DEPARTMENT OF COMMERCE AND LABOR

REPORT OF THE SUPERINTENDENT

OF THE

COAST AND GEODETIC SURVEY

SHOWING

THE PROGRESS OF THE WORK

FROM

JULY 1, 1910, TO JUNE 30, 1911

WASHINGTON
GOVERNMENT PRINTING OFFICE
1912

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 15, 1911.

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, 1911. It is accompanied by maps illustrating the general advance in the operations of the Survey up to that date.

Respectfully,

BENJ. S. CABLE,
Acting Secretary.

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE AND LABOR,
COAST AND GEODETIC SURVEY,
Washington, September 15, 1911.

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, 1911. 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. CHARLES NAGEL,
Secretary of Commerce and Labor.

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REPORT OF THE SUPERINTENDENT.

WORK OF THE YEAR.

FIELD WORK.

Work during the year has included surveys along the coasts of the United States and outlying Territories, including Alaska, Hawaii, and the Philippines, and triangulation, leveling, gravity, and magnetic work in the interior States and Territories.

A reconnoissance for primary triangulation to extend from the thirty-ninth parallel triangulation in the vicinity of Colorado Springs, Colo., to the Canadian boundary was begun in Colorado early in May, and by the end of the fiscal year over 400 miles of progress had been made. Provision was made for connections with triangulation stations of the United States Geological Survey, section corners of the General Land Office, and with monuments of several State boundaries. The line follows approximately the one hundred and fourth meridian.

One party was engaged in primary triangulation, one in reconnoissance for primary triangulation, six in revision of triangulation, one in gravity work, and one in determinations of latitude, longitude, and azimuth.

The Texas-California arc of the primary triangulation extending from central Texas to the Pacific coast, connecting the ninety-eighth meridian primary triangulation in the vicinity of Weatherford, Tex., with the Pacific coast triangulation in the vicinity of San Diego, Cal., was completed during the year. It is connected with the United States and Mexican boundary at a number of places and is joined to and correlates a number of detached Government surveys. It furnishes the geographic positions on the United States Standard Datum of more than 200 points which can be used to control future public surveys within the region traversed.

Tidal observations have been recorded at a number of permanent stations and at temporary tidal stations maintained in the progress of the field work. Observations of currents along the Atlantic coast have been carried on with the cooperation of the Bureau of Lighthouses, and arrangements have been made with the Bureau of Education of the Interior Department and the Revenue-Cutter Service of the Treasury Department by which tidal observations on the coast of Alaska will be obtained at numerous points at a nominal cost to the Government.

Exchange of data with the United States Engineers, the Bureau of Lighthouses, the Hydrographic Office of the Navy Department, the General Land Office, the Geological Survey, and the Isthmian Canal Commission, has been continued as heretofore.

The collection of information for the Coast Pilot and for the correction and revision of charts on both the Atlantic and Pacific coasts, and in Alaska, Hawaii, and the Philippines has been continued.

A number of parties have been engaged in making magnetic observations at numerous points in the United States, in Alaska, Porto Rico, and Hawaii, and magnetic observations have been made on vessels of the Survey at sea whenever practicable.

Work at the latitude observatories at Gaithersburg, Md., and Ukiah, Cal., maintained by the International Geodetic Association, has been continued, under the direction of the Superintendent, and the results have been transmitted to the association.

A zenith tube designed by Dr. F. E. Ross for the determination of the latitude variation by a photographic method has been installed at Gaithersburg. This undertaking was rendered possible by a special grant from the International Geodetic Association.

An officer of the Survey has served as a member of the Mississippi River Commission, in addition to other duties, and another has been continuously employed in cooperation with the Maryland State Board of Shell Fish Commissioners. This officer was also authorized to supervise the survey of certain portions of the oyster beds in the State of Delaware, without expense to the Government.

Assistance was rendered by furnishing points, location of stakes, etc., to the Fish Commission of the State of North Carolina and points were determined by triangulation for use in the survey of the oyster beds of the States of Alabama and Mississippi.

Latitude, telegraphic longitude, and an azimuth were determined at Fairbanks and Tanana, Alaska, at the request of the United States Geological Survey. The latitude and longitude of a point in the grounds of the American Museum of Natural History in New York City were also determined.

On the Atlantic coast hydrographic surveys were made on the coast of Maine, Massachusetts, New Jersey, Maryland, Virginia, and Florida, and field work for the Coast Pilot has covered the coast from Maine to Rhode Island. Four vessels and one land party were employed in the work, as follows:

Steamer *Bache:* Hydrography of Nantucket Shoals, examination of Five Fathom Bank off Cape May, triangulation and hydrography near Key West, search for a reported shoal near Rebecca Shoal Lighthouse and for another shoal reported near Marquesas Rock Buoy; incidentally, the position of the steamer *Luckenbach* while stranded on New Ground Shoal and the position of the wreck of the schooner *Hannah M. Bell* on Elbow Reef were determined.

Steamer *Endeavor:* Hydrographic surveys in Buzzards Bay, Mass., assisting the steamer *Bache* in determining the positions of buoys for use in the survey of Nantucket Shoals, hydrography of Chesapeake Bay between Smith Point and Cherrystone Light, and determination of the positions of lights and beacons in Mobjack Bay, Va.

Schooner *Matchless:* Revision of the hydrography of the James River from the vicinity of Newport News and the triangulation and topography from Jamestown Island to Petersburg and Richmond, Va., and revision of the hydrography, triangulation, and topography of the York River.

Steamer *Hydrographer:* Engaged in Coast Pilot examinations along the coast from Calais, Me., to Point Judith, R. I., for the field revision of the Atlantic Coast Pilots, Parts I–II, and III.

Wire-drag work was done on the coast of Maine in Penobscot Bay, and in Long Island Sound south of Clinton, Conn.

Improvements have been made in the mechanical appliances used in connection with the wire drag, permitting the increase in the length of the drag to any desired extent, and enabling a larger area to be covered in a less time than heretofore.

On the Pacific coast general surveys were made on the coast of Alaska by six vessels of the Survey during the season available for work. During the intervening time one of these vessels was employed on the coast of California, two on the coast of Washington, and one in the Hawaiian Islands, as follows:

Steamer *Explorer:* Triangulation, topography, and hydrography of Bristol Bay, Alaska, examination of the mouth of the Kuskokwim River, hydrography and topography of the island of Oahu, Hawaii, completed.

Steamer *Patterson:* Triangulation, topography, and hydrography in Cook Inlet, Alaska; offshore hydrography of the coast of California between Bodega Head and Cape Arena, and of the coast northward of San Francisco; general surveys on the coast of Alaska in the vicinity of Dolgoi Island.

Steamer *Gedney:* Survey of Tongass Narrows, southeast Alaska, and of Wrangell Strait; topography and hydrography at the head of Portland Canal; chart revision work in Puget Sound; and survey of the entrance to Willapa Bay, Wash.

Steamer *McArthur:* Survey of Cook Inlet, Alaska, north of the Forelands; survey of Grays Harbor, Wash.; examination of Perouse Glacier and Icy Bay, Alaska, and additional hydrography in Katalla Bay.

Steamer *Taku:* Survey of shores of Knights Island, and of Prince of Wales Passage, and Bainbridge Passage, Alaska; location of aids to navigation in Cordova Bay.

Steamer *Yukon:* Surveys on east shore of Cooks Inlet, Alaska, south of the Forelands.

Five parties were engaged in the field revision of charts in various localities on the Atlantic and Pacific coasts.

Magnetic observations were made at the regular observatories at Cheltenham, Md., Tucson, Ariz., Honolulu, Hawaii, Sitka, Alaska, and Vieques, P. R., and the magnetic declination, dip, and intensity were determined by field observers at about 350 stations on land and in 24 localities at sea by the vessels of the Survey.

Self-registering tide gauges were maintained at Portland, Me., Fort Hamilton, N. Y., Philadelphia, Pa., Baltimore, Md., Wilmington, N. C., Fernandina, Fla., Weeks, La., Galveston, Tex., San Diego, Cal., San Francisco, Cal., Seattle, Wash.

The tide indicators at Fort Hamilton, N. Y., Reedy Island, Del., and the electrical tidal indicators in the rooms of the Maritime Association and at the Seaman's Friend Society's Institute in New York City have continued in operation.

HAWAIIAN ISLANDS.

A complete survey of the island of Oahu has been made and data collected for the Coast Pilot of the Hawaiian Islands.

Through the courtesy of the surveyor general of Hawaii, the Coast and Geodetic Survey is furnished with records of tide observations made by the Territorial government.

A magnetic observatory is maintained by the Coast and Geodetic Survey at Honolulu.

PORTO RICO.

A permanent magnetic observatory is maintained by the Coast and Geodetic Survey at Vieques, P. R.

No surveying work was done in Porto Rico during the year.

PHILIPPINE ISLANDS.

In the Philippines surveys have been conducted by the Coast and Geodetic Survey steamer *Pathfinder* and the insular government steamers *Fathomer, Marinduque, Romblon,* and *Research,* and by parties living on shore.

Surveys have been made of the following localities: Northeast coast of Mindanao and adjacent islands; Mindoro, Panay, Masbate, Luzon, Semirara Group, and Tablas; Mindanao Sea, central and western parts; Jolo Harbor and approaches; southwestern coast of Mindanao, Basilan Strait; south coast of Luzon, Burias, and Masbate Islands; southeast coast of Cebu; north coast of Mindanao; and north coast of Leyte.

The field work in the Philippines completed to June 30, 1911, is estimated to cover 51.3 per cent of the whole coast line of the islands.

At the office in Manila the records received from the field parties have been examined, reduced, and checked wherever necessary, duplicates prepared, results of triangulation adjusted, and elevations computed. Progress has been made in the preparation and compilation of results and sketches for the publication of the Luzon triangulation.

The usual studies have been made for each proposed piece of field work from all available sources of information; notes, specifications, and instructions for field parties have been prepared and general supervision exercised over the technical details of the field operations.

Requests for data needed in surveys by the Army have been filled, in addition to other calls for information.

Finished tracings have been made for chart publications, hydrographic sheets plotted and completed, and topographic sheets inked and completed when necessary.

Sailing directions and notices to mariners for the Philippines have been prepared and a large amount of original hydrographic information has been received and filed.

Lights and buoys on the charts have been colored and hand corrections to the charts made when required.

The Survey has a representative on the lighthouse board of the Philippine Government.

Progress has been made in the compilation by the geographic division of a general map of the Philippines.

INTERNATIONAL BOUNDARIES.

Progress made in the survey and marking of the boundary line between the United States and Canada and on the one hundred and forty-first meridian boundary between Alaska and the British possessions, which is conducted under the direction of the Superintendent as Commissioner on the part of the United States, may be briefly stated as follows: The party working on the northeastern boundary between Maine and New Brunswick in the valleys of the St. John and St. Francis Rivers, conjointly with a Canadian party, carried the triangulation and topography from the vicinity of Edmundston, New Brunswick, to the head of Cross Lake, on the St. Francis River, a distance of about 50 miles; and 18 boundary monuments were erected and determined in position by triangulation. Work was resumed in the spring of 1911.

The party, also working in conjunction with a Canadian party on the St. Croix River, began work in the neighborhood of Calais, Me., from which point the triangulation, topography, and traverse line measurement were carried to the vicinity of Vanceboro. From Woodland, Me., to the mouth of the river the survey is entirely completed.

Work was resumed in the neighborhood of Woodland in the spring of 1911 and was in progress at the close of the year.

The party engaged on the survey of the boundary line from Pigeon River westward toward the Lake of the Woods carried the triangulation from South Fowl Lake to the west end of Rose or Mud Lake. The topography of the boundary lakes and connecting waterways between the same limits was completed, with the exception of Rose Lake.

During the season of 1910 the parties working on the northwestern boundary along the forty-ninth parallel east of the Rocky Mountains completed 131 linear miles of triangulation from a little east of the north fork of Milk to the Middle Branch of Poplar River. Two base lines were measured, azimuth determined, and connection made with the triangulation. In the spring of 1911 work was resumed and by the close of the year about 40 miles of triangulation had been completed and the reconnoissance carried 10 miles farther. Eighty-five monuments were set in the season of 1910, and about 30 miles monumented in May and June, 1911. During the same period the topography was carried along the boundary for 131 miles and 161 miles of levels were run. Work was resumed in the spring of 1911 and was in progress at the date of this report.

Work on the portion of the Northwestern boundary from a point at or near Short Creek, a tributary of the Souris or Mouse River, to the eastward, was continued during the season of 1910 by a Canadian party, accompanied by a field officer of the Coast and Geodetic Survey as American representative. The triangulation and topography of the boundary were carried from Short Creek eastward to monument No. 170, nearly at the eastern terminus of Turtle Mountain, a distance of 136.4 miles, but no monuments were set east of 172. In all, 94 monuments were set. In April, 1911, the party again took the field for the identification and establishment of monuments from the vicinity of Bannerman, Mont., eastward.

The party engaged in the survey of the Alaska boundary at the head of the Big Salmon River ran a line of precise levels from Skagway to the summit of White Pass; connected the triangulation at the head of the Big Salmon River with that at the head of Glacier Bay, strengthened the location of certain boundary peaks and extended the topography over the region at the head of Muir Glacier.

A Canadian party, accompanied by a field officer of the Coast and Geodetic Survey representing the United States Commissioner, was engaged at the beginning of the year in marking the Alaska-Canada boundary at the head of Portland Canal. Work during the season included the recovery of old triangulation necessary for the establishment of monuments and the erection of the monuments and their connection with the triangulation reference marks.

Work on the survey and marking of the boundary line along the one hundred and forty-first meridian between Alaska and Canada was continued during the season of 1910.

The demarcation of the boundary line (one hundred and forty-first meridian) was extended from a point about 40 miles north of the Yukon River, where work closed in 1909, to a point 10 miles beyond the Rampart House, a distance of 155 miles. The line projection was in direct charge of a Canadian surveyor, with an assistant surveyor representing the chief of the American party. The line cutting and monumenting were done by a Canadian party. A vista 20 feet wide was cleared through the timber and small aluminum bronze monuments were erected at intervisible points not more than 4 miles apart. The monuments were connected with the triangulation. In all, 62 miles of vista were cut and stadia line run, and 20 monuments placed.

Magnetic declination was observed at 15 stations.

A Canadian party accompanied by an American surveyor was engaged in line cutting and monumenting south of Sixty Mile River, completing the work not previously done from the Yukon River to Mount Natazhat Ridge.

COAST AND GEODETIC SURVEY OFFICE.

The work of the office includes, besides the executive and accounting departments, the reduction and plotting of results obtained in the field and the preparation of these results for publication in the form of charts, Coast Pilots, tide tables, notices to mariners, reports, and special publications. These operations include computing, drawing, engraving, lithographing, photographing, electrotyping, and chart printing, as well as the distribution and sale of the charts, Coast Pilots, and tide tables. Instruments required for the use of field parties are repaired and in some cases constructed in the office, which has a complete equipment for mechanical work.

Good progress has been made in all branches of the work, although the force employed is not sufficient for the most efficient and economical administration, in view of the increasing volume of work and the constant growing demand for the results of the Survey.

Increases made in the compensation of the computers, engravers, and mechanicians, and in the lower grades of clerks, and of certain other employees have been of considerable benefit to the efficiency of the personnel in enabling the Survey to retain employees who would otherwise have sought advancement by transfer to other departments or in private employment.

A large amount of time and labor were devoted to answering calls for information from the President's Commission on Efficiency and Economy and the preparation of data called for by Congress.

Improvements in methods and processes have been made in many branches of the work, tending to increased output and improved quality of results.

The appropriation for the Coast and Geodetic Survey for the fiscal year ending June 30, 1911, was $1,005,120, divided as follows:

Field expenses	$317,400
Repairs and maintenance of vessels	40,000
Officers and men, vessels	245,000
Salaries:	
Superintendent and field force	160,200
Office force	192,520
Office expenses	50,000
Total	1,005,120

GENERAL REMARKS.

The exacting demands of modern navigation, due to increased traffic, larger size and draft of vessels, and the improvement of channels and harbors, require a corresponding extension of the surveys required to keep the charts up to date. A new chart may require extensive corrections soon after it is issued, and when the number of corrections becomes very great, a new edition becomes necessary. Surveys must be made at frequent intervals to keep pace with changes due to natural causes, to artificial improvements, changes in lights and buoys, and newly discovered rocks and shoals. Many waterways formerly but little frequented are now extensively used, and the great development of motor boating, has caused an extensive demand for accurate charts of the inland waterways and shallower waters along the coast. Data concerning

tides and currents and the deflection of the compass needle are necessary for the use of the navigator and are embodied for his use on the charts and in the Coast Pilots and Tide Tables and in other publications. The positions of lighthouses and other aids to navigation must be accurately determined, and finally important channels and harbors must be carefully gone over with the wire drag to make certain that no hidden dangers have been overlooked by the ordinary methods of surveying.

While the whole of the Atlantic coast and the greater part of the Pacific coast of the main portion of the United States have been covered by detailed surveys, resurveys are constantly needed and will always be needed to furnish information required by changed conditions.

Demands are constantly made for new surveys of harbors on the coast of Alaska, as the development of that territory is largely dependent on accurate surveys of the coast and waterways. To meet this need all the vessels of the Survey on the Pacific coast have been employed on that coast during the season available for work.

Attention is again called to the importance of providing means for carrying a scheme of triangulation down the valley of the Yukon River from the international boundary to the mouth of the river as a basis for economic surveys in Alaska.

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 Inspector supervised the field work of the parties on the surveying vessels and all other hydrographic and topographic work, including coast-pilot work in field and Office. He prepared plans for the field work and the necessary instructions for the chiefs of parties and recommended the approval of estimates for expenses and all changes in personnel on the vessels when such changes became necessary. He made monthly reports of the progress of the work and monthly statements covering all employees not under civil-service rules.

Numerous trips of inspection were made by him in personally supervising the repairs of the surveying vessels.

The routine work in connection with the enlistment of crews for the vessels and the administrative examination of the accounts of the vessels was continued.

COAST PILOT.

The following publications were prepared and the proof was read: United States Coast Pilot, Parts I–II, third edition; Supplement to Coast Pilot Notes on Bering Sea and Arctic Ocean.

VESSELS AND THEIR WORK.

Steamer "Bache."—On July 1 the *Bache* was at Boston undergoing repairs, on the completion of which on July 14, hydrographic work on Nantucket Shoals was begun and continued until October 20. Some minor repairs were made at Boston, and on November 9 the vessel sailed for Lewes, Del., arriving there on the 11th. An examination of Five Fathom Bank, off Cape May, N. J., was taken up and continued until December 22, when the *Bache* proceeded to Baltimore to take in stores and equipment for the winter's work.

The vessel left Baltimore for Hampton Roads on January 8 with instructions to make an examination of the shoals off Cape Charles, Va., but, owing to unfavorable weather, this work was abandoned, and the steamer sailed from Norfolk for Key West on January 24, arriving February 2. From that date until the end of June the party was engaged in the extension of the triangulation from the vicinity of Key West to Rebecca Shoal Lighthouse and northward to New Ground Shoal and the revision of the hydrography through Boca Grande Channel and westward to New Ground Shoal.

Steamer "Endeavor."—The *Endeavor* was engaged in hydrographic work in Buzzards Bay, Mass., which work was suspended from July 19 to August 2 in order that the vessel and party might cooperate in the work of the steamer *Bache* in determining the positions of buoys on Nantucket Shoals. Leaving Buzzards Bay August 15 the vessel arrived at Baltimore on the 22d. After taking in supplies the *Endeavor* left Baltimore September 2 for her working ground in the lower Chesapeake, where she took up the revision of the hydrography of Chesapeake Bay between Smiths Point and Cherrystone Light and afterwards in Mobjack Bay. Work was still in progress at the close of the year.

Schooner "Matchless."—This vessel was engaged first in the revision of the surveys of the James River until April 1 and of York River from April 10. On June 13 she proceeded to Baltimore for repairs, which were in progress at the close of the year.

WIRE-DRAG WORK.

Wire-drag work was prosecuted on the coast of Maine at Tennants Harbor and in Penobscot Bay and in Long Island Sound south of Clinton, Conn. A large number of new reefs and shoals were discovered and least water found on many known reefs.

CHART REVISION.

Chart-revision work was done along the eastern coast of Virginia from Wachapreague Inlet to Cape Charles. The revision of the triangulation and topography was completed and the hydrographic revision is well advanced.

Revision of surveys for chart correction was done on the north shore of Long Island and in Greater New York.

Chart-revision work was done on the coast of Massachusetts from Gloucester to Plum Island; in North Landing River, N. C., including incidental triangulation; and on the coast of Maine from Cape Neddick Roads to York.

Revision work was done on Delaware Bay and in the location of buoys and stakes in Albemarle and Croatan Sounds in aid of the North Carolina Fish Commission.

The steamer *Hydrographer* was engaged during the summer of 1910 in the field revision of Coast Pilots, Parts I–II and III. The work covered the coast from Calais,

Me., to Point Judith, R. I. Work closed October 31, and the vessel returned to Baltimore November 9, where she was docked and some small repairs made. She was laid up for the remainder of the year.

The schooner *Transit* has been laid up near Morgan City, La., during the entire year.

PACIFIC COAST.

Steamer "Explorer."—This vessel was engaged in the survey of Bristol Bay, Alaska, and afterwards made an examination of the entrance to the Kuskokwim River. On the completion of this work the vessel sailed October 5 for the Hawaiian Islands and took up the survey of the island of Oahu, which was completed on February 20.

Sailing from Honolulu on February 28, the *Explorer* arrived at San Francisco on March 13. Arrangements were made at once for extensive repairs needed to the vessel, and this work was in progress at the end of the year.

Steamer "Patterson."—The steamer *Patterson* was employed during the summer on surveys in Cook Inlet, Alaska, and afterwards upon hydrography off the coast of California. She sailed from her working ground in Alaska for San Francisco October 3, arriving October 22. The vessel was undergoing repairs from November 24 to January 13, when she took up the hydrographic work off the coast of California, which was continued until March 15. The vessel was under repair from March 20 to about April 15. She sailed for Seattle April 20, making soundings on the way off the coast of Oregon. Arriving at Seattle April 28, she sailed May 4 for Unalaska, was at Ketchikan May 11 and 12, and arrived at the working ground near Dolgoi Island on May 18. Surveys were begun at once in that locality and continued to the close of the year.

Steamer "Gedney."—The *Gedney* was engaged in surveys in southeastern Alaska at Tongass Narrows; at the head of Portland Canal; and in Wrangell Strait. Closing this work October 15, the vessel sailed for Seattle, arriving October 29. She was afterwards employed upon chart-revision work in Puget Sound and the survey of Willapa Bay, Wash. The *Gedney* was undergoing repairs from March 15 to May 23, after which the work at Willapa Bay was taken up and continued to the close of the year.

Steamer "McArthur."—This vessel was engaged upon surveys in Cook Inlet, Alaska, until September 28. She sailed for Seattle October 3, arriving October 21. The vessel was then repaired. On November 25 she sailed for Grays Harbor, Wash., arriving November 29. The survey of that harbor was continued until March 13, and on the 17th the vessel sailed for Seattle. Repairs were in progress between April 5 and 29. On May 12 the *McArthur* sailed for Cook Inlet, Alaska, stopping on the way to make examinations at La Perouse Glacier, Icy Bay, and Katalla Bay. The vessel reached Seldovia June 2. Work in Cook Inlet was in progress at the close of the year.

Steamer "Taku."—The steamer *Taku* was employed during the summer of 1910 in the survey of the shores of Knight Island and of Prince of Wales Passage and Bainbridge Passage, Alaska. Several aids to navigation were also located in Cordova Bay. Work closed September 23, and the *Taku* was laid up. On June 15 work was resumed in Prince William Sound, Alaska, and continued to the close of the year.

Steamer "Yukon."—The steamer *Yukon* was engaged at the beginning of the fiscal year in the survey of the east shore of Cook Inlet, south of the Forelands. Work closed September 15, 1910. Work was resumed in Cook Inlet on June 5, 1911, and was in progress at the end of the year.

An officer of the Survey was engaged upon chart-revision work in southern California and in San Pablo Bay until April, 1911.

The revision of the surveys of the Hawaiian Islands, and especially on the island of Oahu, was carried on by a shore party, acting during the latter portion of the time under the general supervision of the commanding officer of the steamer *Explorer*.

PHILIPPINE ISLANDS.

The details of the work in the Philippine Islands are contained in the report of the Director of Coast Surveys at Manila, under whose immediate supervision all work in those islands is carried on.

INSPECTOR OF GEODETIC WORK.

WM. BOWIE, *Inspector.*

The duties of the Inspector were performed at the Office in Washington by correspondence with field parties and by examination of records, computations, and reports.

The most important event of the year in this branch of the Survey is the completion of the Texas-California arc of primary triangulation, which extends from central Texas to the Pacific coast. It connects the ninety-eighth meridian primary triangulation in the vicinity of Weatherford, Tex., with the Pacific coast primary triangulation in the vicinity of San Diego, Cal. It is connected with the United States and Mexican boundary at a number of places and is joined to and correlates a number of detached Government surveys. It furnishes the geographic positions on the United States Standard Datum of more than 200 points, which can be used to control all future public surveys within the region traversed.

There are 92 primary stations in the main scheme of this triangulation, and in addition 38 stations in secondary schemes, which provide for the connections with the United States-Mexican boundary monuments and existing triangulation. The total area covered by the triangulation is 48 400 square miles, the average length of line east of El Paso being 17 miles, and thence to the Pacific coast 62 miles. The maximum length of line is about 121 miles. Two primary bases were measured and 24 primary azimuths were observed. The total work was done in less than three years and six months, and the observations in less than two years and four months. The remarkable rapidity and low cost of this work were due to the small amount of camp equipage used by each unit of the party, the economical organization of the parties, and to generally favorable conditions of weather.

Gravity work was continued throughout the year, and the intensity of the force of gravitation was determined at 24 new stations, and 3 old stations were reoccupied.

The line of precise levels between Fort Worth and El Paso, Tex., was completed during the fiscal year. The line of precise leveling between El Reno, Okla., and Jericho, Tex., was extended 59 miles beyond the latter place in June, 1911. In all, 520 miles of precise leveling was done during the fiscal year.

An error of 1 meter was discovered near Sherman, Wyo., in the field work of the large loop of leveling extending from Crawford, Nebr., to Pocatello, Idaho; Butte, Mont.; Huntley, Mont.; and thence back to Crawford. Another error of 1 meter had been found between Pocatello and Butte in June, 1910. The closing error of this loop is now

well within the desired limit. The necessary corrections will be made in the published results.

Latitude, telegraphic longitude, and an azimuth were determined at Fairbanks and Tanana, Alaska, at the request of the United States Geological Survey. The latitude and telegraphic longitude of a point in the grounds of the American Museum of Natural History in New York City were determined in June, 1911.

Excellent progress was made in revising the triangulation of the Gulf coast; in the Delaware River the geographic positions of certain aids to navigation were trigonometrically determined; and in North Carolina a party was engaged in connecting the triangulation of the Neuse River, by the United States engineers, with that of the Coast and Geodetic Survey. The revision of the old triangulation on the coast of Delaware, Maryland, and Virginia, between Cape Henlopen and Cape Charles, was finished during the fiscal year.

In connection with the revision, a base line 3,566 meters in length was measured at Metompkin Island, Va.

A reconnoissance for primary triangulation, to extend from the thirty-ninth parallel triangulation in the vicinity of Colorado Springs, Colo., to the Canadian boundary, was begun at the southern end early in May. By the end of the fiscal year over 400 miles of progress had been made. Provision was made for connections with triangulation stations of the United States Geological Survey, section corners of the General Land Office, and with monuments of several State boundaries. The line follows approximately the one hundred and fourth meridian.

Three appendixes to the Annual Report for 1910, viz: Primary Base Lines at Stanton, Tex., and Deming, N. Mex.; Triangulation in California, Part II; and The Measurement of the Flexure of Pendulum Supports with the Interferometer, were prepared and published during the year.

OFFICE OF INSPECTOR OF MAGNETIC WORK.

R. L. FARIS, *Inspector.*

The duties of this Office are the planning of magnetic work to be done in the United States and their outlying territories; the inspection of the magnetic work in the field and at the magnetic observatories; to recommend changes in the personnel and salaries of magnetic observers; recommend the construction or purchase of new magnetic instruments, or alterations of old ones when needed; recommend changes in design of instruments or methods of observing to obtain better results or saving of time; and to supervise the planning and construction of buildings for magnetic observatories.

It was not necessary to make any inspection trips into the field or to any of the magnetic observatories during the year, except in the case of the Cheltenham Observatory, which was twice personally inspected. All other inspection work was perfordme at the Office by examination of the reports and records from chiefs of magnetic parties and others engaged in magnetic work, and by correspondence.

The magnetic observatories at Cheltenham, Md.; Tucson, Ariz.; Honolulu, Hawaii; Sitka, Alaska; and Vieques, P. R., were in operation throughout the year. In addition to the magnetic observations, seismographs were kept in operation and meteorological observations made at all of the observatories.

During the year a book of Directions for Magnetic Measurements was prepared and published for the guidance of those engaged in making magnetic observations on land and at sea.

MAGNETIC WORK ON LAND.

The magnetic elements (declination, dip, and horizontal intensity) were determined at about 350 stations. The stations are distributed over 44 States and Territories and outlying islands under the jurisdiction of the United States, as shown in the table given below. This includes about 83 "repeat" stations.

Summary of results on land.

State.	Localities.	Stations.	Old localities reoccupied.	Declination results.	Dip results.	Intensity results.
Alabama	6	6	0	6	6	6
Alaska	59	59	1	59	3	3
Arizona	1	1	1	1	1	1
Arkansas	7	15	1	15	7	7
California	3	3	3	3	3	3
Colorado	4	4	4	4	4	4
Connecticut	10	10	2	10	10	10
Delaware	2	2	2	2	2	2
Florida	2	2	1	2	2	2
Georgia	22	24	1	26	26	26
Hawaii	5	6	4	7	7	7
Idaho	3	4	4	4	4	4
Illinois	1	1	0	1	1	1
Iowa	1	1	0	1	1	1
Kansas	1	1	1	1	1	1
Kentucky	13	13	1	13	13	13
Maine	16	16	4	16	16	16
Maryland	3	3	3	11	12	9
Massachusetts	5	5	3	5	5	5
Michigan	15	15	2	15	15	15
Minnesota	2	2	0	2	2	2
Mississippi	1	2	0	2	1	1
Missouri	6	6	2	6	6	6
Montana	5	5	2	5	5	5
Nebraska	11	11	3	11	11	11
New Hampshire	6	6	0	6	6	6
New Jersey	10	10	2	10	10	10
New Mexico	2	2	1	2	2	2
New York	10	10	2	10	10	10
North Carolina	6	8	4	8	8	8
Ohio	2	2	2	2	2	2
Oklahoma	22	22	2	22	23	22
Oregon	2	3	2	3	3	3
Pennsylvania	8	8	2	8	8	8
Philippine Islands	.....	8	.....	.....	.....	.....
Porto Rico	1	1	1	2	1	2
Texas	10	10	1	10	10	10
Utah	2	2	2	2	2	2
Vermont	7	7	3	7	7	7
Virginia	14	15	3	15	10	10
Washington	6	7	3	7	3	3
West Virginia	8	9	2	9	9	9
Wisconsin	8	8	2	8	8	8
Wyoming	4	4	3	4	4	4
Foreign countries	1	1	1	1	1	1
Total	333	360	83	364	291	288

MAGNETIC WORK AT SEA.

