic station, a few yards south of the highest point of a gravel knoll. It is marked by a stone buried 20 inches below the surface of the ground. Reference mark No. 1, a stone on the west side of a fence, is 232.3 feet to the east of the station. The following true bearings were determined:

	°	′	
Magnetic azimuth mark	88	12.0	east of north
Strong's windmill at house	62	50.2	east of south
Jerome Church tower	16	06.3	west of south
Hillsdale court-house tower	46	40.0	west of south
Reference mark No. 1	85	49.8	east of north
Bunday astronomic station	88	11.6	west of south

Descriptions of stations—Continued.

MICHIGAN—Continued.

Caro, Tuscola County.—The station is in the southwest corner of the county fair grounds, about three-fourths of a mile southwest of the center of the town. It is 56.8 feet north of the board fence bounding the fair grounds on the south and 231.0 feet east of the wire fence bounding the grounds on the west. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 8 inches above the ground, and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on cupola of county court-house mark)	33	22.5	east of north
Weather vane on schoolhouse	38	23.0	east of north
Ornament at top of southwest corner of tower of Evangelical Church	16	05.8	east of north
Flagstaff on judges' stand	76	28.5	east of north

Cassopolis, Cass County.—The station is on the southwestern edge of the oval within the race track at the county fair grounds, about three-fourths of a mile northeast of the center of the town. It is 29.5 feet northeast of the nearest point in the fence around the inside of the race track, 172 feet northwest of a white square post about 9 feet high, and about 359 feet southwest of the judges' stand. It is marked by a Bedford limestone post 5 by 6 by 30 inches, set flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Ornament on cupola of court-house	28	49.2	west of south
Northeast corner of cupola of public school	61	53.7	west of south

Charlevoix, Charlevoix County.—The station is in the southeast corner of the Charlevoix cemetery, about 1½ miles a little east of south of the center of the town. It is 11.4 feet south of the stake at the southeast corner of the space laid out in cemetery lots, 152.6 feet east of the stake at the intersection of a road on the south side of the cemetery and a road running from the central gate, and 83.6 feet east from the center of the top ridge of stone at the northeast end of the Geiken family vault. It is also about 18 feet north of a steep bank on the southeast side of the cemetery. The following true bearings were determined:

	°	′	
Ball at top of city water tank mark)	4	07.4	west of north
Steeple of Catholic Church	4	33.1	east of north
Center of triangulation tower on Macuba Hill	16	16.3	east of north
Top of monument of Austin C. Newman	43	35.7	west of north

Charlotte, Eaton County.—The station is east of the eastern end of the race track at the county fair grounds, about 1½ miles south of the center of the town. It is 267.0 feet north of the row of horse stalls bordering the fair grounds on the south, 52.5 feet northwest of the northwest corner of the most northern of three low open sheds for cattle, and 28.4 feet east of the outside fence around the race track at the east end. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 5 inches above ground and marked U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on judges' stand (mark)	76	19.7	west of north
Flagstaff on the large exhibition building west of the grand stand	81	38.3	west of north
East end at top of roof on grand stand	69	13.2	west of north

Cheboygan, Cheboygan County.—The station is in the northeastern part of the ground surrounding the Jalbirt School, about 275 feet northeast of the schoolhouse. It is at the west corner of Third and F streets N., about three-fourths of a mile east of the center of town. The station is 87.7 feet southeast of the fence bounding the school ground on the northwest and 134.0 feet west of the fence corner at the north corner of Third and F streets N. It is marked by a Bedford limestone post 5 by 6 by 36

Descriptions of stations—Continued.

MICHIGAN—Continued.

inches, projecting about 10 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on the brick building of Catholic school (mark)	56	32.2	west of south
Rod on cupola of house next door to school to southwest	58	27.4	west of south
Rod on cupola of school	33	00.6	west of south

Coldwater, Branch County.—The station is in the southwest corner of the ground immediately surrounding the State School, about 1¼ miles north of the center of the town. It is 120.1 feet north and 125.6 feet east of the school-yard fence. It is marked by a Bedford limestone post 6 by 6 by 26 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple of First Presbyterian Church	9	36.6	west of south
Steeple of First Methodist Episcopal Church	9	29.3	west of south
Cupola of county court-house	9	16.4	west of south
Ball on steeple of another church	10	42.1	west of south
Top of tower in school grounds	1	11.8	west of north

Corunna, Shiawassee County.—The station is in the northeast corner of McCurdy's Park, about one-half of a mile northwest of the center of the town, and about 600 feet north of the park casino. It is about 350 feet south of a greenhouse, 180 feet south of the river bank, 102.7 feet from a butternut tree to the south, 97.6 feet from a butternut tree a little east of north, and 65.6 feet from a smaller tree to the north. It is also about 29.3 feet east of the east edge of a walk running south to the river. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 6 inches above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on cupola of court-house	49	05.3	east of south
Top of belfry on fire-engine house	60	23.4	east of south
Flagstaff on park casino	3	01.5	west of south

Grand Haven, Ottawa County.—The station of 1891 being no longer available, a new station was established on ground belonging to Mrs. Duncan, about 2 miles east of the center of the town. It is south of the Wiley Waterworks and northeast of a small district schoolhouse. The station is 161 feet a little west of south of the southeast corner of the fence surrounding an old dry reservoir next to the waterworks, and 196 feet a little east of south from the southwest corner of this same fence. The station is marked by a glazed earthen pipe 6 by 30 inches, partly filled with cement, and projecting about 1 inch above the ground. The cement is lettered U. S., 1907. The following true bearings were determined:

	°	′	
Weather vane on town water tank at Spring Lake (mark)	18	22.5	east of north
Steeple of Methodist Church, Spring Lake	21	53.9	east of north
Tower of schoolhouse, Spring Lake	12	32.6	east of north

Grand Rapids, Kent County.—The station is in the southeast corner of John Ball Park, about 2 miles southwest of the center of the town. It is about 155 feet west of the bend in Butternut avenue, where it takes a sharp turn to the south, 39.9 feet west of a large bowlder, which is about 2 by 3 feet, and 96 feet a little north of west of the trunk of a large maple tree about 1.5 feet in diameter. This tree carries a park sign and is a few feet west of the bend in Butternut avenue. The station is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 3 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple of Irish Catholic Church (mark)	46	11.4	east of north
Cupola on nearest public school	46	41.3	east of north
Steeple of German Catholic Church	54	26.7	east of north
Cupola of School of the Sacred Heart	63	31.9	east of north
Electric light tower, about 1 mile north	33	17.8	east of north

Descriptions of stations—Continued.

MICHIGAN—Continued.

Harrison, Clare County.—The station is in the southwest corner of the pasture belonging to the county poor farm, about one-half of a mile northwest of the center of the town. The pasture is the third inclosed field north of the poor house. The station is 121.5 feet north of the south fence, and 307.5 feet east of the west fence. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 8 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple of Methodist Church (mark)	53	19.3	east of south
Cross on cupola of Catholic Church	47	36.8	east of south
North arrow head on cupola with ornament of iron rods	48	43.5	east of south
East gable of poor house	2	51.7	west of south

Harrisville, Alcona County.—The station is in the southeast part of the oval within the race track at the county fair grounds, about one-half of a mile northeast of the center of the town. It is 124.5 feet west of the board fence on the eastern boundary of the fair grounds, and 39.0 feet east of the fifth post, counting from the north of a row of 15 posts with a wooden rail on top running north and south. It is also 43 feet southeast of the second from the north of a row of five maple trees extending north and south, and 142.5 feet northeast of the third from the north of the same trees. The station is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cupola of the school (mark)	39	33.3	west of south
Southeast corner of cupola of the court-house	37	37.7	west of south
Top of only other cupola in sight	40	56.0	west of south
Weather vane of railroad water tank	46	10.1	west of south

Hillsdale, Hillsdale County.—The station is in the northern part of the oval within the race track at the county fair grounds. It is about 1 mile south of the center of the town and about 400 feet from the north end of the race track. It is 205 feet a little to the south of east from the 150-yard post and 274 feet west of the ¼-mile post. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 6 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
South end of roof on long live-stock shed (mark)	34	36.4	east of north
Weather vane with arrow and eagle on barn	80	43.4	east of north
Flagstaff on judges' stand	31	13.2	west of south
South gable of gasoline engine factory	33	56.4	east of north

Howell, Livingston County.—The station is about 3 miles southwest of the center of the town, on the property of the State Sanitarium for Tuberculosis. It is in the northeast corner of the first field southwest of the sanitarium, across the road running south to Doctor Kennedy's house. It is 110 feet from the east fence, 204 feet from the north fence, and 67 feet southwest of a large lone tree. The station is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Top of sanitarium water tank (mark)	71	29.8	east of north
Northeast corner of a house just north of saw and feed mill	72	49.8	west of south
Southeast corner of main sanitarium building just under roof	49	08.3	east of north

Ionia, Ionia County.—The station is in the western part of the oval within the race track at the county fair grounds, about 1 mile east and one-fourth of a mile south of the center of the town. It is 268 feet southwest of the judges' stand, 191 feet east and 169.5 feet north of the fence around the inside

Descriptions of tations—Continued.

MICHIGAN—Continued.

of the track. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting 3 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Spire of Methodist Church (mark)	53	25.8	east of north
Steeple of First Baptist Church	49	53.7	east of north
Head of figure of Justice on court-house	49	50.5	east of north
Ball on the west tower of high school	39	59.8	east of north
Cross on west tower of Catholic Church	23	58.1	east of north

Ithaca, Gratiot County.—The station is in the southern part of the oval within the race track at the county fair grounds, about one-half of a mile southwest of the center of the town. It is on the highest ground within the race track, 331.0 feet from the fence on the south and 210.5 feet from the fence on the east. It is marked by a Bedford limestone post 5½ by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Baptist Church spire (mark)	17	04.7	east of north
Flagstaff on cupola of county court-house	44	40.2	east of north
Weather vane on village hall	19	34.5	east of north
Weather vane with figure of a horse on top	25	07.6	east of north

Kalamazoo, Kalamazoo County.—The station of 1900 being unavailable for future occupation, a new station was established on the southern edge of the grounds of the Kalamazoo College, about 1½ miles southwest of the center of the town. It is about 528 feet west of Bowen Hall, 12 feet north of the edge of a steep bank down to Lovell street on the south side of the grounds, and about 426 feet southwest of a brick dwelling, which is the most western building on the grounds. It is marked by a Bedford limestone post 5 by 7 by 32 inches, projecting about 7 inches above the ground and lettered U. S. C. & G. S., 1907. The location of the stone is known to the college authorities. The following true bearings were determined:

	°	′	
Rod on highest cupola of Michigan Asylum	5	27.2	west of south
Center of top of large tower at the asylum	10	40.4	west of south
Flagstaff on private sanitarium	33	40.9	east of south
Flagstaff on normal school	52	36.3	east of south

Kalkaska, Kalkaska County.—The station is west of the baseball grounds and a little less than one-half of a mile west of the center of the town. It is 215 feet northwest of the southwest corner of the fence surrounding the baseball grounds, 241 feet southwest of the northwest corner of the same fence, and about 200 feet north of the fence across the road. It is marked by a Bedford limestone post 5 by 6 by 36 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Spire on Methodist Church (mark)	68	38.1	east of north
Flagstaff on county court-house	86	08.5	east of north
Weather vane on public school	82	48.5	east of south
Cupola on a large red barn	56	52.5	east of south

Lapeer, Lapeer County.—The station is in the northeast corner of the grounds immediately surrounding the buildings of the State Asylum for the Feeble-Minded. It is about 250 feet southwest of the northeast gate to the asylum, and about 2 miles west of the center of the town. It is 230.0 feet south and 252.5 feet west of the fence around the asylum grounds. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Weather vane on cupola of high school (mark)	84	18.9	east of north
Top of asylum water tank	33	37.5	west of south
Weather vane on tower of asylum chapel	28	39.4	west of south
Top of northern tower of the asylum office building	17	48.2	west of south

Descriptions of stations—Continued.

MICHIGAN—Continued.

Leland, Leelanau County.—The station is in the southeastern corner of the partly inclosed piece of land south of the picnic grounds and between these grounds and the schoolhouse. This piece of land is owned by the Roman Catholic Church, and it is about one-half of a mile a little north of east of the center of the town. The station is 96.5 feet north and 136.0 feet west of the fence inclosing the church property, and 183.0 feet east of the northeast corner of a small wooden cabin used as a carriage house. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 2 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Steeple of German Lutheran Church	64	26.5	west of south
Ball at top of schoolhouse belfry	43	58.5	west of south
Weather vane on Methodist Church steeple	2	43.1	west of south

Marshall, Calhoun County.—The station is in the southern part of the oval within the race track at the county fair grounds, about 1½ miles southeast of the center of the town. It is about 200 feet north of the grand stand, 135.2 feet northeast of the west end of a short picket fence inside of the race track, and north of the grand stand, and 140 feet northwest of the northwest corner of the judges' stand. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 5 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Court-house cupola	61	42.1	west of north
Belfry of fire-engine house	60	28.1	west of north
Steeple of Catholic Church	64	41.6	west of north
Steeple of Methodist Church	54	57.9	west of north
Steeple of Presbyterian Church	50	56.5	west of north

Midland, Midland County.—The station is in the southeastern part of the oval within the race track at the county fair grounds, and is about 1 mile southwest of the center of the town. It is 65.5 feet west of the fence bounding the inside of the race track on the east, 65.8 feet southwest of a hickory tree (the only tree in the eastern part of the oval), and 27.3 feet north of a rock which is about 1.4 feet by 0.8 foot in size and flush with the ground. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Top of oil-well tower about 1 mile away (mark)	66	13.2	east of south
North gable of the grand stand	87	58.7	west of north

Mount Pleasant, Isabella County.—The station is in the southeastern corner of the ground immediately surrounding the buildings of the Mount Pleasant Indian Industrial School, about 1½ miles northwest of the center of the town. It is 148.6 feet north of the fence across that road which bounds the school grounds on the south and 244.0 feet west of the west edge of the stone walk running northwest to the school buildings from the southeast corner of the grounds. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on cupola of county court-house (mark)	56	05.5	east of south
Steeple of Presbyterian Church	56	23.1	east of south
Flagstaff on cupola of high school	52	28.3	east of south
Cross on tallest steeple of Catholic Church	49	50.4	east of south
Spire of Presbyterian Church	39	55.8	east of south
Ornament at top of tallest water tower of Indian school	78	47.7	west of north

Newaygo, Newaygo County.—The station is about one-half of a mile northeast of the center of the town, on a piece of ground owned by the cement works, but will probably be sold to the city for a park. It is in the northwest corner of this ground on the east bank of the river, 87.5 feet south of the fence

Descriptions of stations—Continued.

MICHIGAN—Continued.

bounding the grounds on the north, and 190.0 feet southeast of the fence corner at the northeast corner of the intersection of the road on the north side of the ground and the road running north from its northwest corner. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 2 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flagstaff on cupola of court-house (mark)	43	10.7	west of south
Rod on cupola of public school	29	43.3	west of south
Cross on belfry of Protestant Episcopal Church	31	47.9	west of south

Pontiac, Oakland County.—The station is between the barracks and Orchard Lake, on the grounds of the Michigan Military Academy, about 4 miles southwest of the center of the town. It is 207.8 feet west of the southwest corner of the barracks, 233.5 feet southwest of the southwest corner of the president's house, and about 102 feet east of the east shore of Orchard Lake. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 3 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Point of ornamental cupola on southwest corner of the mess hall (mark)	8	51.9	east of north
Flag pole on roof of a house across the lake	21	53.4	west of south

Port Huron, St. Clair County.—The station is in the northwest part of the Government reservation surrounding the Fort Gratiot Light-house. It is about 400 or 500 feet northwest of the light-house and about 2½ miles northeast of the center of the town. It is 248 feet northwest of the northwest corner of the fence immediately surrounding the light-house, and 146 feet east of the fence bounding the reservation on the west. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting 2 inches above the ground and lettered U. S. C. & G. S., 1907 The following true bearings were determined:

	°	′	
Rod on light-house (mark)	48	15.2	east of south
West gable of a house on the north edge of the reservation	17	08.1	east of north

Rogers, Presque Isle County.—The station is at the north end of the baseball grounds, on land owned by Mr. Miller, about 1 500 feet northwest of the court-house. It is about 387 feet southeast of the southeast corner of the dancing pavilion, and about 290 feet north of the board walk on the south side of the baseball grounds. The station is marked by a Bedford limestone post 5 by 6 by 36 inches, projecting about 7 inches above the ground and lettered U. S. C. & G. S., 1907. The stone may be found by inquiry at the court-house. The following true bearings were determined:

	°	′	
Weather vane on cupola of schoolhouse (mark)	14	11.8	east of south
Cross on cupola of Lutheran Church	13	37.1	east of south
Flagstaff on cupola of court-house	56	27.2	east of south

Sandusky, Sanilac County.—The station is about three-fourths of a mile southwest of the center of the town, in the northwest portion of the county fair grounds, owned by Mr. William Dawson. The station is 68.6 feet west of the fence on the outside edge of the race track, 71.5 feet south of the fence bounding the grounds on the north, and 220 feet northeast of the northwest corner of the house immediately north of the grand stand. It is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 6 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearing was determined:

	°	′	
North gable of grand stand (mark)	30	46.2	west of south

Sherman, St. Joseph County.—The station is about 4 miles northwest from the town of Sturgis, in the northeast quarter of sec. 22, T. 7 S., R. 10 W., Sherman Township. It is 205.7 feet from the astronomic station, directly in line to the magnetic azimuth mark. It is marked by a stone 12 inches in diameter, placed 18 inches below the surface of the ground. It is 124.8 feet from B. M. 1, 107.3 feet from B. M. 2, and 236.2 feet from an oak tree standing about 40 feet south of the edge of the field.

Descriptions of stations—Continued.

MICHIGAN—Continued.

B. M. 1 is a cut-stone reference mark 75 feet west of the corner of the field, just north of the fence. B. M 2 is a stone 15 feet in diameter, with its top projecting about 3 inches above ground. The following true bearings were determined:

	°	′	
Magnetic azimuth mark	44	32.2	west of south
Astronomic station	44	32.2	east of north
B. M. 1	16	50.4	east of north
B. M. 2	85	06.6	east of south
Windmill	2	44.4	west of south
Oak tree	71	39.1	west of north

Standish, Arenac County.—The station is in the northern part of the oval within the race track at the county fair grounds, about one-half of a mile southwest of the center of the town. It is 186.3 feet south of the fence on the inside of the race track to the north, and 198.4 feet from the inside fence to the west. It is also about 237 feet from the inside fence to the east. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Methodist Church spire (mark)	74	33.7	east of north
Flagstaff on cupola of court-house	57	11.7	east of north

Tawas City, Iosco County.—The station is in the south side of the east end of the oval within the race track at the county fair grounds, about one-third of a mile northeast of the center of town. It is 141.5 feet north of the inside fence around the race track and 144.6 feet northwest of the northwest corner of the judges' stand. The station is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on Catholic Church at East Tawas (mark)	60	00.2	east of north
Baptist Church spire at East Tawas	63	10.6	east of north
Steeple of Methodist Church at East Tawas	65	40.9	east of north
Cupola of city hall at East Tawas	82	41.3	east of north
Steeple of old Presbyterian Church at Tawas City	29	28.6	west of south

Traverse City, Grand Traverse County.—The station is in the eastern part of the ground immediately surrounding the main buildings of the asylum for the insane, about 600 feet east of the entrance to the office, and about 1½ miles southwest of the center of the town. It is 107.5 feet west of the asylum fence, 58.6 feet northwest of a maple tree about 1.7 feet in diameter, and about 357 feet north of the stone pavement leading to the main office. It is marked by a Bedford limestone post 5 by 6 by 30 inches, projecting about 2 inches above ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross on Catholic Church (mark)	89	28.0	east of south
Flagstaff on Union Street school	72	33.6	east of south
Spire of Disciple Church	81	03.7	east of north
Weather vane on cupola over entrance to main office of asylum	76	56.2	west of south

West Branch, Ogemaw County.—The station is in the northeast part of the ground surrounding the high school, on a large lot on the east side. It is about one-third of a mile northeast of the center of the town. It is 112.5 feet south of the board fence bounding the school grounds on the north and 324.5 feet a little north of east from the northeast corner of the main school building. It is also about 83 feet west of the fence line bounding the school grounds on the east. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Ball at top of belfry of fire-engine house (mark)	40	01.2	west of south
Weather vane on cupola of high school	73	04.9	west of south
Top of judges' stand at fair grounds	39	20.1	west of north

Descriptions of stations—Continued.

MINNESOTA.