The magnetic work done at sea during the year by vessels of the Survey, was, as heretofore, incidental to the surveying duties upon which they were engaged, and the magnetic observations were made when the vessels were en route to and from their fields of duty, or where opportunity offered on their working grounds. The following table shows, approximately, the amount of magnetic work done on board vessels of the Survey during the year.

Summary of results at sea.

Vessel.	General region.	Results from swings.			Course observations—declination results.
		Declination.	Dip.	Intensity.	
Hydrographer	Atlantic	4	0	0	0
Bache	do	10	10	10	0
Explorer	Pacific	7	7	7	10
Patterson	do	3	6	6	2
Total		24	23	23	12

INSTRUMENTS.

An earth inductor for the Tucson Observatory has been received. Two compass declinometers of a new pattern were completed during the year.

Exchange of information with other magnetic observatories, scientific societies, and foreign government institutions has been continued as heretofore.

OFFICE OF THE DISBURSING AGENT.

SCOTT NESBIT, *Disbursing Agent.*

The statement of disbursements of the Coast and Geodetic Survey required by law to be made annually to Congress and published as a separate document gives an account of the names and number of employees of different classes employed on the work, the amount of their salary or compensation, the length of time employed, to whom payments were made under the different items of appropriation, and on what account and the balances left of amounts appropriated for the fiscal year.

The Disbursing Agent of the Coast and Geodetic Survey also disburses the greater portion of the appropriations made to the Department of State for the survey of the boundary lines between the United States and Canada and Alaska and Canada.

OFFICE OF THE EDITOR OF PUBLICATIONS.

ISAAC WINSTON, *Editor.*

The Annual Report of the Superintendent (pp. 1–454) showing progress in the work of the Survey during the fiscal year 1910 was completed and sent to the Public Printer through the Secretary of Commerce and Labor on September 29, 1910. The first proof of the report was received on November 20, 1910, and the last proof was read and returned to the printer on March 22, 1911. Copies of the report were received for distribution on April 22, 1911.

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, 1909, to June 30, 1910. 454 pp., with the following appendices, also published separately:

No. 3. Results of Magnetic Observations made by the Coast and Geodetic Survey between July 1, 1909, and June 30, 1910. 70 pp.

No. 4. The Primary Base Lines at Stanton, Tex., and Deming, N. Mex. 30 pp.

No. 5. Triangulation in California, Part II. 258 pp.

No. 6. The Measurements of the Flexure of Pendulum Supports with the Interferometer. 19 pp.

Tables for a Polyconic Projection of Maps. Third edition. Special Publication No. 5. 189 pp.

Table of Depths for Channels and Harbors, Coast of the United States, etc. 159 pp.

Arctic Tides. 104 pp.

Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Vieques, P. R., 1905 and 1906. 110 pp.

Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Baldwin, Kans., 1905 and 1906. 108 pp.

Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Cheltenham, Md., 1907 and 1908. 122 pp.

Results of Observations made at the Coast and Geodetic Survey Magnetic Observatory at Honolulu, Hawaii, 1907 and 1908. 118 pp.

Survey of Oyster Bars, Charles County, Md. 62 pp.

Catalogue of Charts, Coast Pilots, and Tide Tables, 1911. 228 pp.

Supplement to Coast Pilot Notes on Bering Sea and the Arctic Ocean. 12 pp.

Supplement to Chart Catalogue of 1909. 4 pp.

Directions for Magnetic Measurements. 132 pp.

Tide Tables for 1912 (complete). 536 pp.

Tide Tables, Pacific Coast, for 1912. Reprint. 166 pp.

Philippine Islands Sailing Directions, Section II, Southwest and South Coasts of Luzon and Adjacent Islands. Fourth edition. 102 pp.

Philippine Islands. Notices to Mariners, Nos. 4, 5, 6, 7, and 8 of 1910 and Nos. 1, 2, and 3 of 1911.

APPENDIX 1

REPORT 1911

DETAILS OF FIELD OPERATIONS

CONTENTS.

DETAILS OF FIELD OPERATIONS.

UNITED STATES.

CONNECTICUT, MASSACHUSETTS, NEW JERSEY, NEW YORK, PENNSYLVANIA, VERMONT, AND WEST VIRGINIA.

[J. R. BENTON.]

STATIONS OCCUPIED.—*Connecticut:* Canaan and Danbury. *New Jersey:* Boonton and Trenton. *New York:* Albany, Carmel, Catskill, Ellenville, Fonda, Hancock, Hudson, Liberty, Sandyhill, and Schenectady. *Pennsylvania:* Carbondale, Easton, Hamburg, Harrisburg, Hazleton, and Tunkhannock. *Vermont:* Barton, Burlington, Guildhall, Rutland, St. Johnsbury, Woodstock. *West Virginia:* Elkins, Fairmont, Glenville, Grantsville, Parsons, and Spencer.

Observations to determine the value of the three magnetic elements were made at the stations mentioned above during the summer season of 1910. The stations in West Virginia were occupied between June 12 and 30, 1911.

COLORADO AND WYOMING.

[J. S. BILBY.]

A reconnoissance for primary triangulation, to extend from the thirty-ninth parallel triangulation in the vicinity of Colorado Springs, Colo., to the Canadian boundary, was begun at the southern end early in May. By the end of the fiscal year over 400 miles of progress had been made. Provision was made for connections with triangulation stations of the United States Geological Survey, section corners of the General Land Office, and with monuments of several State boundaries. The line follows approximately the one hundred and fourth meridian.

Stations Pikes Peak–Bison were selected as a base, with Divide as third point, in starting from the transcontinental triangulation. By June 30 the reconnoissance had been extended to the forty-fifth parallel of latitude, and 29 primary points had been located.

MARYLAND AND MASSACHUSETTS.

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

SUMMARY OF RESULTS.—Hydrography: 172 square miles of area covered, 1 806 miles of lines sounded, 79 186 soundings made. Triangulation: Old stations recovered, 31; new stations established, 125.

Supplementary surveys were in progress in Buzzards Bay, Mass., on July 1 and the work continued until August 16, except for the period July 16 to August 2, when the work was suspended to allow the vessel to be used in determining the position of Nantucket Shoals Lightship by triangulation. (See report by Assistant Hodgkins.)

In Buzzards Bay tide stations were established at Mattapoisett and West Falmouth and referred to the old station at Clarks Point by simultaneous observations. The necessary hydrographic signals were erected at old triangulation stations or at new stations established for the purpose, a number of selected areas were examined by sounding, and the data needed for a revision of the charts of this region were obtained.

After completing the work in Buzzards Bay the vessel proceeded to Chesapeake Bay and resumed hydrographic work in the vicinity of Tangier Island.

Several selected areas between Smith Point and Cherrystone Light were examined by sounding. The work continued until September 7, when it was suspended for three days to determine the position of aids to navigation in Mobjack Bay. The work in the open bay continued until December 7, when the hydrographic revision of Mobjack Bay was begun. This work was completed on March 22, and the vessel proceeded to Baltimore to be repaired. On May 10 the vessel resumed work in Chesapeake Bay, and it was continued during the rest of the fiscal year.

Assistant Boutelle reports that the officers of the ship "all worked faithfully and diligently."

MARYLAND.

[J. E. BURBANK.]

Work at the magnetic observatory at Cheltenham was continued during the year. A continuous record of the relative force of the three magnetic elements was obtained and observations to determine absolute values for the three elements were made at regular intervals.

Twenty-three earthquake shocks were recorded on the seismograph during the year.

DISTRICT OF COLUMBIA.

[W. H. BURGER.]

An additional base station for the relative determination of gravity was established at the Bureau of Standards in Washington, and the necessary observations with a pendulum were made on August 18, 19, and 20. This was the last field work done by Mr. Burger, as his resignation as an assistant in the service became effective on September 20, 1910, and soon afterwards he entered upon his duties as an instructor in the department of engineering in the Northwestern University, at Evanston, Ill.

DELAWARE AND TEXAS.

[C. M. CADE.]

SUMMARY OF RESULTS.—Leveling: 769 kilometers of line completed, 205 bench marks established. Triangulation: Geographic positions of 7 aids to navigation determined.

The extension of the standard levels from Fort Worth to El Paso, Tex., was in progress on July 1 in the vicinity of Abilene.

The route followed the Texas & Pacific Railway to Sierra Blanca and thence along the joint track of the Texas & Pacific Railway and the Galveston, Harrisburg & San Antonio Railway to El Paso. Both these roads granted the privilege of using velocipede cars over their tracks, and the Texas & Pacific Railway also permitted the use of

freight trains by the party. These privileges greatly facilitated the work and reduced its cost.

The elevations of 18 bench marks established by the United States Geological Survey and the United States Reclamation Service were determined. The elevations of seven triangulation stations were also determined. The heat was excessive during the summer months and rod thermometers showed a temperature of 127° F.

The work was completed on January 10, 1911.

From April 10 to May 9 Assistant Cade was engaged in determining the geographic positions of aids to navigation on Delaware River.

Several triangulation stations previously established by the Corps of Engineers, United States Army, and the Coast and Geodetic Survey were recovered and used for this purpose. The work was suspended on May 9 and preparations were made to resume leveling work in Texas. This work began at Jericho, Tex., on June 1 and was continued until the end of the fiscal year. The route followed the Chicago, Rock Island & Gulf Railway to Amarillo, and thence along the Pecos & Northern Texas (Santa Fe) Railroad toward Albuquerque.

NEW YORK.

[G. W. CLARVOE.]

In the early part of April an inspection was made of the tide indicator at Fort Hamilton, N. Y., the indicator put in thorough repair, and the observer instructed in the proper method of keeping it in operation.

An examination was also made of the tide gauge and the methods used in making observations of sea-water densities.

The electrical tidal indicators at the office of the New York Maritime Association and at the Seamen's Friend Society's Institute, in New York City, were also inspected and put in order.

WASHINGTON.

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

SUMMARY OF RESULTS.—Base lines: 1 secondary. Triangulation: 61 square miles of area covered, 20 signals erected, 21 stations occupied for observations of horizontal angles, 29 geographical positions determined. Topography: 33 square miles of area surveyed, 71 miles of general coast line surveyed. Hydrography: 10 square miles of area covered, 208.5 miles run while sounding, 7 029 soundings, 1 tide gauge established, 7 current stations occupied. Magnetic work: 3 magnetic stations occupied.

During the winter the party on the steamer *Gedney* was engaged in chart-revision work in Puget Sound, covering the shores of the Sound from Alki Point to Brown Cove on the east side of the Sound, the greater part of Vashon Island and Colvos Passage, and from the north end of the passage to Manchester; also from Skiff Point, Bainbridge Island, to Spring Beach, Port Orchard, including Eagle Harbor and Port Blakeley.

Upon the urgent request of the Chamber of Commerce of South Bend, Wash., and of one of the United States Senators from that State, the survey of the entrance of Willapa Bay, Wash., was begun early in May. This work was in progress at the close of the year. The work in Willapa Bay includes sufficient triangulation for the control of the other work, the topography of the points on both sides of the entrance, and the extension of the hydrography of the entrance to a satisfactory connection with the old work.

VIRGINIA.

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

SUMMARY OF RESULTS.—Triangulation: 90 square miles of area covered, 84 signals erected, 7 observing tripods and scaffolds erected, 71 stations occupied for observations of horizontal measures, 94 geographic positions determined. Leveling: 26 elevations determined, 3.6 miles of levels run. Topography: 38.2 square miles of area surveyed, 183.7 miles of shore line of rivers surveyed, 26 miles of shore line of creeks surveyed, 58.5 miles of roads surveyed, 9 topographic sheets completed. Hydrography: 136.5 square miles of area sounded, 621.7 miles run while sounding, 3 892 positions determined, 28 270 soundings made, 19 tidal stations occupied, 10 current stations occupied, 12 hydrographic sheets finished.

On July 1 the party on the schooner *Matchless* was engaged in the revision of the triangulation, topography, and hydrography of the James River. The hydrography was revised from the vicinity of Newport News and the topography and triangulation from Jamestown Island to Petersburg and Richmond. A topographical and hydrographic survey of the Appomattox River was made extending from City Point to the head of navigation at Petersburg.

On April 10 the revision of the surveys of the York River was begun, and this work was continued until June 12, when the vessel was taken to Baltimore for repairs. The triangulation of this river was carried from Yorktown to near Moodys Old Wharf, a distance of 16 miles; the topography was completed to Biglers Mill, a distance of 10 miles, and the hydrography from the mouth of the river to Kings Creek 5 miles above Yorktown, a distance of 13 miles. Current, tidal, and magnetic observations were made at a number of stations while the surveys were in progress.

[S. FORNEY.]

SUMMARY OF RESULTS.—Hydrography: 31 square miles of area covered, 156 miles of lines sounded, 5 691 soundings made, 3 tide stations occupied, 2 hydrographic sheets completed. Topography: 48 square miles of area covered, 84 miles of shore line surveyed, 31 miles of shore line of creeks surveyed, 5 miles of shore line of ponds surveyed, 2 topographic sheets completed. Triangulation: 240 square miles of area covered, 26 stations occupied, 32 geographic positions determined.

The revision of the survey of the coast of Virginia south of Wachapreague Inlet was in progress on July 1 and the work was continued during the fiscal year. New stations were selected and the triangulation was extended southward to Cape Charles.

A topographic survey of the shore line was completed from a point above Wachapreague Inlet to the south end of Cobbs Island, including the whole shore line of Cobbs Island and extending well inside the entrances to Wachapreague Inlet and Little and Great Machipongo Inlets.

Hydrographic work was done on Ship Shoal and Sand Shoal, in Great and Little Machipongo Inlets, and in the vicinity of Fishermans and Smiths Islands, where changes in the shore line made such work necessary for chart correction.

GEORGIA.

[O. B. FRENCH.]

In March (8–11) chart revision work was done in the vicinity of Brunswick, Ga.

The geographic positions of three aids to navigation were determined and the survey of the shore line between the quarantine station and the town of Brunswick, a distance of 3 miles, was revised to locate existing wharves. Some large buildings in the vicinity of St. Simons Lighthouse were also located.

ALABAMA, MISSISSIPPI, AND TEXAS.

[J. C. GAUGER.]

SUMMARY OF RESULTS.—1 805 square statute miles covered by triangulation, 319 geographic positions determined, 91 signal poles and 11 scaffold signals erected, and 85 stations occupied for horizontal measures. Total length of triangulation measured along its central axis, 150 statute miles.

The revision of the triangulation of Mississippi Sound, executed between September 15, 1910, and January 8, 1911, was undertaken for the purpose of recovering a sufficient number of old stations or determining the positions of a sufficient number of new points for use in future topographic and hydrographic surveys, for determining changes in shore line since the last surveys, determining and verifying the positions of aids to navigation and of prominent landmarks for use on the charts, and to supply points for use in the oyster survey of Mississippi Sound and a portion of Mobile Bay.

Notes giving details as to changes in shore line, in aids to navigation, and other matters useful for the correction of the charts were turned in by the chief of party at the close of the season.

The auxiliary power schooner *Cincinnati* was used for the transportation of the party.

The revision of triangulation on the coast of Texas between Matagorda and Aransas Pass Lights was executed between March 29 and May 30. No marked changes in the shore line were discovered except at Grass Island in San Antonio Bay on the point on the south side of the mouth of the Aransas River.

Positions of aids to navigation were determined, discrepancies noted, and prominent land marks located for use on the charts.

CONNECTICUT, MAINE, MASSACHUSETTS, AND NEW HAMPSHIRE.

[H. C. GRAVES, Commanding the Steamer *Hydrographer*.]

On July 1 and from that date until November 15 the Coast Pilot party was engaged in field work on the steamer *Hydrographer* for the revision of United States Coast Pilots, Parts I–II and III, from the northeast boundary of Maine to Point Judith. Passamaquoddy Bay and tributaries were completed by July 26 and work was afterwards taken up along the coast between Eastport and Bar Harbor; Bar Harbor and Rockland; Rockland and Portland; Portland and Boston; and Boston and Point Judith.

Many uncharted rocks were located and their positions determined for use on the charts. A hydrographic examination was made in Broad Sound northward of The Graves Lighthouse on the coast of Massachusetts where dangerous shoals were reported, but no marked shoaling was found except as shown on the charts.

Localities were also examined where the hydrography is changing from the action of the sea, notably at Pollock Rip Slue and parts of Nantucket and Vineyard Sounds.

MONTANA.

[C. Y. HARGER.]

SUMMARY OF RESULTS.—Length of line of leveling revised, 441 kilometers.

Revision of the line of precise levels between Pocatello, Idaho, and Butte, Mont., which was in progress at the beginning of the fiscal year, was continued from Monida to Huntley, Mont., until September 7. Some steep grades were encountered in the vicinity of Apex and again at Feeley, which made progress slow at those points. At Butte direct connection was made with the line from Pocatello to Butte. From Whitehall to Bozeman the line runs through nearly level country and over this section rapid progress was made, the 115 miles of line from Livingston to Billings being leveled over in a period of two weeks. Work was afterwards continued on this line by another officer.

CONNECTICUT, MAINE, AND NEW YORK.

[N. H. HECK.]

SUMMARY OF RESULTS.—Triangulation: 286 square miles covered by triangulation, 10 signals erected, 34 stations occupied for horizontal measures, 47 geographic positions determined. Topography: 9½ square miles covered by topography, 26 miles of general coast line run, 26 miles shore line of rivers completed, 5 topographic sheets revised. Hydrography: 109 square miles of area covered with wire drag, 742 miles run while dragging, 453 soundings made, 4 tidal stations established and 2 reoccupied, 4 hydrographic sheets finished.

On July 1 a wire-drag party was at work on the coast of Maine and work was continuously prosecuted until the close of the season on November 23. The entire season's work with the exception of the last month was on the open coast, and included the approaches to West and East Penobscot Bays from Burnt Island to Isle au Haut. An area of 106 square miles was dragged and 308 soundings were taken, about 80 per cent of which represent new shoals or important reductions of depth on charted shoals.

During the season great advances were made in the mechanical equipment used in operating the drag, resulting in a decrease in the size of the party and a greatly increased output of work.

Small gasoline launches of 2 to 3 horsepower were installed, taking the place of manual labor for all heavy work, such as taking up and setting out the drag, hoisting the anchors, and lifting lobster pots. The resulting decrease in the size of the party saved the cost of installation. As the length of the drag can now be increased up to 12 000 feet if necessary, the output of work is much greater, and as much as 9 square miles have been covered in a day with only moderately favorable conditions of weather.

In removing the drag from shoals, an operation which formerly required a great deal of time, the use of power has effected a considerable saving. It is also possible to use a greater drag length in examining shoals; with the longer drag the length of the towline is increased to increase the length of the towline base. The shape of the buoys has been modified to reduce resistance and prevent damage from contact with the boats. A more complete signal code has been developed, and a simple means adopted for indicating on the hydrographic sheet the effective depths obtained.

On January 9 the revision of the topography of the Hudson River between Yonkers and New York was taken up, including the west shore from a point opposite Yonkers to Jersey City, and the east shore from Yonkers to One hundred and twenty-fifth Street,

New York. In this area many changes were found and a large area of land made by filling, and many new wharves were added to the charts.

On April 1 work was resumed on the coast of Maine in West and East Penobscot Bay with the wire drag and was in progress at the close of the year.

On June 10 the party was divided in order that an examination might be made with the wire drag of a portion of Long Island Sound, where a shoal had been reported. The nonexistence of the shoal at the point indicated was proved, but an extensive area with uncharted depths of 5 to 6 fathoms was developed. An area of 3½ square miles was dragged and 13 soundings of uncharted depths were taken.

In addition to the above work, triangulation was done on the coast of Maine to determine stations and objects useful to navigation. A number of tidal bench marks were recovered and established.

ARIZONA, CALIFORNIA, NEW MEXICO, AND WASHINGTON.

[J. S. Hill.]

Summary of results.—Triangulation: 39 200 square miles of area covered, 21 primary stations and 15 secondary stations occupied, 600 miles of scheme completed, 12 azimuth stations occupied.

The primary triangulation in the scheme between Texas and southern California, the reconnoissance for which was made in 1907–8, was in progress at the beginning of the year, the party having taken the field in June, and by February 24, 1911, the entire work remaining to be done in New Mexico, Arizona, and southern California had been completed. Progress made during the season covered about 600 miles between Deming, N. Mex., and Needles, Cal. A connection was made at the western end of the arc with the 1898 primary triangulation of southern California at the stations San Jacinto, Cuyamaca, and Santiago.

The work was carefully planned in advance so as to take advantage of the most favorable conditions for observing and for the transportation of the party, the higher peaks being necessarily occupied during the summer months. Work was begun at the western end of the scheme where the weather conditions were more favorable, and when observations there were complete observations were taken up on the high peaks at the eastern end, near Deming, N. Mex. Observations on the high peaks were completed before the winter storms set in, and rapid progress was made on the remainder of the work.

The triangulation was connected at numerous points with that of the United States Geological Survey; of the United States–Mexican boundary survey; with the Coast and Geodetic Survey primary coast triangulation in southern California; and with the California–Nevada boundary survey. Level connections (by vertical angle measurements) were made with stations of the United States Geological Survey, United States and Mexican boundary survey, and with a bench mark of the Coast and Geodetic Survey at Needles, Cal.

Azimuth observations were made at 12 of the regular triangulation stations.

In May work was begun in preparing stations, building signals, and opening lines of sight for the extension of the primary triangulation along the coast of Washington from Columbia River to Grays Harbor and from Grays Harbor to Tacoma. By July 1 this work was well advanced.

CALIFORNIA, OREGON, WASHINGTON, IDAHO, UTAH, COLORADO, KANSAS, MISSOURI, KENTUCKY, WEST VIRGINIA, MARYLAND, ILLINOIS, PENNSYLVANIA, NORTH CAROLINA, AND GEORGIA.

[WALLACE M. HILL and FRANK NEUMANN.]

STATIONS OCCUPIED.—*California:* Red Bluff and Gazelle. *Colorado:* Grand Junction, Glenwood Springs, and Cheyenne Wells. *Georgia:* Canton, Jasper, Ellijay, Atlanta, Cartersville, Summerville, La Fayette,[1] Ringgold,[1] Dalton,[1] Springplace,[1] Calhoun,[1] Cedartown,[1] Buchanan,[1] Douglasville, Fairburn,[1] Neuman, Franklin, Greenville, Hamilton, Columbus, and Cuseta. *Idaho:* Weiser, Shoshone, and Pocatello. *Illinois:* Belleville. *Kansas:* Russell. *Kentucky:* Wickliffe,[1] Clinton,[1] Eddysville, Bardstown, Springfield, Taylorsville,[1] La Grange,[1] Frankfort,[1] Winchester,[1] Owingsville, and Catlettsburg. *Maryland:* Oakland. *Missouri:* St. Genevieve, Farmington, Sedalia, Hermann, Fredericktown, and Marble Hill. *North Carolina:* Rutherfordtown,[1] Laurinburg,[1] Sandford,[1] Raeford,[1] and Bakersville.[1] *Oregon:* Pendleton. *Pennsylvania:* McConnellsburg,[1] Sunbury, and Shamokin. *Utah:* Ogden and Green River. *Washington:* Seattle and Ellensburg. *West Virginia:* Parkersburg and Martinsburg.[1]

Magnetic work was done in the field between July 1 and November 28, 1910, and from March 5 to June 30, 1911. Observations of the magnetic elements were made at the stations mentioned above, and at 21 stations meridian lines were established at the request of the State or local authorities. Twenty-three of the stations occupied were "repeat" stations.

FLORIDA, MARYLAND, MASSACHUSETTS, NEW JERSEY, AND NORTH CAROLINA.

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

SUMMARY OF RESULTS.—Triangulation: 225 square miles of area covered, 21 signal poles erected, 6 observing tripods and scaffolds built, 19 stations occupied for horizontal measures, 20 geographical positions determined. Magnetic work: 3 land stations occupied, 7 stations at sea occupied. Topography: 16.5 miles of coast line surveyed, 1 topographical sheet completed. Hydrography: 2 249 square miles of area sounded, 5 570.89 miles run while sounding, 69 752 soundings, 9 665 angles measured, 4 tidal stations established, 3 current stations occupied, 4 hydrographic sheets completed.

Work on the hydrography of Nantucket Shoals was begun soon after the middle of July, the lighthouse tender *Azalea* and the steamer *Endeavor* with observers on shore cooperating in the location of buoys in positions convenient for the hydrography. A scheme of triangulation was carried from Sankaty Head and Monomoy Lighthouses across the shoals and the positions of the five buoys and also of the Nantucket Lightship were determined. The steamers *Endeavor*, *Bache*, and *Azalea* took up their positions for the triangulation, returning to their regular stations when the principal part of the work was completed, while the *Bache* was occupied for about 10 days longer in determining the first position of that vessel, the delay being due to the difficulty of seeing Sankaty Head from the ship.

Hydrographic work on the shoals was then taken up and continued as weather permitted until October 20. The results of the work indicated a bank, not dangerous, to the eastward of Fishing Rip; and another, dangerous for large vessels, midway between Fishing Rip and Phelps Bank, and close to the 5-fathom sounding reported by the steamship *Persia* in 1863. The work also indicated that the shoals reported by the *Chelston* in May, 1910, and by the *Manitou* in January, 1910, do not exist where reported, but it is probable that the *Chelston* struck on the 16-foot lump on the north part of Davis

[1] Meridian lines also established.

Bank, shown on the charts, and that the *Manitou's* 8-fathom sounding was on Fishing Rip Shoal. The experience of the *Bache* indicates that owing to the uncertain currents no shipmaster is safe in assuming that he is making good his course and distance when navigating in these waters.

Between November 11 and December 22 the party was engaged in an examination of Five-Fathom Bank, off Cape May, N. J.

On January 8 the *Bache* sailed for Key West, making an unsuccessful search en route for shoals reported off Diamond Shoal Light Vessel; off Cape Romain, and between Cape Canaveral and Jupiter Inlet.

The work of extending the triangulation from the vicinity of Key West to Rebecca Shoal and of revising the hydrography with special reference to New Ground Shoal, Boca Grand Channel, and the region about 11 miles southeast by south of Rebecca Shoal Lighthouse was taken up immediately after arrival at Key West.

Considerable difficulty was experienced in the extension of the triangulation to the westward of the Marquesas Keys, but this was overcome, and at the end of June the triangulation was finished and the hydrography nearly completed.

An exhaustive search was made for a 17-foot spot reported about 11 miles southeast from Rebecca Shoal Lighthouse, and its existence at or near the reported location disproven. Search for another reported shoal near Marquesas Rock buoy was made without success.

Incidentally, during this work the position of the steamship *Luckenbach*, while stranded on New Ground Shoal, and the position of the wreck of the steamship *Hannah M. Bell* on Elbow Reef were determined.

ALABAMA, ARKANSAS, CALIFORNIA, DISTRICT OF COLUMBIA, IDAHO, FLORIDA, MICHIGAN, MINNESOTA, MISSOURI, MONTANA, OKLAHOMA, OREGON, NEBRASKA, NORTH CAROLINA, NORTH DAKOTA, SOUTH DAKOTA, TEXAS, VERMONT, VIRGINIA, AND WYOMING.

[H. D. KING.]

SUMMARY OF RESULTS.—Gravity: 24 stations occupied.

During the season from June 17 to May 4, 1911, the party engaged in gravity observations determined the relative intensity of the force of gravity at the following stations: Iron River, Mich.; Minneapolis, Minn.; Lead, S. Dak.; Bismarck, N. Dak.; Hinsdale, Mont.; Sandpoint and Boise, Idaho; Astoria, Oreg.; Sisson, Cal.; Rock Springs, Wyo.; Paxton, Nebr.; North Hero, Vt.; Washington, D. C.; Virginia Beach, Va.; Durham, N. C.; Fernandina, Fla.; Wilmer and Aliceville, Ala.; New Madrid, Mo.; Mena, Ark.; Nacogdoches, Alpine, and Farewell, Tex.; Guymon, Okla

MAINE, MASSACHUSETTS, AND NORTH CAROLINA.

[E. B. LATHAM.]

SUMMARY OF RESULTS.—Triangulation: 110 square miles covered by triangulation, 20 signals erected, 1 observing scaffold built, 17 stations occupied for horizontal measures, 45 geographic positions determined. Leveling: 2 lines of levels run; total length, 1 050 meters. Topography: 93 square miles of topography revised, 24 miles of general coast revised, 4 miles of shore line of creeks revised, 48 miles of railroads revised, 8 original sheets revised. Hydrography: 4 bench marks recovered, 3 bench marks noted as lost, 5 bench marks established and recovered.

Chart-revision work on the coast of Massachusetts in the vicinity of Gloucester was in progress at the beginning of the year and was continued until January 3, when the

revision of the topography within the limits of proposed chart No. 243 was completed. Aids to navigation were verified in position and the shore line rerun where required. In the revision maps of local surveys by the United States engineers or others were utilized where available. One new position was determined by triangulation and six old triangulation stations were recovered, and witness marks established at some of them. Old tidal bench marks were recovered and new ones established. A line of soundings was run over Essex River bar and soundings were also made alongside of several new wharves. The region included in the revision extends from near Ipswich, Mass., to near Gales Point, covering all of the shore line and indentations around by Cape Ann and much of the interior topography between those limits.

The revision of charts and location of beacons in Currituck Sound, N. C., was executed between February 14 and June 5. Triangulation was extended from station Woodhouse and Currituck Beach Lighthouse as a base to North Landing River and Coanjock Bay. Several railroad lines in the neighborhood of Edenton, N. C., were located on the charts.

Chart revision in the vicinity of York Beach, Me., was begun in the latter part of June.

ARKANSAS, CONNECTICUT, DELAWARE, GEORGIA, MAINE, MARYLAND, MASSACHUSETTS, MISSISSIPPI, NEBRASKA, NEW HAMPSHIRE, NEW JERSEY, AND VIRGINIA.

[H. E. McCOMB.]

STATIONS OCCUPIED.—*Arkansas:* Augusta,[1] Benton,[1] DeValls Bluff, Pine Bluff, Rison, and Warren. *Connecticut:* Middleton, Norwich, Plainfield, Putnam, Waterbury, Willimantic, and Winsted. *Delaware:* Seaford and Wilmington I. *Georgia:* Marietta.[1] *Maine:* Allagash Falls, Ashland, Augusta, Bangor, Chamberlain Lake, Chases Carry, Chesuncook, Depot Farm, Eagles Lake Dam, Eastport, Fort Kent, Fryeburg, Lobster Lake, Portland, Rankin Rapids, and Smyrna Mills. *Maryland:* Salisbury. *Massachusetts:* Fitchburg and Worcester. *Mississippi:* New Albany. *Nebraska:* Aurora, Clay Center, David City, Hartington,[1] Lincoln,[1] Minden, Osceola, Pender, and Tekemah. *New Hampshire:* Epping, Keene, Nashua, North Conway, Ossipee, and Rochester. *New Jersey:* Blairstown, Glassboro, Lakewood, Long Branch, New Brunswick, Newfoundland, Paterson, Sussex, Washington, and Winslow Junction. *Virginia:* Cape Charles City, Courtland, Eastville, Lawrenceville,[1] Ocean View, Petersburg I and II, Prince George, Suffolk, Surrey,[1] and Sussex.[1]

Observations for the determination of the three magnetic elements were made by this observer at the stations above named between July 1 and November 23, 1910; February 28 and March 5, and June 9 to June 30, 1911.