Albert Lea, Freeborn County.—The station is in the southeast corner of the fair grounds, between the race track and the fence. It is 49.6 feet west of the east fence and 109.3 feet north of the south fence. It is marked by a 24-inch stake, projecting 2 inches above the surface of the ground. The following true bearing was determined:

	° ′
Flag pole on Floral Hall (mark)	89 06.6 west of south

Bemidji, Beltrami County.—The station is in the southeast part of the court-house grounds near the flag pole, 28.5 feet from the east fence and 42.2 feet from the south fence. It is marked by a cement post 6 by 8 by 24 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′
Flag pole on opera house (mark)	24 54.6 west of south
Cross on Catholic Church	19 13.7 east of north

Duluth, St. Louis County.—The old station could not be recovered. A new station was established on the north side of Minnesota Point near the lake in line with the north fence of White City at a point 78 feet from the corner. The station is marked by a wooden stake. The following true bearing was determined:

	° ′
Flag pole on dance hall (mark)	8 20.9 east of south

Fairmont, Martin County.—The station is in the northwest part of the public school block, 15 feet east of the west walk and 48 feet north of the walk running from the street to the schoolhouse. It is marked by a red cement post 6 by 8 by 20 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′
Spire of German Church (mark)	10 15.2 west of south
Flag pole on hotel	74 38.3 west of south

Faribault, Rice County.—The station is in the northeast part of the court-house grounds. It is 67.8 feet west of the east walk and 77.8 feet south of the north walk. It is marked by a cement post 4 by 8 by 24 inches, projecting 1 inch above the surface of the ground and lettered U. S. The following true bearings were determined:

	° ′
Northwest corner of water table of court-house (mark)	47 05.4 west of south
Flag pole on schoolhouse	80 29.2 west of south

Glencoe, McLeod County.—The station is in the southeast part of the public school block, in the east part of town. It is 55.1 feet north of the south walk and 50.8 feet west of the walk running from the street to the frame school building. It is marked by a cement post 5 by 7 by 24 inches, lettered U. S., '07. The following true bearings were determined:

	° ′
Southwest corner of Catholic Church (mark)	44 45.3 east of south
Flag pole on frame schoolhouse	24 37.1 east of north

Greenbush, Roseau County.—The station is at the edge of the woods, near the south edge of the school grounds, south of the town, 117 feet from the rear door of the schoolhouse. It is marked by a rough stake driven flush with the surface of the ground. The following true bearings were determined:

	° ′
Church spire (mark)	32 19.6 east of north
Flag pole on schoolhouse	7 11.4 west of north

Heron Lake, Jackson County.—The station of 1900 was reoccupied. It is in the race-track grounds, 84.2 feet from the southeast corner of the judges' stand, 96.3 feet and 139.2 feet, respectively, from the eleventh post south and north of it, and 4⅓ feet from the south side of the grand stand. It is marked by a tent peg. The following true bearing was determined in 1907:

	° ′
Flag pole on Catholic school (mark)	0 55.6 west of south

Descriptions of stations—Continued.

MINNESOTA—Continued.

Hibbing, St. Louis County.—The station is in the northwest part of the public school grounds, 72.7 feet from the north fence and 114.0 feet from the west fence. It is marked by a cement post 6 by 6 by 24 inches, lettered on top U. S. C. & G. S. and on the side 1907. The following true bearings were determined:

	°	′	
East edge of chimney on high school (mark)	3	21.1	west of south
Flag pole on schoolhouse	85	24.2	east of north
Spire on church beyond schoolhouse	89	45.4	east of south

Luverne, Rock County.—The station is west of the town, in the Maple Wood Cemetery, just south of the chapel at the intersection of two drives. It is 6 feet north of the center of the drive running east and west and about 4 feet from the west side of the drive running north and south. The station is marked by a red stone post 6 by 6 by 24 inches, set flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Cross in gable of chapel (mark)	3	21.7	west of north
Barn, cupola	21	07.2	west of north

Marshall, Lyon County.—The station is in the east part of the town near the west side of the street which runs north and south between the Catholic cemetery and the town. It is 62.3 feet west of the northwest corner of the cemetery and in line with the north fence. It is marked by a cement post 4 by 10 by 24 inches, lettered on top U. S. and on the side 1907. The following true bearings were determined:

	°	′	
Cross over cemetery gate	13	17.5	east of south
Flag pole on schoolhouse	42	10.1	west of north

Mora, Kanabec County.—The station is in the south part of the court-house grounds, 102.3 feet from the south fence and 224.6 feet from the west sidewalk. The station is marked by a wooden post 6 by 6 by 24 inches, projecting 4 inches above ground. The following true bearings were determined:

	°	′	
Spire of Lutheran Church (mark)	19	26.9	west of south
Flag pole on schoolhouse	1	33.2	west of north
Flag pole on court-house	65	37.3	west of north

Ortonville, Bigstone County.—The station is in the north part of town just south of the baseball park and on the bluff overlooking Bigstone Lake. It is 33 feet almost true south from the ticket office, and about one-fourth of a mile from the shore of the lake. It is marked by a cement post 5 by 8 by 20 inches, lettered U. S., 1907. The following true bearings were determined:

	°	′	
Court-house flag pole (mark)	21	25.7	east of south
Highest point on schoolhouse	49	52.1	east of south

Preston, Fillmore County.—The station is in the northeast part of the court-house block, near the center of the village. It is 29.5 feet from the north fence, and 80.4 feet from the east fence. It is marked by a cement post 8 by 10 by 24 inches, lettered U. S., 1907. The following true bearing was determined:

	°	′	
Gable on stone building to east of court-house (mark)	8	04.7	east of south

Red Wing, Goodhue County.—The station is in the grounds of Red Wing Seminary, on a hill in the western part of the town, which is known as College Hill. It is between the two sidewalks leading from the street to the old college building. It is 56.9 feet northwest of the southeast walk and 186.2 feet from the west corner of the old building. It is marked by a cement post 4 by 6 by 20 inches, set flush with the surface of the ground. The following true bearings were determined:

	°	′	
Extreme corner of northeast steps of main building (mark)	42	03.1	west of north
Gable of main building	54	35.7	west of north

Descriptions of stations—Continued.

MINNESOTA—Continued.

St. Paul, Ramsey County.—This station is in Oakland Cemetery, 33 feet south and 24 feet west of the station of 1891. The station of 1891 is in the large open space just west of the center of the "Lake," 186.5 and 441 feet, respectively, from the inner edge of the wall of the cemetery along Sycamore and along Sylvan streets. It is marked by a dressed-marble post 4 inches square, with intersecting grooves in the top, lettered U. S. 1891 C. S. and sunk flush with the surface of the ground. The station of 1907 is marked by a rough stone projecting 2 inches above the ground. The following true bearings were determined:

	° ′
East edge of large smokestack in railroad yards (mark)	4 36.0 west of south
Southeast corner of base of large monument	37 55.9 west of north

Swan River, Itasca County.—The station is at the edge of the woods almost due south of the Great Northern Railroad water tank, and 200 paces from it. The station is marked by a large smooth stone cropping out of the ground, and having a cross cut in it. The following true bearing was determined:

	° ′
Point on railroad water tank (mark)	12 02.3 east of north

Thief River Falls, Red Lake County.—The station is in the public-school grounds, in the southwest part of town. It is 31.4 feet from the east sidewalk and 114.8 feet from the north sidewalk. It is marked by a red cement post 9 by 9 by 30 inches, projecting 4 inches out of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′
Point on Great Northern Railroad water tank (mark)	2 24.8 east of south
Cross on Catholic church	49 35.4 west of south
Flag pole on schoolhouse	26 48.0 west of south

Warren, Marshall County.—The station is in the northeast yard of the public school grounds, in the southwest part of town. It is 155.2 feet from the northeast corner of the schoolhouse and 71.9 feet from the north sidewalk. It is marked by a wooden post 6 by 6 by 24 inches, projecting 2 inches above the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′
Gable of small house north of Spaulding elevator (mark)	6 05.2 west of south
Flag pole on schoolhouse	77 24.6 west of south
Spire of Lutheran Church	83 25.4 west of north

Wheaton, Traverse County.—The station is in the cemetery about 1 mile north of the town. It is 7 feet south of the center of the main drive, at a point 101.3 feet east of the main gate. It is marked by a cement post 6 by 8 by 24 inches, and lettered U. S. '07. The following true bearings were determined:

	° ′
Court-house flag pole (mark)	13 43.1 west of south
Lutheran Church steeple	24 20.0 west of south

Willmar, Kandiyohi County.—The station is in the school grounds in the northwest part of town. It is in the northwest part of the grounds, 55.9 feet east of the west line and 111.8 feet south of the north line. It is marked by a cement post 8 by 10 by 24 inches, lettered U. S. C. & G. S., 1907. The following true bearing was determined:

	° ′
Point on roof of Mr. Tallman's house (mark)	69 27.5 east of north

MISSISSIPPI.

Brookhaven, Lincoln County.—The station of 1905 was reoccupied. It is on the grounds of the Whitworth Female College, east of the main building. It is 96.2, 78.2, and 88.7 feet, respectively, from the main building, the southeast corner of the president's house, and the fence on the south line

Descriptions of stations—Continued.

MISSISSIPPI—Continued.

of the grounds. The station is marked by a limestone post 6 by 6 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S. The following true bearings were determined in 1905:

	° ′
Presbyterian Church spire (mark)	2 23.0 east of south
High school cupola	36 51.9 west of south
Apex of front cornice on Inez Hotel	88 12.8 east of south

Jackson, Hinds County.—The station of 1901 was reoccupied. The station is about 2 miles from the town, on the grounds of the Millsaps College, on the south side of Observatory Hill, about 300 feet from the proposed site for the observatory and 224.5 feet from the fence on the west. It is marked by a stone post 6 inches square, projecting 3 inches above the surface of the ground. The following true bearing was determined in 1901:

	° ′
Spire on main college building (mark)	8 10.4 east of south

West Point, Clay County.—The station of 1901 was reoccupied. It is in the west part of the town, on the grounds of the Mary Holmes Seminary. It is 156.4 feet from the southeast corner and 203.1 feet from the southwest corner of the main building. The station is marked by a stone post 6 inches square, projecting 4 inches above the surface of the ground. The following true bearing was determined in 1901:

	° ′
East edge of chimney on cotton mill, distant about 3 miles (mark)	2 13.4 east of south

MISSOURI.

Milan, Sullivan County.—The station is in the Milan fair grounds, about 200 feet south from the main entrance and almost directly west of the entrance to the race track. An elm tree due south of the station is 48 feet distant, and from the station east to the fence along the race track is about 43 feet. It is marked by a gray sandstone post 6 by 6 by 26 inches, projecting 1½ inches above the surface of the ground and lettered on top U. S. C. & G. S. and on the south side 1907. The following true bearings were determined:

	° ′
Standpipe in Milan	40 00.5 west of north
Extreme left edge of judges' stand	10 42.7 east of south

NEBRASKA.

Niobrara, Knox County.—The station is in the schoolhouse grounds, near the northeast corner, on top of a small bluff. It is 90 feet east of the front sidewalk leading from the schoolhouse. The station is marked by a Bedford limestone post 6 by 6 by 24 inches, lettered U. S. C. & G. S., 1907. The following true bearing was determined:

	° ′
Northeast corner of schoolhouse (mark)	25 13.5 west of south

West Point, Cuming County.—The station is in the Catholic cemetery, south of the town. It is near the west side of the cemetery, 49.9 feet east of the west fence and 17.3 feet north of the center of the walk running from the west gate to the church. It is marked by a Bedford limestone post 6 by 6 by 24 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′
Gable of farmhouse mark)	2 53.0 east of south
Southwest corner of church tower	82 46.3 east of south

Descriptions of stations—Continued.

NEW JERSEY.

Barnegat City, Ocean County.—The station of 1903 was reoccupied as nearly as could be determined, the post having become displaced. The post was reset in approximately the old position. The station is on a high sand dune south of the light keeper's dwelling and 269.2 feet from center of light-house. The top of the stone is set flush with the ground, and its elevation above light-house bench mark is 12.4 feet. The following true bearings were determined:

	°	′	
Flagstaff on west tower of Oceanic Hotel (mark)	30	19.8	east of south
Center of windmill on top of Seaside Hotel	76	09.6	west of south
Spire on light-house	20	31.8	west of north

NEW YORK.

Au Sable Forks, Clinton County.—The station is in Fairview Cemetery, about one-half of a mile north of the village. It is in the driveway at the northeast corner of the cemetery, 69.3 feet northeast from the tall Rogers monument and 72.6 feet east from the low, massive granite monument bearing the name of Hart. It is 16 paces from the north fence of the cemetery and 31 feet from the pine tree row on the east side of the drive running north and south. It is marked by a granite post 7 by 7 by 24 inches, set 5 inches below the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Tip of Petty monument (mark)	8	00.9	west of south
West edge of base of the Rogers monument	25	36.2	west of south
Northwest edge of the Albert H. Bullard monument	41	33.7	west of south
Tip of the J. Hamilton Sheffield monument	65	34.6	west of south

Ballston Spa, Saratoga County.—The station is on a sand hill about 1 mile north of the center of the village and about 1 000 feet west from the standpipe. It is on the north line of the city limits and 65.5 feet east from the stone which marks the north point of the city limits. The station is about 200 feet south of Mr. Crandall's house and about 200 feet north from the sandy road which runs east and west past the standpipe, and has an open lot south of it. It is exactly in line between an elm tree 1½ feet in diameter and a maple tree 2½ feet in diameter, being 14.5 feet west from the former and 79.5 feet east from the latter. The station is marked by a marble post 6 by 11 by 22 inches, projecting 2 inches above the surface of the sand and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on court-house tower (mark)	7	47.4	east of south
South wall of standpipe, just below flange at the top	81	18.3	east of south

Observations were also made on the county fair grounds, but the station was abandoned on account of its proximity to an electric car line.

Batavia, Genesee County.—The station is on the county fair grounds, about 1 mile west of the city. It is on the northwest corner of the grounds, just outside the race track. The inside line of the west side of the race course, if produced, would pass through the station. A tangent to the extreme north edge of the race track would also pass through the station, making a right angle with the line above mentioned. It is 61.5 feet from the west fence of the grounds, which separates them from a public road on the west. A small ditch is 20 feet to the north of station. The station is marked with a marble post 6 by 6 by 27 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Methodist Church steeple (mark)	50	02.5	east of south
Center pole on building at entrance to grounds	2	31.0	west of south
Southeast corner of grand stand near ground	36	17	west of south

Descriptions of stations—Continued.

NEW YORK—Continued.

Bath, Steuben County.—The station of 1874 being no longer available, a new one was established on the county fair grounds, about one-half of a mile to the north from the old station. It is on the north end of the oval inside the race track. The inside fence of the track is a gas-pipe railing, and the station is 64 feet to the south from the north end of this railing. If the iron rail (inside) on the west side were produced the line would pass 48 paces from the station, and if produced on the east it would pass 43 paces from the station. The station is marked by a marble post 6 by 10 by 30 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Methodist Church steeple (mark)	49	49.4	west of south
Episcopal Church steeple	40	56.0	west of south
Quarter-mile post	6	15	east of south

Binghamton, Broome County.—The station of 1888 was reoccupied. It is the south stone of the meridian line established in 1888 on a hill south of the city. One stone is at the corner of McKinney and Gertrude streets and the other at the corner of McKinney and Hotchkiss streets, 350 feet apart. The following true bearing was determined in 1907:

	°	′	
Spire of Congregational Church	4	31.4	east of north

Blue Mountain Lake, Hamilton County.—The station is at the end of the lake, about 2½ miles west from Blue Mountain. It is on the shore of the lake just east of the path leading to the boat landing at the Lake View House. It is 122.2 feet from the west corner of the Central House and 131.0 feet from the northeast corner of Lake View House. The station is 5 feet west from a line running north along the east wall of Lake View House. The observations were made over a large granite stone with triangular or tapering top, which is flush with the surface of the ground. A three-eighths-inch drill hole marks the station, and the top is lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Staff on southeast cupola on Hotel Utawana (mark)	79	53.0	west of north
Southwest corner of Merwin's Hotel	3	22.0	east of north

Canton, St. Lawrence County.—The station is about one-half of a mile north of the city, on the county fair grounds. It is on an open strip of ground at the east side of the race track and about halfway between the horse barns and the north end of the fair grounds. It is 126.4 feet southeast of the quarter-mile post, 44.0 feet from the east fence of the tracks, 63.5 feet from the east fence of the grounds, 48.0 feet southwest from a very large elm tree, and 33.5 feet southeast from a large maple tree. It is marked by a marble post 6 by 6 by 26 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Tip of tower on town hall (mark)	10	41.6	east of south
Rod on cupola of building in southwest corner of grounds	3	02.2	west of south
Cross on Catholic Church	36	36.9	east of south
Tip on cupola on dwelling house	85	37.4	east of south

Cooperstown, Otsego County.—The station is in the county fair grounds, on a small, flat piece of ground, 71.5 feet from the outer fence of the race track at its southeast turn. The east turn of the outer fence, if produced, would pass about 5 feet east of the station. The station is marked by a white marble post 6 by 6 by 24 inches, projecting 3 inches above the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	°	′	
Rod on Baptist Church (mark)	17	58.6	east of north
Pole on Doctor Fowler's house	58	45.1	east of north

Descriptions of stations—Continued.

NEW YORK—Continued.

Cortland, Cortland County.—The station is in the northwest corner of the county fair grounds. It is 73 feet east from the wire fence at the west end of the grounds, 50 feet from the fence on north side of the grounds, and 19 feet from outer edge of the race course. The station is marked by a marble post 6 by 6 by 24 inches, projecting 3 inches above the surface of the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	° ′	
Pole on cupola of L. J. Fitzgerald's barn (mark)	1 01.7	west of north
Pole on center of band stand	61 13.8	east of south
Southwest edge of covered stand at race track (5 feet above ground)	48 39.0	east of south

Dannemora, Clinton County.—The station is in the northwest corner of the grounds of the Clinton Penitentiary, at Dannemora, and north of the pond and ice house standing near the northwest corner of the prison. It is about 1 000 feet northwest of the prison, 86.2 feet from a wooden fence on the north, and 88.4 feet from a wooden fence on the west. The station is marked by a native stone about 16 inches long, oval shaped, about 4½ inches thick, and lettered U. S. on top. The top is flush with the ground. The following true bearings were determined:

	° ′	
Vane on residence of warden (mark)	24 47.8	east of south
Vane on cupola of public school	2 19.3	west of south
Eastern of three chimney-like ornaments on asylum	88 19.5	east of south

Fishkill, Dutchess County.—The triangulation station Kit is in the southwest part of the town of Fishkill on the Hudson, in an open field belonging to Doctor Kittredge and used as a pasture. It is on the first hill east of the railroad dock. The top of the hill is flat, and about 20 feet west of the station the ground begins to slope toward the river. A wooden latitude pier was erected 17.4 feet due west of the station. The station is marked by a three-fourths-inch drill hole, with triangle, on an outcropping ledge. There is a cross on a rock 46.2 feet to the northwest and one on a rock 22.9 feet southwest. The magnetic station is south of east from the triangulation station Kit, distant 98.8 feet, and is close to trees at southeast edge of the flat top of the hill. The station is marked by a stub. The following true bearings were determined:

	° ′	
Spire on Baptist Church, Newburgh (mark)	79 25.8	west of north
Cross on St. Patrick's Church, Newburgh	84 06.0	west of south
Flagstaff on schoolhouse, Fishkill	38 31.1	east of north
Kit triangulation station	61 40.8	west of north

Gardiners Island, Suffolk County.—The triangulation station is about one-half of a mile north and a little east of the residence of Mr. John Gardiner, owner of the island. It is west of the stone wall dividing the island into east and west pastures, and is on the highest ground in the west pasture. The station is marked by an 8-inch tile with top 8 inches below the surface of ground. A large rock with no marks forms the surface mark. A wooden latitude pier stands 8.4 feet from the station and in exact line to Little Gull Island Light-house. The magnetic station is on a small rise 139.8 feet from the triangulation station, and is in exact line between the triangulation station and Little Gull Island Light-house. It is marked by a 2 by 2 by 14 inch stub driven flush with ground; also three 2 by 4 by 12 inch pegs. The following true bearings were determined:

	° ′	
Little Gull Island Light-house (mark)	0 26.2	west of north
North gable of small house in east pasture	37 19.0	east of south

Geneseo, Livingston County.—The station is on the athletic field of the Geneseo State Normal School. The field is about 30 rods due east of the county court-house and is surrounded by a high board fence. The station is 159 feet from the northeast corner of the fence and 51 feet from the east fence of the field. The station is marked by a blue sandstone post 5 by 8 by 48 inches, projecting

Descriptions of stations—Continued.

NEW YORK—Continued.

about 8 inches above the ground, west face lettered U. S. C. & G. S. and east face 1908. The following true bearings were determined:

	°	′	
Low spire on southeast corner of Catholic Church (mark)	56	33.6	west of south
Tall spire on Catholic Church	61	34.6	west of south
Tall spire on Episcopal Church	38	55.2	west of south
Pole on county court-house	83	50.0	west of south

Helena, St. Lawrence County.—The station is in the northwest corner of the public school yard. It is 101.6 feet from the northwest corner of the schoolhouse foundation, 24.5 feet from the board fence on the west side of the yard, 35.4 feet from the stone walk past the north side of the grounds, and 41.5 feet from the walk leading up to the schoolhouse door. The station is marked by a rough quarry stone about 5 by 8 by 22 inches, set flush with the ground and having a cross chiseled in the top. The following true bearings were determined:

	°	′	
Lightning rod about 2 feet to the left of center chimney on the Helena House	79	21.7	east of south
Presbyterian Church spire	9	28.2	east of north
West one of two chimneys on farm house about 1½ miles distant	1	27.9	west of south
Northeast corner of schoolhouse (above baseboard)	50	51.7	east of south

Herkimer, Herkimer County.—The station is about 1 mile south from the city on the county fair grounds. It is in the oval inclosed by the race track, near the south end. It is on an elevation about 2 feet higher than the surrounding ground, about 130 feet from the inner fence of race track on the south, and 376 feet a little south of east from the southeast corner of the grand stand. The station is marked by a limestone post 6 by 6 by 30 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Staff of weather vane on Dutch Reformed Church (mark)	1	52.5	west of north
Rod on Methodist Episcopal Church steeple	1	58.7	east of north
Baptist Church steeple	4	49.2	east of north
Pole on building at north end of grounds	30	55.8	west of north
Pole on building at northwest corner of grounds	47	32.8	west of north
Southwest corner of grand stand	84	45.4	west of north

Lake Placid, Essex County.—The station is about 20 feet from the water's edge, on the south shore of Lake Placid. It is on the Schell property, 83.3 feet north and slightly west from the northwest corner of the house porch. It is 102.7 feet west from the United States land survey monument No. 262, which is set in a granite rock near the water's edge. Observations were made over a granite rock, about 1 foot square, flush with the surface of the ground. It is lettered U. S. C. & G. S., 1907, and a drill hole marks the exact spot. The following true bearings were determined:

	°	′	
Steeple on Ruisseaumont	73	12.8	east of north
Episcopal Church steeple	14	05.3	east of south
Flag pole on Bide A Wee House	25	55.2	west of south
Pole on house at far end of lake	28	47.0	east of north

Lake Pleasant, Hamilton County.—The observations were made over a point 50 feet south of the north stone, in the meridian line established by United States surveyors. The south stone was used as mark. The north stone is about halfway between the church and the schoolhouse, set in the fence line on south side of the road. The south stone is in the fence line on the east side of the road, about 600 feet to the south. The station is not marked.

Lowville, Lewis County.—The station is on the county fair grounds, about three-fourths of a mile north from the center of the town. It is on a rough sandy knoll on the west side of the grounds, about midway between the horse barns and the northwest corner of the board fence around the grounds. It is 16 paces from the fence, 38 paces from the race track, and about 70 paces from the horse barns. The

Descriptions of stations—Continued.

NEW YORK—Continued.

spot is marked by a marble post 6 by 6 by 24 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
South cupola on creamery building	56 06.7	east of south
North cupola on creamery building	59 59.2	east of south
East gable of barn cupola one-half of a mile away	52 13.4	west of south

Lyons, Wayne County.—The station is about one-half of a mile north from the center of the city. It is at the north end of Wolfs lane, where Wolfs lane is crossed by an unused street which leads down the hill west to Maple street. It is 27.0 feet from the post of a gate in the board fence to the north, 25.8 feet from the corner of the board fence to the southwest, and 30.4 feet from the end of the north and south fence to the northeast. The station is marked by a marble post 8 by 8 by 36 inches, projecting about 5 inches above the surface of the ground, and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
East spire on Methodist Episcopal Church tower (mark)	0 51.5	east of south
Center of dial on schoolhouse clock	3 35.2	east of south
Rod on Richmond's barn	10 25.2	west of south
South gable of cupola on Charles Roger's barn	41 32.6	west of north

McKeever, Herkimer County.—The station is in the yard of the public school, about 600 feet southeast from the railway depot. Observations were made over a granite rock about 4 feet in diameter and projecting about 10 inches above the ground. It is on top of a small knoll, 98 feet southwest from the south corner of the schoolhouse. The stone is lettered U. S. C. & G. S., 1907. A drill hole marks the exact spot. The following true bearings were determined:

	° ′	
Rod on elevated water tank northwest of depot (mark)	11 43.1	west of north
Northwest corner of depot, 6 feet above ground	12 18.1	west of north
South edge of chimney on Mr. A. H. Merritt's house	45 22.6	west of north
Southeast corner of schoolhouse 6 feet above ground	34 46.0	east of north

Mannsville, Jefferson County.—The triangulation station is on the highest part of a hill on the farm of Mr. Collins, and is about one-half of a mile northeast from the town. It is marked by a stone post with top about 1 foot below the surface of the ground. A stone reference mark bears N. 67° 48′ E., distant 301.2 feet, and another S. 54° 30′ E., distant 353.9 feet. They are both just west of the stone fence to east of the station, and the former is on highest ground crossed by the fence. The magnetic station is in exact line between the triangulation station and the spire of the Methodist Church in Mannsville, and is 124.6 feet from the triangulation station. It is marked by a 2 by 4 stub and three pegs, all about 14 inches long. The following true bearings were determined:

	° ′	
South gable on barn (1 mile to northwest) (mark)	40 52.9	west of north
Spire on Methodist Church, Mannsville	69 09.6	west of south
Spire on Baptist Church, Mannsville	80 19.8	west of south
Spire of church, Lacona	16 18.9	west of south

Morrisville, Morris County.—The station is in Mr. Harwood's pasture, on a hill about 40 rods north from the post-office. It is directly in line with the row of trees which runs east and west along the south side of the cemetery. It is on the first bench of the hill, about 200 feet east from the road in front of the cemetery, and about 350 feet southeast from the cemetery vault, which is also on the east side of the road. The station is marked by a gray stone 6 by 9 by 20 inches, projecting 4 inches above the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	° ′	
Methodist Episcopal Church spire with ball top	51 01.5	east of south
South edge of stone front on vault	61 49.1	west of north
Rod on dome of Congregational Church	39 41.6	east of south

Descriptions of stations—Continued.

NEW YORK—Continued.

Newton Falls, St. Lawrence County.—The station is on a hill south of the village. It is on the east end of an open lot which lies at the east side of the street opposite the schoolhouse. It is 370.6 feet eastward from the southeast corner of the schoolhouse foundation, 19.0 feet north from a line running along the south wall of the schoolhouse, and 33.0 feet east from a line along the ridgepole of the Presbyterian Church. The station is marked by a marble post 6 by 6 by 24 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Wooden spire on Presbyterian Church belfry (mark)	5	48.4	east of north
Cross on Catholic Church	24	00.5	west of north
Wooden point on schoolhouse belfry	80	30.7	west of north

North Creek, Warren County.—The station is in the high school grounds, on a hill west of the main street, at the south end of the village. It is slightly south from the center of a sandy knoll in the southwest corner of the schoolhouse yard. It is 130.5 feet southwest from the southwest corner of the schoolhouse, 51.7 feet from the south fence, and 63.5 feet from the west fence. The station is marked by a native granite stone 9 by 9 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Marble staff, east end of gable on Person's vault (mark)	7	09.4	east of south
Molding in southwest corner boards of schoolhouse	30	19.6	east of north
Colvin's signal pole on Mount Moxon	7	07.3	west of north
Methodist Episcopal Church steeple	9	14.4	west of north

Northville, Fulton County.—The station is in the oval inclosed by the race track of the Gentleman's Driving Park, about three-eighths of a mile southwest from the center of the city. It is somewhat west and north from the center of this inclosure. It is 252 feet south from the board fence on the north side of the grounds, 408 feet west from the south post of the gate at the northeast corner of the grounds, and 345 feet southeast from the east post of the gate near the northwest corner of grounds. The station is marked by a rough granite stone about 9 by 10 by 40 inches, projecting 10 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on J. A. Willard's house (mark)	6	51.8	west of north
Southwest corner of covered stand (about 4 feet above sill)	23	54.4	east of south
East post of gate near northwest corner of grounds	51	13.5	west of north

Oswego, Oswego County.—The station is on the parade ground of Fort Ontario. It is 26.0 feet west from the walk leading to the guardhouse from the officers' row, and 149.3 feet from the southwest rail support on the steps of the parade walk. It is also in line with the commissary office and the commanding officer's quarters. The station is marked by a Bedford limestone post 8 by 12 by 34 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Rod on dome of church across the river	35	05.7	west of south
Pole on Normal School building	52	00.9	west of south
West edge of commanding officer's house	25	23.2	west of north

Owego, Tioga County.—The station is on a small plot of ground just north of the race track on Tioga County fair grounds. It is 40 paces south from the north fence of the grounds, 18 paces from the outer fence of the race track, and 14 paces east from the prolongation of the east line of the west track. It is 35 paces northeast from an elm tree 4 feet in diameter. It is in line with the third row of trees from the north fence of the grounds, and 9 feet east of the sixth row of trees from the woods

Descriptions of stations—Continued.

NEW YORK—Continued.

to the west. The station is marked by a white marble post 9 by 9 by 20 inches, projecting 3 inches above the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	°	′	
Spire of Methodist Church (mark)	72	38.6	east of north
Spire of Baptist Church	77	28.1	east of north
Spire of Presbyterian Church	66	17.5	east of north
North end of gable of roof on baseball stand	15	19.7	east of south

Penn Yan, Yates County.—The station is on the fair grounds of the Yates County Agricultural Association, southwest of the city, and southeast from Lake street. It is in the open space inside the race course at the south end. If a line be drawn perpendicular to Lake street through the station, 95 feet along this line measures the distance between the station and the inside edge of the race course at the southeast side, and upon a line parallel to Lake street 191 feet measures the distance to inside edge of race course on the southwest of station. Measuring along these lines it is 145 feet to the southeast and 250 feet to the southwest to the board fence around the fair grounds. It is marked by a cement post 8 by 8 by 28 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Gable of brick schoolhouse	32	54.2	west of north
Staff on spire of hardware store	21	43.0	east of north
The north edge of chimney on Mr. L. J. Ogden's residence	77	38.2	east of north

Plattsburg, Clinton County.—The station of 1905, in the target-practice grounds of the army post, was reoccupied. It is in line with the row of posts marking the 300-yard range and is 165 feet from post No. 8. The station is 215 feet southeast of the road along the side of the grounds, and about 50 feet southeast of the end of a trench and low embankment. The station is marked by a marble post 6 by 6 by 30 inches, lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
Flag pole at center of middle tower on Hotel Champlain (mark)	19	28.1	east of south
Gable of house (one-half mile distant)	12	55.0	west of north
West gable on south end of band quarters	44	20.3	east of north
Spire of St. Peters Church	8	31.2	west of north

Rochester, Monroe County.—The station is in Highland Park, on a ridge about 1 000 feet northeast from the fountain of Mount Hope Reservoir. A line from the center of the children's pavilion in the park to the center of the Duffy-McInnerney block at the corner of North Main and West Fitcher streets passes through the station, which is about 400 feet distant from the pavilion. A meridian line was established, and the stone at the north end of this line marks the station. The south stone is a few paces north of the refreshment store at the pavilion. The two stones (park monuments), each 4 by 4 by 66 inches, were set flush with the ground. The north stone is roughly lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Pole on tower of Sibley Building (mark)	4	27.2	west of north
South one of four spires on St. Pauls Church	40	06.8	east of north
Tip on center of children's pavilion	20	09.7	east of south
Pole on armory	21	39.3	east of north

Santa Clara, Franklin County.—The station is on a knoll about one-eighth of a mile southwest from the railway depot. Observations were made over a granite rock slightly north of the center of the knoll. This rock is exactly in line with the east end wall of Upland Sanitarium for Working Girls, and is 108 paces south from the center of the east and west road which passes in front of the sanitarium. The top of the rock is about 2 feet square and projects about 3 inches above the surface of the ground.

Descriptions of stations—Continued.

NEW YORK—Continued.

A chisel hole marks the exact spot, and the rock is lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Rod over bay window (mark)	73 33.8	east of north
Southwest gable on railroad depot	83 00.0	east of north
East end of gable on Upland Sanitarium	0 26.8	west of north

Schoharie, Schoharie County.—The station is in the northeast corner of the county fair grounds. It is 65 feet from the east fence and 62 feet from the north fence of the grounds. It is 28 feet from the row of elm trees to the north and 30 feet north from the outer edge of race track. The station is marked by a marble post 6 by 6 by 24 inches, projecting 4 inches above the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	° ′	
Rod on fair ground building (mark)	30 50.8	east of south
Southwest edge of court-house, lower tower	69 59.6	east of south
Lutheran Church steeple	78 15.6	east of south

Syracuse, Onondaga County.—The station is on a hill just west of Woodland Reservoir, about 2½ miles southwest of the center of the town. It is 85 feet south of the fence around the pleasure drive at the top of the hill, and 46 feet, measured by tape on hillside, from the fence below on the west side of the reservior tract. It is exactly on the east and west line of the brick gatehouse at the southeast side of the reservoir. The station is marked by a marble post 6 by 6 by 32 inches, projecting 8 inches above the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	° ′	
Main spire on Crouse College, Syracuse University (mark)	66 54.6	east of north
Pole above cupola on Onondaga Hill Church	10 06.6	west of south
Southwest corner of brick gatehouse at east side of reservoir	73 47.2	east of north

Ticonderoga, Essex County.—The station is in Mount Hope Cemetery, one-half of a mile north from the center of the village. It is on a piece of abandoned ground at the southwest corner of the old part of the cemetery, just north of the main driveway, along the south fence and just east of a proposed driveway between the old and the new parts of the cemetery. It is 85.2 feet from the south fence, 73.3 feet southwest from the southwest corner of the base of the Erastus E. Goodspeed monument, and 179.7 feet southeast from the southwest corner of the large G. H. Hooper monument. The station is marked by a marble post 6 by 6 by 24 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Tip of Deland monument (mark)	77 58.9	east of north
Southeast edge of the Wilson monument	41 25.9	east of north
Southwest edge of G. H. Hooper monument just above the base stone	26 42.4	west of north

Watertown, Jefferson County.—The station is in the City Park, on a hill about 500 feet northwest from the standpipe, nearly in line with it and the primary monument of the park survey. It is 238.1 feet northwest from the monument and 141.5 feet south from a lone shade tree. The station is marked by a marble post 6 by 6 by 23 inches lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Spire of First Presbyterian Church (mark)	61 31.6	west of north
Cross on Jesuit Church north of river	37 00.2	west of north
Church of the Redeemer (Episcopal)	21 53.6	west of north
Pit in center of primary monument	46 37.5	east of south

Watkins, Schuyler County.—The station is on the county fair grounds, five-eighths of a mile south of the main part of the city. A line perpendicular to the center of the main building, by the gate, passes through the station, which is near the eastern end of the oval space inside the race course. Measuring along this line, the station is 40 paces from the inside edge of the race course to the east and 23

Descriptions of stations—Continued.

NEW YORK—Continued.

paces from the inside edge of the race course to the north. It is 425 paces from the interurban trolley line and about 30 rods from the Northern Central tracks. The station is marked by a cement post 9 by 9 by 36 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Small staff on red-tiled tower of school building (mark)	32	40.4	west of north
Pole at center of main building	69	18.3	west of south
Steeple at Montour	27	47.7	east of south

NORTH CAROLINA.

Goldsboro, Wayne County.—The station of 1906 was reoccupied. It is in the southeast corner of the court-house grounds, 57.8 feet from a large tree on Chestnut street and 56.1 feet from a large tree on Williams street. It is marked by a granite post 6 by 6 by 54 inches lettered N. C. G. S., U. S. C. S., and projecting about 8 inches above the ground.

As the old station was found unsuitable for future magnetic work, a new station was established in the southern part of the City Park, about 1 mile southeast of the center of the town and about 255 feet a little east of south of the park shelter house. It is 50.3 feet from the edge of the east brick border of the road to the west, which runs south from the main gate, and 134.7 feet from the fence on the south border of the park. The station is marked by a limestone post 6 by 6 by 30 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Northeast corner of tower of Wayne Cotton Mill	42	53.1	west of north
North cupola of Dawson home	50	04.5	west of south

NORTH DAKOTA.

Balfour, McHenry County.—The station is near the west side of the street which runs between the public-school grounds and the Swedish Church. It is 54 feet from the west fence of the schoolhouse grounds and 115 feet north of the northwest corner of the church. The station is marked by a post 6 by 6 by 24 inches lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Gable on elevator (mark)	24	32.9	west of south
Cross on Swedish Church	6	26.9	west of south
Flag pole on schoolhouse	64	29.4	east of south

Bismarck, Burleigh County.—The station of 1890 could not be recovered. A new station was established in the southwest part of the court-house yard, 42.2 feet from the south fence and 84.4 feet from the west fence. The station was temporarily marked by a 2-inch peg, but was to be permanently marked by the county surveyor. The following true bearings were determined:

	°	′	
Spire of Catholic Church (mark)	68	28.9	east of south
Flag pole on Web block	32	36.7	west of south

Cooperstown, Griggs County.—The station is in the northwest part of the court-house grounds, 41 feet from the west fence and 38.2 feet from the north fence. The station is marked by a cement post 8 by 8 by 18 inches, sunk 1 inch below the surface of the ground, and lettered U. S. The following true bearings were determined:

	°	′	
Seventh post east of the southwest corner of the fence (mark)	6	35.8	east of south
Flag pole on court-house	49	47.1	east of south
Point on water tank in yard north of grounds	3	28.9	east of north

Fessenden, Wells County.—The station is in the northwest part of the fair grounds, southeast of the town. It is 76 feet from the southwest end of the gate at the main entrance and 65 feet from the northwest corner of the fence southwest of the gate. The station is marked by a post 6 by 6 by 24

Descriptions of stations—Continued.

NORTH DAKOTA—Continued.

inches, sunk flush with the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Flag pole on judges' stand (mark)	20 43.3	east of south
Cross on church belfry	9 28.8	east of north
Flag pole on schoolhouse	23 45.6	east of north

Forman, Sargent County.—The station is in the open ground north of the railroad yards and northeast of the town. It is east of a small lake which is just in front of the depot and 310 feet from the railroad track. The station is marked by a 1-inch hole drilled in a large stone, which shows about 4 square feet of surface above the ground. The following true bearings were determined:

	° ′	
West edge of depot chimney (mark)	14 16.3	west of south
Spire on church	56 42. 2	west of south
Weather vane on church	64 14.2	west of south

Glen Ullin, Morton County.—The station is in the open space just west of the town and east of a draw running north and south. It is 107 feet south of Main street extended, 180 feet from the bridge where Main street crosses the draw, 108 feet east of the center of the draw, and 108 paces from the south bridge across the draw. The station is marked by a rough stone showing a surface of 4 by 7 inches, projecting 1 inch above the ground and lettered U. S. It has a small drill hole to indicate the exact spot. The following true bearings were determined:

	° ′	
Flag pole on schoolhouse (mark)	78 02.7	east of south
Cross on church spire	83 44.8	east of south
Point on railroad water tank	67 26.7	east of north

Grafton, Walsh County.—The station is in the southeast part of the public-school grounds, just north of the court-house grounds. It is 15 feet from the east line of the school grounds and 36 feet from a row of trees to the south. It is marked by a wooden post 6 by 6 by 24 inches lettered U. S. C. & G. S., 1907. The following true bearings were determined.

	° ′	
South gable of church belfry (mark)	86 23.3	west of south
Flag pole on schoolhouse	77 43.2	west of north
Flag pole on court-house	43 07.4	west of south

Hillsboro, Traill County.—The station is in the northeast part of the public school grounds, east of the town. It is 20 feet from the east line and 28 feet from the north line. It is marked by a cement post 8 by 10 by 30 inches, set flush with the surface of the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′′	
Center of base of second telegraph pole from southeast corner of grounds (mark)	5 31.0	west of south
South edge of flag pole in school grounds	75 35.9	west of south
Church spire	84 00.5	west of north

Jamestown, Stutsman County.—The station of 1896 was reoccupied as nearly as could be determined. The station is in a large open space on the west side of the North Side public school. It is between Second and Third avenues, on the north side of Fifth street. It is marked by a cement post 4 by 8 by 16 inches, lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Point on court-house mark)	7 35.5	west of south
Court-house flag pole	11 40.6	west of south
South Side schoolhouse flag pole	6 06.7	west of south

Lansford, Bottineau County.—The station is northwest of the town in a large open space south of the Soo depot. It is 51 feet from a fence on the west and 243 feet from the northeast corner of

Descriptions of stations—Continued.