Local surveyors were always much interested in the work and usually requested that copies of the observations be sent to them.

MICHIGAN, NEW YORK, AND OHIO.

[F. A. MOLBY.]

STATIONS OCCUPIED.—*Michigan:* Atlanta, Bay City, Frankfort, Grayling, Hart, Hersey, Kalamazoo, Lake City, Manistee, Mio, Muskegon, Paw Paw, and Saginaw. *New York:* Rochester. *Ohio:* Cleveland and Toledo.

Magnetic observations were made at the above-named stations between August 17 and September 24 for the determination of the value of the three elements of terrestrial magnetism.

[1] Meridian lines also established.

ALABAMA.

[FRANK NEUMANN.]

STATIONS OCCUPIED.—*Alabama:* Abbeville, Andalusia, Dotham, Elba, Geneva, and Seale.

The above stations in Alabama were occupied for the determination of the magnetic elements between June 7 and 30.

MONTANA, NEW JERSEY, VIRGINIA, AND WYOMING.

[E. H. PAGENHART.]

SUMMARY OF RESULTS.—Leveling: 450 miles of check levels run. Base lines: 1 tertiary, measured.

Between September 7 and November 1 a line of check levels was run between Huntley, Mont., and Crawford, Nebr., a distance of 401 miles. On November 7 the party was transferred from Crawford, Nebr., to Cheyenne, Wyo., to take up the revision of the levels between that place and Rock Creek. From this point work was continued until November 23, when the party was disbanded at Cheyenne, the discrepancy in the leveling having been discovered.

Between March 12 and 23 a tertiary base line was measured on the eastern shore of Virginia near Metompkin Inlet and connection made with the existing triangulation.

Between April 7 and 11 determinations were made of the positions of aids to navigation in Navesink River, N. J., including the light on the breakwater at the south entrance to Sandy Hook Bay.

CALIFORNIA.

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

SUMMARY OF RESULTS.—Hydrography: 958 square miles of area sounded, 265 miles run while sounding, 396 angles measured, 198 soundings made, 1 hydrographic sheet completed.

After the necessary repairs and outfitting had been completed at San Francisco, the *Patterson* on January 23 took up the survey of the coast of California between Bodega Head and Point Arena, which work was continued until February 18. Lines of soundings at intervals of 3 miles were run from the inshore hydrography to depths exceeding 100 fathoms between Bodega Head and a point 7 miles northward of Point Arena.

After the close of this work and of the necessary repairs the vessel sailed for Alaska via Seattle on April 20.

DELAWARE AND PENNSYLVANIA.

[R. S. PATTON.]

SUMMARY OF RESULTS.—Triangulation: 14 stations occupied for horizontal angles. Hydrography: 99.5 miles of sounding lines, 3 833 soundings.

Between August 17 and September 15 work was done on the revision of the topography and hydrography of the west shore of Delaware Bay, between Clark Point and Bombay Hook Light.

Triangulation along the Delaware River for the purpose of locating in position lighthouses and other prominent objects which would serve as aids to navigation or be useful in executing surveys was begun September 17. To the above work was after-

wards added the determination of the two monuments fixing the division line between the Delaware Bay and River. Between September 19 and 30, 25 points were determined.

October 1 and 3 were spent in reconnoissance at and above Philadelphia for the recovery of old triangulation stations, but it was found that extensive improvements along the water front since the last surveys have removed all traces of them. For this reason, therefore, no points were located on the Delaware above the mouth of the Schuylkill River.

Between October 1 and 7 five objects were located, and another at Spring Lake, N. J., on October 8.

UTAH.

[JOHN H. PETERS.]

SUMMARY OF RESULTS.—Leveling: 13.4 kilometers of line completed, 2 bench marks established.

Work on the line of levels in Utah along the line of the Southern Pacific Railway from Brigham westward was begun July 17 and was in progress at the close of the month. Actual work of leveling began June 26, the intervening time being spent in organizing the party, adjusting instruments, and overhauling outfit.

MASSACHUSETTS.

[J. F. PRATT.]

In the latter part of June, in accordance with an arrangement with the Bureau of Lighthouses, the light vessels at Nantucket Shoals, Great Round Shoal, Pollock Rip Shoal, Pollock Rip Slue, and Handkerchief Shoal, on the coast of Massachusetts, were equipped with the necessary instruments for making current observations, and the officers of those vessels were instructed in their use.

The results of these observations, obtained at a nominal cost to the Government, will afford valuable information for the use of navigators, supplementing the data on the charts.

CALIFORNIA.

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

SUMMARY OF WORK.—Triangulation: 28 square miles of area covered, 20 stations occupied, 28 geographic positions determined. Topography: 1 sheet completed, 6 sheets revised. Magnetic work: 1 station occupied.

Chart revision work along the coast of California southward from Santa Monica, Cal., was in progress at the beginning of the year. The revision work was carried as far as Newport Beach with extensive corrections in the way of improvements along the shore. Between February 11 and March 27 work of revision was done on the south shore of San Pablo Bay between Pinole Point and the entrance to Carquinez Straits. Revision work in southern California was again taken up and continued until April 19.

The steamer *Explorer*, after the transfer of the command on April 19, was undergoing repairs in Oakland Creek, Cal., until the close of the year. Work of the *Explorer* from July 1, 1910, to April 18 is noticed under another head.

CONNECTICUT, NEW YORK, AND NORTH CAROLINA.

[H. P. RITTER.]

SUMMARY OF RESULTS.—Chart revision: 5 charts revised in whole or in part.

Chart revision work in New York and Connecticut was continued with slight interruptions from July 1 until May 6. The work done is included on charts 268, 269, 369[4], 369[5], and 369[8]. Important topographic and in some case hydrographic changes that were found to have occurred since the charts were published were incorporated in the charts, data being obtained from recent local surveys by the United States Engineers, railroads or others, and by inspection in the field. Points were located by sextant angles and tape measurements where necessary.

Triangulation work was begun in North Carolina on May 6 for the purpose of connecting the triangulation by the United States Engineers on the Neuse River and its tributaries, with that previously executed by the Coast and Geodetic Survey. The observer was directed also to remark and redescribe any old Coast and Geodetic Survey stations found and to determine the geographic positions of any permanent objects along the shore such as beacons, church spires, stacks, etc., not already included in the triangulation by the United States Engineers. This work was in progress on June 30.

On April 6 a determination was made of the position of the North German Lloyds steamer *Prinzess Irene* which had run aground on the south shore of Long Island, N. Y., near the Lone Hill Life-Saving Station.

In the early part of July some days were spent in instructing the tidal observer at Fort Hamilton, N. Y., in his duties.

WASHINGTON.

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

SUMMARY OF RESULTS.—Triangulation: 28.2 square miles of area covered, 28 signals erected, 12 stations occupied for observations of horizontal angles, 53 geographic positions determined. Topography: 18.2 square miles of area surveyed, 34.2 miles of coast line surveyed, 14.7 miles of creeks, 142 miles of roads, streets, railroads, etc., 3 topographic sheets finished. Hydrography: 13 square miles of area covered, 199 miles run while sounding, 9 718 soundings, 3 hydrographic sheets finished. Leveling: 5 elevations determined, 5 tidal bench marks established.

Between November 25 and March 16 the party on the steamer *McArthur* made a survey of Grays Harbor, Wash., in continuation of the work of the previous year. The hydrography was carried from Aberdeen to Stearns Bluff. The topography was continued from Stearns Bluff to South Aberdeen. The triangulation was carried from the termination of the work of 1909 to the head of South Bay; and the hydrography was extended from Stearns Bluff down South Channel to its western entrance and thence into South Bay to its head and up Beardslees Slough and Elk River. The topography was also carried around the head of South Bay and up Beardslees Slough and Elk River. Tidal and magnetic stations were occupied in the progress of the work.

NEW JERSEY AND NEW YORK.

[PAUL SCHUREMAN.]

In April a site was selected for a tide-gauge station at Atlantic City, N. J. Permission was obtained to place the station on Youngs Pier; plans were made and a contract was awarded for furnishing and installing two float pipes and tide shelter. The installation was completed on August 15, an automatic tide gauge with a small tidal indicator attached placed in position, and an observer put in charge. Two bench marks on shore were recovered and 23 new bench marks established and connected with one another and with the tide station by a double line of leveling.

Between November 18 and November 23 an inspection was made of the tide station at Fort Hamilton, N. Y. A new automatic gauge was set up and put in operation, the tide staff adjusted and the observer instructed as to his duties. The tide indicator was examined and found to be working satisfactorily.

NEW YORK.

[L. P. SHIDY.]

The tide station at Fort Hamilton, N. Y., was visited between August 10 and 12, and recommendations made for the correction of certain defects in the apparatus. The observer was instructed as to the care of the gauge and methods of making observations required. The tide indicator at Fort Hamilton was inspected and also the electrica tidal indicators at the Maritime Exchange and the American Seaman's Friend Society's Institute in New York City, all of which were found in satisfactory operation.

ALABAMA, FLORIDA, AND LOUISIANA.

[EDWIN SMITH.]

Revision of the triangulation of Mobile Bay, Ala., Perdido Bay, Ala. and Fla., and Barataria Bay, La., was begun January 16 and continued until May 22.

Search was made in Mobile Bay for stations of the old triangulation; new triangulation was executed where necessary, and the results of recent triangulation by the United States Engineers were obtained and utilized. The station Alabama Port of the United States Engineers was connected with that of the Coast and Geodetic Survey and such additional points were determined as were considered useful as aids to navigation or for geographical purposes. In Perdido Bay search was made for old stations, a new triangulation was executed, and a topographic survey made of the entrance to the bay.

In Barataria Bay search for old stations was unsuccessful and a new triangulation of the bay was found necessary. In this new triangulation there are 22 important points, of which 14 were occupied.

In Mobile Bay 47 old stations were searched for, of which 29 were recovered, 3 were not found but may be in existence, and 15 are known to be lost. In the new triangulation 7 stations were occupied and 8 new points determined.

In Perdido Bay, of 51 stations searched for, 21 were recovered. Eight new stations were occupied and 9 new points determined.

In Barataria Bay only 9 stations were recovered of 32 searched for.

MICHIGAN, MINNESOTA, AND WISCONSIN.

[DON C. SOWERS.]

STATIONS OCCUPIED.—*Michigan:* Crystal Falls and Iron Mountain. *Minnesota:* Blue Earth and Caledonia. *Wisconsin:* Florence, Friendship, La Crosse, Manitowoc, Pembina, Sheboygan, Sturgeons Bay, and Wautoma.

Observations to determine the values of the three magnetic elements were made at the stations named above between June 4 and 11, two old stations being among those occupied.

MAINE.

[W. M. STEIRNAGLE.]

The determination by triangulation of a lighthouse and certain other prominent objects useful as aids to navigation on the coast of Maine in the neighborhood of Eastport and Lubec was undertaken in the latter part of August. Two old triangulation stations were recovered and two new ones established. Observations were made on September 1 and 2. In all, seven points were determined, including Lubec Narrows Lighthouse.

ARIZONA.

[W. F. WALLIS and L. W. WEED.]

Observation of magnetic declination dip and intensity at the magnetic observatory at Tucson, Ariz., were made during the year. The magnetograph records have been continued without interruption, absolute and time observations have been made once a week and dip observations twice a week. Seismograph records were begun September 10 and have been continued from that date. Special declination readings were made at the time of the solar eclipse. Meteorological observations have been made since February 15.

PENNSYLVANIA, TENNESSEE, WASHINGTON, D. C., AND WEST VIRGINIA.

[T. L. WARNER.]

SUMMARY OF RESULTS.—Gravity determination: 5 pendulum stations occupied.

During the season from May 9 to June 30 observations to determine the force of gravity were made at five stations as follows: Helenwood, Tenn.; Roan Mountain, Tenn.; Charleston, W. Va.; State College, Pa.; and Washington, D. C. Observations for the standardization of the pendulums were made in June.

CALIFORNIA.

[F. WESTDAHL.]

The suboffice at San Francisco has been maintained throughout the year, the work including correspondence relating to matters of interest to the Survey on the Pacific coast, the transportation of instruments and supplies sent from Washington to the Philippines, Hawaii, and Alaska, payment of traveling expenses and issue of transportation orders to officers traveling or passing through San Francisco to Washington and Seattle.

On May 6, 10, 11, and 12 a survey was made to determine the boundaries of a proposed extension of the United States immigration station on Angel Island, San Francisco Bay.

On June 7, 8, and 9 the position of the Fort Point Whistling Buoy was determined from stations on shore.

The tide indicator on Alcatraz Island was dismantled in November by an officer and boat's crew from the steamer *Patterson*.

The suboffice was removed from the Columbus Bank Building to rooms in the new customhouse building on February 18, 20, and 23.

An inspection was begun of the stock of charts on hand at the agencies of the Survey in San Francisco.

Supervision has been maintained over the work of the Presidio Tide Station.

Calls for information and charts from Government officers and others have been complied with, and office accommodations have been provided for officers of the Survey temporarily stationed at San Francisco.

MASSACHUSETTS AND TEXAS.

[ISAAC WINSTON.]

SUMMARY OF RESULTS.—Triangulation: 2 observing scaffolds and tripods built, 22 stations occupied for horizontal measures, 50 geographic positions determined.

Between July 19 and 24, observations were made from Sankaty Head Lighthouse to determine the position of the steamers *Bache* and *Endeavor*, engaged in triangulation to furnish positions needed in the survey of Nantucket Shoals, which work was assigned to the *Bache*. During the intervals of this work, when weather was unfavorable for observations, the positions of two new range lights for entering Nantucket Harbor were determined, and six tidal bench marks were recovered. Between March 31 and May 26 a revision was made of the triangulation of Galveston Bay, Tex.

In 1900 a base line had been measured by the United States Engineers near Texas City, and from this base a scheme of triangulation had been extended covering the shores of Galveston and East Bays. In this work a search had been made for the old triangulation stations of the Coast Survey, of which 8 were recovered and made a part of the work.

An examination of the observations and computations showed that no new triangulation would be necessary if the stations established by the United States Engineers could be recovered.

A search was made for triangulation stations established by the United States Engineers, of which 21 were found and 8 have been destroyed, but of the 5 old stations of the triangulation by the Coast Survey searched for none were recovered.

The work in Galveston Bay and in East Bay was practically completed, but no work was done in West Bay.

Channels have been dredged to Port Bolivar, Texas City, and across the bay to the mouth of the San Jacinto River. Channels have also been dredged to the mouths of Dickinson Bayou and Trinity River, to Seabrook, and across Hannas Reef in East Bay (East Bay Pass). The positions of the beacons on these channels were determined by

triangulation. The geographic positions of a number of other aids to navigation were determined.

Observations were made at many of the old stations and 2 new stations were established.

The officer employed on this duty made an inspection of one of the chart agencies of the Survey at New Orleans.

A search was made for tidal bench marks, and 14 were recovered and 10 found to have been destroyed. An inspection was made of the tide station at Galveston, and some necessary repairs were made.

COLORADO, ILLINOIS, INDIANA, IOWA, MONTANA, NEBRASKA, NEW MEXICO, OHIO, OKLAHOMA, PENNSYLVANIA, TEXAS, AND WYOMING.

[C. F. WOODYARD.]

STATIONS OCCUPIED.—*Colorado:* Greeley. *Illinois:* Quincy. *Indiana:* Noblesville and Lebanon. *Iowa:* Des Moines, Rockwell City, and Sac City. *Montana:* Billings, Boulder, Helena, Lima, and Livingston. *Nebraska:* Chadron and Newport. *New Mexico:* Raton and Tecumcari. *Ohio:* Dayton. *Oklahoma:* Ada, Arapaho, Bartlesville, Cherokee, Chickasha, Duncan, El Reno, Enid, Fairview, Holdensville, Kingfisher, Miami, Muskogee, Nowata, Pawnee, Pryor, Purcell, Ryan, Sayre, Stillwater, Tulsa, and Vinita. *Pennsylvania:* Meadville. *Texas:* Amarillo, Cleburne, Corsicana, Daingerfield, Decatur, Granbury, Hillsboro, Longview, Marshall, Montague, and Tyler. *Wyoming:* Cheyenne, Granger, Green River, and Sheridan.

During the season from June 11 to December 7, 56 stations named above were occupied for the measurement of the three magnetic elements as well as for the observation of latitude, azimuth and local time for longitude. Fifteen of the above stations were old stations which were reoccupied.

ALASKA.

[F. L. ADAMS.]

The usual work was done at the magnetic observatory at Sitka, and a record of the value of the three elements of terrestrial magnetism was obtained with self-registering instruments.

Thirty-six earthquakes were recorded on the seismograph during the year.

[H. L. BECK, Commanding Steamer *McArthur*.]

SUMMARY OF RESULTS.—Hydrography: 920 square miles of area covered, 3 595 miles of lines sounded, 43 434 soundings made, 7 tide stations occupied, 6 hydrographic sheets completed. Magnetic observations: 5 stations occupied. Topography: 15 square miles of area covered, 63 miles of general coast line surveyed, 11 miles of shore line of creeks surveyed, 5 topographic sheets completed. Triangulation: 170 square miles of area covered, 17 stations occupied, 23 geographic positions determined.

The survey of the upper portion of Cook Inlet was in progress on July 1, and some details of the work are given in the Annual Report for 1910. The statistics given above cover the whole season, May 12 to September 2, 1910, when work was suspended for the winter. The survey of Cook Inlet from the Forelands to the head of the inlet was completed by making a hydrographic survey of this portion and by making a topographic survey of 22 miles of the shore line on the north shore to complete the survey of the three sections of this shore which were unfinished at the close of the previous season.

In Turnagain Arm the triangulation was extended to a point 15 miles above the entrance, and a topographic survey was made along both shores for a distance of 10 miles.

A hydrographic survey of the entrance south of Fire Island was made and the soundings were extended 12 miles above the entrance.

Similar work was done in Knik Arm, the triangulation extending to the town of Knik and the hydrographic work to a point 10 miles above the entrance. A topographic survey was made of the north shore for a distance of 10 miles south of Knik and along 5 miles of the south shore of the Arm.

During the season one party was kept at work on shore, living in camp, and for a portion of the time another party was so employed.

Some current observations were made during the season, but the other work was not delayed for this purpose.

The strong tidal currents encountered increased the difficulty of making satisfactory soundings and caused considerable delay in this work.

A range of the tide amounting to 35 feet was observed on the tide staff established in Knik Arm at a point about 8 miles above the entrance. The duration of slack water at times does not exceed five minutes and the flood tide advances over the flats at a rapid rate in a line of white breakers of considerable height accompanied by a loud roar.

Knik Harbor affords protection in all kinds of weather, and deep water close inshore was found in the vicinity of the mouth of Ship Creek, where a good supply of fresh water exists throughout the summer.

Magnetic observations were made with a compass declinometer at several triangulation stations in Cook Inlet.

Assistant Beck reports his appreciation of the service rendered by the officers and crew. The officers worked hard and harmoniously and the crew was composed of exceptionally good men.

On October 3 the *McArthur* sailed from Port Graham and reached Seattle on the 21st. Assistant Beck resigned from the service on March 31, 1911, to accept the position of inspector in the Bureau of Lighthouses.

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

SUMMARY OF RESULTS.—Triangulation: 42 square miles of area covered, 33 signals erected, 29 stations occupied for horizontal angle observations, 86 geographic positions determined. Magnetic work: 25 magnetic stations occupied. Topography: 72 square miles of area covered, 133.6 miles of shore line surveyed, 13 miles of creeks, 1 mile of roads, 7 topographic sheets completed. Hydrography: 22.9 square miles of area covered, 578.3 miles run while sounding, 33 767 soundings, 7 tide stations established, 2 current stations occupied, 7 hydrographic sheets completed.

On July 1 the *Gedney* was engaged in the survey of Tongass Narrows, Alaska, with a subparty on shore at Wards Cove and another subparty with the steamer *Cosmos* at work at the head of Portland Canal. On July 27 work was taken up in Wrangell Strait and the triangulation of Sumner Strait and Frederick Sound was connected with the work of the Army Engineers in Wrangell Strait, establishing points for the topographic and hydrographic survey of the strait. On August 6 the *Cosmos*, having completed work at the head of Portland Canal, was assigned to work at the south end of Wrangell Strait and continued with the *Gedney* on this work until the close of the season in October, when the survey of the strait was practically completed. The work done in Tongass Narrows completes the survey from the northern entrance to midway of Pennock Island. All of Wrangell Strait has been surveyed, but some additional soundings at critical points and anchorages outside the southern entrance are desirable. The completed survey at the head of Portland Canal extends from Lion Point to the head of the canal, including the town site of Stewart, British Columbia. This work, including hydrography and topography, was undertaken in order to more accurately locate the international boundary lines at that point.

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

SUMMARY OF RESULTS.—Triangulation: 38 square miles of area covered, 5 signals erected, 6 stations occupied for horizontal measures, 5 stations occupied for vertical measures, 4 geographic positions determined, 4 elevations determined trigonometrically. Magnetic work: 1 land station occupied. Topography: 30 square miles of area surveyed, 37 miles of general coast line run, 4 miles of lagoons, 2 topographic sheets finished. Hydrography: 469 square miles of area sounded, 2 045 miles run while sounding, 21 934 soundings, 1 tidal station established, 4 current stations occupied, 7 hydrographic sheets finished.

At the beginning of the year the steamer *Explorer* was at work on a general survey of Bristol Bay, Alaska.

The triangulation was extended from Point Protection, Nushagak Bay, to a distance of 7 miles beyond Cape Constantine. Little triangulation work was done on the

eastern shore, only one quadrilateral having been laid out and partly observed. The topography was confined to the western shore and was carried from Nichols Hills to 7 miles beyond Cape Constantine, a distance of about 30 miles.

The hydrography was extended from the limits of the work in 1909 to both the southeastward and southwestward, and extends on the southward to deep water. Four hundred and sixty-nine square (statute) miles of hydrography were done, involving more than 2 000 miles of soundings lines and nearly 22 000 soundings. The season was noted for unusual fogs, which often interfered with the progress of the work.

Tides were observed 28 days and nights continuously to determine the datum plane.

Work off the Nushagak was closed on September 17 and the *Explorer* sailed for the Kuskokwim, examining the coast and the approaches to the river. An excellent report of this work was made, furnishing the best sailing directions for entering the Kuskokwim yet available.

[F. H. HARDY, Commanding Steamer *Yukon*.]

SUMMARY OF RESULTS.—Triangulation: 4 stations occupied. Topography: 15 miles of shore line surveyed. Hydrography: 1 tide station occupied.

The steamer *Yukon* began operations in the vicinity of Seldovia, Alaska, on June 13. Topography was done by a subparty on Kalgin Island, while the vessel was obliged to return to Seldovia for repairs to her boiler. Work was in progress at the close of the year.

[C. G. QUILLIAN, Commanding Steamers *Yukon* and *McArthur*.]

SUMMARY OF RESULTS.—Triangulation: 9 signals erected, 6 stations occupied. Topography: 16-square miles of area covered, 21.2 miles of general shore line run, 10 miles of shore line of rivers, 1 topographic sheet finished. Hydrography: 526 square miles of area sounded, 1 552.1 miles of sounding lines run, 16 347 soundings made, 2 hydrographic sheets completed. Currents: 4 stations occupied for current observations.

At the beginning of the fiscal year the party on the steamer *Yukon* was engaged in surveys on the east coast of Cook Inlet, Alaska, from East Foreland southward. This work was completed westward to Kalgin Island, and 30 miles to the southward.

A small local triangulation with a short base line was executed to furnish positions and orientation for a 1/10 000 harbor sheet at Kenai, and the topography was continued 5 miles up the river. Two lines of soundings were run up the river to the limits of the topography.

A number of dangers to navigation were located and determined in position.

The approaches to the Kenai and Kasilof Rivers were developed sufficiently for the demands of the ports.

Tidal observations with automatic and staff gauges were made during the season, and current observations were made at four stations. Work was closed about the middle of October and the vessel was laid up at Kodiak.

In May work was resumed on the coast of Alaska with a party on the steamer *McArthur*. On the way to Prince William Sound an examination was made of La Perouse Glacier and an attempt to enter Icy Bay was prevented by the ice in the bay at that season. Some supplementary soundings were made in Katalla Bay and east of the Martin Islands to complete the hydrography previously executed.

An automatic tide gauge was reestablished at Seldovia, and on June 9 the vessel proceeded across Cook Inlet to Harriet Point. Work of topography and hydrography was at once begun southward from that point, and was in progress at the close of the year.

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

SUMMARY OF RESULTS.—Reconnoissance: 430 square miles covered, 45 lines determined, 19 points selected. Base lines: 1 secondary, length of 1 988 meters. Triangulation: 77 square miles of area covered, 5 signal poles erected, 15 observing tripods built, 12 stations occupied for horizontal measures, 4 stations occupied for vertical measures, 14 geographical positions determined. Latitude, longitude, and azimuth: 1 latitude station occupied, 1 azimuth station occupied. Topography: 70 square miles covered, 87.7 miles of general coast line, 2¼ topographic sheets completed. Hydrography: 1 043 square miles of area sounded, 3 007 miles of sounding lines, 55 489 angles measured, 23 327 soundings, 3 hydrographic sheets completed. Magnetic work: 11 stations occupied for magnetic observations.

On July 1 the steamer *Patterson* was engaged in the topography and hydrography of Cook Inlet, Alaska. The eastern shore line of Cook Inlet was surveyed from abreast the southern end of Kalgin Island southward to Kachemak Bay. A topographic survey was made of Kachemak Bay and approaches from Anchor Point on the north and the north side of Port Graham on the south to just above Homer Spit and Coal Bay. The hydrography of Cook Inlet was completed from the southern end of Kalgin Island to Port Graham and from the eastern shore to about the center of the inlet. In Kachemak Bay the hydrography has been finished as far eastward as a line north and south passing through Gull Island. This includes Coal Bay and anchorage near Homer.

Tidal observations were made at Port Graham with an automatic gauge and staff gauges were read at other points. In all, 6 stations were occupied for the observation of tides.

Currents were observed at 12 stations on the eastern shore of Cook Inlet.

In the magnetic work, 4 stations in Cook Inlet were occupied for declination. The ship was swung in Kachemak Bay, once at sea, three times in the inside passage, and at Union Bay on the return from Alaska.

The vessel arrived at Seattle on October 22 and at San Francisco on November 2. Soundings were made along the usual steamer routes between Seattle and San Francisco.

Work on the coast of Alaska was resumed in the vicinity of Dolgoi Island on May 19.

A base line was measured at the head of Volcano Bay, signals erected, and triangulation begun. An automatic tide gauge was set up in Dolgoi Harbor, at which continuous tidal records were taken from June 9 to the end of the month. Topography was begun on June 24 and hydrography on June 27. Work was in progress at the close of the year.

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

SUMMARY OF RESULTS.—Triangulation: 110.2 square miles covered, 39 signals erected, 25 stations occupied for horizontal measures, 11 stations occupied for vertical measures, 37 geographical positions determined, 11 elevations determined trigonometrically. Topography: 59.9 square miles of area covered, 148.3 miles of coast line run, 2 topographical sheets completed. Hydrography: 143.5 square miles of area sounded, 602.4 miles of sounding lines run, 3 607 positions determined, 11 952 soundings made, 4 tidal stations established, 5 hydrographic sheets finished. Magnetics: 2 magnetic stations occupied. Leveling: 10 elevations determined, 0.6 mile of levels run, 10 tidal bench marks established.

On July 1 the party on the steamer *Taku* was at work on the shores of Knight Island, Alaska, making a topographic and hydrographic survey from Passage Point to Drier

Bay, including Herring, Lower Herring, and Johnson Bays. This work was completed on July 27 and work begun in Prince of Wales Passage, triangulation, topography, and hydrography, and continued until September 8, after which work was taken up in Bainbridge Passage. Reconnoissance for triangulation was carried through the passage and the stations marked. This work was in progress when the season closed. On the way back to Cordova, aids to navigation between Middle Ground Shoal and Cordova were determined in position.

Work was resumed in the neighborhood of Cordova in May, beginning with the survey of Naked Peak and Storeys Islands, and was in progress at the close of the year.

[P. A. WELKER.]

SUMMARY OF RESULTS.—Latitude, longitude, and azimuth work: 1 longitude station occupied, telegraphic signals exchanged on 8 nights.

Determinations of the longitude of Fairbanks and Tanana, Alaska, by exchange of telegraphic signals with Valdez, Alaska, were made between July 30 and September 8. The astronomical station at Valdez, established in 1905, was found, a pier built, a temporary observatory erected and the necessary telegraphic connections made. Time observations and exchange of signals with the observer at Fairbanks were obtained on August 11, 12, and 13, and with the same observer at Tanana on August 28, 29, 30, and September 5 and 8.

OUTLYING TERRITORY.

PHILIPPINE ISLANDS.

[E. F. DICKINS and P. A. WELKER, *Directors.*]

The Director of Coast Surveys in the Philippine Islands, whose office is at Manila, has immediate direction of the details of the field and office work of the Survey in those islands, under general instructions from the Superintendent. He makes plans for field work and issues instructions to field parties. The results of observations made in the field are computed and discussed in the office at Manila, and drawings for new charts are there prepared and transmitted to the Office at Washington for publication.

Sailing Directions and Notices to Mariners are prepared and published at Manila.

Cooperation was maintained with the various bureaus of the insular government and with the military and naval authorities in the Philippines.

Valuable data have been collected in relation to geographic names in the Philippine Islands and in relation to the geography of the islands.

The progress of the work of the field parties is detailed in the abstracts which follow:

[H. C. DENSON, Commanding Steamer *Romblon.*]

SUMMARY OF RESULTS.—Reconnoissance: 246 square miles of area covered, 8 lines of intervisibility determined, 5 signals and scaffolds erected. Triangulation: 1 960 square miles of area covered, 6 scaffolds and signals poles erected, 11 stations occupied for horizontal measures, 5 stations occupied for vertical measures, 48 geographical positions determined, 25 elevations determined trigonometrically. Topography: 426 square miles of area covered, 109 miles of general coast line run, 10 miles of shore line of rivers and creeks, 38¼ miles of roads, 7 topographic sheets finished. Hydrography: 1 922 square miles of area sounded, 2 283 miles run while sounding, 25 568 soundings, 3 tidal stations established, 7 hydrographic sheets finished.

At the beginning of the fiscal year this party was at work along the northern shore of Mindanao. Work was extended around the shores of Macajalar Bay to a connection with previous work at Sulanang Point, also around Camiguin Island, and including all the adjacent hydrography. From the side Baguian–Tubay the triangulation was extended to Suluan Point, a distance of 90 miles, with a side scheme covering Gingo-og Bay. The topography extends along the coast from Bagacay Point to Suluan Point and around Camiguin Island. The hydrography extends around the coast line above mentioned and also fills in the whole area of Surigao Sea, joining the work of the previous season. A search was made without result for a shoal reported about 10 miles off the south coast of Bohol Island.

Field operations which were suspended October 25 were resumed on January 2 for surveys in the vicinity of Burias, Masbate, and Sibuyan Islands. Reconnoissance, signal building, etc., occupied the party until January 22, when the command was transferred. Further work of the vessel is noticed under another head.

[H. C. DENSON, Commanding Steamer *Pathfinder*.]

SUMMARY OF RESULTS.—Reconnoissance: 240 square miles of area covered, 6 points selected for scheme. Triangulation: 380 square miles of area covered, 39 signal poles erected, 23 stations occupied for horizontal measures, 50 geographic positions determined. Topography: 156 square miles of area covered, 219 miles of shore line surveyed, 39 miles of rivers and creeks surveyed, 4½ topographic sheets finished. Hydrography: 588 square miles sounded, 2 509 miles run while sounding, 3 212 positions determined, 39 475 soundings made, 2 tidal stations established, 5⅓ hydrographic sheets finished.

The work of the season includes a topographic survey of the coasts of Bucas Grande, Middle Bucas, and East Bucas Islands, the south coast and part of the east coast of Siargao Island, also some of the outlying islands; hydrographic survey of Dapa Channel and Port Sibonga, with approaches, and the determination of sufficient secondary triangulation points for the control of the area surveyed. Reconnoissance for triangulation had on April 30 been completed to latitude 9°.

By June 30 the triangulation had been carried down the east coast of Mindanao as far as Cauit Point. The topography and hydrography were carried to the same point. An automatic tide gauge was kept in operation at General Island, and staff gauge readings for use in the reduction of soundings were made at various points throughout the locality of the work.

[F. G. ENGLE, Commanding Steamer *Research*.]

SUMMARY OF RESULTS.—Triangulation: 4 298 square miles of area covered, 3 signals and scaffolds erected, 6 stations occupied for observations of horizontal angles.

From February 15 the party on the steamer *Research* continued the revision of observations of the triangulation between Siquijor and Camaguin Islands and Illigan Bay, across the Mindanao Sea, for the purpose of obtaining trustworthy data for the continuation of the triangulation across the island of Mindanao. The object of this work was to secure data for the proper coordination of all surveys of the Philippine Islands.

This work was completed on May 13, after which date the vessel went to Cebu for some minor repairs, and then proceeded to Tacloban for the purpose of taking up the work of triangulation, topography, and hydrography of Carigara Bay and Daram Channel. This work was in progress at the close of the year.

[C. V. HODGSON, Commanding Steamer *Research*.]

SUMMARY OF RESULTS.—Triangulation: 5 signals erected, 3 stations occupied. Topography: 159 square miles of area covered, 55 miles of general coast line surveyed, 92.2 miles of roads surveyed, 4 topographic sheets completed. Hydrography: 819.7 square miles of area covered, 2 673.5 miles of lines sounded, 50 072 soundings made, 4 tidal stations established, 6 hydrographic sheets completed.

During July the party on board the steamer *Research* was engaged in hydrography along the south coast of Masbate Island, the triangulation and topography of which had already been executed. From August 1 to September 3 the vessel was undergoing repairs at Iloilo. In September the party was transferred to the east coast of Cebu Island, investigating on the way the location of a reported shoal off the mouth of the Himugaan River on the north coast of Negros. No traces of such a shoal were found. Work on the coast of Cebu was begun September 15. The triangulation having been previously executed, the topography and hydrography were begun at once and progressed rapidly. No offshore dangers to navigation in the waters between Bohol and Cebu were found. The eastern part of the hydrography joined the hydrography done

in 1908 and 1909. Cascar Harbor was developed on a 1/10 000 scale and found to be an excellent typhoon anchorage for small vessels. Aside from this anchorage no good harbors exist in the region surveyed. Work on Cebu was closed December 21 and the work of triangulation on the north coast of Mindanao taken up, but owing to unfavorable weather conditions observations were not completed at either of the two stations occupied.

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

SUMMARY OF WORK.—Triangulation: 3 stations occupied for observations of horizontal angles. Hydrography: 275 miles of area covered, 124 miles run while sounding, 82 soundings made.

At the beginning of the fiscal year this party was engaged in reconnoissance between Negros and Siquijor Islands. On July 22 the command of the vessel was transferred. The details of subsequent work are stated under another head.

[R. F. LUCE, Commanding Steamer *Romblon*.]

SUMMARY OF RESULTS.—Triangulation: 2 890 square miles of area covered, 26 signals and scaffolds erected, 25 stations occupied for horizontal angles, 33 geographical positions determined. Topography: 89 square miles of area surveyed, 91 miles of coast line surveyed, 4 topographic sheets completed. Hydrography: 1 732 square miles of area sounded, 1 420 miles run while sounding, 21 849 soundings made, 2 tidal stations established, 2 hydrographic sheets finished.

During the period from January 25 to the date of last report received the party on the steamer *Romblon* was continuously engaged in surveys in the vicinity of Burias and Masbate Islands.

The triangulation consisted of a large scheme of triangulation which was carried on in conjunction with the work of the steamer *Fathomer*. Progress in this work was necessarily slow on account of the difficulty of observing over the long lines. When conditions were unfavorable for observing the longer lines the tertiary scheme was carried forward and points were located for use in topography and hydrography.

The topography consisted of the mapping of the shore line of the outlying islands between Bondoc Peninsula and Burias Island, including the harbor of San Pascual and the entire west coast of this island to Aguja Point at the south end. A detached survey was also made of a portion of Port Barrera, Masbate Island.

The hydrography was carried on over the region covered by the topography and over a considerable portion of the sea between Burias, Sibuyan, Romblon, and Banton Islands.

An automatic tide gauge was operated at San Pascual, Burias Island, and staff readings were taken at the same place and at Barrera.

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

SUMMARY OF RESULTS.—Triangulation: 8 002 square miles covered by triangulation, 50 signals and scaffolds erected, 29 stations occupied for observations of horizontal angles, 73 geographic positions determined, 6 stations occupied for vertical angles, 9 elevations determined. Topography: 807 square miles of area covered, 277 miles of shore line surveyed, 130 miles of rivers, creeks, and ponds, 9 topographic sheets completed. Hydrography: 3 474 square miles covered, 7 472 miles of sounding line, 73 215 soundings, 8 tide stations established, 9 current stations occupied, 11 hydrographic sheets completed. Magnetics: 7 magnetic stations established.

During the season from July 1 to December 31, the party on the steamer *Fathomer* was engaged upon surveys on Mindoro, Tablas, and Panay Islands, with the exception

of a short time spent in repairing and outfitting at Manila. The triangulation consisted of the completion of observations at 6 secondary stations and at 10 tertiary stations. The main scheme of secondary work was completed around the southern end of Mindoro to the west coast; southward it was completed over the Semarara group and the Maniguin Island, from which the Cuyo Islands may be easily seen; and eastward and southeastward it rests on Tablas and Panay, extending to the locality selected for the Ibajay base net on the north coast of Panay.

The topography between July 1 and December 31 was extended over the Semerara group, some portions of Mindoro and the south end of Tablas Island, and a subsheet of small topographic corrections near Sicogan and Calagnaan Islands, northeastern Panay.

The hydrography includes the Semerara group, portions of the Mindoro coast, the entire west and south coasts of Tablas Island, and all the waters between Mindoro and Tablas and 5 miles to seaward south and southeast of the Semerara Islands. A development was also made near Sicogan and Calagnaan Islands, northeast Panay.

Tides were observed with an automatic gauge at Looc Bay and with staff gauges at numerous points.

Magnetic observations were made with compass declinometer at seven stations on shore and the ship was swung five times.

Work was begun in February on the survey of the area bounded by Luzon, Burias, Masbate, Panay, and Tablas Islands in conjunction with the party on the steamer *Marinduque*.

The triangulation consists mainly of large figures in the principal or secondary scheme for the islands, laid out to complete the final connection between Luzon and all of the islands south of it, for the coordination of the various independent surveys. The scheme had reached Tablas Island in the year 1910, and is being connected directly with the southern work extending from Masbate and northern Panay southward. The site for a base line at Navas, northwestern Panay, was selected and the small figure near it laid out.

The topography included the northwest end of Panay and Maniguin Islands, beginning at Pandan on the west coast, where it was connected with the work of 1907, and was extended on the north coast to Ibajay, leaving only 14 miles for the completion of the shore line of the entire island of Panay. On Tablas Island the survey was extended along the southern half of the east coast and over Carabao and Borocay Islands; the southern half of the west coast of Romblon Island, and more than half of the south coast of Sibuyan Island were also completed.

The inshore hydrography was completed along all of the shore covered by the topography and was generally extended to the 50-fathom curve.

The offshore hydrography was completed southward to a line 1½ miles south of Maniguin Islet and westward and northwestward to a connection with the work of the previous season, thus completing the hydrographic survey of all the area between Mindoro, Tablas, and Panay. Carabao and Borocay Passages between Tablas and Panay were finished and much work was done in various parts of the sea between Tablas, Panay, Masbate, Sibuyan, and Romblon Islands. Soundings were obtained over the proposed cable route from Calivo to Romblon for the use of the Bureau of Posts.

Tides were recorded by an automatic gauge on Tablas Island and staff gauges were read at various points.

The magnetic work consisted of ship swings and declinometer observations at stations about 15 or 20 miles apart.

Current observations were made at nine stations distributed over an area of 5 000 square miles. A log line and a 12-foot pole were used and hourly or half-hourly readings were taken. The currents measured were generally less than 1 knot, but in the passages between Tablas and Panay they were 2 or 3 knots. Sea-water temperatures were measured twice, once west of Panay and once east of Tablas, using the Negretti-Zambra thermometer. In these localities the sea is about 700 fathoms in depth and connected with the China Sea and the Pacific by channels of less than 300 fathoms. The temperature was found constant below this depth and 50° to 51° F., compared with a surface temperature of 83° to 86° F.

The ascent of Sibuyan Peak, 6 722 feet high, was made for the purpose of placing a triangulation station there. This is said to be the first ascent ever made, although there had been several attempts by various persons both in Spanish times and since. Two reconnoissance parties were used, with a total of 2 officers and 21 men; one party being engaged for 10 days and the other for 8 days. The only difficulty was found to be the thick small growth on the upper half of the ascent, making extensive trail cutting an absolute necessity. One night was spent on the summit and the peak was rejected as a station site on account of the difficulty of clearing and making it ready for occupation, and on account of almost impossible cloud conditions about it throughout the year. The mountain lies upon an island about 12 miles in extent and is the highest elevation in a radius of 90 miles. It has always been called the roughest and most difficult peak of the Archipelago, although Mount Baco, 8 200 feet, in Mindoro, which is not so well known and has never been climbed, is probably worse. The vegetation and geology of it appear to be of little interest and there is no wild life. In structure it appears to be part of the rim of some crater of very great age, so old that few traces of volcanic activity remain, and there is left only the curved form of the steep, sharp range on which it lies. The rock is a very homogeneous limestone, not stratified or otherwise marked, reddish brown and coarse grained, its surface showing constant erosion by rain and wind, pitted thus 1 to 2 feet deep. The upper slopes of the peak are almost completely covered by bowlders 10 to 30 feet in size, which had apparently been much shaken about in the severe earthquakes six weeks before.

There are large landslides on all the slopes and a few were heard during the ascent. The vegetation extends entirely to the summit and grows on the bare rocks, as practically no moss is found and no soil, the heavy and continual condensation from the clouds supporting it. The shrubs are 6 to 12 feet in height, growing in a thick interwoven matted fashion, so that one may crawl over their tops. They are very crooked, with a hard tough wood which burns with difficulty. The most frequent are a kind of dwarf fir or agojo, and a chaparral. Only a few other varieties are found. The pitcher plants are numerous, with pitchers containing a quart of water, good for drinking. The Bejuco stops at 5 000 feet and there is no cogon grass. There are few insects and none of the wood leeches, so numerous on the other islands.

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

SUMMARY OF RESULTS.—Triangulation: 1 193 miles of area covered, 70 signals and scaffolds erected, 31 stations occupied for horizontal measures, 2 stations occupied for vertical measures, 89 geographical positions determined, 17 elevations determined. Topography: 388.7 square miles of area covered, 386 miles of shore line, 85.6 miles of shore line of rivers and creeks, 19.7 miles of roads, 9½ topographic sheets completed. Hydrography: 1 347.8 square miles of area covered, 4 100 miles of sounding line run, 46 884 soundings made, 5 tidal stations established, 10 hydrographic sheets completed.

At the beginning of the fiscal year this party was engaged in extending the survey along the northeast coast of Mindanao to the eastward of Surigao, and including the islands of Dinagat, Siargao, Bucas Grande, and other adjacent islands.

The triangulation and topography were extended along the northeast coast of Mindanao, eastward as far as Tugas Point; along the whole eastern shore of Dinagat Island, and along the whole western shore of Siargao and Bucas Grande Islands. The hydrography was completed in the whole area between the islands above mentioned and was also extended to the eastward from Tugas Point and the south end of Bucas Grande Island out beyond and around Ballena Rock, so that the entrance to this southerly passage is now completely sounded, and with the exception of Ballena Rock the entrance is shown to be unobstructed.

Four tidal stations with self-registering gauges and one staff gauge station were established during the season, notes were made in regard to the strength and direction of currents, and several shoals and reefs were located during the season.

In January data was obtained in Hongkong upon which to base detailed estimates for repairs required by the steamer *Pathfinder*.

[PAUL C. WHITNEY, Commanding Steamer *Marinduque*.]

SUMMARY OF RESULTS.—Triangulation: 500 square miles of area covered, 43 signals and scaffolds erected, 25 stations occupied for observations of horizontal angles, 100 geographical positions determined, 1 azimuth station occupied, 1 base line measured. Topography: 35 square miles of area covered, 88.3 miles of general coast line surveyed, 7 miles of roads, 5 topographic sheets completed. Hydrography: 2 265 square miles of area sounded, 2 587 miles run while sounding, 44 058 soundings made, 5 tidal stations established, 9 hydrographic sheets finished.

Between September 17 and December 27 this party was at work on the hydrography in the vicinity of Dumaguete and Siquijor Islands, including surveys of Port Canaon and Port Siyt. From January 1 to March 10 the party was engaged in a survey of Jolo Harbor and approaches, after the completion of which the survey of Basilan Straits was taken up. By May 5 the reconnoissance for the main scheme of triangulation had been completed and all signals built, practically all lines cleared for tertiary work, and sufficient points had been located to commence the topography and hydrography, which were started in the vicinity of Sachol Island and carried forward with the main scheme of triangulation as circumstances would permit.

MANILA OFFICE.

At the office in Manila the records received from the field parties have been examined, reduced and checked wherever necessary, duplicates prepared, results of triangulation adjusted, and elevations computed.

Progress has been made in the preparation and compilation of the results and sketches for the publication of the triangulation of the island of Luzon.

The usual studies have been made for each proposed piece of field work; notes, specifications, and instructions for field parties prepared, and general supervision exercised over the details of the field operations.

Requests for data needed in surveys by the Army have been filled in addition to other calls for information.

Finished tracings have been made for chart publication, hydrographic sheets plotted, and topographic sheets inked, and completed when necessary.

Sailing directions and notices to mariners for the Philippines have been prepared and a large amount of original hydrographic information has been received and filed. Lights and buoys on the charts were colored and hand corrections to the charts made when required.

The Survey has a representative on the lighthouse board of the Philippine Government.

Progress has been made in the Geographic Division in the compilation of a general map of the Philippines.

PORTO RICO.

[GEORGE HARTNELL.]

A continuous record of the magnetic elements has been maintained at the observatory at Vieques, P. R. Absolute and time observations have been taken as usual.

The seismograph has performed satisfactorily and several large earthquakes have been recorded.

HAWAIIAN ISLANDS.

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

SUMMARY OF RESULTS.—Triangulation: 32 square miles of area covered, 2 signal poles erected, 7 stations occupied for horizontal measures, 3 geographical positions determined. Magnetic work: 6 land stations occupied and observations made in 5 positions at sea. Topography: 22 miles of general coast line surveyed, 1 topographic sheet completed. Hydrography: 590 square miles sounded, 1 580 miles run while sounding, 6 300 positions determined, 16 324 soundings made, 17 hydrographic sheets finished.

During the season from October 18 to February 20 the steamer *Explorer* was engaged in the survey of the island of Oahu. The triangulation had been completed and the topography begun by another party. The party on the *Explorer* completed the topography and extended the hydrography to the 100-fathom curve all around the island and at frequent intervals to much deeper water.

By the end of the season the survey of the island of Oahu had been completed.

The instructions for this work contemplated the prosecution of systematic surveys of the Hawaiian group, beginning with the island of Oahu.

Work already done was not to be repeated. The hydrography of Oahu was to include the 100-fathom curve, and the topography was to be restricted to a delineation of the shore line.

A party in charge of Assistant O. B. French had been at work on the islands for some months previous to the arrival of the *Explorer*, and upon the departure of Mr. French in October he was succeeded as chief of party by Mr. L. W. Smith, aid. Mr. Smith was instructed by the Superintendent to place himself and party under the direction

of the commanding officer of the *Explorer* for duty upon the arrival of that vessel in Hawaiian waters.

When the *Explorer* reached Honolulu the shore line had been completed from a point just eastward of Mokapu Peninsula, along the northeastern and northwestern coasts of the island nearly to Kaena Point. The hydrography had been completed between Honolulu and Diamond Head out to the 20-fathom curve, and Mr. Smith was then engaged upon the development of Kaneohe Bay, his equipment consisting of a chartered schooner and launch. A subparty was at work upon the island of Kauai.

Mr. Smith continued work in Kaneohe Bay until completed and then took up the inshore sounding and hydrography of Waialae Bay. When that was done the unsurveyed portion of the shore line of the island of Oahu was run and sufficient local triangulation was executed for the control of the hydrography and topography.

The hydrography executed by the *Explorer* includes the entire water area adjacent to the island of Oahu, excepting Pearl and Honolulu Harbors. Pearl Harbor was omitted on account of dredging in progress and the chart of Honolulu Harbor was found to be sufficiently accurate without an additional survey.

The development of the hydrography was completed out to the 100-fathom curve and along nearly the whole coast widely spaced soundings extend much farther, reaching to from 3 to 5 miles from shore. Seventeen current stations were occupied, and magnetic observations were made at a number of land stations. Magnetic observations were also made on shipboard at five positions off the coast of Oahu, and the ship was swung on sixteen headings at the beginning of the season and again at the end. The ship was swung also off Mokapu Peninsula, off Waialae, and off Wainae.

[O. B. FRENCH.]

SUMMARY OF RESULTS.—Astronomic observations: 1 azimuth determined. Base measurement: 1 base line measured. Hydrography: 2 square miles of area covered, 25 miles of line sounded. Topography: 80 miles of shore line surveyed, 6 miles of shore line revised, 10 miles of roads surveyed, 3 topographic sheets completed. Triangulation: 352 square miles of area covered, 53 stations occupied, 132 geographical positions determined.

The revision of the survey of the Hawaiian Islands was in progress on July 1 and was continued under the direction of Assistant French until October 11, 1910, and after that date under the direction of Assistant W. C. Dibrell. (See the report of his work.)

An abstract from the Territorial records on file at Honolulu to furnish the data needed in the work and for use at the Office in Washington, was completed. The triangulation was extended along the coast of the western half of the island of Kauai and a topographic survey was made of the shore line. In connection with this work, observations were made to determine an azimuth, and a base line more than 2 miles long was measured. The region covered by the triangulation is very rough and broken with ridges 4 000 feet in elevation and precipitous in many places. These ridges are covered with a dense mass of tropical vegetation, through which it was often necessary to cut a passage. Hydrographic signals were established along the coast covered by the triangulation at intervals of approximately 1 mile.

[O. H. GAARDEN.]

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

Special declination observations were made on April 28 in connection with the eclipse of the sun on that date.

In order to comply with the request of the Royal Society of London for international cooperation in magnetic work on certain term days from May, 1911, to January, 1912, covering a portion of the period of the magnetic work of the English South Polar Expedition now in the Antarctic regions, a special record was obtained on the magnetograph in accordance with an international program.

Daily meteorological observations were made and continuous temperature records were obtained in the open air, in the magnetograph room, and in the seismograph room.

Time observations were made every week.

The seismograph was kept in operation and a practically continuous record was obtained. One hundred and seventy earthquakes were registered during the year at this station.

[E. VANCE MILLER.]

During the season from April 1 to June 30 this officer was in the Hawaiian Islands engaged in the collection of information for the correction of the sailing directions of those islands. This work is now being prepared for publication.

SPECIAL DUTY.

HIGH-WATER LINE, BELLE HARBOR, N. Y.

[O. B. FRENCH.]

In response to a request from the West Rockaway Land Co. and the Department of Docks and Ferries of New York City for the location on a drawing furnished by them of the high-water line at Belle Harbor, Jamaica Bay, N. Y., as shown by the surveys of 1835 and subsequent years, it became necessary to send an officer to Belle Harbor in order to make a connection between points shown on the drawing and the triangulation of the Coast and Geodetic Survey. This work was completed May 22 to 25. The field expenses of the work were paid by the West Rockaway Land Co.

ROCKLAND SPEED TRIAL COURSE.

[O. B. FRENCH.]

In response to a request from the Navy Department, an officer was assigned to supervise the erection of permanent beacons to mark speed trial course in the vicinity of Rockland, Me., in place of the temporary wooden structures used in the past.

Designs for iron structures were prepared to meet the requirements of the Navy Department and a contract for the work was made with the lowest responsible bidder.

During the period May 6 to May 12 the sites for the foundations of the new beacons were selected, and the positions were determined by triangulation and marks were placed so that the contractor could use them in placing the foundations.

The foundations were completed before the end of the fiscal year, but the erection of the superstructure remained to be done at that time. The field expenses of this work were paid by the Navy Department.

COVE HARBOR, CONN.

[J. C. GAUGER.]

SUMMARY OF RESULTS.—Area of hydrography: 0.04 square statute mile, 3.4 miles of sounding lines run, 793 soundings taken, 2 tidal stations established.

Chart revision work on the coast of Connecticut was done between June 27 and 29 for the purpose of obtaining hydrographic information covering recent harbor improvements by the Stamford Manufacturing Co. in Cove Harbor. The work was plotted upon a hydrographic sheet and will be incorporated in the charts of the locality.

NORTH CAROLINA FISHING GROUNDS.

[J. C. GAUGER.]

At the request of the Fish Commission of North Carolina, surveys were undertaken in Pamlico, Croatan, and Roanoke Sounds, for the purpose of relocating the stakes and buoys marking fishing limits in Pamlico and Croatan Sounds, which had been dragged

out of position or destroyed, and to establish stakes in Roanoke Sound to meet the requirements of recent legislation by the State.

The field work was begun on February 11 and completed on March 4.

Positions in Pamlico Sound established to meet the requirements of the acts of the General Assembly of North Carolina of 1909 relating to fish and fisheries, were re-marked in position or the position checked if the marking was found to be satisfactory; two additional stakes were placed on the Oregon Inlet Reservation.

The recent legislation relative to fishing in Roanoke Sound forbids pound or other net fishing during the shad and herring fishing season anywhere in the Sound except west of a line extending from Buoy No. 39 (1 000 yards east of Hog Island) to a point 200 yards east of Broad Creek Point and one-fifth of the width of the Sound from the shore line northward of a line bearing east 10° north from Ballast Point. In compliance with the law and under the direction of the Fish Commission, stakes were placed in the Sound in the proper localities and their positions determined by sextant angles.

The execution of the work was facilitated by the cooperation and assistance rendered by the officers of the Fish Commission of North Carolina.

[R. S. PATTON.]

Work in Albemarle and Croatan Sounds, N. C., for the location of boundaries of fishing grounds was begun October 15, in accordance with the request of the State authorities. Buoys marking the limits of the grounds were placed and their location determined by sextant angles on points determined by triangulation. In Albemarle Sound 42 buoys were planted between October 31 and November 23, completing the work required.

Work in Croatan Sound was begun November 25, and by November 30 thirteen buoys were planted, completing the work.

The boundaries of the fishing grounds were marked in accordance with acts passed in 1909 by the Legislature of North Carolina, providing that in the Carolina sounds all net fishing should be so restricted as to leave a free passage for the fish from the inlets, through the sounds to the various rivers tributary to them. Thus in the two sounds in which the present work was executed the law provides that an area of one-third of the width of the Sound shall have no nets set in it.

MASSACHUSETTS, BOSTON HARBOR.

[J. F. PRATT.]

At the request of the Boston Chamber of Commerce, an inspection was made of Boston Harbor with a view to the erection of tidal indicators for the guidance of vessels entering the harbor. Owing to the influence of the winds and the natural fluctuations of the tides, it is well known that the water level is at times below the plane of mean low water shown on the charts, and also that the times of high and low water may differ from those in the predicted tables, which represent normal conditions. The tidal indicators are intended to show to vessels the actual height of the tide at any time by inspection. They have been successfully used in New York and San Francisco Harbors and in the Delaware River.

A careful examination was made of various localities suggested as suitable sites for the indicators and information gathered for a report on the subject, with an estimate of probable cost and other data.

MISSISSIPPI RIVER COMMISSION.

[H. P. RITTER.]

As authorized by law, an officer of the Survey continued to serve as a member of the Mississippi River Commission and performed the duties incident to that office. He was engaged on this work and attending meetings of the commission in November, April, and June.

GEOGRAPHICAL POSITIONS, ALASKA.

[EDWIN SMITH.]

SUMMARY OF RESULTS.—Latitude, longitude, and azimuth work: 2 latitude stations occupied, 42 pairs of stars observed for latitude, average number of observations on a pair, 1; 2 longitude stations, telegraph signals exchanged on 8 nights; 2 azimuth stations occupied, observations of azimuth on 11 nights.

Early in July preparations were made for determining the latitude and longitude of a point and the azimuth of a line at Fairbanks, Alaska, and similar work at Tanana, Alaska. This work was undertaken at the request of the United States Geological Survey and was intended to furnish a starting point and an azimuth for the land surveys.

Latitude and azimuth were observed, latitude on 7 and azimuth on 4 nights; and longitude was determined by exchange of telegraphic signals on 3 nights with an observer at Valdez.

At Tanana a station was selected in the Government reservation on which Fort Gibson is located. Telegraphic signals for the determination of longitude were exchanged with the observer at Valdez on 5 nights, azimuth determined by observations on 3, and latitude on 7 nights.

GEOGRAPHICAL POSITION, NEW YORK.

[EDWIN SMITH.]

At the request of the United States Geological Survey a station was selected and marked in Manhattan Square, New York City, just north of the buildings of the American Museum of Natural History. This station was marked with a concrete pier, and about 100 meters to the northward of it a meridian mark was set. The station was connected trigonometrically with points in and upon the museum buildings. Latitude was observed on five nights and longitude determined from the base station at the Coast and Geodetic Survey Office, Washington, D. C., signals being exchanged on four nights.

INTERNATIONAL BOUNDARIES.

[O. H. TITTMANN, *Commissioner.*]

UNITED STATES AND CANADA BOUNDARY.

[E. C. BARNARD.]

SUMMARY OF RESULTS.—131.78 miles (linear) of topography along the boundary completed, 263.56 square miles mapped, 122.78 miles of levels run along boundary, 38.20 miles of levels for check and elevation control, 2 base lines leveled, 97 permanent bench marks established, 129 temporary bench marks established.

Topographic work on the boundary line between the United States and Canada along the forty-ninth parallel east of the Rocky Mountains was in progress on July 1.

Topography, levels and line profile were carried from the end of the work of 1909 to monument 355 near Coutts, the point of starting by the Canadian parties, a distance of 50.13 miles, by July 31, the levels being extended 2.5 miles south to the United States Geological Survey bench mark. The levels run along the boundary by the Canadian parties were also connected with the United States Geological Survey bench mark near Hinsdale, Mont. Work was then taken up at a point west of Frenchmans Creek, and continued until August 24, when the party returned to the camp at Bluff Creek.

Topographic work was completed to monument site 261 B, a distance of 81.65 miles, by October 14, and work was then closed for the season. Work was resumed early in June, 1911, and was in progress at the close of the year.

[J. B. BAYLOR.]

SUMMARY OF RESULTS.—Triangulation: 89 triangulation points occupied, 18 monuments erected and determined in position by triangulation, 1 base line measured. Topography: 50 miles of boundary line mapped, 15 plane table sheets completed.

These statistics include work by the Canadian party.

At the beginning of the fiscal year work was in progress on the northeastern boundary line of the United States and Canada between Maine and New Brunswick, the party representing the Commissioner on the part of the United States working conjointly with a Canadian surveying party in the trigonometric and topographical survey of the St. John and St. Francis River valleys. The triangulation points on each side of the St. John River were marked with concrete monuments. These monuments are used as reference monuments to fix the exact location of the international boundary line on the St. John and St. Francis Rivers as reproduced from the official boundary charts of the Commissioners, under the treaty of 1842.

In a short section of the St. Francis River, where the triangulation points are located on the heavily wooded hills, separated from the bed of the river by a dense growth of woods, concrete reference monuments were located near the banks of the river and connected with the triangulation points. Three base lines were measured, two by the Canadian party and one by the American party. A line of levels was run by the Canadian party up the St. John and St. Francis River valleys to the head of Cross Lake above the rapids, where the season's work ended. This line of levels was connected wherever practicable with the bench marks of the Canadian transcontinental railway, in course of construction.

Detailed plane table maps were made of the adjacent valleys on a scale of 1/5 000, with 20-foot contours.

Work was begun on May 5, 1910, in the vicinity of Edmundston, New Brunswick, and the survey and monumenting were carried to the head of Cross Lake on the St. Francis River, where the season closed on October 30.

Work was resumed about the middle of May, 1911, and was in progress at the close of the year.

Field work was begun by the American party near the head of Beau Lake and by the Canadian party on the St. Francis River, where the boundary line leaves it at what is now known as Boundary Lake.

Up to June 30 ten triangulation points were observed on along the St. Francis River by the American party, and a base line was measured. Lines of sight had to be cut

through the woods for much of this work. A plane table sheet on the St. Francis River was nearly completed and the reference triangulation points for defining by coordinates the boundary line on the St. Francis River were marked with concrete monuments.

A line-cutting party was kept at work clearing a vista 30 feet in width through the forests along the boundary.

[W. B. FAIRFIELD.]

SUMMARY OF RESULTS.—Triangulation: 144 stations occupied, 144 points determined, 1 base line measured. Topography: 101 miles of shore line run, 3 plane table sheets completed.

The survey of the boundary from the mouth of Pigeon River westward toward the Lake of the Woods was continued during the season of 1910. The party was in the field at the beginning of the year, but owing to delay caused by forest fires field work was not begun until July 18. Starting from a line of the stadia work of 1909 near South Fowl Lake as a base, a scheme of triangulation was begun extending along the chain of of lakes through which the boundary runs, from Pigeon River to Rose or Mud Lake. Subsidiary triangulation of the separate lakes was executed for the purposes of the topography and connected with the general scheme. The triangulation points were marked in a permanent manner. The heights of triangulation stations on each lake were determined by vertical angles. Observations for azimuth were made at station Abel on South Fowl Lake.

The topography covers the shore line of the lakes and of the streams connecting them, all of the portages, and the location of the high cliffs or bluffs along the chain of lakes.

At Watup portage, between Mountain and Rove Lakes, where there is no water communication, the portage was surveyed and contour lines run. This portage takes the shortest route from lake to lake. It was cut out to a width of some 20 feet, and new blazes were made on the trees. No indication of any water connection between the lakes could be found.

A base line was measured on the ice between triangulation stations Cad and Arthur on Rose Lake.

The triangulation was carried to the west end of Rose Lake, but the topography of the lake was not completed.

Field operations closed for the season on December 8, and were resumed on May 31. During June, 22 stations were occupied for observations of horizontal angles, and some progress was made in the topographic work.