NORTH DAKOTA—Continued.

this fence. Observations were made over a large stone projecting 3 inches above the ground; a small hole in the stone indicates the exact spot. The following true bearings were determined:

	°	′	
Cross on church south of the Ruford Hotel (mark)	40	31.7	east of south
West edge of depot chimney	1	15.2	west of north
Gable of C. G. Irey's elevator	14	17.7	west of north

Mercer, McLean County.—The station is on open ground south of the town, almost due south of the Great Western elevator and 384 feet from the sidetrack. The station is marked by a post 6 by 6 by 24 inches, projecting 8 inches above the ground, with stones piled about it, and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Gable of elevator office mark)	7	13.8	east of north
Point on railroad water tank	78	12.7	east of south

Minnewaukon, Benson County.—The station is in the northwest part of the court-house grounds, 60 feet from the west fence and 50 feet from the north fence. The station is marked by a post 6 by 6 by 24 inches, projecting 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Northwest corner of court-house water table mark)	53	22.3	east of south
Flag pole on court-house	78	41.3	east of south
West corner of depot chimney	19	12.9	west of north

Steele, Kidder County.—The station is in a large, open space in the northwest part of the town. It is 135 feet almost due south of the public school building and 169 paces from the west side of Main street. The station is marked by a 3-inch stake driven flush with the ground. The following true bearing was determined:

	°	′	
Gable of Presbyterian Church mark)	76	01.3	east of south

Towner, McHenry County.—The station is within the athletic park northeast of the town. It is 90 feet southwest of the bleachers, 13 feet from the fourth post west of the bleachers, and 32 feet northwest of first base. The station is marked by a wooden post 6 by 6 by 24 inches, projecting 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Flag pole on elevator mark)	87	00.2	west of south
Flag pole on schoolhouse	49	45.2	west of south

Valley City, Barnes County.—The station is in the southwest part of the court-house grounds, west of the public school. It is 43.3 feet from the west fence and 82.6 feet from the south fence. It is marked by a cement post 6 by 12 by 27 inches, projecting 1 inch above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Ornament on south gable of public library mark)	87	26.4	east of south
Flag pole on schoolhouse	86	13.2	east of north
Flag pole on court-house	26	20.8	east of north

OREGON.

Jacksonville, Jackson County.—As the station of 1906 had been destroyed, a new station was established about 60 feet south of the old station and in the line to Table Mountain. It is in the grounds surrounding the public school, about one-fourth of a mile east of the center of the town. It is 105.2 feet south of the north fence of the schoolhouse grounds, 66.4 feet east of the west fence of grounds, and just north of gravel walk running westward from the main entrance of the schoolhouse. It is almost directly at right angles to the west face of the building from the south side of the brick pilaster

Descriptions of stations—Continued.

OREGON—Continued.

at the north side of the steps of the west entrance. The station is marked by a small drill hole in a brick placed end up and top flush with the ground. The following true bearings were determined:

	°	′	
Flagstaff on court-house mark)	68	44.4	west of south
Small spire on east end of ornamental ridge of Mr. Hoffman's house	65	15.6	west of north
Gable of square white house	37	54.4	west of north
Flagstaff on schoolhouse	86	01.1	east of south
Presbyterian Church spire	43	49.6	west of south

Roseburg, Douglas County.—The station is located on the east bank of the Umpqua River, on the open lot on the north side of the second street south from the railway depot at Roseburg. This is the first street south of the big bridge crossing the Umpqua River and west of the depot. The lot is owned by Doctor Hamilton, of Roseburg. The station is near the southwest corner of the lot, 66.6 feet from the fence on the east and 12.1 feet from the property line on the north side of the street. The station is marked underground by an inverted bottle, the center of the bottle marking the station. The surface mark is a piece of 3-inch sewer tile, 12 inches long and flush with the surface of the ground, center of top marking station. The following true bearings were determined:

	°	′	
High school spire mark)	36	02.3	east of south
East edge of brick chimney on old house	61	09.2	west of south
East edge of west chimney of large square white house house No. 47)	80	40.6	east of north
Roseburg Astronomical Station	16	09.3	west of north

PENNSYLVANIA.

Lewisburg, Union County.—The station of 1900 being no longer available, a new station was established on the campus of Bucknell University. It is 162 feet northwest from the academy building and 17.5 feet back from a line along the southwest side of the building. It is about 200 feet from the southwest road and the same distance from the northwest road bounding campus. Two large oak trees are on line 6 paces northeast of the station. The station is marked by a marble post 9 by 9 by 24 inches, projecting 2 inches above the surface of the ground and lettered C. & G. Survey, 1907. The following true bearings were determined:

	°	′	
Central rod on Miller's barn (mark)	35	33.0	west of south
West edge of West College (third story)	46	43.2	east of south
Octagonal monument in cemetery marked Sharkley	71	15.4	west of north

Tunkhannock, Wyoming County.—The station of 1902 was reoccupied. It is in Sunnyside Cemetery, on a piece of reserve ground at the center of the cemetery, 22.3 feet southeast from the Kunzman monument, 30.4 feet east of the northeast corner of the base of the Billings monument, and 15.3 feet west of the small Walter monument. The station is marked by a St. Lawrence marble post 6 by 6 inches, projecting about 1 inch and lettered U. S. C. & G. S., 1902. A meridian line was established, using the old stone for the north stone and setting a second St. Lawrence marble post, 6 by 7½ by 36 inches, 100 paces south for the south stone. This south stone sets 2 feet inside the cemetery fence and 14 paces west from the main gate to cemetery. It is set 3 inches above ground and marked C. & G. S., 1907, Meridian Mark. The following true bearings were determined in 1907:

	°	′	
Court-house staff (mark)	89	04.3	west of south
Methodist Church spire	88	06.8	west of south

Williamsport, Lycoming County.—The station of 1901 was reoccupied. It is the south stone of the meridian line established in Brandon Park by the United States Geological Survey. The line is

Descriptions of stations—Continued.

PENNSYLVANIA—Continued.

about 500 feet long and is marked by stone posts 5 by 8 inches in cross section. These posts project about 4 inches bove the surface of the ground. The south stone is about 100 feet east, slightly north, of a large granite drinking fountain. The north stone of meridian line was used as the mark.

PHILIPPINE ISLANDS.

Atimonan, Tayabas.—The station is on a hill back of Atimonan, almost due south of the church. This hill is conspicuous as being the only one uncultivated. It is part of the first ridge back of the town and about 300 feet high. Calle Mariano Pilapil, if continued, would run almost into the station. The station is on the northeastern part of the summit near the beginning of the slope. The station is marked by an irregular shaped rock about 9 by 18 by 18 inches, sunk flush with the surface of the ground. A hole 2 inches deep and one-h[illegible] inch in diameter drilled into the rock marks the exact spot. The center is 11.6 feet S. 38° W. of a triangle cut in the stump of a small sapling. It is also 14.1 feet N. 22° E. of another triangle cut in a small tree, and 21.0 feet N. 64° E. of a triangle cut in still another small tree. The last two trees are the largest in a row of trees forming a sort of hedge over the crest of the hill. The following true bearings were determined:

	° ′	
Church tower Atimonan	1 04.8	west of north
Edge of trees Sangirin Point	2 26.0	west of north
Right E.) tangent, Baliscan Island	4 17.9	west of north
Left W.) gable, municipal building	40 27.2	east of north

Cauit Island, Cebu Harbor.—The station is on the western shore of Cauit Island, in a small bight and about 25 feet from high water mark It just permits sight of Lipata Reefs Light between one of the outhouses belonging to the Marine Hospital Service and the line of trees. The station is almost in range with Lipata Reefs Light and the double white tower on Cebu Island. It is marked by a big rock about 9 by 9 by 24 inches, sunk flush with the surface of the ground. A triangle of 6-inch side cut in the trunk of one of the largest trees is 68.2 feet S. 80° E. of the station. A triangle of 8-inch side cut in the trunk of another of the largest trees about 16 inches above the ground is 91.9 feet S. 16° E. of the station. The northwest corner of the most southwesterly outhouse on the island is 160.4 feet S. 11° W. of the station. The following true bearings were determined:

	° ′	
Lipata Reefs light-house	6 22.7	west of south
Pardo Church	68 59.2	west of north
Right of two towers on hillside, Cebu Island	6 45.5	east of north
Lanis Ledge light-house	33 56.2	east of south

Cebu, Cebu.—The station of 1901 was reoccupied as nearly as could be determined. It is about 100 feet south of the Cebu astronomical station. The station is probably within 10 or 15 feet of the old one, the exact location of which could not be recovered. The station was not marked as the harbor improvements now in progress would destroy it. The following true bearings were determined:

	° ′	
Lanis Ledge light-house	5 22.6	west of south
Flag pole on south end of building on southwest corner Calles Magallanes and Martieres	54 37.1	west of north

Davao, Mindanao.—The station is about half a mile north of the town of Davao and about a mile from the boat landing. It is on a small hill on which the cemetery is located, on an unfenced road that is the prolongation of Magallanes street. The station is on the east side of the road, the cemetery on the west side about 200 feet farther on. The knoll is nicely grass covered and has a few shrubs on it. For the most part it is open. The station is almost on the highest part and should be easily recovered. It is about 65 feet from the traveled part of the road. The station is marked by a cement post

Descriptions of stations—Continued.

PHILIPPINE ISLANDS—Continued.

5 by 6 by 18 inches, projecting about 1 inch above the ground, the top being marked with a 3/8-inch drill hole and the letters U. S. 07. The following true bearings were determined:

	°	′	
High tree on Samal Island mark)	72	29.2	east of south
South peak on Samal Island	59	34.2	east of south
Cocoanut tree east side of road, near edge of town	48	14.2	east of south
Middle of Magallanes street	46	19.2	east of south
Nearest corner of cemetery	75	12.8	west of south
Left tangent to cemetery chapel	83	28.8	west of south

Matarinao Bay, Samar.—The station is just inside the left hand entrance to Matarinao Bay, on the southeastern coast of Samar. It is practically the same as triangulation station Rock, 1906. The station was placed on the beach in range with triangulation station Petra, and at about high-water mark. The inclined distance from the drill hole of triangulation station Rock to the station stub was 55.3 feet. The rock is about 12 feet high. No permanent mark for the station could be established. The mark used was triangulation station Petra about 2 miles to the eastward. The following true bearing was determined:

	°	′	
Mark	55	07.1	east of north

Romblon, Romblon.—No description furnished with record.

Zamboanga, Mindanao.—The station is the triangulation station called Santa Cruz on Great Santa Cruz Island, just opposite Zamboanga and about 2 miles away. The triangulation station was occupied by a party from the steamer *Fathomer*. The following true bearings were determined:

	°	′	
Astronomic station on Fort Pilar	30	32.1	east of north
South stack No. 5) of ice plant	40	44.6	east of north
Light-house, Little Cruz Island	60	50.0	west of north
Flagstaff on Provincial Building	20	19.0	east of north
Flagstaff army parade grounds	27	36.4	east of north

PORTO RICO.

Mayaguez.—The station of 1905 could not be found, so a new one was established as near to it as could be determined from the description. The new station is about in the center of the open space in front of the Roosevelt School (formerly the United States Military Hospital). It is about 100 feet from the northwest corner of the wire fence in front of the school, about 63 feet from the corner of the board fence on the north, and about 70 feet from the northeast corner of the shack directly in front of the school building. The station is marked by a pine stake. The following true bearings were determined:

	°	′	
Nearest edge of chimney on sugar mill (mark)	55	33.8	west of north
Southwest tangent to United States barracks	15	35.9	west of north
Southwest tangent to Roosevelt School	31	26.7	east of south

Porto Rico Magnetic Observatory, Vieques Island.—Since April, 1907, the observatory has been in operation at the new site, about five-eighths of a mile west of old Fort Isabel, the former location. The buildings comprise an absolute observatory, variation observatory, seismograph house, and an office.

San Juan, South Base.—The station of 1904 was reoccupied. It is in range with and between Morro Light-house and South Base triangulation station, 20 paces from the latter. The following true bearing was determined:

	°	′	
Morro Light-house (mark)	37	09.4	east of north

Descriptions of stations—Continued.

SOUTH CAROLINA.

Aiken, Aiken County.—Station A of 1904 was reoccupied as nearly as could be determined. It is located in the park which is in the middle of the street passing in front of the Immanuel Training School. It is northwest from the northwest corner of this school, 68.9 feet from a board fence on the west side of the street, and 117.4 feet from the hydrant near the northwest corner of the school building. It was marked by a sandstone post, 5 by 6 inches, projecting 5 inches above the ground. The following true bearings were determined:

	°	′	
Cross on steeple of Catholic Church (mark)	28	59.9	west of south
Spire on Baptist Church	57	06.0	west of south
Cupola of Ott Hotel	39	38.6	west of north

Columbia, Richland County.—The station of 1905 was reoccupied. It is the south stone of the meridian line established by the United States Geological Survey in 1900. It is on the golf links east of the brick wall inclosing the buildings of the South Carolina College and just across the road from the southeast corner of the brick wall. The north stone is on the northern margin of the tennis courts. The following true bearings were determined in 1908:

	°	′	
A weather vane with arrow and eagle on green cupola (mark)	10	09.0	east of north
North meridian stone	0	00.5	west of north

Florence, Florence County.—The station of 1903 was reoccupied. It is in the central avenue of the Florence National Cemetery, 1½ miles southeast of Florence. It is 68.5 feet from the west wall of the cemetery, 36.1 feet from an oak tree east of north, 51.1 feet from an oak tree almost due northwest of the station, and 34.6 feet from a hickory tree east of south. It is marked by a copper nail in the center of a hard pine block, 6 by 6 by 15 inches, set 1 inch below the surface of the ground.

The old station being unsuitable for future magnetic work, a new station was established, about 800 feet southwest of the old station, on the grounds of the Industrial School. The station is marked by a cement post 4 inches square on top and projecting about 3 inches above the ground. A second stone, about 6 inches square and projecting about 10 inches above the ground, was set 300 feet north of the station to mark the true meridian. This second stone is 61 9 feet southwest of the northeast corner of the fence at the intersection of Morris Bluff road and Galliard street and 66.0 feet southeast of the northwest corner of the fence at the intersection of the same streets. The following true bearings were determined at the south stone:

	°	′	
Top of town water tank (mark)	28	51.8	west of north
Spire of Baptist Church	41	29.8	west of north
Base of spire on Methodist Church	31	01.4	west of north
Spire on cupola of court-house	31	46.3	west of north

SOUTH DAKOTA.

Aberdeen, Brown County.—The station of 1896 was reoccupied as nearly as could be determined. The station of 1907 is in the northeast part of the court-house grounds, 44.5 feet south of the north fence and 89.9 feet west of the east fence. The following true bearings were determined:

	°	′	
North side of north post of northeast gate	62	34.6	east of north
Weather vane on schoolhouse	57	15.5	east of north

Brookings, Brookings County.—The station is in the southeast part of the public school grounds near the intersection of Fourth street and Sixth avenue. It is 2.0 feet north of the line from the southeast corner of the schoolhouse to the southeast corner of the block and 113.2 feet from the schoolhouse. It is marked by a cement post, 8 by 8 by 28 inches, set 2 inches below the surface of the ground. The following true bearings were determined:

	°	′	
Southeast corner of chimney on small building (mark)	2	01.2	west of north
Southeast corner of schoolhouse	44	01.1	west of north

Descriptions of stations—Continued.

SOUTH DAKOTA—Continued.

De Smet, Kingsbury County.—The station is in the southeast part of the public school grounds, 100 feet west from the center of the street on the east and 84 feet north of the street on the south. It is marked by a cement post, 5 by 8 by 24 inches, projecting 4 inches above the ground, lettered on top U. S. and on the side 1907. The following true bearing was determined:

	° ′	
Southwest corner of the schoolhouse water table (mark)	25 09.2	west of north

Faulkton, Faulk County.—The station is in a meadow south of the Chicago and Northwestern Railway depot. It is almost due south of the telegrapher's window and about 300 feet from the edge of the platform. The station is marked by a cement post, 6 by 8 by 24 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	° ′	
Top of the Chicago, Milwaukee and St. Paul Railroad water tank	38 08.3	east of north
Ball on spire of the Catholic Church	14 29.7	west of north

Huron, Beadle County.—The station of 1900 was reoccupied. Observations were made over the south stone of the meridian line, which is in the court-house grounds near the south fence. The top of this stone is in the shape of a truncated pyramid, 24 by 24 inches at the base and 12 by 12 inches at the top, projecting 1 foot above the ground and lettered U. S. C. & G. S. The north stone is similar and is 338.5 feet distant. The following true bearing was determined in 1907:

	° ′	
North meridian stone	00 03.1	west of north

Salem, McCook County.—The station is in the east part of the high school grounds, 36 feet west of the east fence and 50 paces south of the north fence. It is marked by a cement post, 5 by 8 by 24 inches, projecting 2 inches above ground and lettered U. S., 1907. The following true bearings were determined:

	° ′	
Presbyterian Church spire (mark)	55 30.0	west of north
Cupola of fire-department building	75 14.4	west of south

Webster, Day County.—The station is in the southeast part of the public school grounds, 47.9 feet west of the east sidewalk and 43.4 feet north of the south walk. It is marked by a cement post, 8 by 10 by 24 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S., 1907. The following true bearing was determined:

	° ′	
Southwest corner of foundation of new part of schoolhouse (mark)	62 51.3	west of north

TENNESSEE.

Covington, Tipton County.—The station is in the southwestern corner of the grounds of the city school, about one-fourth of a mile southwest of the center of town. It is 51.8 feet east of the fence bounding these grounds on the west, 71.0 feet north of the fence on the south, and 17.0 feet from the center of the trunk of a small maple tree. It is marked by a Bedford limestone post, 5 by 6 by 20 inches, projecting about 3 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′	
Southeast corner of main building of flour mill, just under roof (mark)	3 38.6	west of north
Base of southwest corner of brick school building	61 51.1	east of north

Memphis, Shelby County.—The station of 1901 was reoccupied. It is in the southwest corner of the United States Marine-Hospital grounds, 33.0 feet from the upper edge of the terrace, which marks the southern boundary of the grounds, and 52.3 feet from the west fence. It is marked by a sandstone

Descriptions of stations—Continued.

TENNESSEE—Continued.

post, 6 by 6 inches on top, sunk flush with the surface of the ground. The following true bearings were determined in 1908:

	° ′
Center of iron pipe (mark)	70 22.7 east of south
Southwest corner of asylum office building	84 45.7 east of south

Ripley, Lauderdale County.—The station is north of the city school building, about three-fourths of a mile south of the center of the town. The growth of bushes and weeds was too great for accurate measurements, but the position of the station is approximately 231 feet from the northeast corner of the school building, 204 feet from the northwest corner of the school building, 30 feet east of a steep bank, 65 feet northeast from a tree about 2½ feet in diameter, and 103 feet northwest of a tree about 3 feet in diameter The station is marked by a Bedford limestone post, 5 by 6 by 20 inches, projecting about 4 inches above the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	° ′
Steeple of colored Baptist Church (mark)	28 29.4 east of north
Steeple of a small wooden church	24 40.7 east of north
Point at top of east roof of the school building	8 00.6 east of south

TEXAS.

Austin, Travis County.—The station of 1906 was reoccupied. It is in the northwest part of the grounds of the State Deaf and Dumb School and is the north end of a meridian line 570 feet long. The south end of this line is about 6 feet from the northwest corner of the laundry building. Both stones are lettered U. S. C. & G. S., the south stone being set flush with the ground. The following true bearings were determined in 1906:

	° ′
Middle tower on main building of University of Texas (mark)	17 49.4 east of north
Congregational Church spire	19 44.8 east of north
Cross over entrance to St. Mary's Academy	33 28.9 east of north
East spire, main building, Deaf and Dumb School	17 04.6 east of south
South meridian (mark)	0 01.4 east of south

Groesbeck, Limestone County.—The station of 1901 was reoccupied as nearly as could be determined. The station is on the grounds of the public school. It is now 71.5 feet from the northeast corner of the school building and 100.5 feet from the northwest corner of the same. It is marked by the neck of a green glass bottle, buried 4 inches below the surface of the ground. The following true bearings were determined in 1908:

	° ′
Spire of Baptist Church	60 03.2 east of south
Tip of cupola of Mark Allison's house	38 31.6 west of north

Lagrange, Fayette County.—The station of 1902 was reoccupied. It is near the southeast corner of an unoccupied square known as the City Park. The station is 94.5 feet from the south fence and 61.5 feet from the east fence and is marked by a limestone post 7 by 10 inches on top, set flush with the ground and lettered U. S. C. & G. S., 1902. The following true bearing was determined in 1902:

	° ′
Cross on Episcopal Church (mark)	13 08.4 west of north

VERMONT.

Hyde Park, Lamoille County.—The station of 1905 is north of the village, west of the Eden road, and in a pasture belonging to Mr. Vernon D. Fitch, west of his house and barn. A pine tree 48.5 feet from the station bears 6° west of north. The highest part of a limestone ridge 115 yards away bears 60½° east of south, and a stone pile a little south of east is 105 feet distant. Observations were taken

Descriptions of stations—Continued.

VERMONT—Continued.

over a cross mark chiseled in a low protrusion of white limestone. The uncovered part of this stone is about 30 inches long and 18 inches across, only a few inches above ground and rather flat. The letters U. S. are also cut on the stone.