[F. D. GRANGER.]

Work on the portion of the northwestern boundary from a point at or near Short Creek, a tributary of the Souris or Mouse River, to the eastward, was continued during the season of 1910 by the Canadian party under charge of Mr. J. J. McArthur, D. L. S. Mr. F. D. Granger, assistant, Coast and Geodetic Survey, accompanied this party as American representative.

Base lines were measured near Short Creek astronomical mound and in the vicinity of Portal, N. Dak. Observations for azimuth were made near the base, and later in the season further observations were made in the vicinity of old monument No. 179.

With the inception of the triangulation a general survey of the line covering a strip 2 miles in width was carried on.

Beginning at Short Creek astronomical station the work was carried eastward as far as monument No. 170, near the eastern terminus of Turtle Mountain, a distance of 136.4 miles, but owing to unfavorable weather no new monuments were set east of 172. In all 94 cast-iron monuments were set between and including old monuments 219 and 172, 48 replacing the old and 46 for the new sites. The average distance between sites was 1.4 miles. Two hundred and sixty square miles of topography was completed during the season. The statistics given are for the season beginning April 26 and ending November 27, 1910.

Mr. Granger again took the field with the party of Mr. McArthur at St. John, N. Dak., on April 27, 1911, for the identification of old and the establishment of new monuments from the vicinity of Bannerman, Manitoba, eastward, and the work was in progress at the close of the fiscal year.

Work on the survey and monumenting the boundary was begun at old monument No. 171 and carried eastward, and by June 30 the triangulation, topography, and monumenting had reached monument No. 154, a distance of 39 miles.

[J. E. McGRATH.]

SUMMARY OF RESULTS.—2 square miles of triangulation, 14 signals erected, 62 stations occupied for horizontal measures, 371 geographic positions determined, 17¼ miles of level lines run, 17¼ miles of traverse line measurement.

Two cooperating parties for the survey of the boundary line between the United States and Canada on the St. Croix River were in the field at the beginning of the year, the Canadian party being under the charge of Mr. A. J. Brabazon.

Work was begun by the American party in the vicinity of Calais, Me., the Canadian party having just completed the triangulation to a point immediately above the bridge at Baring, but having yet to execute the reconnoissance and signal building between that point and Woodland, Me. In the meanwhile the American party undertook the connection of the more marked topographical features with the triangulation in the vicinity of International, Union, Milltown, and Baring Bridges and the reoccupation of such points below Baring as had to be connected with the points built by the Canadians during the current season. Upon the completion of the first part of the scheme the American surveyor made a reconnoissance of the section of the river between Woodland and the Grand Falls of the St. Croix and then began operations for connecting recognizable points in this area with the triangulation of 1887. In this work a number of traverse lines were run in two directions, measurements being made with a 50-meter steel tape, and lines of leveling were run to reduce the measurements to their horizontal values. The changes of directions between the various sections were measured with a 7-inch theodolite. The ends of the traverse lines were connected by triangulation. Work was closed near Vanceboro on October 26. From Woodland to the mouth of the river the survey is entirely completed.

The same parties resumed operations near Woodland in June, 1911, and work was in progress at the close of the fiscal year.

[C. H. SINCLAIR.]

SUMMARY OF RESULTS.—131 linear miles of triangulation, 524 square miles covered by triangulation, 75 stations occupied, 77 monuments occupied, 1 198 horizontal angles measured, 1 198 vertical angles measured, 128 miles of boundary monumented, 85 monuments set, 2 bases measured, 1 azimuth determined.

From a line a little east of the north fork of Milk River, where the triangulation was carried during the season of 1910 the work was extended to Sweet Grass or Coutts, where a base was measured and a junction made with the Canadian triangulation. An azimuth was measured, by a Canadian surveyor, in connection with longitude work, and a connection made with the triangulation. A base was also measured and an azimuth determined a little west at Rocky Creek. Work closed in the latter part of October at Scobey, Mont.

In May, 1911, work was resumed on the Middle Branch of Poplar River and up to the close of the year about 40 miles of triangulation had been completed and the reconnoissance had been extended about 10 miles farther. About 30 miles of boundary were monumented in the same period.

ALASKA BOUNDARY.

[O. M. LELAND.]

The party engaged in the survey of the Alaska Boundary at the head of the Big Salmon River began work on June 16 and closed field operations on September 17.

The work done included the running of a line of precise levels between Skagway and the summit of White Pass, a connection by triangulation of the work of 1907 at the head of Glacier Bay by Mr. Fremont Morse of the Coast and Geodetic Survey with that at the head of the Big Salmon River by the Canadian party of Mr. Ratz in 1905, the more accurate determination of the positions of peaks Nos. 6900, 6600, and 6000 of the latter work, and the extension of the photo-topographical work to cover the region at the head of Muir Glacier.

This party did not take the field in 1911, but the computations of the field work were completed for 1910, and work was continued on the photographic plotting of the work done in 1907, 1908, 1909, and 1910, which is yet unfinished.

[FREMONT MORSE.]

At the beginning of the year a Canadian party was engaged in marking the Alaska-Canada boundary near the head of Portland Canal, the United States being represented by a field officer assigned for that duty.

The instructions to the Canadian surveyor were, in brief, as follows:

To draw a line from Eagle Point Monument on an azimuth of 270 (astronomical east) and mark it on the east side of Portland Canal with a concrete monument. Also to mark it near the shore on the west side of the canal in the same way, determining the distance between the monuments.

To mark all Coast and Geodetic Survey triangulation points on both sides of the canal, south from the above line to the latitude of Lion Point with concrete. If these points can not be found by the marks on the rocks, etc., to reestablish them as nearly as possible by triangulation and then mark them.

To remove the monument placed on the straight line joining D and G 6535, and to place it on the straight line joining S 5117 and S 6535. Monument G 5117 and trace the line 5117-6535 by a narrow cutting to the Salmon River at least.

To connect S 6600, S 6800, and S 7780 by triangulation.

Reference monuments were put up at East Monument on the east side of Portland Canal due east from Eagle Point Monument; at Law Reference Monument, built over the

old Coast and Geodetic Survey triangulation "Law," on the east side of the canal; Southwest Base Reference Monument, built over the Coast and Geodetic Survey triangulation station "Salmon River Southwest Base"; Keen Reference Monument, built close to the old triangulation station "Keen." These monuments were built of concrete. At Lion Point Astronomical Station, the old brick pier was utilized and repaired.

The necessary triangulation was executed by the Canadian surveyor from the northern end of Portland Canal to a junction with that of the American representative working from the southern end of the scheme.

On the American side at the mouth of Salmon River, where a town site had been laid out, the end of a wharf projecting over the flats was determined to see whether it crossed the boundary. It was found to be a short distance from the boundary on United States territory.

The determination of Boundary Peak 7780, which had previously been determined by triangulation from the Unuk River, showed a remarkably close agreement with the previous work.

Work in this locality under a similar arrangement was resumed in the spring of 1911 for the purpose of locating reference monuments for defining the boundary line down Portland Canal, but no field work was done before the close of the fiscal year.

[THOS. RIGGS, Jr.]

SUMMARY OF RESULTS.—Triangulation: 65 signals erected, 72 stations occupied, 157.7 miles of progress in triangulation, 1 231.6 square miles covered. Topography: 610 square miles covered, 750 miles of traverse lines run, 5 883 elevations computed from vertical angles, 139.7 miles of topographical belt completed. Line projection: 155 miles of line cutting and monumenting, 62 miles of vista cut and stadia line run, 20 monuments placed. Magnetic observations: 15 stations occupied.

The statistics given are for the whole season of 1910, beginning May 24.

Work on the survey and marking of the boundary line between Alaska and Canada along the one hundred and forty-first meridian was in progress at the beginning of the fiscal year.

The object in view for the season of 1910 was to complete the projection of the one hundred and forty-first meridian through to the Porcupine River from the point reached in 1909 about 40 miles north of the Yukon River, and to push the triangulation and topography well north of the Yukon so that during another season the base of supplies might be moved to Rampart House, on the Porcupine.

By May 24, 1910, the party with its outfit, forage, provisions, and horses had arrived at Sheep Creek, Alaska, where a permanent base camp was established.

The party was divided into eight subparties, each with its own cook, outfit, and pack train. To one of these subparties was assigned the work of triangulation, to another the reconnoissance; three parties were engaged upon topography, one was occupied in transporting supplies, and another had charge of the base camp on Sheep Creek. The chief of party exercised general supervision of the whole work and also occupied a number of stations in the triangulation.

The difficulties of transporting a large party and its supplies and equipment through a wild and rugged country and of keeping open a line of communication by which the advance parties could be supplied with provisions necessary for their maintenance were very great. Pack horses and canoes were used for transportation; of the 76 horses taken in at the beginning of the season only 45 remained at its close, and those in a worn-out condition, owing to hard service and scanty provender.

Reconnoissance.—The duties assigned to this party were the laying out of the triangulation scheme and the erection of signals. In addition to this, practically all the main routes of travel were laid out, and much trail cutting was done.

After assisting in cutting the main pack trails up Sheep Creek and down the Yukon River, the party was steadily employed on reconnoissance until August 15, when a connection was made with the work near the Porcupine River. Work to the southward was then begun, and connection was made with the triangulation at stations Salmon and Storm on August 28.

Triangulation.—From the final points occupied in 1909, about 40 miles north of the Yukon, a belt of triangulation along the one hundred and forty-first meridian was carried to points north of the Porcupine. A base line was laid out near the Porcupine, with which the triangulation will be connected, but its measurement was postponed until the next field season.

Observations were made on the main line signals wherever possible, and observations were made at the line signals by the line projection party.

Topography.—One of the topographic parties executed the work from latitude 65° 10′ to 65° 30′ and from 66° 10′ to 66° 30′, covering 200 square miles of area included on four sheets. The second party completed seven sheets, closing at latitude 66° 10′. The triangulation party was occupied on topographical work for a portion of the season, and completed the topography of a little over 50 square miles from latitude 66° 30′ to 66° 41′.

Line projection.—The line projection was in direct charge of a Canadian surveyor, with an assistant surveyor representing the chief of the American party. During a portion of the season this work was done in conjunction with that of the triangulation party, but later the parties were operated independently.

The line was projected from point E of the boundary to P, about 10 miles beyond Rampart House, a total of 155 miles, the extremes of latitude being 65° 16′ 13″ and about 67° 29′.

Line and monumenting.—The line cutting and monumenting were done by a Canadian party. A vista 20 feet wide was cleared through the timber, and small aluminum bronze cone monuments were erected at intervisible points not more than 4 miles apart. The monuments not already tied into the triangulation were located by three point observations. In all 62 miles of vista were cut and stadia run and 20 monuments placed. The boundary crosses the Porcupine River at the mouth of Sunaghun Creek.

Magnetic observations.—Observations of magnetic declination were made by the triangulation party, and 15 stations were occupied.

The party for the survey of the Alaska boundary again took the field in the spring of 1911, and by June 1 had arrived at Rampart House. Work was in progress at the close of the fiscal year.

[D. W. Eaton.]

A Canadian party accompanied by an American surveyor was engaged in line cutting and monument setting along the boundary south of Sixty Mile River, completing the work not previously done from the Yukon River southward to the Mount Natazhat Ridge. In all, monuments were set for about 110 miles, and about 60 miles of line were cut.

SPEED TRIAL COURSE, DELAWARE BREAKWATER.

[ISAAC WINSTON.]

At the request of the William Cramp & Sons Shipbuilding & Engine Co. a new speed trial course, 1 nautical mile in length, was established off Delaware Breakwater at the entrance to Delaware Bay, the Cramp company paying all field expenses.

Signals were erected at the approximate location of south range E, and at a point on shore on the prolongation of the old (south) range line, and also near three additional points needed for the range marks; and observations of horizontal angles were made at these four points and at two of the three lighthouses, whose positions furnished the bases for the determination of the trial course. The positions of the poles on the south range were then shifted to the positions indicated by the preliminary computation and the observations were repeated. The final computation was then made, and the positions of the range marks were indicated on the south range. The range marks on the north range were to be placed over the triangulation stations on that range.

The positions of the range marks with reference to the points indicated for them were afterwards verified by measurements on the ground, as requested by the Board of Inspection and Survey of the Navy Department.

MARYLAND OYSTER BEDS.

[C. C. YATES.]

SUMMARY OF RESULTS.—Triangulation: 360 square miles of area covered, 102 stations occupied, 100 geographic positions determined. Physical hydrography: 240 observations of the density of water made.

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 State of Maryland. All field work undertaken by the Survey was completed on December 15, 1910, and since that date the whole party has been engaged in completing the records and computations and in the preparation of the charts and reports for the remaining counties covered by the work for publication.

The descriptions of the boundaries and landmarks in Charles County were published during the fiscal year.

DELAWARE OYSTER BEDS.

[C. C. YATES.]

Under the authority of the Secretary of Commerce and Labor, an officer of the Survey continued the supervision of the survey of the oyster beds of the State of Delaware. The necessary field work was completed under his direction as consulting engineer on October 19, 1910, and since that date the preparation of the necessary charts and description of boundaries, etc., for publication has been continued.

The expense of this work, including the salary of the officer of the Survey while engaged on it, was paid by the State of Delaware.

The appreciation of the State authorities for the service rendered by the Government in assigning an officer to this duty is shown in a resolution adopted by the State legislature, thanking Assistant Yates for the very valuable service rendered by him in successfully carrying out the work of the Delaware Oyster Survey Commission.

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APPENDIX 2

REPORT 1911

DETAILS OF OFFICE OPERATIONS

CONTENTS.

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 Tidal Research Section is under the immediate direction of the Assistant in Charge, and the Miscellaneous Section is a subdivision of his office.

COMPUTING DIVISION.

Satisfactory progress was made in the reduction and discussion of field operations and the preparation of results for publication.

Among items of work of importance done during the year may be mentioned the preparation for publication of the results of the triangulation in the northern portion of California, which is published as Appendix 5, report for 1910; the preparation for publication of the results of triangulation along the east coast of Florida; along the northern portion of the ninety-eighth meridian in Nebraska, South Dakota, and Minnesota; and along the southern portion of the ninety-eighth meridian in Texas. This work was nearly completed at the end of the year. Computations have been made to show the effect of topography and isostatic compensation upon the intensity of gravity.

Considerable progress has been made in the computation of the triangulation along the coasts of the United States as well as along the boundaries between the United States and Canada and Alaska and Canada.

DIVISION OF TERRESTRIAL MAGNETISM.

The report of this division shows an increased demand for information concerning terrestrial magnetism, chiefly of the magnetic declination in the United States.

The results of the field observations on land and at sea during the fiscal year 1910 were prepared for publication as Appendix No. 3, Report for 1910. A chart was nearly completed, showing the lines of equal magnetic declination in the United States for 1910, and the secular change tables were revised and extended to 1910. The reduction of the work of the Cheltenham Observatory for 1907–8, the Sitka Observatory for 1907–1909, the Honolulu Observatory for 1907–8, and the Baldwin Observatory for 1907–1909 were completed and submitted for publication. The work of the Porto Rico Observatory for 1907–8 was completed. "Directions for magnetic measurements" were completed and published.

Tabulations were made of data relating to earthquakes recorded at the magnetic observatories, and copies of the records of the principal earthquakes were furnished to the International Seismological Association. Similar information relating to Honolulu was

furnished to the seismological committee of the British association. Other special requests for data were promptly complied with.

The reduction of the work of the Cheltenham Observatory for 1909–10 was begun.

The times of the abrupt beginnings of 15 selected magnetic storms, 1906–1909, were determined for each of the five magnetic observatories, to be compared with similar readings from foreign magnetic observatories.

TIDAL DIVISION.

There were received, examined, registered, and indexed in this division records from 24 self-registering tide-gauge stations, with a combined length of 15 years and 27 days, and records from 95 staff gauges, with a combined length of 6¼ years. The total of all tide observations made by the Survey and received during the year is 21 years and 4 months at 119 stations, and from other sources, 29 years, 4 months, and 23 days at 42 stations, making a grand total of 50 years, 8 months, and 23 days at 161 stations.

The preparation of the annual Tide Tables was continued. Harmonic analyses were completed for 11 stations, with a combined length of 2 years and 9 months. Nonharmonic reductions were made for 73 stations, with a combined length of 26 years, 7 months, and 23 days. Mean sea level was computed for 19 stations, with a combined length of 11 years, 11 months, and 25 days. High and low waters and hourly heights of the sea were tabulated for 222 stations, with a combined length of 41 years, 4 months, and 29 days.

The following is a list of the sources from which tide observations were received besides those made by the Survey:

1. United States Army Engineers, tides in the United States; 1 station, 8 months and 3 days; Canal Zone, 3 stations, 3 years.

2. American ambassador to Mexico, Mexico, 36 stations, 23 years, 4 months, and 20 days.

3. Alaska boundary survey; 1 station, 1 year.

4. Hawaiian government survey; 1 station, 2 years.

Copies of predicted tides for the year 1912 for Sandy Hook, N. J., Baltimore, Md., Charleston, S. C., and San Francisco, Cal., were sent to the Imperial Hydrographic Office at Wilhelmshaven, Germany, in exchange for similar data for Hamburg and Apia.

At the request of the Secretary of the Marine Department of New Zealand, copies of predicted tides for the year 1912 for Wellington and Auckland, New Zealand, were furnished.

The Tide Tables for the year 1912 were completed and the proof read.

DRAWING AND ENGRAVING DIVISION.

In the work of this division during the year, progress has been made toward carrying out the recommendations of the chart board as to the simplification of information shown on the charts, the construction of charts on the mercator projection, and the replacing of present charts of the Atlantic, Gulf, and Pacific coasts by a smaller number of new charts. The construction of the proposed new charts also affords an opportunity for the orientation of charts with the meridian and the elimination of double units of depths.

In cooperation with the Bureau of Lighthouses in compiling information for the Notices to Mariners issued weekly as a joint publication of that bureau and the Coast and Geodetic Survey.

The principal items of work done during the year is shown in the tables which follow.

Drawing Section.

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

No.	
0329.	Portsmouth Harbor.
449.	Nansemond River.
534.	Rappahannock River.
535.	Rappahannock River.
536.	Rappahannock River.
543.	Shrewsbury River.
917.	East Coast of Porto Rico.
1108.	Approaches to New York.
1109.	Delaware Bay to Cape Hatteras.
1115.	Cape St. George to Mississippi River.
1208.	Cape Cod Bay.
1222.	Chesapeake Bay Entrance.
1281.	San Luis Pass to Matagorda Bay.
4101.	Makukona Harbor.
4115.	Hawaii to Maui.
4116.	Maui to Oahu.
5502.	San Francisco to Point Arena.
7002.	Cape Flattery to Dixon Entrance.
8002.	Dixon Entrance to Cape St. Elias.
8555.	Shelikof Strait.
9050.	Nushagak Bay.
9400.	Arctic Coast of Alaska.
131.	Chesapeake Bay Entrance.
951.	Panama Harbor.
8833.	Port Moller and Herendeen Bay.

Extensive corrections were made to the drawing of 139 charts in preparing them for the issue of new editions. Seventeen drawings for new charts of the Philippine Islands were received from Manila and prepared for publication. Eleven maps for the Maryland Shell Fish Commission and a number of miscellaneous maps were completed.

Engraving Section.

The following original etched plates for new charts were completed:

No.	
1208.	Cape Cod Bay.
4272.	Unisan to Mulanay.

The following new plates (etched) were finished for charts formerly published by lithography:

No.	
262.	Bradford Coaling Station.
539.	Patuxent River.
918.	Yabucca Harbor.
4101.	Makukona Harbor.
4428.	Tanon Strait.
4463.	Escalante Harbor.
6440.	Sinclair Inlet.
8246.	Whitewater and Chaik Bays.
8589.	Port Graham and Seldovia Bay.

The following new bassos for new editions were completed:

No.	
10.	Cape Henry to Cape Lookout.
110.	Cape Cod Bay.
119.	Fire Island Beach to Rockaway Beach.
120.	New York Bay and Harbor.
141.	Albemarle Sound.
146.	Ocracoke Inlet to Beaufort.
147.	Core Sound to Bogue Inlet.
169.	Newfound Harbor Key to Boca Grande Key.
170.	Key West to Rebecca Shoal.
199.	Point au Fer to Marsh Island.
246.	Boston Harbor.
271.	Rye Neck to New Rochelle.
338.	Plymouth, Kingston, and Duxbury Harbors.
341.	Provincetown Harbor.
352.	Providence Harbor.
362.	New Haven Harbor.

No.	
366.	Hempstead Harbor.
381.	Philadelphia Water Front.
421.	Core Sound and Straits.
431.	Charleston Harbor.
435.	Bull and Combahee Rivers.
474.	Entrance to Charlotte Harbor.
517.	Sabine Pass and Lake.
542.	Jamaica Bay and Rockaway Inlet.
931.	Mayaguez Bay.
5525.	Mare Island Strait.
5531.	San Francisco Bay.
5532.	San Francisco Entrance.
5533.	San Pablo Bay.
5534.	Suisun Bay.
5600.	San Francisco to Point Arena.
6400.	Waters of Washington.
6445.	Seattle Harbor.

The following new bassos for reissues were completed:

No.	
52.	Montauk Point to New York.
14.	Cape Canaveral to Fowey Rocks.
103.	Mount Desert Island, etc.
104.	Penobscot Bay.
115.	Plum Island to Stratford Shoal.
154.	Isle of Palms to Hunting Island.
407.	Pasquotank River.
5100.	San Diego to Point St. George.

Extensive corrections were made on 159 plates and minor corrections on 923.

Printing Section.

New charts printed by transfer from copper plates:

No.	
1308.	Cape Cod Bay.
4272.	Unisan to Mulanay.

New charts printed by photolithography:

No.	
0329.	Portsmouth Harbor.
534.	Rappahannock River.
535.	Rappahannock River.
536.	Rappahannock River.
917.	East Coast of Porto Rico.
1281.	San Luis Pass to Matagorda Bay.
4101.	Makukona Harbor.
4116.	Maui to Oahu.
4218.	Bantique Point to Bugui Point.
4425.	Eastern Bohol and part of Leyte.
4428.	Tanon Strait.
4429.	Western Bohol.
4464.	San Juanico Strait.
4466.	Harbors in Negros.
7002.	Cape Flattery to Dixon Entrance.
8002.	Dixon Entrance to Cape St. Elias.
8555.	Shelikof Strait.
9050.	Nushagak Bay.
9400.	Arctic Coast of Alaska.

	Number.
New charts printed by transfer from copper plates	2
New charts printed by photolithography	19
New editions printed from copper plates	61
New edition printed by transfer from copper plates	10
New editions printed by photolithography	36
Number of different charts printed from stones	73
Number of different charts printed from plates	707
Miscellaneous photolithograph publications	4
Charts printed and delivered from stones	49 358
Charts printed and delivered from plates	75 969
Total	126 239
Number of impressions from stones (all work)	120 774
Number of impressions from plates (all work)	86 794
Total	207 568

Photographing Section.

The following etched plates were made:

No.		No.	
0329.	Portsmouth Harbor.	4223.	San Miguel and Lamit Bay.
534.	Rappahannock River.	4271.	Lamit and Sisiran Bays.
535.	Rappahannock River.	4428.	Tanon Strait.
917.	East Coast of Porto Rico.	4457.	Guiuan and Approaches.
918.	Yabucca Harbor.	8246.	Whitewater and Chaik Bays.
1208.	Cape Cod Bay.	8247.	Hood Bay and Kootznahoo Inlet.
4101.	Makukona Harbor.		

Negatives were made of 74 charts for use in reproducing them by photolithography and a large amount of miscellaneous work was done.

Electrotyping Section.

	Number.
Altos completed	73
Bassos completed	56
Copper deposited (pounds)	3 991

CHART DIVISION.

The usual distribution has been made of the Charts published by the Survey to the departments and to Government officers requiring them for official use, to certain libraries, scientific institutions; to foreign Governments with whom publications are exchanged through the Smithsonian Institution; and to Members of Congress who are entitled to 10 charts for each regular session of Congress.

To the public generally there is no free distribution of charts, but they are sold at the cost of printing and paper by sales agents at the principal ports and at the office of the Survey in Washington.

During the year charts were received from the Drawing and Engraving Division as follows:

	Number.
Prints from plates	75 969
Prints from stone	46 318

In addition to the above there were received 6 435 sheets of the International Boundary map from Halls Stream to the Richelieu River, and printed by contract.

All work in connection with the sale of Charts, Coast Pilots, and Tide Tables is done in this division.

Charts were issued as follows:

	Number.
Sales agents	45 296
Sales at Office	2 746
Congressional account	6 276
Hydrographic Office, U. S. Navy	30 793
Bureau of Lighthouses	4 952
Coast and Geodetic Survey Office	6 630
Suboffice, Manila, P. I.	7 873
Executive departments	6 414
Foreign Governments	605
Miscellaneous	2 628
Total	114 213

Coast Pilots and Tide Tables issued during the year:

Coast Pilots:	Copies.
Atlantic Coast	1 953
Porto Rico	30
California, Oregon, and Washington	408
Alaska, Part I	248
Tide Tables:	
Complete—	
1903	1
1904	1
1905	1
1906	1
1907	1
1908	1
1909	1
1910	147
1911	670
1912	93
Atlantic Coast—	
1891	1
1894	1
1895	1
1903	1
1904	1
1905	1
1906	1
1907	1
1908	1
1909	2
1910	157
1911	1 303

Tide Tables—Continued.	Copies.
Pacific Coast—	
1871	1
1872	1
1873	1
1874	1
1875	1
1876	1
1877	1
1878	1
1879	1
1880	1
1881	1
1882	1
1883	1
1884	1
1885	1
1886	1
1887	1
1895	1
1903	1
1904	1
1905	1
1906	1
1907	4
1908	3
1909	486
1910	9 171
1911	63

Charts were issued at the suboffice, Manila, P. I., as follows:

	Number.
Sales agents	1 048
Sales at suboffice	2 164
Hydrographic Office, U. S. Navy	828
Suboffice in Manila	391
Executive departments, Philippine Islands	1 111
Miscellaneous	98
Total	5 640

INSTRUMENT DIVISION.

This division attends to the accounting for all instruments and general property of the Survey and the necessary correspondence relating to instruments and property; the repairs to instruments; the designing and construction of new instruments and apparatus; experimental work arising from the proposed application of new discoveries and inventions to the purposes of the Survey; the determination of instrumental constants; the selection and purchase of new instruments and material; the construction and repair of office furniture, and minor repairs to the office buildings.

The principal work of the division is to keep in repair the instruments used in the Survey, and to undertake new work only when special designs, experiments, or conditions required by the special and peculiar needs of the Survey make purchases in the open market impracticable.

The gas engine, furnishing power for the freight elevator and instrument shop, and the pneumatic time system and call-bell system are attended to by employees of this division.

The new tide-predicting machine completed in February, 1910, was taken apart in April of this year for the purpose of polishing, gilding, lacquering, etc. Considerable progress has so far been made, and the large glass case for housing the machine when finally finished is about half completed.

A short article descriptive of the machine has been prepared for publication.

Two new compass declinometers have been completed and subjected to a preliminary test, which establishes the fact that the main purpose of their design, the elimination of index error, has been realized. Two new geodetic levels were also completed during the year.

The use of permanent metal station marks to fix and identify triangulation stations has been much increased during the year, and extended by the adoption of similar reference marks, one or more of which are placed in the vicinity of each triangulation station. Similar marks are also used for marking magnetic stations.

Fifteen new invar tapes for base measurement were completed during the year.

A testing apparatus for the purpose of detecting magnetic properties in brass castings was designed and constructed, and a method was devised of illuminating at night poles used in current observations. A set of these poles with the necessary apparatus was furnished to five light vessels stationed along the New England coast.

The new zenith tube for latitude observations, constructed by William Gaertner upon plans prepared by Dr. F. E. Ross, for the International Geodetic Association Observatory, Gaithersburg, Md., was inspected and adjusted.

A new adjustable copying or target board was devised and constructed in the Instrument Division and installed in the Photographic Section of the Office. By its use a large tracing can be photographed in sections without restretching and fastening into place. An apparatus was also designed and constructed for making readily accessible the tide curves produced automatically by the new Coast and Geodetic Survey tide-predicting machine. The rolls containing the curves, which are over 365 feet long, can be mounted in it and quickly unwound and rewound, thus exposing for reference the curve for any day of the year for which the information is sought.

LIBRARY AND ARCHIVES.

The current routine work of the division was kept up to date except in the Library Section, where the work fell slightly behind owing to lack of clerical assistance.

The revision of the book-subject catalogue was nearly completed. The records received from the field were indexed as received. The library file of Coast and Geodetic Survey charts and the files of foreign charts are now arranged in proper numerical order.

Five thousand obsolete, duplicate, and unnecessary books and pamphlets have been removed from the shelves for transmission to the Library of Congress, the Superintendent of Documents, and the Weather Bureau.

Accessions.

	Purchased.	Donated.	Exchanged.	Total.
Books and pamphlets	149	150	660	959
Maps and charts	25	11	1 400	1 436

The following is a list of the original records received:

Subject.	Volumes.	Cahiers.	Sheets.	Miscellaneous.
Astronomy	7	12	.....	[1] 4
Geodesy	98	124	.....	.....
Gravity	16	4	.....	[1] 10
Hydrography	1 412	.....	167	.....
Hypsometry	21	24	.....	.....
Log books	60	.....	.....	.....
Magnetics	429	.....	.....	[1] 53
Miscellaneous surveys	10	8	.....	([2])
Negatives, photographic	.....	.....	.....	960
Prints, photographic	.....	.....	.....	1 190
Tides	128	28	.....	[1] 147
Topography	.....	.....	156	.....

[1] Rolls. [2] 1 map, 2 sheets, and 4 rolls.

TIDAL RESEARCH SECTION.

The principal work done in the Tidal Research Section, which was organized at the beginning of the year, may be briefly summarized as follows:

A paper entitled "Arctic tides" was completed and issued by the Survey as a Special Publication. Harmonic constants are given for 50 stations, all but one of which lie north of the sixtieth parallel. The discussion was undertaken primarily for the purpose of utilizing the observations secured by the Peary expedition, but in order to show their full significance and to throw as much light as possible upon remaining Arctic problems, an effort was made to collect and use all available results pertaining to the tides in Arctic waters.

A paper entitled "General description and uses of the new or simultaneous tide-predicting machine" was prepared and submitted for publication. The preparation of the matter in this paper involved numerous tests of the machine.

Numerous requests for information in regard to tidal and current problems were answered.

Current observations taken on Nantucket Shoals and in the James River were reduced.

A new diagram of the East River currents was completed for the annual Tide Tables.

During the last two months of the fiscal year a systematic compilation of tidal matter from published (French and German) sources was begun

MISCELLANEOUS SECTION.

The Miscellaneous Section makes all purchases under the appropriation for Office expenses and also makes many purchases to fill orders for supplies required for field parties, including the necessary correspondence, sending out of blank proposals to bidders for supplies, preparation of orders for the same, preparation of vouchers, and other miscellaneous work. All requisitions for printing and binding are also prepared

in this section. Stationery for the Office and field parties is kept in stock and issued on requisition.

In July, 1910, the sale and distribution of Coast Pilots and Tide Tables was transferred from the Miscellaneous Section to the Chart Division.

In the same month, in accordance with instructions from the Department, all publications of the Survey, excepting Charts, Coast Pilots, and Tide Tables, were transferred to the Division of Publications. This Bureau ceased to distribute publications on August 10, and the transfer of the publications on hand to the Department was completed September 30, except such as were retained for official use. The appended report of publications distributed for the year, therefore, includes only the July distribution.

The office inventories of furniture, machinery, and tools, with all papers and records relating thereto, were turned over and placed in charge of the Instrument Division on December 31, 1910.

The following publications were received from the Public Printer during July, 1910:

	Number.
Table of Depths	800

The following publications were issued by the Office during July, 1910:

	Number.
Annual Reports, 1851–1909	76
Appendixes to Annual Reports	3
Bulletins Nos. 1 to 41, inclusive	17
Atlantic Coast Pilots, parts 1 to 8 (latest editions)	244
Atlantic Coast Pilot, part 4, third edition	21
Atlantic Coast Pilot, part 4, fourth edition	12
Atlantic Coast Pilot, part 5, third edition	4
Atlantic Coast Pilot, part 7, second edition	14
Pacific Coast Pilot, Alaska, part 1, fourth edition	1
Pacific Coast Pilot, part 1, fifth edition	6
Pacific Coast Pilot, California, Oregon, and Washington, 1903, first edition	3
Pacific Coast Pilot, California, Oregon, and Washington, 1909, second edition	44
Coast Pilot, Porto Rico	2
Sailing Directions for Philippine Islands, Section II, fourth edition	100
Sailing Directions for Philippine Islands, Section V, third edition	15
Special Publication No. 1	1
Special Publication No. 4	3
Special Publication No. 5 (paper)	6
Special Publication No. 7	1
Tide Tables, complete	51
Tide Tables, Pacific Coast	144
Tide Tables, complete, 1905 (destroyed)	286
Tide Tables, Pacific Coast, 1905 (destroyed)	113
Coast Pilot Notes, Yakutak Bay to Cook Inlet, second edition	31
Description of Long Wire Drag	2
Figure of the Earth and Isostasy	3
Supplemental Investigation, 1909, of the Figure of the Earth and Isostasy	16
General Instructions for Field Work, Coast and Geodetic Survey	11
General Properties of Equations of Steady Motion	1
Geodetic Operations in United States, 1900–1903	1
List and Catalogue, 1908	13
List of Publications Available for Distribution, 1908	2
Precise Leveling in United States, 1903–1907	1
Principal facts of the Earth's Magnetism (paper)	9
Results of Magnetic Observations:	
Cheltenham, 1905–6	4
Honolulu, 1905–6	4
Sitka, 1905–6	4
Star Factors, A B C	1
Survey of Oyster Bars:	
Anne Arundel County, Md	1
Somerset County, Md	1
Wicomico County, Md	1
Worcester County, Md	1
Table of Coefficients	3
Table of Depths	59
Tables of Factors (in feet)	3
Tables of Factors (in meters)	3
Table of Heights (in meters)	4
Tides and Tidal Action in Harbors	1
Tidal Researches	2
Treatise on Projections	2
United States Magnetic Tables and Charts, 1905	26
Work of the Coast and Geodetic Survey, second edition	6

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APPENDIX 3

REPORT 1911

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1910, AND JUNE 30, 1911

By

R. L. FARIS

Inspector of Magnetic Work; Assistant, Coast and Geodetic Survey

CONTENTS.

RESULTS OF MAGNETIC OBSERVATIONS MADE BY THE COAST AND GEODETIC SURVEY BETWEEN JULY 1, 1910, AND JUNE 30, 1911.

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 all outlying territories during the fiscal year ended June 30, 1911. There are also included some results obtained by surveyors engaged in marking out the Alaskan boundary along the one hundred and forty-first meridian.

Five magnetic observatories have been in continuous operation throughout the year—at Cheltenham, Md.; Sitka, Alaska; near Honolulu, Hawaii; on Vieques Island, P. R.; and near Tucson, Ariz. There will be found in the tables the values of the magnetic elements for each of the observatories, 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 43 States and Territories. Numerous old stations were reoccupied, in order to determine the secular change of the magnetic elements.

Summary of results on land.

States	Localities	Stations	Old localities reoccupied.	Declination results	Dip results	Intensity results
Alabama	6	6	0	6	6	6
Alaska	59	59	2	59	3	3
Arizona	1	1	1	1	1	1
Arkansas	7	15	1	15	7	7
California	3	3	3	3	3	3
Colorado	4	4	4	4	4	4
Connecticut	10	10	2	10	10	10
Delaware	2	2	2	2	2	2
Florida	1	1	1	1	1	1
Georgia	22	24	1	26	25	26
Hawaii	5	6	4	7	7	7
Idaho	3	4	3	4	4	4
Illinois	1	1	0	1	1	1
Iowa	1	1	0	1	1	1
Kansas	1	1	1	1	1	1
Kentucky	13	13	1	13	13	13
Maine	16	16	4	16	16	16
Maryland	3	3	3	11	12	9
Massachusetts	5	5	3	5	5	5
Michigan	15	15	2	15	15	15
Minnesota	2	2	0	2	2	2
Mississippi	1	2	0	2	1	1
Missouri	6	6	2	6	6	6
Montana	5	5	2	5	5	5
Nebraska	11	11	3	11	11	11
New Hampshire	6	6	0	6	6	6
New Jersey	10	10	2	10	10	10
New Mexico	2	2	1	2	2	2
New York	10	10	2	10	10	10
North Carolina	6	8	4	8	9	8
Ohio	2	2	2	2	2	2
Oklahoma	22	22	2	22	23	22
Oregon	2	3	2	3	3	3
Pennsylvania	8	8	2	8	8	8
Porto Rico	1	1	1	2	1	3
Texas	10	10	1	10	10	10
Utah	2	2	2	2	2	2
Vermont	7	7	3	7	7	7
Virginia	14	15	3	15	10	10
Washington	6	7	3	7	3	3
West Virginia	8	9	2	9	9	9
Wisconsin	8	8	2	8	8	8
Wyoming	4	4	3	4	4	4
British Columbia	1	1	1	1	1	1
Total	332	351	83	363	290	288

SECULAR CHANGE OF THE MAGNETIC DECLINATION.

A comparison of the declination results at "repeat" stations occupied during the year with the results of earlier observations in the same localities is presented in the following table. The letters after the names of stations indicate, (*a*) that the old station was reoccupied exactly, (*b*) that the new station was very near the old one, and (*c*) that the new station was some distance (a quarter of a mile or more) from the old one. A tabular 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. It will be seen that west declination is

increasing at the rate of about 6′ a year in New England and that east declination is increasing at the rate of about 5′ a year on the Pacific coast. The line of no change extends from Key West, Fla., to Duluth, Minn. At the magnetic observatory at Vieques, P. R., west declination is increasing at the rate of about 9′ a year.

Comparison of declination results at repeat stations.

State and station	Former observation		Last observation		Average annual change
	Date	Declination	Date	Declination	
		° ′		° ′	′
Maine:					
Fort Kent (*a*)	1909 Jy	21 00. 1 W	1910 Au	21 07. 8 W	−7. 0
Bangor (*a*)	1905 Oc	17 27. 7 W	1910 Au	17 55. 4 W	−5. 7
Eastport (*a*)	1906 Se	19 39. 2 W	1910 Au	20 04. 6 W	−6. 5
Portland (*a*)	1906 Oc	14 57. 0 W	1910 Au	15 17. 6 W	−5. 4
Vermont:					
St. Johnsbury (*a*).	1905 Au	13 44. 6 W	1910 Jy	14 15. 0 W	−6. 2
Burlington (*a*)	1905 Au	12 48. 0 W	1910 Au	13 18. 2 W	−6. 0
Rutland (*a*)	1905 Au	12 28. 0 W	1910 Au	13 00. 0 W	−6. 4
Massachusetts:					
Pittsfield (*a*)	1905 Oc	11 17. 2 W	1910 Jy	11 50. 0 W	−6. 9
Worcester (*a*)	1898 No	11 42. 6 W	1910 Se	12 35. 8 W	−4. 5
Connecticut:					
Danbury (*a*)	1904 Au	10 35. 5 W	1910 Jy	11 08. 4 W	−5. 6
Middletown (*b*)	1904 Jy	10 11. 8 W	1910 Se	10 45. 2 W	−5. 4
New York:					
Albany (*a*)	1905 Se	11 08. 0 W	1910 Jy	11 34. 5 W	−5. 5
Rochester (*a*)	1907 Au	7 26. 9 W	1910 Au	7 43. 9 W	−5. 7
New Jersey:					
Paterson (*a*)	1904 Je	8 54. 7 W	1910 Se	9 33. 3 W	−6. 2
New Brunswick (*a*)	1903 Se	8 17. 5 W	1910 Oc	8 57. 0 W	−5. 6
Pennsylvania:					
Tunkhannock (*a*)	1907 Jy	8 07. 0 W	1910 Au	8 24. 0 W	−5. 5
Harrisburg (*b*)	1907 Je	6 40. 7 W	1910 Se	7 01. 2 W	−6. 3
Maryland:					
Cheltenham (*a*)	1906 Je	5 21. 3 W	1911 Je	5 45. 2 W	−4. 8
Salisbury (*a*)	1896 De	5 09. 7 W	1910 Oc	6 13. 1 W	−4. 6
Oakland (*a*)	1904 Jy	3 30. 7 W	1910 Oc	3 56. 8 W	−4. 2
Virginia:					
Cape Charles (*c*)	1900 My	4 17. 1 W	1910 Oc	5 00. 8 W	−4. 2
Ocean View (*c*)	1906 Jy	4 34. 5 W	1910 Oc	4 51. 1 W	−3. 9
Petersburg (*a*)	1901 No	3 40. 4 W	1910 No	4 15. 7 W	−3. 9
West Virginia:					
Parkersburg (*a*)	1908 Jy	1 40. 7 W	1910 Oc	1 49. 2 W	−3. 8
Martinsburg (*a*)	1900 Mh	4 36. 8 W	1910 No	5 24. 6 W	−4. 5
North Carolina:					
Rutherfordton (*c*)	1899 Au	0 15. 6 W	1911 Mh	0 43. 4 W	−2. 4
Laurinburg (*a*)	1899 No	1 20. 6 W	1911 Mh	1 35. 7 W	−1. 3
Whiteville (*a*)	1899 No	1 43. 8 W	1911 Mh	2 02. 6 W	−1. 7
Bakersville (*c*)	1900 Se	0 40. 8 W	1911 Ap	1 27. 7 W	−4. 4
Georgia:					
Atlanta (*c*)	1905 Ja	1 39. 9 E	1911 Ap	1 36. 4 E	−0. 6
Florida:					
Key West (*a*)	1906 Ap	2 30. 0 E	1911 Fe	2 28. 8 E	−0. 2
Kentucky:					
Princeton (*a*)	1901 Jy	3 48. 1 E	1910 Se	3 47. 8 E	0. 0
Ohio:					
Cleveland (*a*)	1907 Je	3 32. 7 W	1910 Au	3 39. 9 W	−2. 3
Toledo (*b*)	1907 Je	1 10. 9 W	1910 Au	1 19. 6 W	−2. 7
Michigan:					
Kalamazoo (*a*)	1907 Oc	1 15. 8 E	1910 Au	1 09. 4 E	−2. 3
Bay City (*a*)	1907 Au	1 33. 0 W	1910 Se	1 42. 6 W	−3. 1

Comparison of declination results at repeat stations—Continued.

State and station	Former observation		Last observation		Average annual change
	Date	Declination	Date	Declination	
		° ′		° ′	′
Wisconsin:					
Florence (*a*)	1908 Au	2 22. 1 E	1911 Je	2 17. 8 E	−1. 5
La Crosse (*a*)	1907 Au	5 22. 2 E	1911 Je	5 35. 3 E	+3. 4
Nebraska:					
Newport (*a*)	1900 Au	12 06. 1 E	1910 Jy	12 26. 2 E	+2. 0
Chadron (*a*)	1906 Se	14 21. 8 E	1910 Jy	14 32. 8 E	+2. 9
Lincoln (*c*)	1902 Oc	10 10. 0 E	1911 Je	10 10. 7 E	+0. 1
Kansas:					
Russell (*a*)	1904 Oc	10 05. 2 E	1910 Au	10 15. 6 E	+1. 8
Missouri:					
Sedalia (*a*)	1900 No	7 35. 3 E	1910 Au	7 46. 0 E	+1. 1
Hermann (*a*)	1906 Je	6 30. 4 E	1910 Au	6 31. 1 E	+0. 2
Arkansas:					
Pine Bluff (*b*)	1901 Ap	6 27. 2 E	1911 Mh	6 40. 0 E	+1. 3
Oklahoma:					
Enid (*c*)	1904 De	9 51. 2 E	1910 Au	10 10. 0 E	+3. 3
Vinita (*a*)	1904 Oc	8 21. 7 E	1910 Se	8 34. 0 E	+2. 1
Texas:					
Amarillo (*c*)	1902 Au	11 38. 7 E	1910 Au	12 05. 2 E	+3. 3
New Mexico:					
Tucumcari (*a*)	1906 Ap	12 24. 9 E	1910 Au	12 43. 4 E	+4. 3
Arizona:					
Tucson (*a*)	1910 Ja	13 23. 8 E	1911 Ja	13 27. 6 E	+3. 8
Colorado:					
Grand Junction (*a*)	1905 Se	15 07. 8 E	1910 Au	15 27. 8 E	+4. 1
Glenwood Springs (*a*)	1905 Se	15 54. 4 E	1910 Au	16 12. 4 E	+3. 7
Cheyenne Wells (*a*)	1906 Je	12 26. 1 E	1910 Au	12 37. 5 E	+2. 7
Greeley (*b*)	1906 Oc	14 04. 9 E	1910 Au	14 25. 8 E	+5. 5
Utah:					
Ogden (*a*)	1905 My	17 39. 7 E	1910 Au	18 01. 0 E	+4. 1
Green River (*a*)	1906 Au	15 48. 2 E	1910 Au	16 01. 8 E	+3. 4
Wyoming:					
Sheridan (*a*)	1906 Au	17 05. 5 E	1910 Jy	17 17. 2 E	+3. 0
Green River (*a*)	1905 My	16 49. 6 E	1910 Jy	17 11. 4 E	+4. 2
Cheyenne (*c*)	1906 Jy	14 59. 8 E	1910 Jy	15 13. 2 E	+3. 4
Montana:					
Billings (*b*)	1906 Oc	18 02. 5 E	1910 Jy	18 18. 4 E	+4. 2
Helena (*a*)	1905 Au	19 49. 2 E	1910 Jy	20 05. 2 E	+3. 3
Idaho:					
Weiser (*a*)	1905 Jy	20 41. 6 E	1910 Jy	21 03. 4 E	+4. 4
Shoshone (*a*)	1905 Je	19 22. 0 E	1910 Jy	19 46. 8 E	+4. 9
Pocatello (*a*)	1905 Je	18 08. 5 E	1910 Jy	18 22. 7 E	+2. 8
Washington:					
Seattle (*a*)	1905 Jy	23 16. 7 E	1910 Jy	23 42. 6 E	+5. 2
Ellensburg (*a*)	1906 Mh	22 52. 2 E	1910 Jy	23 08. 2 E	+3. 7
Oregon:					
Portland (*a*)	1905 Au	22 43. 9 E	1910 Jy	23 08. 3 E	+5. 0
Pendleton (*a*)	1906 Jy	21 51. 2 E	1910 Jy	22 04. 5 E	+3. 3
California:					
Red Bluff (*a*)	1906 Je	19 04. 2 E	1910 Jy	19 23. 2 E	+4. 6
Gazelle (*a*)	1908 My	20 10. 0 E	1910 Jy	20 14. 7 E	+2. 2
Goat Island (*a*)	1906 My	17 43. 6 E	1911 Je	18 04. 6 E	+4. 1

OBSERVATIONS AT SEA AND THEIR DISTRIBUTION.

Magnetic observations at sea were secured by the *Bache* in connection with the hydrographic work along the Atlantic coast, by the *Explorer* in going from Alaska to Hawaii, and by the *Patterson* in connection with the work in Alaska.

Summary of results at sea.

Vessel	General region	Results from swings			Declination results from course observations
		Declination	Dip	Intensity	
Bache	Atlantic coast	10	10	10	0
Explorer	Pacific Ocean	7	7	7	10
Patterson	do	3	6	6	2
Total		20	23	23	12

INSTRUMENTAL CORRECTIONS.

The instrumental comparisons made with the standard instruments at Cheltenham during the year indicate that the corrections used for the previous year's work require little correction except in the case of magnetometer No. 31, the Porto Rico Observatory instrument. As a result of comparisons at Cheltenham in 1903 and at the Porto Rico Observatory in 1905, +0.00095 *H* was adopted as the correction to be applied to horizontal intensity results with that magnetometer to reduce them to the Cheltenham standard. In July, 1910, the yacht *Carnegie* of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, stopped at Vieques on her way to South America, and her instruments were compared with those of the Porto Rico Observatory. These comparisons indicated that some change had taken place in magnetometer No. 31 since the comparisons of 1905. To verify this, magnetometer No. 36 was compared at Cheltenham in January, 1911; with No. 31 at the Porto Rico Observatory in February and April; and again at Cheltenham upon its return. These comparisons gave for the correction to No. 31 in March, 1911, −0.0005 *H*.

A careful scrutiny of the observatory records failed to find any evidence of a sudden change in magnetometer No. 31 which might account for this change in its relation to the standard magnometer, and it was therefore considered best to assume a gradual change from +0.00095 *H* in January, 1907, to −0.0005 *H* in March, 1911. The values given in the appendixes for 1908, 1909, and 1910 must therefore be corrected to read as follows: 1908.0, 29095γ; 1909.0, 28993γ; 1910.0, 28895γ.

Corrections to magnetometers.

Magnetometer	Correction to east declination	Correction to *H* in parts of *H*
10	0.0	+0.0009
11	0.0	0.0000
17	0.0	0.0000
18	0.0	+0.0016
19	−0.8	−0.0010
20	0.0	+0.0018
22	+0.9	+0.0016
29	0.0	−0.0008
30	0.0	0.0000
31	0.0	−0.0005
36	0.0	+0.0011
37	0.0	+0.0022

Corrections to dip circles.

Number	Pattern	Needles	Designation	Correction
				′
15	Kew-Casella	5 and 6	15. 56	−1. 5
23	Kew-Casella	3 and 4	23. 34	−2. 0
23	Kew-Casella	4 and 2 Dover	23. 42	−0. 7
30	Kew-Dover	1 and 2	30. 12	0. 0
31	Kew-Dover	1 and 2	31. 12	1. 9
31	Kew-Dover	3 and 4	31. 34	0. 0
32	L. C.-Dover	1 and 2	32. 12	0. 0
34	L. C.-Dover	5 and 6	34. 56	[1] −2. 6
35	L. C.-Dover	1 and 2	35. 12	+2. 3
36	Kew-Dover	1 and 2	36. 12	−1. 3
4655	Kew-Casella	3 and 4	55. 34	−1. 4
5676	Kew-Casella	1 and 2	76. 12	−3. 4
5678	Kew-Casella	1 and 2	78. 12	−1. 0

[1] The correction to these dip needles varies with latitude. The correction +3.′5 was used for observations in Alaska.

REDUCTION OF OBSERVATIONS.

Each value of the magnetic declination has been reduced to the mean of the 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 range with change in magnetic latitude. No attempt has been made to correct the dip and intensity results 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, and the results for each State are 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 or a chart the geographical coordinates were scaled from the best available map, either a topographic sheet of the United States Geological Survey, 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 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 Greek letter γ.

In order to include the desired amount of information in the available space the following abbreviations have been adopted. Only the month and day of the date are given, since all the observations were made between July 1, 1910, and June 30, 1911, except where a statement to the contrary is made in a footnote. 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

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

F. L. Adams	W. M. Hill	W. E. Parker
J. R. Benton	A. Joachims	R. S. Patton
J. E. Burbank	R. F. Luce	T. Riggs, jr.
L. O. Colbert	R. R. Lukens	E. E. Smith
D. W. Eaton	H. E. McComb	D. C. Sowers
R. B. Elder	F. A. Molby	S. G. Townshend, jr.
O. W. Ferguson	F. Neumann	L. W. Weed
O. H. Gaarden	A. I. Oliver	C. F. Woodyard
G. Hartnell		

SEA OBSERVATIONS.

The results obtained on board ship are given in Table II. The general arrangement is indicated by the headings. Unless otherwise stated the ship was swung both with port and starboard helms. In the column headed "Sea," sm. means smooth; sw., swell; lt., light; mod., moderate; hvy., heavy. The commanding officers of the different ships were as follows:

Bache	W. C. Hodgkins
Explorer	W. C. Dibrell
Patterson	W. E. Parker

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

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911.*

ALABAMA.

Stations	Latitude	Longitude	Date		Declination	Dip	Horizontal intensity	Instruments		Observer
								M	DC	
	° ′	° ′			East ° ′	° ′	γ			
Geneva	31 01.4	85 51.6	Je	16–21	3 15.8	62 27.9	25857	10	36.12	F.N.
Dothan	31 13.6	85 23.2	Je	24	3 06.1	62 32.9	25761	10	36.12	F.N.
Andalusia	31 18.2	86 28.7	Je	13, 14	3 31.8	62 37.2	25661	10	36.12	F.N.
Elba	31 24.6	86 03.8	Je	30	4 05.5	62 53.3	25464	10	36.12	F.N.
Abbeville	31 33.6	85 14.6	Je	27, 28	2 50.7	63 04.5	25488	10	36.12	F.N.
Seale	32 18.2	85 09.8	Je	8	2 40.9	63 41.7	24934	10	36.12	F.N.

ALASKA.

	° ′	° ′			East ° ′	° ′	γ			
Wrangell Narrows:										
Island, East	56 30.0	133 00.7	Au	18	30 38.4	.. ....	.....	15	.....	R.B.E.
Start	56 30.5	132 57.0	Au	20	29 26.2	.. ....	.....	15	.....	R.B.E.
Work	56 30.8	132 58.8	Au	13	30 19.8	.. ....	.....	15	.....	R.B.E.
In	56 31.0	132 58.7	Au	13	30 32.1	.. ....	.....	15	.....	R.B.E.
Hum	56 32.8	132 57.6	Au	27	30 29.0	.. ....	.....	15	.....	R.B.E.
No. 65 U.S.E.	56 33.9	132 57.6	Se	1	31 39.1	.. ....	.....	15	.....	R.B.E.
No. 63 U.S.E.	56 34.1	132 58.2	Se	2	31 29.9	.. ....	.....	15	.....	R.B.E.
No. 62 U.S.E.	56 34.1	132 58.6	Se	2	31 24.1	.. ....	.....	15	.....	R.B.E.
No. 60 U.S.E.	56 34.7	132 58.6	Au	31	31 02.2	.. ....	.....	15	.....	R.B.E.
No. 57 U.S.E.	56 35.5	132 58.4	Se	26	31 42.9	.. ....	.....	15	.....	R.B.E.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

ALASKA—Continued.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
Wrangell Narrows—Continued	° ′	° ′		East ° ′	° ′	γ			
Near No. 53 U.S.E.	56 36.5	132 58.4	Se 26	32 09.1	.. ....	.....	15	.....	R.B.E.
Near No. 48 U.S.E.	56 37.1	132 58.1	Se 26	31 57.1	.. ....	.....	15	.....	R.B.E.
Near No. 47 U.S.E.	56 37.8	132 56.6	Se 26	31 47.6	.. ....	.....	15	.....	R.B.E.
Near No. 45 U.S.E.	56 38.2	132 55.6	Se 26	30 14.8	.. ....	.....	15	.....	R.B.E.
Near No. 38 U.S.E.	56 39.2	132 55.7	Se 26	31 19.3	.. ....	.....	15	.....	R.B.E.
No. 35 U.S.E.	56 40.6	132 56 0	Oc 3	31 07.5	.. ....	.....	15	.....	R.B.E.
Near No. 30 U.S.E.	56 41.0	132 57.0	Oc 3	30 51.5	.. ....	.....	15	.....	R.B.E.
Near No. 28 U.S.E.	56 41.9	132 57.3	Se 27	30 43.4	.. ....	.....	15	.....	R.B.E.
Near No. 31 U.S.E.	56 41.9	132 56.3	Se 27	30 55.1	.. ....	.....	15	.....	R.B.E.
No. 27 U.S.E.	56 42.8	132 56.4	Se 27	30 45 2	.. ....	.....	15	.....	R.B.E.
No. 22 U.S.E.	56 44.3	132 57.5	Oc 3	30 32.7	.. ....	.....	15	.....	R.B.E.
No. 21 U.S.E.	56 45.7	132 57.6	Oc 3	30 09.7	.. ....	.....	15	.....	R.B.E.
Near No. 17 U.S.E.	56 46.9	132 58.6	Oc 3	30 30.6	.. ....	.....	15	.....	R.B.E.
Near No. 9 U.S.E.	56 48.1	132 58.8	Oc 3	30 46.3	.. ....	.....	15	.....	R.B.E.
Near No. 2 U.S.E.	56 49.5	132 56.7	Oc 3	30 25.3	.. ....	.....	15	.....	R.B.E.
Sitka Observatory	57 03.0	135 20.1	De–Ja	30 17.9	74 31.8	15597	37	2E1	F.L.A.
Protection Point	58 29.6	158 40.2	Se 8, 9	21 34.5	71 24.1	17722	18	34.56	R.R.L.
Danger, Cook Inlet	59 25.3	151 53.5	Oc 1	23 04.4	.. ....	.....	742	.....	A.J.
Seldovia, Kachemak Bay	59 28.0	151 42.6	Se 30	24 02.9	.. ....	.....	742	.....	A.J.
Homer, Kachemak Bay	59 35.9	151 25.4	Se 22, 23	24 48.8	73 07.0	16288	C	32.12	W.E.P.
Gull Rock, Turnagain Arm	60 58.0	149 50.3	Se 26	26 00.0	.. ....	.....	737	.....	L.O.C.
Palisade, Knik Arm	61 22.2	149 43.6	Se 23	28 02.4	.. ....	.....	737	.....	L.O.C.
141st Mer. Boundary:									
Monum't No. 31	63 17.7	141 00.0	Je 29[1]	33 40	.. ....	.....	744	.....	D.W.E.
Monum't No. 30a	63 20.6	141 00.0	Jy 6	33 52	.. ....	.....	744	.....	D.W.E.
Monum't No. 30	63 22.7	141 00.0	Jy 9	33 07	.. ....	.....	744	.....	D.W.E.
Monum't No. 29	63 25.3	141 00.0	Jy 14	33 56	.. ....	.....	744	.....	D.W.E.
Monum't No. 28	63 28.1	141 00.0	Jy 16	33 56	.. ....	.....	744	.....	D.W.E.
Summit	63 28.7	141 08.1	Jy 18	33 22	.. ....	.....	744	.....	D.W.E.
Monum't No. 27	63 30.1	141 00.0	Jy 22	33 32	.. ....	.....	744	.....	D.W.E.
Monum't No. 26	63 33.3	141 00.0	Jy 23	33 35	.. ....	.....	744	.....	D.W.E.
Monum't No. 25a	63 34.5	141 00.0	Jy 27	33 29	.. ....	.....	744	.....	D.W.E.
Monum't No. 25	63 36.9	141 00.0	Au 1	33 50	.. ....	.....	744	.....	D.W.E.
Monum't No. 24	63 39.4	141 00.0	Au 2	33 48	.. ....	.....	744	.....	D.W.E.
Monum't No. 23	63 41.8	141 00.0	Au 6[1]	33 37	.. ....	.....	744	.....	D.W.E.
View N. E.[2]	65 16.1	140 55.0	Je 8[1]	36 20	.. ....	.....	741	.....	A.I.O.
Nation	65 16.5	141 07.7	Je 9[1]	36 35	.. ....	.....	741	.....	A.I.O.
Casca	65 20.8	141 03.3	Je 13[1]	36 22	.. ....	.....	741	.....	A.I.O.
Yellow	65 27.6	141 02.6	Je 19[1]	36 36	.. ....	.....	741	.....	A.I.O.
Halley	65 33.7	141 04.4	Je 27[1]	36 26	.. ....	.....	741	.....	A.I.O.

[1] 1910.

[2] In Canada.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

ALASKA—Continued.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
141st Mer. Boundary—Continued.	° ′	° ′		East. ° ′	° ′	γ			
Union	65 36.1	141 01.0	Je 28[1]	36 37	.. ....	.....	741	.....	A.I.O.
Seal [2]	65 45.8	140 50.1	Jy 7	37 12	.. ....	.....	741	.....	A.I.O.
Fire	65 48.4	141 12.4	Jy 9	36 31	.. ....	.....	741	.....	A.I.O.
Kandik [2]	65 55.1	140 54.4	Jy 11	37 01	.. ....	.....	741	.....	A.I.O.
Bench	65 57.1	141 15.5	Jy 15	36 34	.. ....	.....	741	.....	A.I.O.
Stripe [2]	66 06.0	140 57.6	Jy 20	37 06	.. ....	.....	741	.....	A.I.O.
Fishing [2]	66 14.3	140 58.6	Jy 26	36 50	.. ....	.....	741	.....	A.I.O.
Igloo	66 21.3	141 10.6	Au 1	36 40	.. ....	.....	741	.....	T.R.
White	66 38.7	141 10.8	Au 16	38 10	.. ....	.....	741	.....	T.R.
Storm	66 51.0	141 08.3	Au 28	37 03	.. ....	.....	741	.....	T.R.

ARIZONA.

	° ′	° ′		East ° ′	° ′	γ			
Tucson observatory	32 14.8	110 50.1	De–Ja	13 27.6	59 18.0	27373	30	15.56	L.W.W.

ARKANSAS.

	° ′	° ′		East ° ′	° ′	γ			
Warren	33 37.5	92 04.0	Mh 30	7 03.6	64 05.8	24948	20	78.12	H.E.M.
Warren, B	33 37.5	92 04.0	Mh 30	6 57.1	.. ....	.....	20	.....	H.E.M.
Rison	33 58.3	92 12.0	Mh 29	1 49.2	65 08.1	25116	20	78.12	H.E.M.
Pine Bluff, new	34 14.0	92 02.4	Mh 27, 28	6 41.6	64 48.1	24531	20	78.12	H.E.M.
Pine Bluff, B	34 14.0	92 02.4	Mh 27	6 34.9	.. ....	.....	20	.....	H.E.M.
Pine Bluff, old	34 14.7	92 01.9	Mh 27	6 40.0	.. ....	.....	20	.....	H.E.M.
Sheridan	34 18.9	92 23.6	Mh 23, 24	7 02.9	64 12.6	25244	20	78.12	H.E.M.
Sheridan, B	34 18.9	92 23.6	Mh 24	7 07.6	.. ....	.....	20	.....	H.E.M.
Benton	34 34.4	92 36.0	Mh 20, 21	7 37.6	65 13.2	24332	20	78.12	H.E.M.
Benton, S. M.	34 34.4	92 36.0	Mh 21	7 31.1	.. ....	.....	20	.....	H.E.M.
Benton, B	34 34.4	92 36.0	Mh 20	7 22.4	.. ....	.....	20	.....	H.E.M.
DeValls Bluff	34 47.9	91 27.0	Mh 16	6 35.7	65 21.5	24282	20	78.12	H.E.M.
DeValls Bluff, B	34 47.9	91 27.0	Mh 16	6 30.9	.. ....	.....	20	.....	H.E.M.
Augusta	35 17.2	91 21.7	Mh 13, 14	5 34.9	65 45.3	23967	20	78.12	H.E.M.
Augusta, B	35 17.2	91 21.7	Mh 14	5 46.2	.. ....	.....	20	.....	H.E.M.