The observations in 1907 were made over a point 42.0 feet from the station of 1905 and in exact line between the station and the vane on town hall. The station is also east of the North Hyde Park road, just north of its junction with the Battle Row road, being 140 paces northward from the junction along the road and 70 paces eastward from the fence line. It is about one-fourth of a mile north of the new cemetery and near the southeast corner of a grove of trees in the pasture. The following true bearings were determined in 1907:

	°	′	
Vane on town hall (mark)	15	14.6	west of south
Spire of Congregational Church	26	47.9	west of south
Cross on Catholic Church	46	37.7	west of south

WASHINGTON.

Dungeness, Clallam County.—The station is on Dungeness spit about 700 feet west of the light-house and about 20 feet east of Dungeness triangulation station, which is marked by a white concrete pier. The magnetic station is marked by a wooden stub 4 by 4 inches, and is probably identical with the magnetic station of 1892. The following true bearings were determined:

	°	′	
Bluff triangulation station (mark)	54	02.8	west of south
Spit triangulation station	71	00.8	west of south
Dungeness triangulation station	86	49.8	west of south
Stack on old fog signal	79	40.6	east of north
Flag pole at Dungeness Light-house	86	41.8	east of north
Dungeness Light-house	84	04.7	east of south

Port Angeles, Clallam County.—The station is about half a mile west of the light-house on the spit which forms the harbor. It is about the center of the spit and about 200 yards west of the station of 1904. The following true bearings were determined:

	°	′	
Methodist Church spire (mark)	4	09.0	west of south
Station of 1904	88	32.2	east of south
Ediz Hook Light-house	82	55.2	east of south

Declination observations were also made at the station of 1904, which is marked by a fir post about 1 foot square and projecting about 10 inches above the ground.

Port Orchard, Kitsap County.—The station of 1906 was reoccupied. It is on a knoll in the southwest corner of the court-house square, 52 feet from the southwest corner stake, about 14 feet from the west line of the square, and 280 feet from the northwest corner of the court-house. The station is marked by a 6-inch sandstone monument, lettered U. S. C. & G. S., 1906, set about 33 inches deep and projecting about 4 inches above the ground. The following true bearings were determined:

	°	′	
Navy-yard flagstaff (mark)	6	59.0	east of north
West tangent to administration building	8	13.2	east of north
Southeast corner main building	11	14.1	east of north
East edge of base of power-house chimney	13	08.2	east of north
Northwest corner of court-house	50	19.0	east of north

Seattle, King County.—The station of 1903 was reoccupied. It is in the grounds of the State University, about 600 feet north of the administration building, 315 feet from the southwest corner of the gymnasium, and 20 feet west of the path between the administration building and the gymnasium.

Descriptions of stations—Continued.

WASHINGTON—Continued.

The station is marked by a stone post 8 inches square, projecting 2 inches above the ground and lettered U. S. C. & G. S., 1903. The following true bearing was determined:

	° ′
East corner of administration building (mark)	23 08.9 west of south

Striped Peak, Clallam County.—Observations were made as near the station of 1893 as could be determined from the description. It is about a mile east of Crescent Bay, near the triangulation station Striped Peak, which is marked by a concrete pier 12 by 12 by 50 inches.

WISCONSIN.

Baraboo, Sauk County.—The station is in the Protestant cemetery, in the center of a graded drive on the west side. It is 38.2 feet due west of the center of the base of a light-colored monument lettered Emery, and 40.5 feet northwest of a smaller dark-colored monument marked Emery. It is marked by a rough Bedford limestone post 4½ inches square on top, set about 1 inch below the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′
Right edge of base of flag pole in cemetery	1 38.6 east of south
Dead tree on hill across valley	12 04.6 east of south
Left edge of monument	33 44.1 east of south

Barron, Barron County.—The station is in the city baseball park, 165 feet west of the board fence along the east side of the grounds and 187 feet north from the wire fence along the south side of the grounds. The station is marked by a cement block 4 by 8 by 24 inches sunk flush with the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′
Steeple of church (mark)	4 23.7 east of south
Apex of cone-shaped roof of water tank	7 56.2 west of south
Southeast corner of Mr. Heffner's house	40 15.9 east of north

Dodgeville, Iowa County.—The station is in the Dodgeville Cemetery, in the older part, toward the south side and west of the main drive. It is 60.0 feet from the fence along the south side, 107.5 feet west from the main drive running north and south, 8.5 feet northeast of the monument marked Edmunds, and 11.8 feet from the monument marked Williams. The station is marked by a Vermont marble post, set flush with the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′
Spire of Catholic Church (mark)	74 59.9 west of south
Spire of Welsh Church	70 59.2 west of north
Cupola of schoolhouse	72 50.5 west of north

Glidden, Ashland County.—The station is on a hill northeast of town, near the Catholic cemetery. It is 90 feet from the northwest corner of the fence around the old Catholic Church, 75 feet from the southwest corner of the cemetery, and 45 feet south of the fence continuing west from the cemetery. It is 8 feet east of a large round stone. The station is marked by a rough stone 5 by 8 by 16 inches, set flush with the surface of the ground. The following true bearings were determined:

	° ′
Left side of sawmill chimney (mark)	82 40.1 west of south
Cross on Catholic Church	6 32.6 west of south

Hayward, Sawyer County.—The station is in the fair grounds to the west of the town, about 110 feet from the entrance. It is 79 feet from the board fence to the east and 92.5 feet from the board

Descriptions of stations—Continued.

WISCONSIN—Continued.

fence to the north. The station is marked by a cement post 4 by 8 by 24 inches, sunk flush with the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Church steeple (mark)	19	53.0	west of south
Cupola of schoolhouse	7	34.7	west of south
Spire of Catholic Church	27	41.0	east of south
Cupola of court-house	59	23.8	east of south

Iron River, Bayfield County.—The station is in the northeast corner of the Protestant cemetery, east of the town. It is 58 feet from the board fence to the east and 71 feet from the fence to the north. The station is marked by a cement post 8 by 8 by 18 inches, set flush with the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Cupola of schoolhouse (mark)	64	16.4	west of south
Highest point of railroad water tank	86	54.3	west of south
Cupola of schoolhouse north of town	82	55.7	west of north

Janesville, Rock County.—The station is in the large cemetery, on the edge of an unused drive, about 150 feet south and a little west of the waiting room. It is 36 feet east of south of a large white-oak tree and 48 feet west of south of the base of a monument marked Sandow. The station is marked by a limestone post 6 by 6 by 24 inches, set flush with the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Center of base of cross on James Hart monument in Catholic cemetery	24	40.0	east of north
Right edge of William Grimm monument	76	15.6	west of north

Jefferson, Jefferson County.—The station is on the campus of the Jefferson High School, 156 feet due north of a point midway between the first and second windows of the high school, counting from the east. The station is marked by a limestone post 6 by 6 by 24 inches, set about 1 inch below the surface of the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Cupola on city hall	83	39.4	east of south
Spire on German Methodist Church	85	51.4	east of north
Spire on Catholic Church	75	53.6	east of north
Spire on Lutheran Church	70	56.0	east of north

La Crosse, La Crosse County.—The station of 1900 was reoccupied. It is inside the race course at the fair grounds, about 1 mile east of the town. It is 81.7 feet east of the race-track fence and 134.1 feet northeast from the northeast corner of the judges' stand. It is marked by a Bedford stone post 8 inches square, set flush with the ground and lettered U. S. C. & G. S. The following true bearings were determined in 1907:

	°	′	
Gable of roof (mark)	3	35.7	east of south
Southeast corner of exposition building	24	54.7	west of south

Ladysmith, Rusk County.—The station is in the southeast corner of the court-house square, 44.5 feet from the inner edge of the sidewalk on the east, 76.5 feet from the inner edge of the sidewalk on the south, and 79.2 feet from the southeast corner of the court-house. It is marked by a cement post 2 feet long and about 3 by 5 inches at the top. The following true bearings were determined:

	°	′	
Steeple of German Lutheran Church (mark)	84	18.7	west of north
Cupola of schoolhouse	81	04.0	west of north
Cupola of Mr. Thomas's house	3	12.4	east of south

Descriptions of stations—Continued.

WISCONSIN—Continued.

Madison, Dane County.—The station of 1900 and 1905 was reoccupied. It is on the grounds of the State Agricultural Farm, 277.5 feet from the wire fence along the east side of the meadow and 98.4 feet from the wire fence along the south side. The station is marked by a Bedford limestone post 8 inches square, set 6 inches below the surface of the ground. The following true bearings were determined in 1907:

	°	′	
Cupola on dairy barn	18	39.9	west of south
Tower on C. E. Buell's residence	7	26.9	west of south
Cupola on horse barn	16	57.7	east of south

Medford, Taylor County.—The station is in the fair grounds, about 300 feet north of the entrance to the grounds, in the open space between the small sheds on the west side of the grounds and the main barns. It is 120 feet north of the fence along the north side of the small lot or corral and 169 feet west of the fence along the outside of the race track. The station is marked by a cement post 4 by 8 by 24 inches, set flush with the ground. The following true bearings were determined:

	°	′	
Southwest corner of Mr. Fred Seidle's residence (mark)	9	18.3	west of north
Southwest corner of large new barn on the Schweppe farm	83	57.3	east of south
Rod on judges' stand	79	24.3	east of north

Monroe, Green County.—The station is in the fair grounds, 82.5 feet northwest of the northwest corner of Agricultural Hall and 131.0 feet north of the fence along tne outside of the race track. It is marked by a limestone post 6 by 6 by 24 inches, set flush with the surface of the ground. The following true bearings were determined:

	°	′	
Highest rod on court-house	88	23.0	west of south
Center of base of rod on Floral Hall	81	53.3	west of south

Phillips, Price County.—The station is in the cemetery, about midway between the drives leading west from the first and second entrances to the cemetery. These drives are about 150 feet apart. It is in a cross drive running north and south. There are four lots between the station and the fence along the east side. The station is 100.0 feet from the east fence, 32.5 feet west of the Harmidas Boyer monument, and 20.5 feet east of the Carrie Cochran monument. The station is marked by a rough hard limestone rock about 2 feet long, tapering to about 4 by 4 inches at the top, set flush with the ground. The following true bearings were determined:

	°	′	
Court-house cupola (mark)	4	36.9	west of south
Schoolhouse cupola	16	51.5	west of south
Swedish Church steeple	27	10.5	west of south

Solon Springs, Douglas County.—The station is on the grounds belonging to Mr. Nick Lucius, about 50 feet from the edge of Lake St. Croix, on the south side of the main road running from the town to the lake. It is 37 feet northeast of the northeast corner of a cottage, 56.0 feet east of a small shed or storeroom, 46.5 feet northwest of a birch tree, and 17.7 feet south of the east post of a small gate. The observations were made over a native granite rock, rounded on top, projecting about 2 inches above the ground, with a small hole roughly drilled in the top and roughly lettered U. S. The following true bearing was determined:

	°	′	
Right edge of smokestack on sawmill 2 or 3 miles along the lake (mark)	0	14.4	east of south

Sparta, Monroe County.—The station is in the fair grounds, about 300 feet southwest of the entrance. It is 58.5 feet southeast of a large gnarly oak tree, and 135.0 feet west of the west end of the building just inside and south of the entrance to the grounds. It is marked by a marble slab 3½ by 8

Descriptions of stations—Continued.

WISCONSIN—Continued.

by 16 inches, set about 1 inch below the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Spire on Catholic Cathedral	43	24.7	east of north
Base of rod on cupola of court-house	45	55.8	east of north
Base of rod on judges' stand	63	17.2	west of south

Viroqua, Vernon County.—The station is in the fair grounds, east of the baseball field and inside the race track. It is 118.0 feet from the northeast corner of the judges' stand, about 122.0 feet north of the nearest point in the fence along the inside of race track, and 49.5 feet east of the southeast corner post of the baseball grand stand. The station is marked by a marble post 6 by 6 by 18 inches, set half an inch below the surface of the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Cupola on Mr. Foster's house	62	29.0	east of south
Left edge of water tank at the insane asylum	15	33.2	east of north

Waukesha, Waukesha County.—The station is on the campus of the Carroll College, 192.5 feet west from the second window north of the southwest steps of the main building and 127.0 feet north and slightly west of the northwest corner of the Rankin Hall of Science. It is marked by a marble post 6 by 6 by 19 inches, set flush with the ground and lettered U. S. C. & G. S., 1908. The following true bearings were determined:

	°	′	
Baptist Church spire (mark)	18	50.4	west of north
Base of flag pole on Milwaukee Waukesha Brewery	64	14.5	west of north
Base of flag pole on south end of main building of Carrol College	84	12.0	east of south
Extreme left edge of large chimney, Rest Haven Sanitarium	32	27.6	east of north

Whitehall, Trempealeau County.—The station is in a new addition to the cemetery, well toward the northeast corner. It is 56.5 feet from the fence along the east side, 77.0 feet from the fence along the north side, and 20.5 feet south of west of a monument marked Beach. The station is marked by a cement block 6 by 6 by 24 inches, set level with the ground and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Cupola on high school	21	43.7	east of north
Cupola on court-house	43	34.2	east of north
Spire on Evans Lutheran Church	56	36.5	east of north

FOREIGN COUNTRIES.

Acapulco, Mexico.—The station is about 200 yards northeast of Fort San Diego, on a small projecting point, with the outer point visible from the anchorage. The shore line is steep, rough, and rocky from the town to the station and beyond, making landing difficult. The station is on a bluff about 30 feet above the water, about 20 feet directly back from the point and 17 feet from the edge of the bluff on each side. The largest and outside white rock south of the station is nearly in range with the light-house on Griffo or Roqueto Island. The station is marked by a screw in the top of a 2-inch square wooden peg projecting about 2 inches above the surface. The following true bearings were determined:

	°	′	
Light-house on Griffo Island (mark)	10	02.5	west of south
Lower right tangent to fort at ground	49	55.5	west of south
Flagstaff, Fort San Diego	71	20.5	west of south
Right tangent to round white sentry box on wall of fort	87	49.5	west of north

Callao, San Lorenzo Island, Peru.—The station occupied was as near to the station of 1899 as could be determined. It is 78.1 feet from the northeast corner of the house of the prefect of police,

Descriptions of stations—Continued.

FOREIGN COUNTRIES—Continued.

56.7 feet from the center of the door, 67.4 feet from the southeast corner of the house. The soil is fine sand mixed with pebbles and coarse rocks. Back of the station bare hills rise to a considerable height. The following true bearings were determined:

	° ′	
Clock tower (mark)	67 03.6	east of north
Flagstaff on square house	35 34.4	west of north
Iron pipe on top of square house	4 43.9	west of north
Chimney	59 00.6	east of north
Yellow spire on church in Callao	69 15.4	east of north
Square tower with a clock	70 30.6	east of north
Large white dome	72 26.6	east of north
Yellow spire on church on peninsula	76 00.6	east of north

Camp Davidson, Yukon Territory.—The station is about 100 yards south and a little east of the site of Camp Davidson, and is the same as "International Boundary, Station B," established in 1907 by J. C. Pearson, of the Department of Terrestrial Magnetism of the Carnegie Institution, and described by him as follows:

"A second station was occupied near what was said by those resident in the region to be Ogilvie's station of 1887. It is on a ledge on the north bank of the Yukon River, about 2 miles east of the boundary, about 50 feet above the water, and about 50 feet north of a skeleton pyramid of spruce logs erected above a wooden stake, reported to be the site of Ogilvie's station. The new station is marked by a round wooden stake about 2 inches in diameter, and projecting about 6 inches above the surface of the ground. The azimuth mark was a point, resembling the nose of a human profile, on the west side of the summit of the nearest hill, directly back from the river, and was found to bear 51° 33′.0 east of north."

Chatham Island, Wreck Bay, Galapagos Group, Ecuador.—The station is about 150 yards true east of the light-house and about 50 yards from the road to Progresso. The soil is rocky, and the ground in this vicinity seems to have a rock plateau a few inches below the surface. The station is marked by a three-fourth-inch drill hole in the top of a projecting rock. The following true bearings were determined:

	° ′	
Light-house (mark)	89 55.8	west of north
Dalrymple Rock, highest part	18 40.8	west of north
Top of small mountain El Cerro	68 39.2	east of north
Prominent rock on top of near-by hill, which is a short distance from the road to Progresso	59 18.8	east of south

Coronel, Chile.—The station is about three-fourths of a mile southeast of the town, on a sandy plain. A road passes about 100 yards to the east of the station, and the railroad to Lota is about a quarter of a mile to the west. The station is on a small sandy knoll, about 500 yards from the outskirts of the town and about 200 yards northwest of the slaughterhouse, a red-roofed building with two chimneys. It is marked by a wooden peg projecting about 2 inches above the surface of the ground. The following true bearings were determined.

	° ′	
Smokestack on soap factory	29 56.1	west of north
Stack east of town	24 33.0	east of north
North gable of slaughterhouse	25 01.0	east of south
Stack at Lota, right side of hill	25 59.0	west of south
Puchoco Point light	75 33.0	west of north

Dawson, Yukon Territory.—The station occupied by J. C. Pearson, of the Department of Terrestrial Magnetism of the Carnegie Institution, in 1907, was reoccupied. It is on a tract of Government land in the rear of the Administration Building, in the deep right field of the baseball grounds, about half a mile north of the Klondike River. It is about 300 feet southeast of the Administration Building; about

Descriptions of stations—Continued.

FOREIGN COUNTRIES—Continued.

200 feet nearly due south of the astronomical pier of 1907; about 88 feet south of a roadway, little used, running from Sixth avenue toward Fifth avenue, and 62.3 feet west from the board walk along Sixth avenue. The station is marked by a post 6 by 8 by 36 inches, set flush with the surface of the ground, the precise point being marked by a brass screw. The following true bearings were determined:

	°	′	
Flagstaff on ferry tower	5	20.2	west of north
Flagstaff on court-house	87	01.2	west of north
Flagstaff on north side of Klondike River	10	49.6	east of south

Forty Mile, Yukon Territory.—The station occupied by J. C. Pearson, of the Department of Terrestrial Magnetism of the Carnegie Institution, in 1907, was reoccupied. It is described by him as follows:

"The station is between the custom-house and the barracks of the Northwest mounted police, about one-fourth mile south of the confluence of the Forty Mile and Yukon rivers, about 150 feet from the west bank of the latter. It is 80 feet south of the custom-house, and 57 feet from a small log cabin in the rear of the lot. The station is marked by a brass screw in the top of a wooden post 2 by 4 by 24 inches, set so as to project slightly above the ground. The azimuth mark used was the left edge at the base of the south chimney on the North American Transportation Company's store, and was found to bear 39° 34′.3 west of north."

Magdalena Bay, Lower California, Mexico.—The astronomic station of the Coast and Geodetic Survey was recovered. It is situated upon the high bank or cliff immediately north of the village intercepted by two deep ravines. It is marked by a block of timber 20 inches square and projecting about 3 feet above the ground. The instrument was set up about 16 feet from the astronomic station in line with the light-house in front of the village.

Observations were also made at a second station about 1 mile to the north, owing to signs of magnetic deposits in the vicinity of the first. It is on the shore of the bay, about 1½ miles north from the village and about 1 mile N. 5° E. from the astronomic station and on the west side of a small river, about 20 feet from the bank. The station is marked by a wooden peg. The true bearing of this station from the astronomic station is 4° 40′.4 east of north. The light-house bears 2° 51′.6 west of south.

Montevideo, Uruguay.—Observations were made near the station occupied by Lieutenant Mottez in 1893. It is at the head of the bay and in the neighborhood of the bath houses. It is on the turf about 150 yards from the beach and about halfway between the bathing establishment on the beach and the wall around a sugar refinery, which is conspicuous on account of its large brick chimney. An iron rail signpost is about 200 yards west of the station, which is in a small hollow with mounds 50 to 75 feet on either side. The station is marked by a wooden tent peg, projecting 2 inches above the surface of the ground. The following true bearings were determined:

	°	′	
Spire of San Francisco Church (mark)	3	10.7	east of south
Right spire of church near by	62	24.7	east of south
Flagstaff of Hotel de la Punta	4	28.3	west of south
El Cerro light-house	70	41.3	west of south

Panama, Flamenco Island, Canal Zone.—The station is on the northeast end of Flamenco Island. It is 40 or 50 feet from the beach, back from the wall of the old fort, and about 12 yards north of a large rock 8 feet high. It is marked by a wooden stake in center of a cleared space. The following true bearings were determined:

	°	′	
Triangulation station on Naos Island	66	31.8	west of north
Tall brick chimney in Panama	23	05.8	west of north
Left spire of cathedral, Panama	20	17.4	west of north
Right spire of cathedral, Panama	20	08.8	west of north
Center of old square tower in old city of Panama	19	26.2	east of north
Apex of white tombstone marking grave of officers and men of U. S. S. *Lancaster*, on side of hill, 100 yards from station	13	42.4	west of south

Descriptions of stations—Continued.

FOREIGN COUNTRIES—Continued.