CALIFORNIA.

	° ′	° ′		East ° ′	° ′	γ			
Goat Island	37 48.8	122 21.7	Je 9	18 04.6	62 05.6	25230	18	34.56	R.R.L.
Red Bluff	40 11.5	122 16.3	Jy 1	19 23.2	64 37.4	23790	19	23.34	W.M.H.
Gazelle	41 31.6	122 31.1	Jy 5	20 14.7	65 38.1	23141	19	23.34	W.M.H.

[1] 1910.

[2] In Canada.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

COLORADO.

Stations	Latitude	Longitude	Date		Declination	Dip	Horizontal intensity	Instruments		Observer
								M	DC	
	° ′	° ′			*East* ° ′	° ′	γ			
Cheyenne Wells	38 49.2	102 20.4	Au	13, 14	12 37.5	67 25.1	22630	19	23.34	W.M.H.
Grand Junction	39 04.8	108 33.2	Au	6, 8	15 27.8	66 29.1	23072	19	23.34	W.M.H.
Glenwood Springs	39 32.0	107 20.2	Au	9	16 12.4	66 47.3	23330	19	23.34	W.M.H.
Greeley	40 26.0	104 41.0	Au	2	14 25.8	68 28.5	21849	36	76.12	C.F.W.

CONNECTICUT.

	° ′	° ′			*West* ° ′	° ′	γ			
Danbury	41 23.5	73 24.2	Jy	1	11 08.4	72 26.9	17948	29	36.12	J.R.B.
Norwich	41 31.4	72 03.3	Se	15	9 13.9	72 57.7	17355	20	78.12	H.E.M.
Waterbury	41 33.1	73 02.6	Se	22	11 07.2	72 37.2	17770	20	78.12	H.E.M.
Middletown	41 34.0	72 36.3	Se	19	10 45.2	72 47.6	17606	20	78.12	H.E.M.
New Milford	41 34.3	73 24.4	Jy	4, 5	10 57.0	72 36.1	17764	29	36.12	J.R.B.
Plainfield	41 41.5	71 55.3	Se	14	11 42.2	72 52.4	17604	20	78.12	H.E.M.
Willimantic	41 43.4	72 12.2	Se	16	11 27.5	72 52.7	17554	20	78.12	H.E.M.
Putnam	41 54.9	71 55.4	Se	12	12 55.1	73 08.6	17307	20	78.12	H.E.M.
Winsted	41 56.3	73 03.9	Se	20	13 17.9	72 24.6	18210	20	78.12	H.E.M.
Canaan	42 00.7	73 19.2	Jy	6	11 35.8	73 02.4	17486	29	36.12	J.R.B.

DELAWARE.

	° ′	° ′			*West* ° ′	° ′	γ			
Seaford	38 38.7	75 35.1	Oc	19	6 15.2	70 15.8	19879	20	30.12	H.E.H.
Wilmington	39 45.2	75 33.0	Oc	17	6 09.6	71 36.0	18752	20	30.12	H.E.M.

FLORIDA.

	° ′	° ′			*West* ° ′	° ′	γ			
Key West	24 33.5	81 47.7	Fe	25	2 28.8	55 29.7	29000	C	35.12	R.S.P.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

GEORGIA.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		East ° ′	° ′	γ			
Cusseta	32 18.6	84 47.0	Je 29	2 26.2	63 55.8	24745	19	23.42	W.M.H.
Columbus	32 27.6	84 59.8	Je 26, 27	2 31.7	63 44.3	25089	19	23.42	W.M.H.
Hamilton	32 45.5	84 50.7	Je 22, 23	2 10.8	64 13.9	24767	19	23.42	W.M.H.
Greenville	33 02	84 42.1	Je 19, 20	2 20.1	64 30.7	24509	19	23.42	W.M.H.
Franklin	33 17	85 06.0	Je 15, 16	2 24.1	64 48.0	24330	19	23.42	W.M.H.
Newnan	33 22.1	84 48.5	Je 13, 14	1 59.3	64 54.8	24338	19	23.42	W.M.H.
Fairburn	33 33.5	84 35.5	Je 10	1 22.7	65 09.6	24160	19	23.42	W.M.H.
Atlanta, old	33 43.9	84 22.3	Ap 27, 29	2 11.4	65 07.1	24136	19	23.42	W.M.H.
Atlanta, new	33 44.2	84 22.0	Ap 29, 30	1 36.4	65 15.2	24078	19	23.42	W.M.H.
Douglasville	33 45.9	84 45.7	Je 7	1 49.0	65 11.7	24067	19	23.42	W.M.H.
Buchanan	33 48.2	85 12.8	Je 2, 3	2 20.5	65 20.7	24035	10	36.12	F.N.
Buchanan A	33 48.2	85 12.8	Je 1, 2	2 19.2	65 21.9	23994	10	36.12	F.N.
Do.	33 48.2	85 12.8	Je 2, 3	2 17.8	65 21.0	23998	19	23.42	W.M.H.
Buchanan	33 48.2	85 12.8	Je 1, 2	2 20.2	65 19.1	24019	19	23.42	W.M.H.
Marietta	33 57.2	84 33.0	Mh 8, 9	1 46.1	65 22.9	24044	20	78.12	H.E.M.
Cedartown	34 00.6	85 15.5	My 27, 29	2 19.3	65 26.7	23940	19	23.42	W.M.H.
Cartersville	34 10.3	84 46.0	My 3, 4	1 52.3	65 39.1	23827	19	23.42	W.M.H.
Canton	34 15.0	84 30.0	Mh 14	2 23.6	65 41.8	23846	19	23.22	W.M.H.
Jasper	34 28.3	84 26.5	Mh 16, 17	2 18.0	.....	23465	19	.....	W.M.H.
Summerville	34 29.2	85 17.6	My 5, 6	2 02.2	65 41.7	23743	19	23.42	W.M.H.
Calhoun	34 29.9	84 57.6	My 23, 24	1 46.4	65 56.9	23588	19	23.42	W.M.H.
Ellijay	34 42.4	84 28.0	Mh 20	1 53.6	66 07.1	23382	19	23.34	W.M.H.
La Fayette	34 43.1	85 11.8	My 8, 9	1 29.6	65 54.6	23613	19	23.42	W.M.H.
Springplace	34 46.0	84 50.2	My 19, 20	1 48.5	66 15.9	23320	19	23.42	W.M.H.
Dalton	34 46.3	84 58.1	My 16, 17	1 58.0	66 10.7	23422	19	23.42	W.M.H.
Ringgold	34 55.7	85 05.3	My 12, 13	1 28.2	66 02.7	23605	19	23.42	W.M.H.

HAWAII.

	° ′	° ′		East ° ′	° ′	γ			
Honolulu, old	21 18.0	157 51.5	Oc 20	10 42.2	38 58.4	29560	18	34.56	R.R.L.
Honolulu, new	21 18.6	157 52.8	Oc 24	10 43.8	38 54.0	29345	18	34.56	R.R.L.
Honolulu mag. obs'y.	21 19.2	158 03.8	De, Ja	9 30.8	39 44.6	29144	22	22EI	O.H.G.
Do.	21 19.2	158 03.8	Ja 14	9 33.1	39 44.6	29140	18	34.56	R.R.L.
Waikane	21 29.7	157 52.1	Fe 13, 14	13 10.1	36 41.9	30734	18	34.56	R.R.L.
Mokuleia	21 35.0	158 10.6	Fe 7	10 29.8	38 36.2	29723	18	34.56	R.R.L.
Kahuku Ranch	21 42.3	158 00.5	Fe 8, 9	10 41.0	40 14.0	29174	18	34.56	R.R.L.

IDAHO.

	° ′	° ′		East ° ′	° ′	γ			
Pocatello, old	42 51.4	112 26.2	Jy 26, 27	18 22.7	68 52.9	21230	19	23.34	W.M.H.
Pocatello, new	42 51.5	112 26.4	Jy 28	18 29.9	68 53.4	21207	19	23.34	W.M.H.
Shoshone	42 55.9	114 24.8	Jy 23, 24	19 46.8	69 19.4	20509	19	23.34	W.M.H.
Weiser	44 15.7	116 57.9	Jy 21, 22	21 03.4	69 00.9	21072	19	23.34	W.M.H.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

ILLINOIS.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		East ° ′	° ′	γ			
Belleville	38 30.2	89 58.3	Au 23, 24	5 23.2	69 36.3	21169	19	23.34	W. M. H.

IOWA.

	° ′	° ′		East ° ′	° ′	γ			
Sac City	42 25.3	94 59.9	Jy 1	8 33.8	72 08.3	18872	36	76.12	C.F.W.

KANSAS.

	° ′	° ′		East ° ′	° ′	γ			
Russell	38 54.1	98 53.5	Au 16	10 15.6	68 13.8	22098	19	23.34	W.M.H.

KENTUCKY.

	° ′	° ′		East ° ′	° ′	γ			
Clinton	36 40.1	89 04.9	Se 17	4 26.1	67 51.8	22236	19	23.34	W.M.H.
Bardwell	36 52.0	89 04.6	Se 13, 14	4 26.8	67 57.6	22158	19	23.34	W.M.H
Wickliffe	36 58.5	89 05.7	Se 10	4 31.0	67 57.8	22156	19	23.34	W.M.H.
Eddyville	37 03.4	88 20.1	Se 21	3 50.4	68 14.8	21977	19	23.34	W.M.H.
Princeton	37 06.9	87 53.2	Se 23, 24	3 47.8	67 59.2	22096	19	23.34	W.M.H.
Springfield	37 41.4	85 27.5	Se 30	2 17.4	69 31.2	20905	19	23.34	W.M.H.
Bardstown	37 47.8	85 41.8	Se 27, 28	1 20.4	69 17.2	20983	19	23.34	W.M.H.
				West					
Winchester	38 00.0	84 09.3	Oc 18–20	0 10.8	69 29.2	20601	19	23.34	W.M.H.
				East					
Taylorsville	38 02.3	85 25.3	Oc 5–7	1 37.3	69 33.0	20945	19	23.34	W.M.H.
Owingsville	38 09.3	83 45.7	Oc 21, 22	0 50.0	69 47.5	20688	19	23.34	W.M.H.
Frankfort	38 11.9	84 51.9	Oc 14, 15	1 21.2	69 52.3	20547	19	23.34	W.M.H.
La Grange	38 25.0	85 23.8	Oc 10, 11	0 25.2	70 27.7	19951	19	23.34	W.M.H.
				West					
Catlettsburg	38 25.5	82 35.2	Oc 25, 26	1 11.9	70 24.8	20251	19	23.34	W.M.H.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

MAINE.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		*West* ° ′	° ′	γ			
Portland	43 38.8	70 16.6	Au 15	15 17.6	74 03.3	16471	20	78.12	H.E.M.
Fryeburg	44 00.9	70 57.7	Au 17	15 19.2	74 29.6	16007	20	78.12	H.E.M.
Augusta	44 20.1	69 45.6	Au 13	15 44.6	74 40.8	15822	20	78.12	H.E.M.
Bangor	44 48.2	68 48.2	Au 8	17 55.4	74 45.7	15646	20	78.12	H.E.M.
Eastport	44 54.9	66 59.7	Au 9	20 04.6	74 19.5	16169	20	78.12	H.E.M.
Northeast Carry	45 52.1	69 32.7	Jy 7	18 40.2	75 28.8	15058	20	78.12	H.E.M.
Chesuncook	46 04.2	69 23.9	Jy 9	19 13.8	75 27.7	15169	20	78.12	H.E.M.
Smyrna Mills	46 08.3	68 08.4	Au 5	20 01.8	75 25.8	14986	20	78.12	H.E.M.
Chamberlain Lake	46 13.6	69 18.5	Jy 11	19 00.5	75 45.6	14828	20	78.12	H.E.M.
Eagle Lake	46 24.2	69 20.2	Jy 14	19 06.0	75 46.9	14734	20	78.12	H.E.M.
Chase's Carry	46 28.0	69 15.9	Jy 16	18 55.6	75 51.8	14659	20	78.12	H.E.M.
Ashland	46 39.6	68 23.4	Au 2, 3	20 21.2	75 49.4	14658	20	78.12	H.E.M.
Depot Farm	46 42.4	69 22.0	Jy 21	19 46.6	75 58.0	14556	20	78.12	H.E.M.
Allagash Falls	46 57.2	69 07.3	Jy 25, 26	20 17.3	76 07.6	14392	20	78.12	H.E.M.
Rankin Rapids	47 09.5	68 54.6	Jy 28, 29	20 38.5	76 13.9	14350	20	78.12	H.E.M.
Fort Kent	47 14.7	68 34.9	Au 1	21 07.8	76 15.0	14259	20	78.12	H.E.M.

MARYLAND.

	° ′	° ′		*West* ° ′	° ′	γ			
Salisbury	38 22.4	75 38.2	Oc 24	6 13.1	70 06.0	19976	20	30.12	H.E.M.
Cheltenham Observatory	38 44.0	76 50.5	De–Ja	5 43.9	70 37.3	19788	26	26EI	J.E.B.
Do.	38 44.0	76 50.5	Se 13, 14	5 44.5	70 35.1	19806	29	36.12	J.E.B.
Do.	38 44.0	76 50.5	De 2–7	5 43.1	70 35.4	19808	20	30.12	J.E.B.
Do.	38 44.0	76 50.5	De 8	.. ....	70 36.5	....	..	78.12	J.E.B.
Do.	38 44.0	76 50.5	De 20–29	5 43.3	70 38.1	19786	19	23.34	J.E.B.
Do	38 44.0	76 50.5	Ja 24–27	5 43.6	70 38.5	19789	36	76.12	S.G.T.
Do.	38 44.0	76 50.5	Ja 24	.. ....	70 37.1	.....	..	76.56	J.E.B.
Do.	38 44.0	76 50.5	Ja–Fe	.. ....	70 38.1	.....	..	31.34	J.E.B.
Do.	38 44.0	76 50.5	Mh 30	5 44.8	.. ....	.....	29	.....	J.E.B.
Do.	38 44.0	76 50.5	Ap. 12, 17	5 45.5	.. ....	.....	29	.....	J.E.B.
Do.	38 44.0	76 50.5	My–Je	5 45.6	70 37.9	19760	36	3EI	J.E.B.
Do.	38 44.0	76 50.5	Je 2–6	5 44.3	70 36.9	19775	11	55.34	J.E.B.
Oakland	39 24.8	79 25.3	Oc 31	3 56.8	70 48.6	19656	19	23.34	W.M.H.

MASSACHUSETTS.

	° ′	° ′		*West* ° ′	° ′	γ			
Coatue Beach	41 17.8	70 05.2	Au 3	13 28.1	72 39.9	*17437*	*C*	35.12	R.F.L.
Worcester	42 16.7	71 48.5	Se 8	12 35.8	73 15.6	17217	20	78.12	H.E.M.
Pittsfield	42 26.0	73 16.0	Jy 7, 8	11 50.0	73 23.8	17128	29	36.12	J.R.B.
Greenfield	42 34.0	72 35.2	Jy 15, 16	12 28.9	73 24.2	17056	29	36.12	J.R.B.
Fitchburg	42 36.4	71 48.0	Se 7	12 41.4	73 29.2	17016	20	78.12	H.E.M.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

MICHIGAN.

Stations	Latitude	Longitude	Date		Declination	Dip	Horizontal intensity	Instruments		Observer
								M	DC	
	° ′	° ′			East ° ′	° ′	γ			
Paw Paw	42 13.8	85 54.3	Au	27	0 46.2	73 08.3	17856	10	30.12	F.A.M.
Kalamazoo	42 17.5	85 37.0	Au	25, 26	1 09.4	73 12.9	17832	10	30.12	F.A.M.
Muskegon	43 15.2	86 11.7	Au	30, 31	1 22.2	73 58.5	17189	10	30.12	F.A.M.
					West					
Saginaw	43 24.8	84 00.0	Se	6, 7	1 38.2	74 07.6	16893	10	30.12	F.A.M.
Bay City	43 36.2	83 50.9	Se	22	1 42.6	74 16.3	16804	10	30.12	F.A.M.
					East					
Hart	43 43.3	86 21.6	Se	1	1 37.4	74 40.1	16471	10	30.12	F.A.M.
Hersey	43 51.8	85 25.0	Se	3	0 14.5	74 22.3	16705	10	30.12	F.A.M.
Manistee	44 16.8	86 16.6	Se	19	1 40.2	74 47.7	16442	10	30.12	F.A.M.
					West					
Lake City	44 20.5	85 12.0	Se	16	0 55.8	75 02.3	16081	10	30.12	F.A.M.
					East					
Frankfort	44 38.2	86 14.4	Se	20, 21	1 11.9	75 18.3	15944	10	30.12	F.A.M.
					West					
Mio	44 39.7	84 08.1	Se	10	1 46.0	75 24.6	15658	10	30.12	F.A.M.
Grayling	44 40.9	84 42.4	Se	14, 15	1 05.2	75 18.5	15772	10	30.12	F.A.M.
Atlanta	45 01.1	84 09.4	Se	13	1 44.0	75 16.4	15890	10	30.12	F.A.M.
					East					
Iron Mountain	45 48.2	88 05.2	Je	15	6 11.3	73 40.9	17986	36	30.12	D.C.S.
Crystal Falls	46 06.1	88 21.2	Je	13	3 25.2	76 16.7	14910	36	30.12	D.C.S.

MINNESOTA.

	° ′	° ′			East ° ′	° ′	γ			
Blue Earth	43 38.3	94 06.5	Je	29, 30	9 09.6	73 02.0	17926	36	30.12	D.C.S.
Caledonia	43 39.0	91 30.4	Je	27	5 12.8	73 45.4	17305	36	30.12	D.C.S.

MISSISSIPPI.

	° ′	° ′			East ° ′	° ′	γ			
New Albany	34 29.4	89 00.9	Mh	11	4 37.3	65 45.2	23871	20	78.12	H.E.M.
New Albany, B	34 29.4	89 00.9	Mh	11	4 39.4	.. ....	.....	20	.....	H.E.M.

MISSOURI.

	° ′	° ′			East ° ′	° ′	γ			
Marble Hill	37 19.0	89 57.8	Se	6	5 06.4	68 05.9	22272	19	23.34	W.M.H.
Fredericktown	37 34.5	90 19.3	Se	2, 3	5 29.3	68 31.1	21986	19	23.34	W.M.H.
Farmington	37 47.4	90 24.3	Au	29, 30	4 43.8	68 34.9	21768	19	23.34	W.M.H.
St. Genevieve	37 59.1	90 03.0	Au	26, 27	4 48.8	68 09.7	22243	19	23.34	W.M.H.
Hermann	38 42.3	91 26.5	Au	20	6 31.1	69 27.9	21065	19	23.34	W.M.H.
Sedalia	38 42.7	93 13.6	Au	18, 19	7 46.0	68 58.2	21652	19	23.34	W.M.H.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

MONTANA.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		East ° ′	° ′	γ			
Lima	44 37.9	112 34.9	Jy 23	19 33.7	70 19.6	20105	36	76.12	C.F.W.
Livingston	45 39.7	110 36.2	Jy 16	19 37.7	71 43.2	18999	36	76.12	C.F.W.
Billings	45 46.3	108 32.4	Jy 14	18 18.4	72 17.2	18628	36	76.12	C.F.W.
Boulder	46 14.2	112 06.5	Jy 21	21 20.2	71 56.0	18820	36	76.12	C.F.W.
Helena	46 37.1	112 00.8	Jy 19	20 05.2	72 10.5	18462	36	76.12	C.F.W.

NEBRASKA.

	° ′	° ′		East ° ′	° ′	γ			
Minden	40 30.0	98 56.7	Je 13	12 39.8	69 53.3	20999	20	78.12	H.E.M.
Clay Center	40 31.8	98 00.5	Je 14	10 37.2	69 47.2	20823	20	78.12	H.E.M.
Lincoln	40 49.5	96 40.8	Je 9	10 10.7	70 38.3	20172	20	78.12	H.E.M.
Aurora	40 52.3	98 00.2	Je 19	11 46.3	70 18.5	20436	20	78.12	H.E.M.
Osceola	41 10.6	97 33.3	Je 21, 22	11 08.8	70 59.2	20028	20	78.12	H.E.M.
David City	41 15.1	97 08.2	Je 23	10 43.5	70 55.5	19916	20	78.12	H.E.M.
Tekamah	41 46.3	96 14.2	Je 30	10 50.2	71 17.9	19592	20	78.12	H.E.M.
Pender	42 06.4	96 43.9	Je 29	9 58.0	71 41.2	19443	20	78.12	H.E.M.
Newport	42 35.8	99 20.2	Jy 6	12 26.2	71 27.4	19447	36	76.12	C.F.W.
Hartington	42 37.5	97 14.4	Je 28	10 44.8	71 43.0	19275	20	78.12	H.E.M.
Chadron	42 49.1	103 00.2	Jy 7	14 32.8	71 13.1	19629	36	76.12	C.F.W.

NEW HAMPSHIRE.

	° ′	° ′		West ° ′	° ′	γ			
Nashua	42 46.3	71 27.0	Au 29	13 27.0	73 28.7	17002	20	78.12	H.E.M.
Keene	42 57.5	72 15.4	Au 31	13 26.8	73 44.2	16836	20	78.12	H.E.M.
Epping	43 02.4	71 04.4	Au 27	13 57.7	73 38.8	16781	20	78.12	H.E.M.
Rochester	43 18.2	70 56.7	Au 25	16 45.9	73 59.4	16599	20	78.12	H.E.M.
Ossipee	43 41.4	71 05.9	Au 22	14 51.2	74 13.6	16374	20	78.12	H.E.M.
North Conway	44 04.4	71 07.8	Au 19, 20	15 19.6	74 29.1	16063	20	78.12	H.E.M.

NEW JERSEY.

	° ′	° ′		West ° ′	° ′	γ			
Winslow Junction	39 40.6	74 49.8	Oc 13	7 38.1	71 16.1	18935	20	78.12	H.E.M.
Glassboro	39 42.0	75 06.1	Oc 14	7 34.8	71 09.7	18960	20	78.12	H.E.M.
Lakewood	40 04.8	74 11.5	Oc 12	8 41.4	71 31.2	18749	20	78.12	H.E.M.
Long Branch	40 17.7	73 59.3	Oc 10	9 09.2	71 38.7	18631	20	78.12	H.E.M.
New Brunswick	40 30.2	74 27.2	Oc 5	8 57.0	71 55.1	18481	20	78.12	H.E.M.
Washington	40 46.6	74 56.7	Oc 3	8 52.7	71 38.1	18907	20	78.12	H.E.M.
Paterson	40 55.1	74 08.7	Se 24	9 33.3	72 15.1	18251	20	78.12	H.E.M.
Blairstown	40 59.0	74 58.3	Se 30	8 51.3	72 24.7	18239	20	78.12	H.E.M.
Newfoundland	41 03.8	74 26.3	Se 26	10 15.6	72 20.5	18203	20	78.12	H.E.M.
Sussex	41 13.2	74 36.4	Se 28	9 08.2	72 41.1	17774	20	78.12	H.E.M.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

NEW MEXICO.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		East ° ′	° ′	γ			
Tucumcari	35 09.8	103 43.7	Au 9	12 43.4	63 36.8	25483	36	76.12	C.F.W.
Raton	36 54.7	104 25.6	Au 5	13 37.2	65 14.1	24324	36	76.12	C.F.W.

NEW YORK.

	° ′	° ′		West ° ′	° ′	γ			
Ellenville	41 41.5	74 23.8	Au 22	10 35.5	72 54.7	17573	29	36.12	J.R.B.
Liberty	41 47.8	74 42.8	Au 23, 24	9 24.6	72 59.7	17638	29	36.12	J.R.B.
Hancock	41 57.4	75 18.2	Au 25, 26	9 14.2	73 04.9	17570	29	36.12	J.R.B.
Catskill	42 13.8	73 51.2	Au 18	10 58.3	73 13.9	17350	29	36.12	J.R.B.
Hudson	42 14.6	73 46.9	Jy 12, 13	11 12.4	73 11.2	17330	29	36.12	J.R.B.
Albany	42 40.5	73 45.0	Jy 14	11 34.5	73 45.4	16823	29	36.12	J.R.B.
Schenectady	42 49.1	73 57.1	Au 12	11 17.8	73 49.5	16756	29	36.12	J.R.B.
Fonda	42 57.4	74 23.1	Au 16	12 11.7	73 45.9	16898	29	36.12	J.R.B.
Rochester	43 07.9	77 36.0	Au 19	7 43.9	74 07.8	16654	10	30.12	F.A.M.
Hudson Falls	43 18.3	73 36.0	Au 9	12 16.2	74 12.5	16453	29	36.12	J.R.B.

NORTH CAROLINA.

	° ′	° ′		West ° ′	° ′	γ			
Whiteville	34 21.3	78 42.5	Mh 28, 29	2 02.6	66 13.0	23078	19	23.34	W.M.H.
Laurinburg, new	34 46.0	79 28.4	Mh 25	1 41.8	66 47.6	22629	19	23.34	W.M.H.
Laurinburg, old	34 46.2	79 27.8	Mh 24	1 35.7	66 46.5	22657	19	23.34	W.M.H.
Raeford	34 59 6	79 12.7	Ap 11	1 25.6	67 23.5	22410	19	23.42	W.M.H.
Rutherfordton	35 21.3	81 58.2	Mh 7, 8	0 43.4	67 09.5	22622	19	23.22	W.M.H.
Sanford	35 28.0	79 09.8	Ap 3–6	2 19.4	67 42.2	22065	19	23.42	W.M.H.
Do.	35 28.0	79 09.8	Ap 6	.....	67 41.5	.....	....	23.23	W.M.H.
Bakersville, new	36 00.6	82 09.4	Ap 21, 22	1 27.7	67 46.4	22298	19	23.42	W.M.H.
Bakersville, old	36 01.6	82 11.4	Ap 20, 21	2 14.0	67 31.3	22483	19	23.42	W.M.H.

OHIO.

	° ′	° ′		West ° ′	° ′	γ			
Cleveland	41 28.8	81 36.5	Au 20	3 39.9	72 32.4	18256	10	30.12	F.A.M.
Toledo	41 41.7	83 26.5	Au 23, 24	1 19.6	72 51.2	17980	10	30.12	F.A.M.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

OKLAHOMA.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		East ° ′	° ′	γ			
Ryan	34 01.4	97 59.3	Oc 28	9 43.8	63 00.7	26033	36	31.34	C.F.W.
Duncan	34 29.4	97 59.0	Oc 26	9 27.5	64 24.6	24813	36	31.34	C.F.W.
Ada	34 46.5	96 40.4	Se 8	8 35.4	64 41.5	24761	36	31.34	C.F.W.
Purcell	34 59.8	97 23.2	Se 3	9 59.7	64 43.1	24868	36	31.34	C.F.W.
Chickasha	35 02.1	97 57.6	Oc 25	10 06.5	64 39.1	24773	36	31.34	C.F.W.
Holdenville	35 05.6	96 23.4	Se 9	9 02.4	65 02.1	24521	36	31.34	C.F.W.
Sayre	35 18.1	99 39.0	Au 15	10 45.0	64 30.7	24862	36	76.12	C.F.W.
El Reno	35 31.4	97 55.9	Au 31	9 46.8	65 09.6	24479	36	31.34	C.F.W.
Arapaho	35 35	98 57.8	Au 17	10 43.0	64 59.6	24571	36	76.12	C.F.W.
Muskogee	35 45.6	95 20.1	Se 12	8 30.8	66 02.4	23789	36	31.34	C.F.W.
Kingfisher	35 52.6	97 53.9	Au 30	9 59.4	65 43.6	23943	36	76.12	C.F.W.
Do.	35 52.6	97 53.9	Au 30	.. ....	65 43.0	.....	..	31.34	C.F.W.
Stillwater	36 07.5	97 04.0	Oc 21	9 35.9	65 52.6	23870	36	31.34	C.F.W.
Tulsa	36 08.9	95 58.6	Oc 17	9 04.9	66 11.0	23742	36	31.34	C.F.W.
Fairview	36 15.5	98 29.7	Au 22, 23	10 37.6	66 01.4	23734	36	76.12	C.F.W.
Pryor	36 18.5	95 18.1	Se 13	8 51.6	66 32.5	23500	36	31.34	C.F.W.
Pawnee	36 21.8	96 47.4	Oc 19	9 31.6	66 16.6	23682	36	31.34	C.F.W.
Enid	36 25.4	97 54.4	Au 26	10 10.0	66 05.2	23776	36	76.12	C.F.W.
Vinita	36 39.4	95 09.2	Se 14	8 34.0	66 53.9	23251	36	31.34	C.F.W.
Nowata	36 40.9	95 38.4	Oc 7	9 02.8	66 55.4	23163	36	31.34	C.F.W.
Bartlesville	36 44.1	95 58.5	Oc 10	8 52.0	66 49.6	23199	36	31.34	C.F.W.
Cherokee	36 44.5	98 21.8	Au 24	10 40.1	66 22.3	23574	36	76.12	C.F.W.
Miami	36 55.0	94 52.7	Se 15	8 28.2	67 12.2	22947	36	31.34	C.F.W.

OREGON.

	° ′	° ′		East ° ′	° ′	γ			
Portland, new	45 30.8	122 41.6	Jy 9, 10	23 20.8	68.32.9	21063	19	23.34	W.M.H.
Portland, old	45 31.4	122 42.2	Jy 8	23 08.3	68 31.6	21641	19	23.34	W.M.H.
Pendleton	45 39.9	118 47.4	Jy 19, 20	22 04.5	69 14.7	20761	19	23.34	W.M.H.

PENNSYLVANIA.

	° ′	° ′		West ° ′	° ′	γ			
McConnellsburg	39 56.5	78 00.6	No 10	5 37.2	71 23.6	19101	19	23.34	W.M.H.
Harrisburg	40 13.9	76 53.0	Se 8	7 01.2	71 47.2	18725	29	36.12	J.R.B.
Hamburg	40 33.1	75 58.8	Se 6, 7	6 51.1	72 00.1	18442	29	36.12	J.R.B.
Shamokin	40 48.4	76 33.4	No 25, 26	7 22.1	72 13.0	18336	19	23.34	W.M.H.
Sunbury	40 52.6	76 44.5	No 23	7 01.5	72 16.4	18302	19	23.34	W.M.H.
Hazleton	40 56.2	75 57.5	Se 2, 5	7 33.5	72 15.9	18153	29	36.12	J.R.B.
Tunkhannock	41 32.0	75 55.4	Au 31, Se 1	8 24.0	72.43.9	17893	29	36.12	J.R.B.
Carbondale	41 32.8	75 32.4	Au 29, 30	8 50.4	72 44.4	17838	29	36.12	J.R.B.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

PORTO RICO.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		West ° ′	° ′	γ			
Porto Rico Observatory	18 08.8	65 26.9	De–Ja	2 25.1	49 56.8	28802	31	1 E1	G.H.
Do.	18 08.8	65 26.9	Fe 27, 28	2 26.0	.. ....	28778	36	....	G.H.
Do.	18 08.8	65 26.9	Ap 5	. ....	.. ....	28795	36	....	G.H.

TEXAS.