Pernambuco, Brazil.—The station is on the Isthmus of Olinda between the cable house and Fort Bunaco. The Isthmus of Olinda consists of a high sand ridge. The station is about 16 feet from the edge of the ridge toward the river and opposite a growth of mangrove trees on the river bank. The station is marked by a rough flint stone 15 inches long and 3 inches square on top, projecting 1 inch above the surface of the ground. A red brick 3 by 4 by 14 inches was set 16 feet toward the sea and in range with the station and the chimney of the Beltrao sugar refinery. The following true bearings were determined:

	°	′	
Chimney of Beltrao sugar refinery	21	17.0	west of north
Red dome of Assembly Hall	39	15.3	west of south
Top of old monument near cable house	31	17.2	west of south
Spire of church	24	22.0	west of south
Signal mast	21	55.4	west of south
Center of dome of Arsenal Marinha	8	14.7	west of south
Picao light-house, on reef off Recife	18	35.8	east of south

Port Castries, St. Lucia.—The station occupied was established by the Department of Terrestrial Magnetism of the Carnegie Institution, of Washington, in 1905. It is in the Botanical Garden, along the east side of the harbor, in the northeast corner of the town. It is in the northeast corner of the garden, about 75 feet from the walk to the north, 64 feet from the walk to the east, 18.5 feet from the edge of the flower bed to the west, and about 80 feet from the walk to the south. Two palm trees stand, one 39.8 feet to the northeast and another 22.3 feet nearly east. The station is marked by two stones, the lower one being 12 by 12 by 15 inches and the upper one about 12 by 12 by 8 inches. The top stone is lettered C. I. 1905. The following true bearings were determined in 1905:

	°	′	
Spire on the governor's house	54	53.2	west of south
Cupola on Mr. Peter's office	65	23.3	west of south
Episcopal Church spire	1	15.5	west of south

Punta Arenas, Chile.—The station is about 1 mile northeast of the settlement on Sandy Point. It is on the bluff bordering the beach about 50 yards from low-water line. By following the road up the beach until it ascends the bluff the station will be found 100 yards from the road. The station is 8 yards from the bluff, 200 yards southwest of a dwelling, and 38 yards north northeast of a cut in the bluff extending some 40 feet inland. It is marked by a wooden tent peg, projecting about 2 inches above the ground. The following true bearings were determined:

	°	′	
Highest cross on gable of small church in northern part of town	49	21.0	west of south
Right corner of brick house (distant, three-fourths of a mile)	86	46.0	west of north
Smokestack, to left of house with red gable (distant, 3 miles)	80	43.0	west of north
Beacon, on point	49	03.5	east of north
Red buoy	88	34.5	east of south
End of small wharf north of river	12	12.0	west of south
Flag pole on large square house	29	24.0	west of south
Signal mast	39	17.0	west of south
Clock tower	43	16.0	west of south

Rio de Janeiro, Brazil.—Observations were made at the meteorological observatory on Morro de Santo Antonio, conducted by the Brazilian naval officers under the direction of the minister of marine. The magnetic observatory is a small building about 250 yards northwest of the main building. Two stone piers are in the building. The south one of the two was used as the station. The following true bearing was furnished:

	°	′	
Pilar II of the Salesiano monument on eastern side of bay	84	04.1	east of north

Descriptions of stations—Continued.

FOREIGN COUNTRIES—Continued.

Union, British Columbia.—The station of 1903 was reoccupied. It is on an alluvial spit, about one-fourth of a mile north of the Wellington Colliery Company's pier and about half that distance east of the railroad and coke ovens. It is about 10 feet east of the cart path, 100 feet north of a large wooden post about 18 inches in diameter and 8 feet high, and 75 feet from high-water mark. The station is marked by a fir post about 6 inches in diameter, projecting about 10 inches above the ground. The following true bearings were determined in 1903:

	° ′
Northeast edge of chimney at brick kiln	19 50.4 west of south
Church spire at Comox	18 44.8 west of north

Observations were also made at a second station about 1 000 feet from the old one in a direct line to the church spire at Comox, near the auxiliary station of 1906, on a low shingle spit across the small stream. It is marked by a wooden stub about 2 inches square, driven flush with the ground, with stones piled over it.

Whitehorse, Yukon Territory.—The station occupied by J. C. Pearson, of the Department of Terrestrial Magnetism of the Carnegie Institution, in 1907, was reoccupied. It is located near the northeast corner of the quadrangle formed by the barracks of the Northwest mounted police. It is 28 feet east of the edge of a walk bordered with white stones, 40 feet northeast of the northeast corner of the garden fence on the west side of the walk, about 55 feet north of the tennis court, and about 75 feet from the near edge of the road to the north. The station is marked by a wooden peg 1¾ by 1¾ by 24 inches, driven nearly flush with the surface of the ground. The following true bearings were determined:

	° ′
Base of post-office flagstaff	70 11.6 east of north
Spire of Catholic Church	1 46.6 east of north
Northeast corner of barracks hospital	88 38.7 west of north

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ALPHABETICAL INDEX.

(Exclusive of Appendix 3.)

A.

AIDS TO NAVIGATION. Positions determined. California, p. 30. Florida, pp. 25, 34.
ALABAMA. Hydrography, p. 30. Longitude work, p. 31. Magnetic observations, p. 29. Topography, p. 30. Triangulation, p. 30.
ALASKA. Astronomic observations, pp. 37, 38, 39. Base measurement, pp. 37, 39. Boundary, p. 56. Coast Pilot work, p. 38. Hydrography, pp. 36, 37, 38, 39, 40. Magnetic observations, pp. 36, 37, 38. Topography, pp. 36, 37, 38, 39, 40. Triangulation, pp. 36, 37, 38, 39.
APPROPRIATIONS, p. 12.
ARIZONA. Reconnaissance, p. 21.
ARKANSAS. Magnetic observations, p. 29.
ASTRONOMIC OBSERVATIONS. Alabama, p. 31. Alaska, pp. 37, 38, 39. California, pp. 23, 31. Florida, p. 31. Georgia, p. 31. Illinois, p. 21. Indiana, p. 21. Maine, p. 23. Michigan, p. 21. New York, p. 23. Oregon, p. 23. Philippine Islands, pp. 49, 50. South Dakota, p. 31. Tennessee, p. 31. Vermont, p. 23. Virginia, p. 25. Washington, p. 31.

B.

BACHE, STEAMER, pp. 34, 54. Work of, p. 13.
BALDWIN MAGNETIC OBSERVATORY, p. 24.
BALDWIN, G. C., Assistant, p. 56.
BARREN ISLANDS, Alaska. Survey of, p. 39.
BASE MEASUREMENT. Alaska, pp. 37, 39. Philippine Islands, pp. 49, 50.
BAYLOR, J. B., Assistant, p. 55.
BECK, H. L., Assistant, pp. 21, 47.
BOHOL ISLAND, P. I. Survey of, p. 49.
BOUNDARIES, INTERNATIONAL, p. 55.
BOUTELLE, J. B., Assistant, p. 48.
BOWIE, WILLIAM, Assistant, p. 21.
BRAID, ANDREW, Assistant, pp. 12, 61.
BRABAZON, A. J., p. 56.
BURBANK, J. E., Magnetic Observer, p. 23.
BURGER, W. H., Assistant, p. 23.

C.

CALIFORNIA. Aids to navigation, positions determined, p. 30. Astronomic observations, p. 23. Coast Pilot work, p. 33. Dangers to navigation located, p. 30. Longitude work, p. 31 Magnetic observations, p. 23. Reconnaissance, p. 21. Tide observations, p. 32. Triangulation, p. 24.
CANADA AND UNITED STATES BOUNDARY, p. 55.
CANADA AND VERMONT BOUNDARY, p. 55.
CATANDUANES ISLAND, P I Survey of, p. 51.
CHARTS. New, p. 65. New bassos, p. 64. New drawings, p. 63. New editions, p. 65. New engraved plates, p 63. New etched plates, p. 65. New prints, p. 64. Number issued, p. 65.
CHART DIVISION, p. 66.
CHELTENHAM MAGNETIC OBSERVATORY, p. 23.
CITY OF BIRMINGHAM. Wreck of, located, p. 31.
COAST PILOT WORK, p. 13. Alaska, p. 38. California, p. 33. Oregon, p. 33. Washington, p. 33.
COMPUTING DIVISION, p. 61.
CONNECTICUT. Topography, p. 30. Wire drag work, p. 27.
CORDOVA BAY, ALASKA. Survey of, p. 40.
CORPS OF ENGINEERS, U. S. A., pp. 25, 27.
COSMOS, STEAMER, p. 36.

D.

DEEL, S. A., Magnetic Observer, p. 24.
DERICKSON, R. B., Assistant, pp. 24, 36.
DENSON, H. C., Assistant, pp. 39, 49.
DETAILS OF FIELD OPERATIONS, p. 19.
DETAILS OF OFFICE OPERATIONS, p. 61.
DIBRELL, W. C., Assistant, pp. 25, 36.
DICKINS, E. F., Assistant, pp. 37, 41.
DISTRICT OF COLUMBIA. Topography, p. 26.
DIVISION OF TERRESTRIAL MAGNETISM, p. 61.
DIXON ENTRANCE, ALASKA. Triangulation, p. 36.
DRAWING AND ENGRAVING DIVISION, p. 63.

E.

EDMONDS, H. M. W., Magnetic Observer, p. 37.
EGERIA, H. M. S., p. 37.
ENDEAVOR, STEAMER, p. 15.
ERICA, LAUNCH. Work of, p. 47.
EXPLORER, STEAMER, pp. 25, 36, 37, 39, 61. Work of, p. 14.

F.

FAIRFIELD, W. B., Assistant, p. 25.
FARIS, R. L., Assistant, p. 15.
FATHOMER, STEAMER, pp. 15, 51. Work of, p. 42.
FERGUSON, O. W., Assistant, pp. 26, 32.
FIELD OPERATIONS. Details of, p. 19.
FLORIDA. Aids to navigation, positions determined, pp. 25, 34. Longitude work, p. 31. Magnetic observations, p. 29. Tide observations, p. 32. Triangulation, pp. 25, 34. Wire drag work, p. 27.
FRENCH, O. B., Assistant, pp. 26, 31.
FRANKS, F. L., Aid, p. 32.
FORNEY, S., Assistant, p. 26.

G.

GEDNEY, STEAMER, pp. 24, 36, 37. Work of, p. 14.
GEORGES BANK. Hydrography, p. 34.
GEORGIA. Longitude work, p. 31. Magnetic observations, p. 29.
GILBERT, J. J., Assistant, p. 13.
GRANGER, F. D., Assistant, pp. 27, 55.
GRAVES, H. C., Nautical Expert, p. 38.
GREEN, J. W., Magnetic Observer, p. 38.
GULF OF DAVAO, P. I. Survey of, pp. 42, 52.

H.

HAWAII. Magnetic observations, p. 33. Tide observations, p. 32.
HAYFORD, J. F., Assistant, p. 15.
HECK, N. H., Assistant, p. 27.
HILL, J. S., Assistant, p. 28.
HILL, W. M., Magnetic Observer, p. 29.

HODGKINS, W. C., Assistant, p. 38.
HODGSON, C. V., Assistant, pp. 46, 49.
HONOLULU MAGNETIC OBSERVATORY, p. 33.
HYDROGRAPHY. Alabama, p. 30. Alaska, pp. 36, 37, 38, 39, 40. Connecticut, p. 34. Maryland, pp. 26, 32. Massachusetts, p. 34. Philippine Islands, pp. 47, 48, 49, 50, 51, 52, 53. Porto Rico, p. 54. Rhode Island, p. 34. Virginia, p. 26.
HYDROGRAPHER, STEAMER. Work of, p. 13.

I.

ILIAMNA BAY, ALASKA. Survey of, p. 39.
ILLINOIS. Astronomic observations, p. 21. Magnetic observations, pp. 23, 29.
INDIANA. Astronomic observations, p. 21. Magnetic observations, pp 23, 29.
INSTRUMENT DIVISION, p. 66.
INTERNATIONAL BOUNDARIES, p. 55.
IOWA. Magnetic observations, pp. 24, 29.

J.

JAMESTOWN, U. S. HOSPITAL SHIP, p. 54.
JEWELL, D. R., Assistant, p. 49.

K.

KANSAS. Magnetic observations, p. 24.
KEELING, W. B., Magnetic Observer, p. 53.
KING, H. D., Assistant, p. 49.
KING, W. F., pp. 55, 56.
KODIAK ISLAND. Survey of, p. 38.
KUPREANOF STRAIT, ALASKA. Survey of, p. 38.
KURTZ, FORD, Aid, p. 29.

L.

LAKE BORGNE CANAL. Survey of, p. 26.
LATHAM, E. B., Assistant, pp. 29, 50.
LELAND, O. M., pp. 56, 57.
LEVELING. Montana, p. 31. Nevada, p. 29. Utah, pp. 29, 30.
LIBRARY AND ARCHIVES DIVISION, p. 67.
LONGITUDE WORK. Alabama, p. 31. California, p 31. Florida, p. 31. Georgia, p 31 Minnesota, p. 31. Missouri, p. 31 Nebraska, p. 31. North Dakota, p. 31 Oklahoma, p. 31. South Dakota, p. 31 Tennessee, p. 31. Washington, p. 31.
LOUISIANA. Magnetic observations, p. 29. Survey of Lake Borgne Canal, p. 26. Tide observations, p. 32.
LUZON, P. I. Survey of east coast of, pp. 49, 50.

M.

MAGNETIC OBSERVATIONS. Alabama, p. 29. Alaska pp. 36, 37, 38. Arkansas, p. 29. California, p. 23. Florida, p. 29. Georgia, p. 29. Hawaii, p. 33. Illinois, pp. 23, 29. Indiana, pp. 23, 29. Iowa, pp. 24, 29. Kansas, p 24 Louisiana, p. 29 Maine, p. 23. Maryland, p. 23. Michigan, p. 29. Minnesota, p. 24. Mississippi, p. 29. Missouri, p. 24 Nebraska, p 24. New Jersey, p. 23 New York, p. 23. North Carolina, p. 29. North Dakota, p. 24. Ohio, p. 23. Oregon, p 23. Pennsylvania, p. 23 Philippine Islands, pp. 49, 51. Porto Rico, p. 53. South Carolina, p. 29. South Dakota, p. 24 Tennessee, p. 29. Texas, p. 29. Vermont, p. 23 Wisconsin, pp. 23, 24. At sea, pp. 34, 36; summary, p. 16 On land, summary, p. 16.
MAGNETIC OBSERVATORIES, p. 15 Baldwin, Kans., p. 24. Cheltenham, Md., p. 23. Honolulu, Hawaii, p. 33. Sitka, Alaska, p. 37. Vieques, P. R., p. 53.
MAINE. Astronomic observations, p. 23. Magnetic observations, p. 23. Wire drag work, p 27
MARINDUQUE, STEAMER, pp. 15, 44, 49
MARINDUQUE ISLAND, P. I. Survey of, p. 50
MARYLAND. Hydrography, pp. 26, 32. Magnetic observations, p. 23. Shellfish Commission, p, 35. Survey of oyster bars, p. 35. Tide observations, p. 32. Topography, pp 21, 26, 29, 32. Triangulation, pp. 25, 26, 32, 35
MASSACHUSETTS. Topography, p. 30.
MATCHLESS, SCHOONER, pp. 26, 32. Work of, p. 14.
MAYFLOWER, STEAMER. Light-house tender, p. 34.
MAUPIN, J. W., Assistant, p. 30.
MAYNARD, H. W., Aid, p. 30.
McARTHUR, J. J., p. 55.
McARTHUR, STEAMER, p. 39. Work of, p. 14.
McGRATH, J. E., Assistant, p. 41.
MICHIGAN. Astronomic observations, p. 21. Magnetic observations, p. 29.
MILLER, J. B., Assistant, p. 45.
MINNESOTA. Longitude work, p. 31. Magnetic observations, p. 24. Triangulation, p. 21.
MISCELLANEOUS SECTION, p. 68.
MISSISSIPPI. Magnetic observations, p. 29.
MISSOURI. Longitude work, p. 31. Magnetic observations, p. 24.
MONGOLIA, STEAMER. Shoal reported by, p. 33.
MONTANA. Leveling, p. 31.
MORSE, FREMONT, Assistant, pp. 30, 57.
MORVEN, LAUNCH. Work of, p. 46.
MOSMAN A. T., Assistant, p. 55.
MOUNT WEATHER, VA. Geographic position determined, p. 25.

N.

NEBRASKA. Longitude work, p. 31. Magnetic observations, p. 24.
NEGROS, P. I. Survey of, pp. 48, 50.
NESBIT, SCOTT, Disbursing Agent, p. 17.
NEVADA. Leveling, p. 29.
NEW HAMPSHIRE. Topography, p. 33.
NEW JERSEY. Astronomic observations, p. 23. Magnetic observations, p. 23. Topography, p. 33.
NEW MEXICO. Reconnaissance, p. 21.
NEW YORK. Astronomic observations, p. 23. Magnetic observations, p. 23. Tide observations, p. 32. Topography, p. 30. Triangulation, p. 55. Wire drag work, p. 27.
NORTH CAROLINA. Magnetic observations, p. 29. Tide observations, pp. 27, 32, 34. Triangulation, pp. 26, 28.
NORTH DAKOTA. Longitude work, p. 31. Magnetic observations, p. 24.

O.

OFFICE OF ASSISTANT IN CHARGE, pp. 12, 61.
OFFICE OF DISBURSING AGENT, p. 16.
OFFICE OF EDITOR OF PUBLICATIONS, p. 18.
OFFICE OF INSPECTOR OF GEODETIC WORK, p. 15.
OFFICE OF INSPECTOR OF HYDROGRAPHY AND TOPOGRAPHY, p. 13.
OFFICE OF INSPECTOR OF MAGNETIC WORK, p. 15.
OFFICE OPERATIONS. Details of, p. 61.
OGILVIE, N. J., p. 55.
OHIO. Magnetic observations, p. 23.
OKLAHOMA. Longitude work, p. 31.
ORCA INLET, ALASKA. Survey of, p. 40.
OREGON. Astronomic observations, p. 23. Coast Pilot work, p. 33. Magnetic observations, p. 23. Triangulation, p. 28.
OUTLYING TERRITORY. Field work, p. 41.

P.

PANAY, P. I. Survey of, p. 48.
PARKER, W. E., Assistant, p. 51.
PATHFINDER, STEAMER, pp. 15, 52, 53. Work of, p. 41.
PATTERSON, STEAMER, pp. 38, 39. Work of, p. 14.
PENNSYLVANIA. Magnetic observations, p. 23. Tide observations, p. 32.
PHILIPPINE ISLANDS. Astronomic observations, pp. 49, 50. Base measurement, pp. 49, 50. Field work, p. 41. Hydrography, pp. 47, 48, 49, 50, 51, 52, 53. Office work, p. 47. Topography, pp 47, 48, 49, 50, 51, 52, 53. Triangulation, pp. 47, 48, 49, 50, 51, 52, 53. Magnetic observations, pp. 49, 51.
PORT GRAHAM, ALASKA. Survey of, p. 39.
PORTO RICO. Hydrography, p. 54. Magnetic observations, p 53.
PRATT, J. F., Assistant, p. 52.
PRINCE WILLIAM SOUND, ALASKA. Survey of, pp. 36, 40.
PRINCE OF WALES ISLAND, ALASKA. Triangulation, p. 37.
PUBLICATIONS. List of, p. 18. Issued, p. 68. Received, p. 68.

Q.

QUILLIAN, C. G., Assistant, p. 25.

R.

RAINBOTH, G. C., p. 55.
RECONNAISSANCE. Arizona, p. 21. California, p. 21. New Mexico, p. 21. Texas, p. 21.
RESEARCH, STEAMER, p. 15. Work of, pp. 45, 48.
REPORT OF THE SUPERINTENDENT, p. 7.
RHODE ISLAND. Topography, p. 30. Wire drag work, p. 27.
RHODES, H. W., Assistant, p. 39.
RIGGS, THOMAS, JR., p. 56.
RITTER, H. P., Assistant, p. 30.
RODGERS, A. F., Assistant, p. 31.
ROMBLON, STEAMER, p. 15. Work of, pp. 43, 49.
ROY, H M., Aid, p. 31.
RUDE, G. T., Assistant, p. 40.

S.

SAMAR, P. I. Survey of east coast, p. 53.
SAN MIGUEL BAY, P. I. Survey of, p. 49.
SELDOVIA HARBOR, ALASKA. Survey of, p. 39.
SHELIKOF STRAIT, ALASKA. Triangulation, p. 37.
SHELL FISH COMMISSION, MD., p. 35.
SIBUGUEY BAY, P. I. Survey of, p. 52.
SINCLAIR, C. H., Assistant, p. 55.
SITKA MAGNETIC OBSERVATORY, p. 37.
SMITH, EDWIN, Assistant, p 31.
SOUTH CAROLINA. Magnetic observations, p. 29.
SOUTH DAKOTA. Longitude work, p. 31. Magnetic observations, p. 24.
SPARROW, C. M., Assistant, p. 32.
SPECIAL DUTY, p. 55.
SURVEY OF OYSTER BARS, MD., p. 35.

T.

TAKU, STEAMER, pp. 36, 40. Work of, p. 14.
TENNESSEE. Longitude work, p. 31. Magnetic observations, p. 29.
TEXAS. Magnetic observations, p. 29. Reconnaissance, p. 21. Tide observations, pp. 21, 32.
TIDAL DIVISION, p. 62.
TIDE GAUGE INSPECTION. Baltimore, Md., p. 32, Philadelphia, Pa., p. 32. Fernandina, Fla., p. 35. Fort Hamilton, N. Y., p. 32.
TIDE OBSERVATIONS. California, p. 32. Florida, p. 32. Hawaii, p. 32. Louisiana, p. 32. Maryland, p. 32. New York, p. 32. North Carolina, pp. 27, 32, 34. Pennsylvania, p. 32. Texas, pp. 21, 32. Virginia, p. 32. Washington, p. 32.
TITTMANN, O. H., Superintendent, pp. 55, 56.
TOPOGRAPHY. Alabama, p. 30. Alaska, pp. 36, 37, 38, 39, 40. Connecticut, p. 30. District of Columbia, p. 26. Maryland, pp. 21, 26, 29, 32. Massachusetts, p. 30. New Hampshire, p 33 New Jersey, p. 33. New York, p. 30. Philippine Islands, pp. 47, 48, 49, 50, 51, 52, 53. Rhode Island, p. 30. Virginia, p. 26. Washington, pp. 24, 25.
TRANSIT, SCHOONER, pp. 15, 26.
TRIANGULATION. Alabama, p. 30. Alaska, pp. 36, 37, 38, 39. California, p. 24. Florida, pp. 25, 34. Maryland, pp. 25, 26, 32, 35. Minnesota, p. 21. New York, p. 55. North Carolina, pp. 26, 28. Oregon p. 28. Philippine Islands, pp. 47, 48, 49, 50, 51, 52, 53. Virginia, pp. 25, 26. Washington, pp. 24, 25, 32.

U.

UNITED STATES AND CANADA BOUNDARY, p. 55.
UTAH. Leveling, pp. 29, 30.

V.

VERMONT. Astronomic observations, p. 23. Magnetic observations, p. 23.
VERMONT AND CANADA BOUNDARY, p. 55.
VESSELS AND THEIR WORK, p. 13.
VIEQUES MAGNETIC OBSERVATORY, p. 53.
VINAL, W. I., Assistant, p. 32.
VIRGINIA. Astronomic observations, p. 25. Hydrography, p. 26. Tide observations, p. 32. Topography, p. 26. Triangulation, pp. 25, 26.

W.

WAINWRIGHT, D. B., Assistant, pp. 33, 53.
WALCOTT, C. D., p. 55.
WALLIS, W. F., Magnetic Observer, p. 33.
WASHINGTON. Coast Pilot work, p. 33. Longitude work, p. 31. Magnetic work, p. 25. Tide observations, p. 32. Topography, pp. 24, 25. Triangulation, pp. 24, 25, 32.
WELKER, P. A., Assistant, p. 54.
WESTDAHL, F., Assistant, p. 33.
WESTDAHL, L. H., Assistant, p. 34.
WINSTON, ISAAC, Assistant, p. 34.
WIRE DRAG WORK. Connecticut, p. 27. Florida, p. 27. Maine, p. 27. New York, p. 27. Rhode Island, p. 27.
WISCONSIN. Magnetic observations, pp. 23, 24.
WORK OF THE YEAR. Field work, p. 7. Office work, p. 11.

Y.

YATES, C. C., Assistant, p. 35.
YUKON, STEAMER, pp. 38, 39. Work of, p. 14.
YUKON RIVER. Magnetic observations, p. 38.

LIST OF THE PUBLICATIONS OF THE COAST AND GEODETIC SURVEY (EXCEPT MAPS AND CHARTS), AUGUST 1 TO NOVEMBER 26, 1908, INCLUSIVE.

This list supplements the "Reprint of the List and Catalogue of the Publications of the United States Coast and Geodetic Survey, 1816–1902. With Supplement, January, 1903, to August, 1908." The Reprint and Supplement, and all of the publications listed here, except Coast Pilots and Tide Tables, which are sold at cost of paper and printing, may be obtained free of charge upon application to the Superintendent of the Coast and Geodetic Survey, Washington, D. C.

SEPARATELY ISSUED PUBLICATIONS.

These are papers that have been published on a variety of professional, scientific, bibliographical, or administrative subjects, in separate form, and without serial number.

1908. Supplement to the List and Catalogue of the publications of the United States Coast and Geodetic Survey, 1816–1902. January, 1903, to August, 1908. By R. M. Brown. 44 pp.

1908. List and Catalogue of the publications issued by the United States Coast and Geodetic Survey, 1816–1902. Reprint, with Supplement, January, 1903, to August, 1908. By E. L. Burchard and R. M. Brown. 237, 44 pp.

1908. Survey of the oyster bars, Somerset County, Maryland. Description of boundaries and landmarks, and report of the work of the United States Coast and Geodetic Survey in cooperation with the United States Bureau of Fisheries and the Maryland Shell Fish Commission. By C. C. Yates. 118 pp., map.

1908. General instructions for the field work of the Coast and Geodetic Survey. 127 pp., 21 figs.

1908. United States magnetic tables and magnetic charts for 1905. By L. A. Bauer. 154 pp., 7 charts, 1 diag.

COAST PILOTS.

These are a series of volumes covering the continental coasts of the United States, Porto Rico, and a portion of Alaska, containing descriptions of the coast and harbors, sailing directions, and general information, etc., for the use of mariners. They are corrected to the date of issue as nearly as practicable, and new editions issued from time to time.

Supplement to the third edition of the United States Coast Pilot. Atlantic coast. Part V. From New York to Chesapeake Bay entrance. August 17, 1908. 10 pp.

Supplement to the second edition of the United States Coast Pilot. Atlantic coast. Parts I–II. From the St. Croix River to Cape Ann. September 18, 1908. 15 pp.

Supplement to the first edition of the United States Coast Pilot. Pacific coast. California, Oregon, and Washington. October 2, 1908. 15 pp.

Supplement to the third edition of the United States Coast Pilot. Atlantic coast. Part VI. Chesapeake Bay and tributaries. October 16, 1908. 6 pp.

Supplement to the third edition of the United States Coast Pilot. Atlantic coast. Part VII. Chesapeake Bay entrance to Key West. October 30, 1908. 19 pp.

NOTICES TO MARINERS.

These contain corrections that should be applied to charts to keep them up to date. Commencing with January 3, 1908, the Monthly Notice to Mariners issued in Washington was, by the direction of the Secretary of Commerce and Labor, consolidated with and made a part of the Weekly Notice to Mariners issued by the Light-House Board, and hence, commencing with January 1, 1908, was discontinued as a publication of the survey.

Philippine Islands. Notice to Mariners. 1908. Nos. 6–10. 1908.

CHART CATALOGUES.

The Catalogue of Charts, Coast Pilots, and Tide Tables contains lists of the latest coast pilots, tide tables, sailing directions, miscellaneous maps and plans, and charts issued by the survey. New editions are issued whenever necessary. Diagrams opposite each page show the limits of each chart. A catalogue of charts, sailing directions, and tide tables for the Philippine Islands is issued as a separate publication. New editions are issued whenever necessary.

Catalogue of Charts, Coast Pilots, and Tide Tables. 1908. 231 pp. 1908.

Catalogue of Charts, Sailing Directions, and Tide Tables of the Philippine Islands. 1908. 20 pp. 1908.

FOR LIBRARY CATALOGUE CARDS.

U. S. *Coast and Geodetic Survey.*

. . . Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1907, to June 30, 1908. Washington, Gov't print. off., 1908.

169 pp. 9 progress sketches in pocket. 30 cm.
At head of title. Department of Commerce and Labor.
3 appendices: no 3 also issued separately
Contents of appendices: 1. Details of field operations. 2. Details of office operations. 3. Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1907, and June 30, 1908. By R. L. Faris.

SLIPS FOR LIST AND CATALOGUE.

LIST ENTRY.

1908.

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1907, to June 30, 1908. Washington, Gov't print. off., 1908.

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3 appendices; no. 3 also issued separately.

APPENDICES.

1. Details of field operations. p. 19–57.
2. Details of office operations. p. 58–68.
3. Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1907, and June 30, 1908. p. 69–165.

CATALOGUE ENTRIES.

Faris, Robert Lee.

Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1907, and June 30, 1908. Rept., 1908, app. 3, p. 69–165.

Terrestrial magnetism.

FARIS, R. L. Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1907, and June 30, 1908. Rept., 1908, app. 3, p. 69–165.

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PLATE No. 1655
UNITED STATES
COAST AND GEODETIC SURVEY
SKETCH OF GENERAL PROGRESS
JUNE 30 1908.
Eastern Sheet
Scale 5,000,000
Statute Miles
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
INDIAN TER
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
S. CAROLINA
NORTH CAROLINA
VIRGINIA
W. VIRGINIA
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NEW YORK
VERMONT
NEW HAMP.
MAINE
MASS.
CONN.
R.I.
NEW JERSEY
MARYLAND
DEL.
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO
ATLANTIC OCEAN
Axis of the Gulf Stream - Warmest Band
Bismarck
Aberdeen
Watertown
Pierre
Deadwood
Chamberlain
Sioux Falls
Yankton
Sioux City
Alliance
Columbus
Omaha
Lincoln
North Platte
Des Moines
Davenport
Rock Island
Peoria
Springfield
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Quincy
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Jefferson City
Colby
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Dodge City
Wichita
Guthrie
Amarillo
Texarkana
Greenville
Dallas
Fort Worth
Shreveport
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Austin
Galveston
Port Arthur
Eagle Pass
Duluth
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Fond du Lac
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Milwaukee
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Nashville
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Natchez
Baton Rouge
NEW ORLEANS
Mobile
Montgomery
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Atlanta
Macon
Augusta
Savannah
Brunswick
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ATLANTIC
GULF OF MEXICO
MEXICO
CUBA
BAHAMAS

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Cairo
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Little Rock
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Texarkana
Greenville
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Cape Catoche
Progreso
Belize
Atlanta
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Augusta
Columbia
Charleston
Georgetown
Wilmington
Raleigh
Cape Hatteras
Newbern
Savannah
Brunswick
Fernandina
Jacksonville
Tallahassee
Apalachicola
St. Augustine
Cape Canaveral
Tampa
Key West
Tortugas
Santa Cruz
Miami
Nassau
HAVANA
Cienfuegos
C. San Antonio
Santiago de Cuba

25°
30°
20°
100°
95°
90°
85°
80°
75°

EXPLANATION OF SYMBOLS

Primary Triangulation
Secondary } Triangulation
Tertiary }
Reconnaissance
Surveyed Topography
.....do.....In-shore Hydrography
.....do.....Off-shore.....do.....
Lines of Deep Sea Soundings
.....do.....Geodetic Levelling

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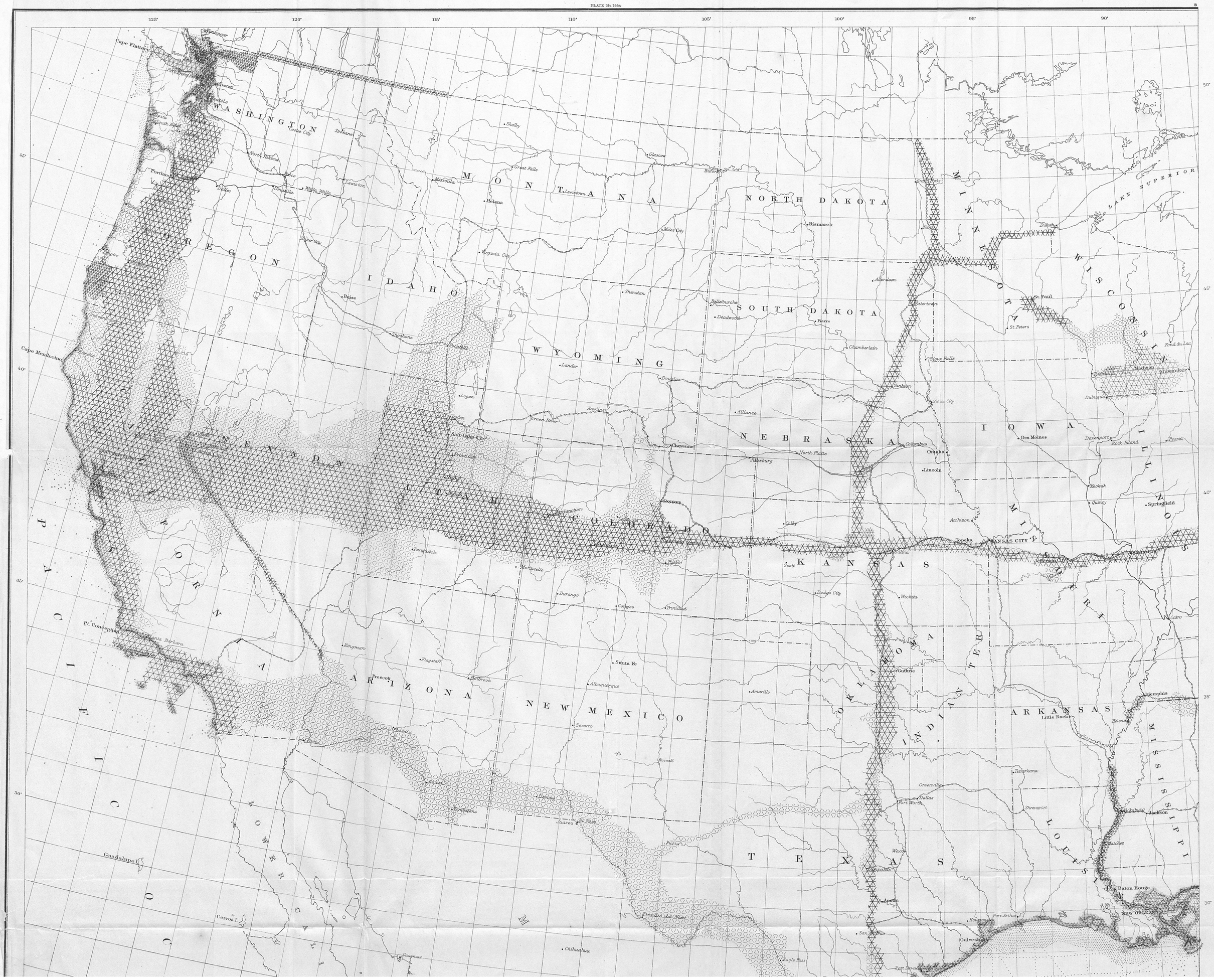
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45°
40°
35°
30°
Cape Flattery
Vancouver
Victoria
Port Townsend
Everett
Seattle
Tacoma
Olympia
Aberdeen
Coos Bay
Roseburg
Portland
Salem
Eugene
Astoria
Cape Mendocino
Cape Blanco
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Santa Barbara
Guadalupe I.
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Cuaymas
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Coolee City
Spokane
North Yakima
Pasco
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Dalles
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Boise
Shoshone
Pocatello
Logan
Ogden
Salt Lake City
Provo City
Nephi
Parowan
Panguitch
Monticello
Durango
Congos
Trinidad
Kingman
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Fond du Lac
Des Moines
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Cheyenne
North Platte
Jillesburg
Alliance
Douglas
Lander
Rawlins
Green River
Denver
Colby
Pueblo
Sheridan
Miles City
Virginia City
Helena
Great Falls
Shelby
Glascow
Butte
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Fargo
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Duluth
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Watertown
Aberdeen
Pierre
Chamberlain
Deadwood
Bellefourche
WASHINGTON
OREGON
IDAHO
MONTANA
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SOUTH DAKOTA
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NEBRASKA
IOWA
MINNESOTA
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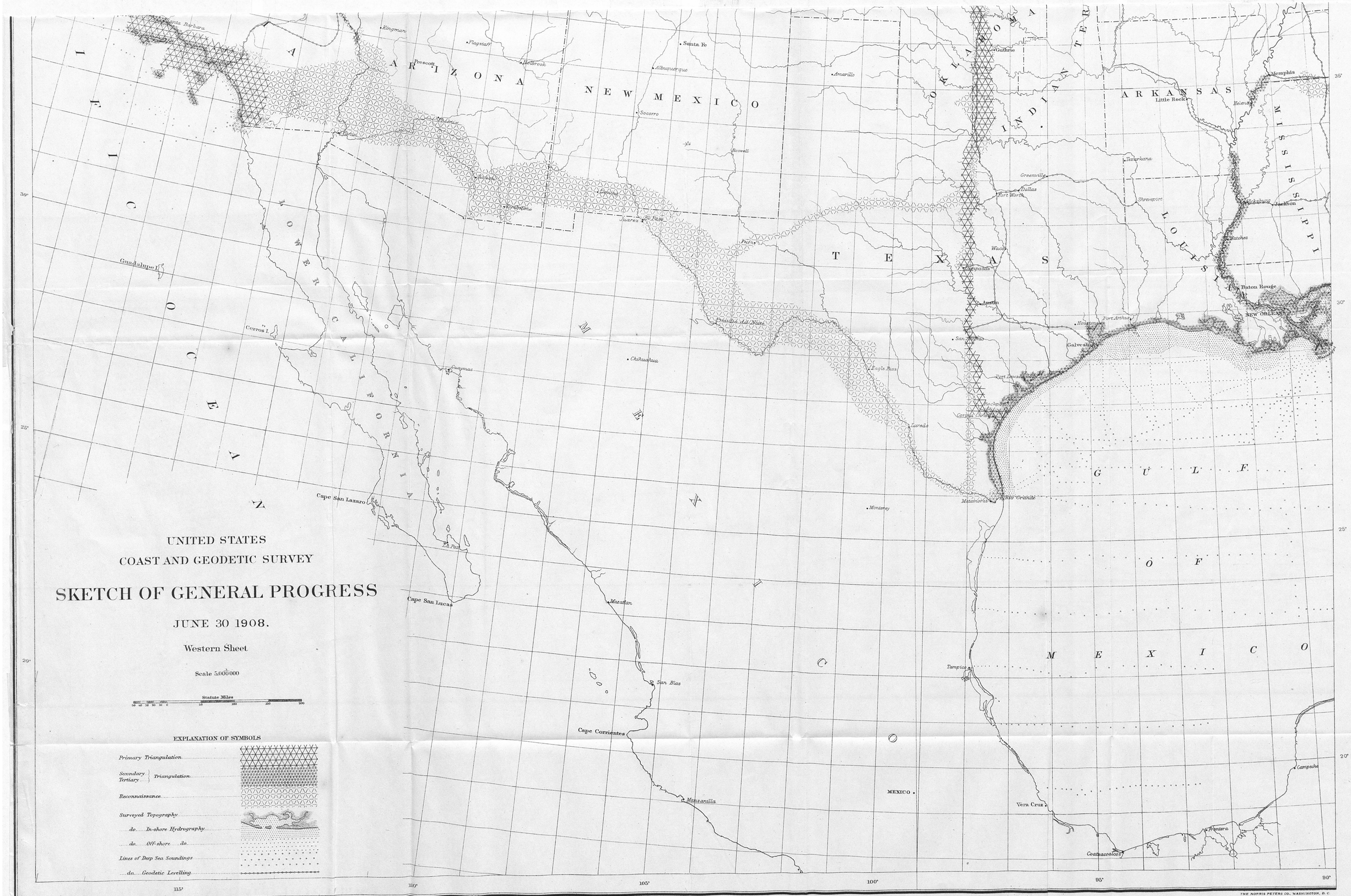
NEVADA
CALIFORNIA
LOWER CALIFORNIA
PACIFIC OCEAN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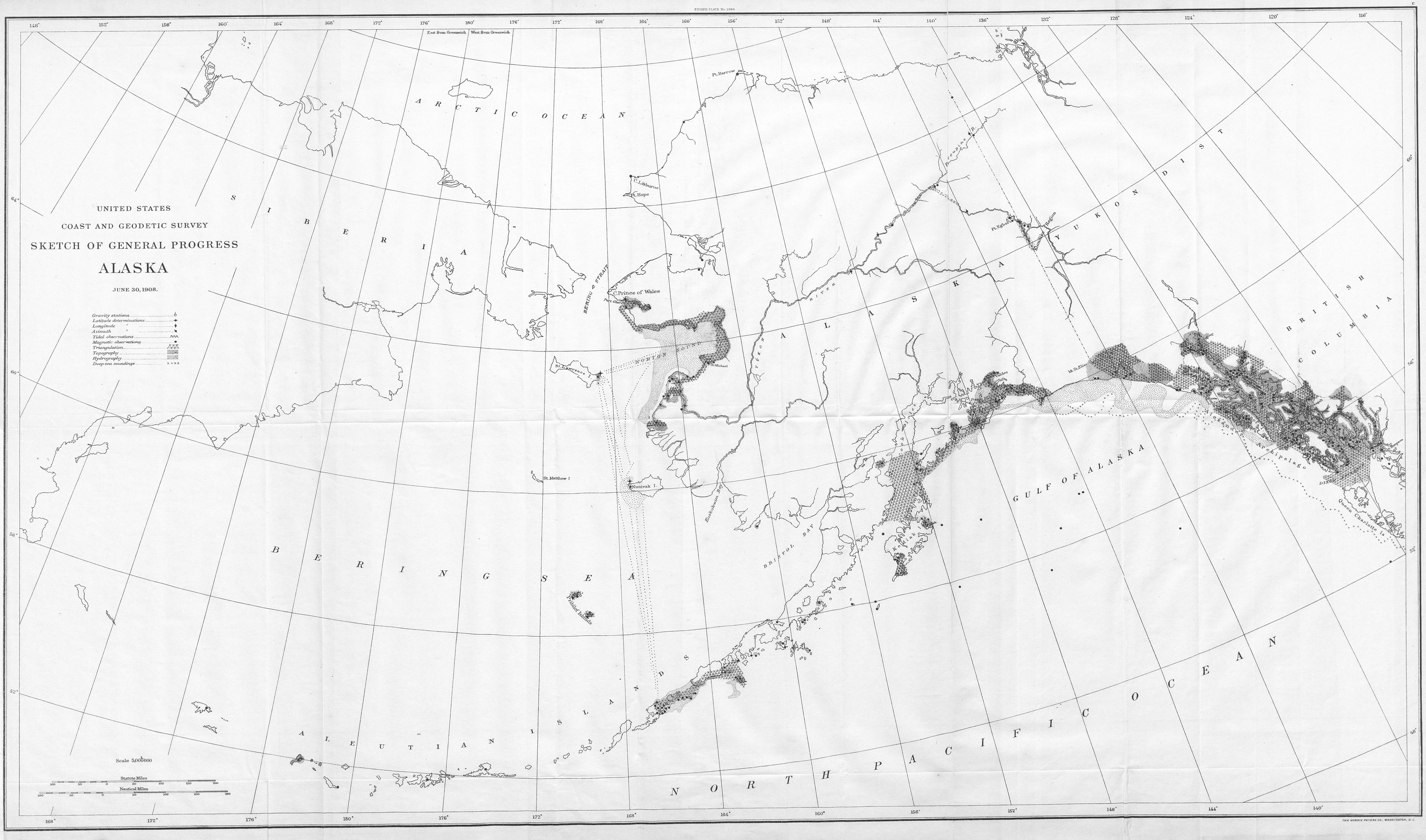
Holbrook
Santa Fe
Albuquerque
Amarillo
Guthrie
Memphis
Little Rock
Helena
Socorro
Roswell
Texarkana
Greenville
Dallas
Fort Worth
Shreveport
Jackson
Natchez
Baton Rouge
NEW ORLEANS
Juarez
El Paso
Wacco
Campasas
Austin
Port Arthur
Houston
Galveston
San Antonio
Presidio del Norte
Eagle Pass
Laredo
Port Lavaca
Rockport
Corpus Christi
Matamoras
Rio Grande
Monterey
Guadalupe I.
Cerros I.
Guaymas
Chihuahua
Cape San Lazaro
La Paz
Cape San Lucas
Mazatlan
San Blas
Cape Corrientes
Manzanilla
Tampico
Vera Cruz
Coatzacoalcos
Frontera
Campeche
MEXICO
115°
110°
105°
100°
95°
90°
35°
30°
25°
20°
THE NORRIS PETERS CO., WASHINGTON, D. C.


UNITED STATES
COAST AND GEODETIC SURVEY
SKETCH OF GENERAL PROGRESS
ALASKA
JUNE 30, 1908.
Gravity stations
Latitude determinations
Longitude "
Azimuth "
Tidal observations
Magnetic observations
Triangulation
Topography
Hydrography
Deep sea soundings
Scale 5,000,000
Statute Miles
Nautical Miles
ARCTIC OCEAN
SIBERIA
BERING SEA
ALEUTIAN ISLANDS
NORTH PACIFIC OCEAN
GULF OF ALASKA
ALASKA
YUKON DIST
BRITISH COLUMBIA
BERING STRAIT
NORTON SOUND
BRISTOL BAY
Pt. Barrow
C. Lisburne
Pt. Hope
C. Prince of Wales
St. Lawrence I.
St. Matthew I.
Nunivak I.
Pribilof Islands
Kodiak I.
Mt. St. Elias
Alexander Archipelago
Queen Charlotte Is.
East from Greenwich
West from Greenwich
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GENERAL PROGRESS SKETCH

D.

161° 160° 159° 158° West of Greenwich 157° 156° 155°

22° 21° 20° 19°

KAUAI
Niihau
OAHU
Pearl R.
Honolulu
MOLOKAI
Kaunakakai
LANAI
Lanai
MAUI
Kahului
Kaholawe
HAWAII
Hilo

HAWAIIAN ISLANDS

(Hawaiian Government Surveys also shown.)

Triangulation
Topography
Hydrography
Deep Sea Sdgs. ++++
Longitude determination (telegraphic)

30′ 67°00′ 30′ West of Greenwich 66°00′ 30′ 65°00′

18° 30′

Desecheo I.
Mona I.
Mayaguez
Ponce
Guayanilla Bay
Guayanilla Hbr.
Jobos Hbr.
San Juan
Fajardo
Culebra I.
St. Thomas
Vieques I.

PORTO RICO

Primary triangulation
Secondary and tertiary triangulation
Topography
Hydrography

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES

COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

PHILIPPINE ISLANDS

JUNE 30 1908

Latitude determinations
Longitude " (telegraphic)
Azimuth "
Tidal observations
Magnetic observations
Triangulation
Topography
Hydrography
Deep sea soundings

Formosa
Batan Islands
CHINA SEA
PACIFIC OCEAN
LUZON
Aparri
Laoag
Vigan
Tuguegarao
Candon
S. Fernando
Baguio
Bolinao
Dagupan
Casiguran
Cruz
Tarlac
Baler
Iba
Subic
Manila
Cavite
Mariveles
Atimonan
Lucena
Batangas
Paluan
Mindoro
Romblon
Mangarin
Masbate
Calbayog
Samar
Catbalogan
Borongan
Cuyo
San Jose
Iloilo
Panay
Tacloban
Ormoc
Leyte
Racolod
Negros
Cebu
Maasin
Bohol
Tagbilaran
Surigao
Dumaguete
Puerto Princesa
PALAWAN
SULU SEA
Dapitan
Cagayan
Misamis
Iligan
Lianga
Hinatuan
Tucuran
Malabang
MINDANAO
Cotabato
Davao
Mati
Zamboanga
Cagayan Sulu
Jolo
Sandakan
Siasi
BORNEO
Bongao
SULU ARCHIPELAGO

Mercator projection $\frac{1}{5000000}$ *in lat. 13° N.*

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Distribution of the principal astronomic stations occupied by the U.S. Coast and Geodetic Survey for Latitude, Longitude and Azimuth to June 30, 1903.

U. S. Coast and Geodetic Survey

O. H. Tittmann, Superintendent

BASE MAP OF THE UNITED STATES

(Projected on intersecting cone)

Scale 1:7000000

Statute Miles 150 50 0 100 200 300 400

Kilometres 150 50 0 100 200 300 400 500 600 700 800

Explanation of Signs:
- Latitude Stations
- Longitude "
- Azimuth "
- Combination Stations

THE NORRIS PETERS CO., WASHINGTON, D. C.

PLATE No. 2231 PLATE No. 2200

No. 2.

Positions and Connections of Telegraphic Longitude Stations from 1846 to June 30 1908.

D O M I N I O N O F C A N A D A

W A S H I N G T O N

O R E G O N

C A L I F O R N I A

N E V A D A

I D A H O

M O N T A N A

W Y O M I N G

U T A H

A R I Z O N A

C O L O R A D O

N E W M E X I C O

N O R T H D A K O T A

S O U T H D A K O T A

N E B R A S K A

K A N S A S

O K L A H O M A

T E X A S

M I N N E S O T A

I O W A

M I S S O U R I

A R K A N S A S

L O U I S I A N A

W I S C O N S I N

I L L I N O I S

M I C H I G A N

I N D I A N A

O H I O

K E N T U C K Y

T E N N E S S E E

M I S S I S S I P P I

A L A B A M A

G E O R G I A

S O U T H C A R O L I N A

N O R T H C A R O L I N A

V I R G I N I A

W E S T V I R G I N I A

P E N N S Y L V A N I A

N E W Y O R K

M A I N E

V E R M O N T

N E W H A M P S H I R E

M A S S A C H U S E T T S

C O N N E C T I C U T

R H O D E I S L A N D

L A K E S U P E R I O R

L A K E M I C H I G A N

L A K E H U R O N

L A K E E R I E

L A K E O N T A R I O

P A C I F I C O C E A N

A T L A N T I C O C E A N

G U L F O F M E X I C O

B A H A M A I S L A N D S

C U B A

Mexico

Vancouver Victoria Seattle Tacoma Olympia Spokane Falls Chinook Kalama Portland Walla Walla Baptista Eugene Gabelle Boise City Yellow Stone Helena Bismarck Stephen Dalton Minnesota St. Paul Pierre Howard La Crosse Fountaine Madison Williamson Bay Cedar Falls Page S.W. Base Chicago Lansing Detroit Buffalo Rochester Albany Boston Portland Augusta Montpelier Burlington Concord Providence Hartford New Haven Springfield Worcester Newport Philadelphia Harrisburg Pittsburg Cape May Baltimore Washington Wheeling Cincinnati Columbus Indianapolis Union City Logansport Terre Haute Ellis Springfield Macon Quincy Burlington Des Moines Omaha Lincoln Julesburg Sherman Cheyenne Broadwell Salt Lake City Ogden Virginia City Austin Carson City Summit Marysville Sacramento San Francisco Mt. Hamilton Los Angeles Yuma Needles Prescott Wilson Peak Santa Fe Denver Colorado Springs Pueblo Gunnison Grand Junction Green River Trinidad Kansas City Topeka Jefferson City Rolla Millard Ellsworth Fort Riley Fort Leavenworth Council Bluffs Omaha Parkersburg Point Pleasant Charleston Huntington Ironton Portsmouth Louisville Frankfort Lexington Covington Richmond Irvine Staunton Lynchburg Petersburg Richmond Potosi Ironton Bardstown Danville Cave City Hickman Paducah Nashville Clarksville Gallatin Cleveland London Jellico Bristol Knoxville Asheville Raleigh Wilmington Columbia Charleston Augusta Atlanta Macon Greenville Vicksburg Jackson Natchez Meridian Montgomery Eufaula Pensacola Tallahassee St. Marks St. Augustine Jacksonville Tampa Key West Havana Nassau Kingston Pond Creek Guthrie Fort Smith Memphis Little Rock Marlow Fort Worth Bowie N.W. Base Texarkana Jacksonville Austin Galveston Brownsville Alice Laredo Eagle Pass Fort Stockton Fort Hancock Presidio Marcopa Yuma Boundary Line Fort Yuma Fort Selden Santa Fe Prescott Needles Los Angeles Wilson Peak Mt. Hamilton San Francisco Sacramento Carson City Virginia City Austin Summit Marysville Chico Red Bluff Gabelle Baptista Eugene Portland Walla Walla Olympia Seattle Tacoma Victoria Vancouver Chinook Spokane Falls Kalama Helena Yellow Stone Boise City Ogden Salt Lake City Green River Grand Junction Gunnison Colorado Springs Denver Julesburg Sherman Cheyenne Broadwell Omaha Lincoln Des Moines Cedar Falls Page S.W. Base Howard Pierre Stephen Bismarck Dalton Minnesota St. Paul La Crosse Fountaine Madison Williamson Bay Chicago Lansing Detroit Buffalo Rochester Albany Boston Portland Augusta Montpelier Burlington Concord Providence Hartford New Haven Springfield Worcester Newport Philadelphia Harrisburg Pittsburg Cape May Baltimore Washington Wheeling Cincinnati Columbus Indianapolis Union City Logansport Terre Haute Ellis Springfield Macon Quincy Burlington Kansas City Topeka Jefferson City Rolla Millard Ellsworth Fort Riley Fort Leavenworth Council Bluffs Omaha Parkersburg Point Pleasant Charleston Huntington Ironton Portsmouth Louisville Frankfort Lexington Covington Richmond Irvine Staunton Lynchburg Petersburg Richmond Potosi Ironton Bardstown Danville Cave City Hickman Paducah Nashville Clarksville Gallatin Cleveland London Jellico Bristol Knoxville Asheville Raleigh Wilmington Columbia Charleston Augusta Atlanta Macon Greenville Vicksburg Jackson Natchez Meridian Montgomery Eufaula Pensacola Tallahassee St. Marks St. Augustine Jacksonville Tampa Key West Havana Nassau Kingston Pond Creek Guthrie Fort Smith Memphis Little Rock Marlow Fort Worth Bowie N.W. Base Texarkana Jacksonville Austin Galveston Brownsville Alice Laredo Eagle Pass Fort Stockton Fort Hancock Presidio Marcopa Yuma Boundary Line Fort Yuma Fort Selden Santa Fe Prescott Needles Los Angeles Wilson Peak Mt. Hamilton San Francisco Sacramento Carson City Virginia City Austin Summit Marysville Chico Red Bluff Gabelle Baptista Eugene Portland Walla Walla Olympia Seattle Tacoma Victoria Vancouver Chinook Spokane Falls Kalama Helena Yellow Stone Boise City Ogden Salt Lake City Green River Grand Junction Gunnison Colorado Springs Denver Julesburg Sherman Cheyenne Broadwell Omaha Lincoln Des Moines Cedar Falls Page S.W. Base Howard Pierre Stephen Bismarck Dalton Minnesota St. Paul La Crosse Fountaine Madison Williamson Bay Chicago Lansing Detroit Buffalo Rochester Albany Boston Portland Augusta Montpelier Burlington Concord Providence Hartford New Haven Springfield Worcester Newport Philadelphia Harrisburg Pittsburg Cape May Baltimore Washington Wheeling Cincinnati Columbus Indianapolis Union City Logansport Terre Haute Ellis Springfield Macon Quincy Burlington Kansas City Topeka Jefferson City Rolla Millard Ellsworth Fort Riley Fort Leavenworth Council Bluffs Omaha Parkersburg Point Pleasant Charleston Huntington Ironton Portsmouth Louisville Frankfort Lexington Covington Richmond Irvine Staunton Lynchburg Petersburg Richmond Potosi Ironton Bardstown Danville Cave City Hickman Paducah Nashville Clarksville Gallatin Cleveland London Jellico Bristol Knoxville Asheville Raleigh Wilmington Columbia Charleston Augusta Atlanta Macon Greenville Vicksburg Jackson Natchez Meridian Montgomery Eufaula Pensacola Tallahassee St. Marks St. Augustine Jacksonville Tampa Key West Havana Nassau Kingston

Station connection without change of observers and without the use of the transit micrometer.

U. S. Coast and Geodetic Survey

O. H. Tittmann, Superintendent

BASE MAP OF THE UNITED STATES

(Projected on intersecting cone)

Scale 1:7000000

Statute Miles 100 50 0 100 200 300 400

Kilometres 100 50 0 100 200 300 400 500 600 700 800

125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65°

West from Greenwich

THE NORRIS PETERS CO., WASHINGTON, D. C.

Routes of Geodetic Spirit Leveling and Positions of Gravity and Tide Stations to June 1908.

U. S. Coast and Geodetic Survey

O. H. Tittmann, Superintendent

BASE MAP OF THE UNITED STATES

(Projected on intersecting cone)

Scale 1:7000000

Statute Miles

Kilometres

Gravity stations

The location of Tide Stations are shown thus:
Where series of Observations of 1 to 3 years
" " " " 3 to 9 "
" " " " 9 and more years
The letter d affixed to the symbol indicates that daily predictions for that station are given in the Tide Tables.

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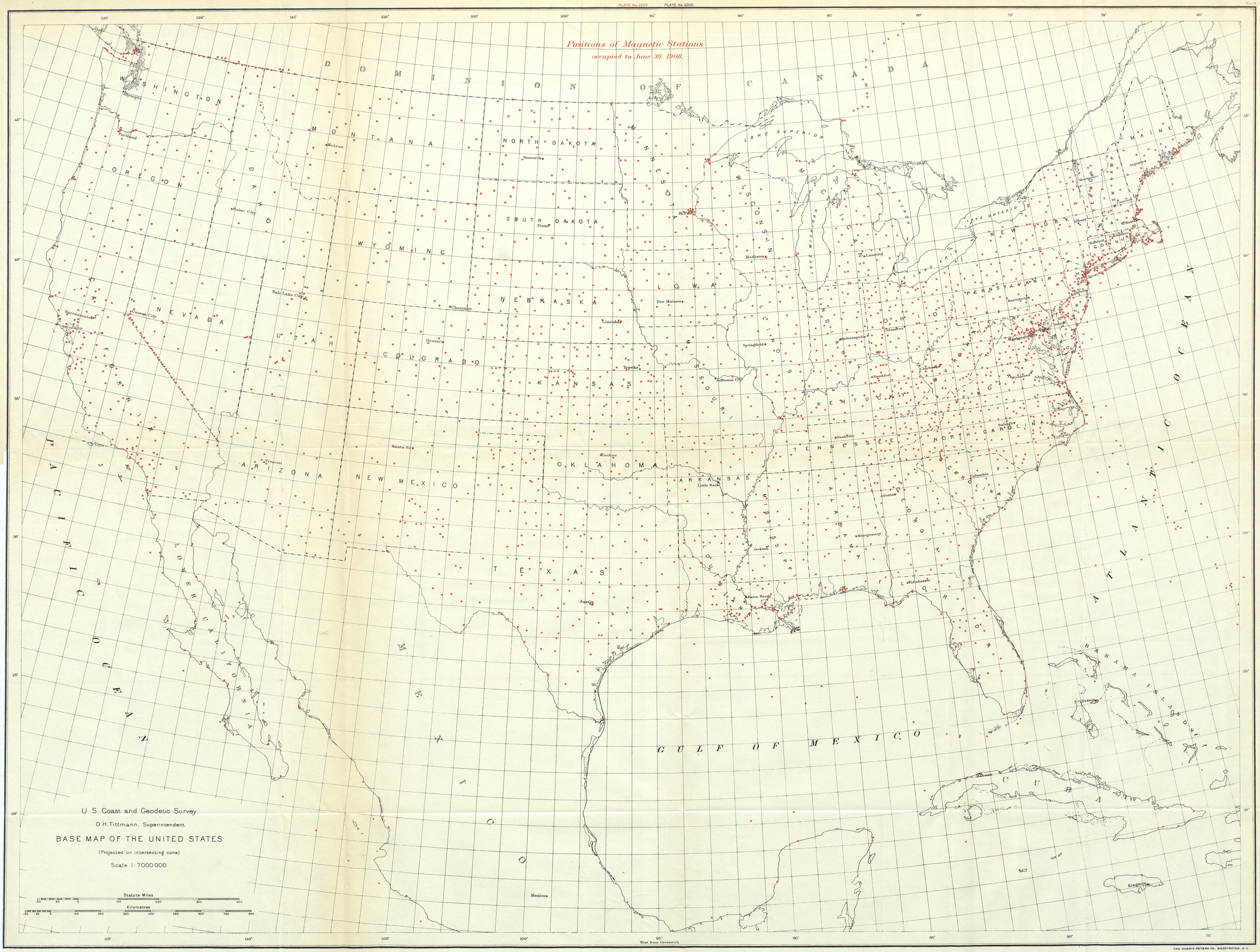
Positions of Magnetic Stations
occupied to June 30, 1908.
DOMINION OF CANADA
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
ARIZONA
COLORADO
NEW MEXICO
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
MASSACHUSETTS
CONNECTICUT
NEW JERSEY
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO
LOWER CALIFORNIA
MEXICO
GULF OF MEXICO
PACIFIC OCEAN
ATLANTIC OCEAN
BAHAMA ISLANDS
CUBA
Olympia
Portland
Helena
Bismarck
Boise City
Pierre
St. Paul
Madison
Lansing
Salt Lake City
Cheyenne
Sacramento
Carson City
Denver
Lincoln
Des Moines
Springfield
Indianapolis
Columbus
Harrisburg
Washington
Richmond
Raleigh
Columbia
Atlanta
Montgomery
Tallahassee
Jackson
Baton Rouge
Little Rock
Austin
Santa Fe
Prescott
Topeka
Jefferson City
Frankfort
Nashville
Charleston
Albany
Augusta
Concord
Boston
Hartford
Providence
Trenton
Nassau
Havana
Kingston
Mexico
Statute Miles
Kilometres
West from Greenwich
U. S. Coast and Geodetic Survey
O. H. Tittmann, Superintendent
BASE MAP OF THE UNITED STATES
(Projected on intersecting cone)
Scale 1:7000000
THE NORRIS PETERS CO., WASHINGTON, D. C.