	° ′	° ′		East ° ′	° ′	γ			
Hillsboro	32 01.5	97 08.0	No 12	9 05.0	61 26.7	26723	36	31.34	C.F.W.
Corsicana	32 05.7	96 29.2	No 14	8 26.6	61 53.6	26489	36	31.34	C.F.W.
Cleburne	32 20.7	97 23.7	No 10	9 11.4	61 49.5	26418	36	31.34	C.F.W.
Tyler	32 21.4	95 17.9	No 19	8 08.2	62 19.2	26071	36	31.34	C.F.W.
Granbury	32 27.5	97 46.4	No 7	8 55.4	62 11.6	26222	36	31.34	C.F.W.
Longview	32 30.2	94 43.7	No 22	8 01.0	62 35.7	25961	36	31.34	C.F.W.
Marshall	32 32.8	94 21.8	No 23	7 44.1	62 36.3	25939	36	31.34	C.F.W.
Daingerfield	33 01.6	94 43.7	No 28	7 53.0	63 03.6	25729	36	31.34	C.F.W.
Decatur	33 15.6	97 33.8	Oc 31	9 29.1	62 51.1	25737	36	31.34	C.F.W.
Amarillo	35 10.6	101 50.6	Au 13	12 05.2	64 08.8	25114	36	76.12	C.F.W.

UTAH.

	° ′	° ′		East ° ′	° ′	γ			
Green River	38 59.3	110 09.9	Au 4	16 01.8	66 08.6	23334	19	23.34	W.M.H.
Ogden	41 13.1	111 59.9	Au 2	18 01.0	67 29.6	22307	19	23.34	W.M.H.

VERMONT.

	° ′	° ′		West ° ′	° ′	γ			
Newfane	42 59.8	72 39.2	Jy 20, 21	13 02.8	73 27.3	17096	29	36.12	J.R.B.
Rutland	43 37.1	72 57.7	Au 6, 8	13 00.0	74 06.5	16485	29	36.12	J.R.B.
Woodstock	43 37.4	72 30.0	Jy 23	13 35.2	74 09.7	16379	29	36.12	J.R.B.
St. Johnsbury	44 24.6	72 00.0	Jy 28, 29	14 15.0	74 41.6	15843	29	36.12	J.R.B.
Burlington	44 28.5	73 11.7	Au 3	13 18.2	74 27.8	16184	29	36.12	J.R.B.
Guildhall	44 34.8	71 32.8	Jy 26, 27	14 37.4	74 46.8	15731	29	36.12	J.R.B.
Barton	44 44.6	72 10.2	Jy 30, Au 1	15 08.4	74 53.4	15668	29	36.12	J.R.B.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

VIRGINIA.

Stations	Latitude	Longitude	Date		Declination	Dip	Horizontal intensity	Instruments		Observer
								M	DC	
	° ′	° ′			*West* ° ′	° ′	γ			
Courtland	36 42.9	77 02.7	No	7, 8	4 11.0	68 44.0	21148	20	30.12	H.E.M.
Suffolk	36 43.8	76 34.1	No	2	5 03.5	68 48.0	21069	20	30.12	H.E.M.
Lawrenceville	36 45.4	77 51.6	No	9	3 41.2	68 33.7	21393	20	30.12	H.E.M.
Sussex	36 55.2	77 16.2	No	12	3 57.4	68 45.5	21270	20	30.12	H.E.M.
Ocean View	36 56.6	76 13.5	Oc	29	4 51.1	68 59.4	20904	20	30.12	H.E.M.
Surry	37 08.4	76 50.4	No	16	4 25.5	69 09.2	20803	20	30.12	H.E.M.
Prince George	37 13.2	77 16.8	No	22	3 51.0	69 08.2	20835	20	30.12	H.E.M.
Petersburg, S. M.	37 13.8	77 23.4	No	19	4 12.3	.. ....	.....	20	30.12	H.E.M.
Petersburg, N. M.	37 13.8	77 23.4	No	19	4 19.1	69 10.2	20723	20	30.12	H.E.M.
Sandy Point	37 14.2	76 56.4	Au	29	4 53.7	.. ....	.....	*153*	.....	O.W.F.
Cape Charles	37 16.3	76 00.7	Oc	27	5 00.8	69 16.5	20673	20	30.12	H.E.M.
City Point	37 18.9	77 16.4	No	29	3 08.4	.. ....	.....	*153*	.....	O.W.F.
Willcox Wharf	37 19.0	77 05.9	Oc	20	5 44.8	.. ....	.....	*153*	.....	O.W.F.
Eppes Island	37 19.6	77 16.0	De	3	3 34.3	.. ....	.....	*153*	.....	O.W.F.
Eastville	37 21.4	75 55.3	Oc	26	4 40.8	69 24.5	20642	20	30.12	H.E.M.

WASHINGTON.

	° ′	° ′			*East* ° ′	° ′	γ			
Grays Harbor, Ocosta	46 53.6	124 03.5	Mh	7	24 01.0	.. ....	.....	*737*	.....	E.E.S.
Grays Harbor, Rennie	46 57.9	123 52.7	Ja	27	23 57.9	.. ....	.....	*737*	.....	E.E.S.
Ellensburg	46 59.9	120 31.6	Jy	16, 18	23 08.2	70 31.3	19674	19	23.34	W.M.H.
Brace Point	47 31.0	122 23.8	Mh	13	23 53.2	.. ....	.....	*15*	.....	R.B.E.
Colby	47 31.7	122 32.8	Mh	1, 3	22 49.5	.. ....	.....	*15*	.....	R.B.E.
Seattle, new	47 39.6	122 18.3	Jy	13, 14	23 38.6	70 43.2	19362	19	23.34	W.M.H.
Seattle, old	47 39.6	122 18.4	Jy	12, 13	23 42.6	70 40.3	19333	19	23.34	W.M.H.

WEST VIRGINIA.

	° ′	° ′			*West* ° ′	° ′	γ			
Spencer	38 48.5	81 20.8	Je	28	2 05.7	70 14.8	20272	11	31.12	J.R.B.
Elkins	38 55.2	79 51.4	Je	17–19	3 28.0	70 23.5	19944	11	31.12	J.R.B.
Grantsville	38 55.9	81 04.9	Je	26	2 03.2	70 24.5	19993	11	31.12	J.R.B.
Glenville	38 56.8	80 52.6	Je	23	1 46.4	70 32 5	19927	11	31.12	J.R.B.
Parsons	39 04.2	79 40.2	Je	15	3 40.6	70 34.8	19837	11	31.12	J.R.B.
Parkersburg	39 16.1	81 33.6	Oc	27–29	1 49.2	70 55.8	19746	19	23.34	W.M.H.
Martinsburg, old	39 27.3	77 58.0	No	3–5	5 24.6	70 37.9	19741	19	23.34	W.M.H.
Fairmont	39 28.3	80 08.3	Je	21	3 42.4	70 58.1	19698	11	31.12	J.R.B.
Martinsburg, new	39 29.2	77 59.8	No	7	5 14.4	70 59.5	19423	19	23.34	W.M.H.

TABLE I.—*Magnetic observations on land, July 1, 1910, to June 30, 1911*—Continued.

WISCONSIN.

Stations	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Instruments		Observer
							M	DC	
	° ′	° ′		*East* ° ′	° ′	γ			
Sheboygan	43 45.9	87 41.8	Je 6	2 28.3	74 33.3	16472	36	30.12	D.C.S.
La Crosse	43 49.2	91 14.0	Je 23	5 35.3	74 01.5	17059	36	30.12	D.C.S.
Friendship	43 58.0	89 50.7	Je 20	4 24.6	73 55.2	17081	36	30.12	D.C.S.
Wautoma	44 04.6	89 18.4	Je 19	3 49.3	74 13.6	16939	36	30.12	D.C.S.
				West					
Manitowoc	44 05.1	87 41.0	Je 7	2 16.4	74 25.6	16613	36	30.12	D.C.S.
				East					
Sturgeon Bay	44 50.0	87 22.4	Je 9	2 17.6	75 24.2	15797	36	30.12	D.C.S.
Pembine	45 38.2	88 01.1	Je 16	2 27.8	75 29.9	15669	36	30.12	D.C.S.
Florence	45 54.8	88 16.1	Je 14	2 17.8	76 03.6	15085	36	30.12	D.C.S.

WYOMING.

	° ′	° ′		*East* ° ′	° ′	γ			
Cheyenne	41 09.1	104 50.2	Jy 30	15 13.2	69 12.5	21279	36	76.12	C.F.W.
Green River	41 31.6	109 27.9	Jy 28	17 11.4	68 26.4	21689	36	76.12	C.F.W.
Granger	41 35.4	109 57.2	Jy 26	17 13.2	68 29.6	21658	36	76.12	C.F.W.
Sheridan	44 50.3	106 58.1	Jy 11	17 17.2	71 55.5	18906	36	76.12	C.F.W.

BRITISH COLUMBIA.

	° ′	° ′		*East* ° ′	° ′	γ			
Union 2	49 35.8	124 54.0	Oc 20	26 40.6	71 15.8	19011	C	32.1	A.J.

TABLE II.—*Magnetic observations at sea, July 1, 1910, to June 30, 1911.*

ATLANTIC OCEAN.

Place	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Total intensity	Ship	Headings	Sea
	° ′	° ′		*East* ° ′	° ′	*c. g. s.*	*c. g. s.*			
Key West Entrance	24 31	81 50	Fe 25	2 24	55 29	.2900	.5117	Bache	16	Sm.
Southwest of Knights Key	24 32	81 11	Fe 2	1 19	55 47	.2889	.5138	Do.	8	Sm.
Northwest Passage to Key West	24 39	81 58	Fe 13	2 43	55 45	.2885	.5127	Do.	8	Sm.
South of Cape Canaveral	28 22	80 32	Ja 31	0 13	60 20	.2671	.5396	Do.	8	Sm.
Off St. Johns River	30 24	81 20	Ja 30	1 53	62 12	.2573	.5516	Do.	8	Mod.
				West						
Off Savannah River	31 57	80 44	Ja 29	0 03	63 57	.2468	.5619	Do.	8	Hvy. sw.
Off Winyah Bay	33 12	78 56	Ja 28	0 22	65 05	.2398	.5691	Do.	8	Hvy. sw.
Chesapeake Bay	38 21	76 21	Ja 9, 11	5 55	70 07	.1999	.5878	Do.	16	Sm.
Nantucket Shoals	40 43	69 30	Se 24	13 08	72 02	.1816	.5886	Do.	16	Sm.
Do.	41 05	69 20	Se 22	12 33	72 38	.1763	.5906	Do.	8	Mod.

PACIFIC OCEAN.

Place	Latitude	Longitude	Date	Declination	Dip	Horizontal intensity	Total intensity	Ship	Headings	Sea
	° ′	° ′		*East* ° ′	° ′	*c. g. s.*	*c. g. s.*			
Honolulu Harbor	21 16	157 53	Fe 15	10 18	39 02	.2949	.3797	Explorer	16	Sm.
Do.	21 17	157 53	Oc 31	10 23	38 58	.2956	.3802	Do.	16	Sm.
Off Waianae	21 24	158 12	Ja 31	10 05	39 10	.3002	.3872	Do.	8	Lt. sw.
Off Mokapee Head	21 26	157 41	Oc 31	10 02	37 55	.3085	.3910	Do.	8	Lt. sw.
Off Mokuleia	21 37	158 11	Ja 17	10 18	38 26	.2960	.3780	Do.	8	Lt. sw.
At Sea	22 39	156 49	Oc 17	9 59	.. ..	....	....	Do.	3	Lt. sw.
Do.	23 49	156 41	Oc 17	10 42	.. ..	....	....	Do.	3	Mod. sw.
Do.	26 07	156 25	Oc 16	11 28	.. ..	....	....	Do.	3	Lt. sw.
Do.	27 28	156 30	Oc 16	11 52	.. ..	....	....	Do.	3	Mod. sw.
Do.	45 01	162 56	Oc 8	15 48	60 23	.2394	.4844	Do.	8	Hvy. sw.
Do.	47 05	163 36	Oc 7	15 49	.. ..	....	....	Do.	3	Mod. sw.
Do.	48 33	164 02	Oc 7	16 43	.. ..	....	....	Do.	3	Mod. sw.
Union Bay	49 40	124 54	Oc 21	.. ..	71 17	.1894	.5901	Patterson	16	Sm.
Queen Charlotte Sound	50 41	127 16	Oc 18	.. ..	71 28	.1852	.5827	Do.	8	Sm.
At Sea	50 52	164 50	Oc 6	15 47	.. ..	....	....	Explorer	3	Lt. sw.
Clarence Strait	56 09	132 45	Oc 15	28 56	74 14	.1609	.5923	Patterson	8	Sm.
Frederick Sound	56 51	132 53	Oc 15	.. ..	74 44	.1547	.5877	Do.	8	Sm.
At Sea	58 22	160 30	Se 17	20 12	.. ..	....	....	Explorer	1	Ch.
Do.	58 25	162 29	Se 21	19 08	.. ..	....	....	Do.	3	Lt. sw.
Do.	59 29	162 31	Se 20	18 51	.. ..	....	....	Do.	1	Sm.
Off Protection Point	58 30	158 39	Se 7	21 29	71 25	.1768	.5547	Do.	16	Sm.
At Sea	58 40	141 27	Oc 9	28 50	74 13	.1560	.5736	Patterson	8	Rough.
Do.	58 49	145 04	Oc 8	29 14	.. ..	....	....	Do.	3	Choppy.
Do.	58 53	147 24	Oc 8	27 05	.. ..	....	....	Do.	3	Mod. sw.
Kachemak Bay	59 37	151 23	Se 26	25 00	73 13	.1632	.5652	Do.	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. Previous to 1911 these stones were lettered on top U. S. C. & G. S., with a drill hole in the center to mark the exact point, but beginning with the year 1911 a circular brass station marker 3½ inches in diameter, set flush in the top of the marking stones, has been substituted for the lettering just mentioned. These brass station markers have the words "U. S. Coast & Geodetic Survey Magnetic Station" cast on them. A small drill hole in the center of the marker marks the center of station. Whenever the local authorities desired, and were willing to bear the expense, a second stone was set to denote the true meridian.

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

ALABAMA.

Abbeville, Henry County.—The station is on the grounds of the primary school, about 4 blocks south of the town's center. It is in the southeastern section of the field, 285 feet from the fence west of it, 380 feet from the iron railing around the cemetery north of it, 92 feet from the footpath east of it, and 87 feet from the fence south of it. It is marked by a granite post 10 by 10 by 30 inches, projecting 4 inches above ground, with a brass station marker in the top. The following true bearings were determined:

	° ′
Lightning rod on small brick building (mark)	40 12. 7 west of south
East gable of residence at west end of schoolhouse road	67 45. 8 west of north
Southwest edge of roof of school	25 04. 6 west of north
Water tank northeast of school	7 21. 1 east of north

A concrete block 8 by 5 by 20 inches, with a half-inch hole drilled in the top, placed 296 feet from the station, marks the north end of a meridian line.

Andalusia, Covington County.—The station is located in the eastern section of the town on the field in the rear of the high school, which is about 4 blocks due east of the courthouse and on the main street. It is 70 paces from the road to the west, 115 paces north of the school, and 180 paces from the road to the north. The station is marked by a granite post 8 by 8 by 30 inches with a C. & G. S. plate in the top which projects 3 inches above the ground. The following true bearings were determined:

	° ′
Center gable of house to the east of the school	34 51. 9 east of south
Extreme edge of roof at northwest corner of west wing of school	16 15. 3 west of south
Gable of small outhouse on grounds immediately west of school	57 46. 3 west of south
West gable of residence at north end of field	4 21. 6 west of north

Dothan, Houston County.—The station lies about 3 blocks north and 5 blocks west of the center o the town, on a lot owned by Colonel Pace. The lot is on the northwest corner of the intersection of two public roads. It is 22.5 feet from a wood fence marking the north extreme of the lot, 58.7 feet from the

Descriptions of stations—Continued.

ALABAMA—Continued.

center of the road to the east, and 100.5 feet from the south boundary of the lot. It is marked by a granite post 8 by 8 by 35 inches with a C. & G. S. plate in the top which projects about 4 inches above the ground. The following true bearings were determined:

	°	′	
South gable of large barn east of an old brick church (mark)	19	42.3	west of north
Lower gable of residence	87	50.8	east of south
West gable of first house southeast of station	34	36.4	east of south

Elba, Coffee County.—The station is in the northeastern part of the town, about 4 blocks from the courthouse, on the grounds of the county high school. It is in the southeast corner of the field surrounding the school, 318 feet southeast from the corner stone of the schoolhouse, and about 70 feet northwest of some shrubbery. The station is marked by a granite post 10 by 10 by 30 inches, projecting 5 inches above ground, with a magnetic station marker in the top. The following true bearings were determined:

	°	′	
Lower corner of schoolhouse corner stone (mark)	78	27.0	west of north
Northeast corner of frame building	80	30.4	west of south
North edge of base of flagpole on school	86	05.9	west of north

A stake, to mark the north end of the meridian line, was placed 348 feet from the station.

Geneva, Geneva County.—The station is about three-fourths of a mile south of the center of the town on the field of Mr. Tilton. The west end of this field borders on the main road going south from Geneva. The magnetic station is in the southeast end of the field, about one-fourth mile from this road, and may readily be located by first going to the large oak tree which stands out very prominently. It is 57.4 feet northwest of the base of this tree and 89.2 feet north of a wire fence inclosing the field on the south. It is marked by a granite post 8 by 8 by 30 inches with a C. & G. S. plate in the top, projecting 4 inches above ground. The following true bearings were determined:

	°	′	
East gable of Mr. Tilton's residence (mark)	44	27.3	west of north
Water tower	31	45.8	west of north
East gable of barn	67	34.1	west of north

Seale, Russell County.—The station lies about one-fourth mile north of the town's center in the field in the rear of the courthouse and west of the brick schoolhouse. It is 208 feet from the northwest corner of the school, 88 feet from the center of the path to the west of station, and 78 feet south of a wire fence running east and west. It is marked by a granite post 8 by 8 by 30 inches with a C. & G. S. plate in the top. The following true bearings were determined:

	°	′	
East gable of pumping station at courthouse (mark)	3	22.9	west of south
North gable of Baptist Church	46	12.5	east of south
North gable of Methodist Church	73	54.3	east of south
Southwest corner of roof of farmhouse	3	31.7	east of north
Center of water tank at east end of Dudly Hotel	11	42.8	west of south

ALASKA.

Homer, Kachemak Bay.—The station is on the southern side of Homer Spit, near the village, and just above high-water mark. It is 103.8 feet from triangulation station East Base, nearly on a line to triangulation station Cohen, and is marked by a 1 by 4 inch stub driven flush with the ground. The following true bearings were determined from the triangulation:

	°	′	
Triangulation station Cohen	26	58	west of south
Triangulation station Bluff	64	32	west of north
Triangulation station East Base	26	41	east of north
Gable of most western house	31	24	east of north
Flagpole on large house	86	20	east of north

Descriptions of stations—Continued.

ALASKA—Continued.

Protection Point, Nushagak Bay.—The station of June, 1910, was reoccupied. Magnetic observations were made at a point 27 feet from the triangulation station "Pro" in the direction of and in line with triangulation station "Tec." The magnetic station is marked by a pine hub having a V-shaped cross section with an 8-penny nail for center. The triangulation station is on the southwestern side of the entrance to Nushagak Bay, on the spit extending out from the general bluff line. It is on a low grass-covered sand ridge, about 200 feet from the high-water line. The triangulation station is marked by a small granite bowlder buried 1.7 feet below the surface and a long granite stone projecting 5 inches above ground and having a small triangle cut on its seaward face and a small drill hole in the top to mark the center. The following true bearings were determined from the triangulation:

	°	′	
Hydrographic signal "Goon" (mark)	28	59.4	west of south
Triangulation station "Tec"	71	45.1	west of north
Triangulation station "Nichols"	33	26.6	west of north

ARKANSAS.

Augusta, Woodruff County.—The station is in the northwest corner of the courthouse yard, about one-fourth of a mile north of the town's center. It is 45.7 feet from the west fence and 40 feet from the north fence. The station is marked by a cement post 8 by 8 by 36 inches, with the U. S. C. & G. S. plate in the top. A test for local disturbance was made by determining the declination at a point (B) 105.6 feet east of the main station. The following true bearings were determined:

	°	′	
Spire on colored Baptist Church (mark)	51	02.6	west of south
Center of base of spire on white Baptist Church	40	32.2	west of north
Spire on cupola of Methodist Church	3	43.6	west of south
Station "B" (test station)	83	40.8	east of south

A similar cement post with brass plate in the top sets 160.2 feet to the south and marks the meridian.

Benton, Saline County.—The station is in the northeast corner of the courthouse yard, near the north edge of town. It is 100.2 feet northeast of northeast corner of the courthouse, 16.1 feet south of north fence, 18.7 feet west of east fence. A test for local disturbance was made 169.6 feet west of the magnetic station and also over the south meridian stone. The station is marked by a limestone post 6 by 8 by 30 inches, with brass station marker in the top, the stone projecting 4 inches above ground. The following true bearings were determined:

	°	′	
North edge of south brick chimney on house (mark)	88	46.2	west of north
Southeast corner of courthouse at center of lowest brick	29	32.0	west of south

A cement post 10 by 10 by 30 inches, with brass station marker in the top, sets 207.3 feet to the south and marks the true meridian.

De Valls Bluff, Prairie County.—The station is on the hill at the head of Main Street. It is directly in front of Mr. C. F. Wells's house, 100 feet east of a board fence, 75 feet south of the bank of the White River. The station is marked by a granite post 6 by 6 inches on top and projecting 2 inches above the ground. It is lettered U. S. and center-marked, and is a River Survey corner. The following true bearings were determined:

	°	′	
Presbyterian Church spire (mark)	68	26.4	west of north
Magnetic Station "B" (test station)	88	06.2	east of north

Pine Bluff, Jefferson County.—The station is near the center of the Bellwood Cemetery, about 1½ miles west of town's center. It is at the north apex of the triangular-shaped flower bed on the north side of the large Carr Monument. The station is marked by a Bedford limestone post 6 by 6 by 36 inches,

Descriptions of stations—Continued.

ARKANSAS—Continued.

with brass station marker in the top, projecting 4 inches above ground. The following true bearings were determined.

	°	′	
Northwest corner of base stone of Dreyfus Monument (mark)	79	34.0	west of south
Ball at apex of cemetery office building	11	37.8	west of south
Southwest corner of Mr. Frazer's house	45	33.6	east of north
Southwest corner of top of cement wall around the Altheimer lot	84	49.0	west of north
Magnetic Station "B" (test station)	80	52.4	west of north

Declination observations were also made near the station of 1901.

Rison, Cleveland County.—The station is near the south edge of the courthouse yard, and one-fourth of a mile south of the town's center. It is 86.2 feet east from the corner of a board fence; 70.8 feet north from a board fence on the south side of a street; 85 feet west of the edge of another street. The station is marked by a Bedford limestone post 6 by 8 by 30 inches with the brass station marker in the top and projecting 2 inches above the ground. The following true bearings were determined:

	°	′	
Spire of an old church (mark)	79	24.1	east of south
Ball on belfry of new school building	19	10.8	east of south
Northwest corner of Methodist Church (near ground)	39	26.2	west of south
Northeast corner of the southeast chimney on courthouse	69	50.8	west of north

Sheridan, Grant County.—The station is in the northwest corner of the courthouse yard, near the town's center. It is 145.1 feet northwest of the northwest corner of the courthouse, 48.7 feet east of the curbstone along a street, 43.8 feet south of the curbstone along Main Street. It is marked by a limestone post 6 by 8 by 30 inches, with brass station marker in the top. The stone projects about 4 inches above the ground, the part that projects being surrounded by concrete. The following true bearing was determined:

	°	′	
East gable of Mrs. Bales's house (mark)	87	35.6	west of south

A cement stone 40 by 8 by 8 inches with brass station marker in top, sets 234.1 feet to the south and marks the true meridian.

Warren, Bradley County.—The station is located in the southeast corner of the courthouse yard near the town's center. It is marked by a Bedford limestone post 7 by 5 by 30 inches, projecting 3 inches above the surface, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Apex of spire of old Methodist Church (mark)	85	40.6	west of south
Northeast corner of Saline Grocery Co.'s brick building	5	54.0	west of north
Southwest corner of base stone at southwest corner of Owen building	65	27.2	east of south
Northeast corner of the Thompson building	3	13.3	west of south
Northwest corner of the Ederington Block	57	41.4	west of south

CALIFORNIA.

Red Bluff, Tehama County.—The station of 1906 was reoccupied. Azimuth observations were made over a hewn granite post 4 feet long, projecting 1½ feet above the ground, 6½ by 7 inches on top, with a cross marking the center. This north meridian stone is lettered on its north vertical face 1897, on its east face Magnetic Station, and on its west face U. S. C. & G. S. It is located about 1¼ miles northwestward from the county courthouse, and is on the line forming the northeastern boundary of Johnson Street, and is about 648 feet from the northwestern line of Breckenridge Street. A similar post to this north meridian stone was located 970 feet true south of it, on the southern edge of the county road. This

Descriptions of stations—Continued.

CALIFORNIA—Continued.

south meridian stone is lettered on its west vertical face Mer. Mark, on its south face 1897, and on its north face U. S. C. & G. S. The magnetometer station is on the line joining the center of the north meridian stone with the flagpole on the belfry of the Red Bluff public school, when this line is extended 15 feet from the center of the stone. The dip station is on the same line 50 feet from the center of the stone in the direction of the schoolhouse. The following true bearings were determined in 1906:

	°	′	
Flagpole on belfry of schoolhouse	40	27.0	east of south
Presbyterian Church spire	67	19.7	east of south
Town hall belfry	66	08.3	east of south

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

Goat Island, San Francisco County.—The station of 1904 was reoccupied. It is near the center of the plateau just west of the hill at the extreme eastern end of the island, on ground belonging to the Army. The station is 50 feet north of the line of the two flagpoles, one of which is on the highest part of the island and the other on the southern part of the lawn in front of the officers' quarters. The station is marked by a rough stone 6 by 6 by 12 inches, projecting about 1 inch above ground and having a flat top in which there is a small hole to mark the exact spot. The following true bearings were determined in 1904:

	°	′	
Flagstaff on highest part of island (mark)	44	59.5	west of south
Base of flagstaff on lawn	42	47.3	west of south

COLORADO.

Cheyenne Wells, Cheyenne County.—The station of 1906 was reoccupied. It is about 350 yards northwest of the courthouse, 142 feet from the corner of the water-tank support, 185.3 feet from the Methodist Episcopal Church, and 198.4 feet from the corner of a small stable. The station was marked by a cement block 8 by 8 by 36 inches, set 1 inch below the surface, and lettered U. S. C. & G. S., 1906. The following true bearings were determined:

	°	′	
Lightning rod on the north gable of house (mark)	16	47.9	west of south
Methodist Episcopal Church spire	14	51.1	east of south
Upper southwest corner of courthouse (under eaves)	46	35.0	east of south
Lower northwest corner of schoolhouse	2	05.6	west of south

Glenwood Springs, Garfield County.—The station of 1905 was reoccupied. The station is in the eastern part of the Glenwood Fair Grounds, about 1 mile south of the town. It is in the southeast corner of a fenced field, near the northeast corner of the polo grounds and east of the grand stand and race track. It is 81.5 feet west of the east fence of the fair grounds and 116 feet north of the north

Descriptions of stations—Continued.

COLORADO—Continued.

fence of the polo grounds. The station is marked by a sandstone post 8 by 8 by 35 inches, projecting about 5 inches above the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
South point at top of red cupola (mark)	2	17.6	west of north
East point of roof of exhibition building	83	56.0	west of north
East edge of flagpole at polo clubhouse	37	53.7	west of south

Grand Junction, Mesa County.—The station of 1905 was reoccupied. It is in the northeast corner of the Grand Junction Fair Grounds, northeast of the race track and grand stand, and about 1½ miles northeast of the town. It is 102.7 feet south of the north fence of the fair grounds, 215.7 feet west of the fence on the east, and 225.5 feet north of the outside fence on the north side of the race track. The station is marked by a sandstone post 6 by 6 by 30 inches, projecting about 3 inches above the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
Base of flagstaff on judges' stand (mark)	24	39.7	west of south
East gable of only roof to be seen over fence	70	31.8	west of north

Greeley, Weld County.—The old station could not be recovered. A new station was established about 55 feet northeast of the old station site, at the fair grounds in northwest part of town, 81.5 feet north of the northeast corner of the potato oven, 29 feet south of the outside race track fence, and 80.5 feet east of a large cottonwood tree. Station is marked by a Bedford limestone post 6 by 6 by 10 inches, lettered U. S. C. & G. S., and sunk 1 inch below the surface of the ground. The following true bearings were determined:

	°	′	
Right edge of west brick chimney at pumping plant (mark)	43	55.3	west of south
Right edge of brick chimney at county hospital	80	42.2	west of south
Flagpole, judges' stand	13	00.6	west of north

CONNECTICUT.

Canaan, Litchfield County.—Observations were made in the Canaan cemetery, about 1 mile south of town, in the new part, near the northwest corner, and about 600 feet west of the main entrance. The point is in the grass, but not on any lot; it is 24 feet southeast of the southeast corner of the base of the large Van Deusen Monument, 16.5 feet south-southwest of the southwest corner of the tombstone of Milton J. Killmer, and about 100 feet south of the north fence of the cemetery. It is marked by a block of concrete 6 by 6 by 14 inches, having three ½-inch holes in its face, along a diagonal, and set flush with the ground. The following true bearings were determined:

	°	′	
Spire of the Canaan Church (mark)	25	52.4	east of north
Chocolate-colored monument in the southeast part of the cemetery	18	57.4	east of south
Eddy Monument (grayish white)	29	39.3	west of south

Danbury, Fairfield County.—The station of 1904 was reoccupied. It is on city land in a meadow about 1½ miles due east of central part of the city, on the east side of a large hill called Shelter Rock. It is about one-fourth of a mile south of the east end of the city filtration beds and about one-eighth of a mile southeast of Starr's barn, which was used as a mark. The station is 211.9 feet from the north post of a gate and 59.5 feet south of a wire fence. The station and gate are in line with a spring in a pasture across the road. A meridian line was established, the south stone being 292.4 feet due south of the station and 84.8 feet from the nearest point of fence beside the road. Both stones are of granite 6 by 7 by 36 inches, with a ½-inch hole 2 inches deep in the center, and are lettered U. S. C. & G. S.

Descriptions of stations—Continued.

CONNECTICUT—Continued.

The tops of the stones are about 2 inches below the level of the ground. The following true bearings were determined:

	°	′	
Gable on Starr's barn (mark)	52	37.4	west of north
Water tank on private farm	37	44.0	east of south
Tip of gable on red barn	81	37.5	east of south

Middletown, Middlesex County.—The old station could not be located and a new station was established about 400 yards south of the old one. The new station is in a pasture at the highest point of the hill and about one-half mile south of the house at the poor farm. It is 300 feet north of a fence and 330 feet north of a stone wall. Station is marked by a granite post 10 by 10 by 15 inches lettered U. S. C. S., center marked and set level with the ground. The following true bearings were determined:

	°	′	
Cross on Catholic Church steeple in Portland (mark)	43	57.3	west of north
Weather vane on tower of insane hospital	68	24.6	west of south
Church spire in Middletown	69	37.6	west of north
Church spire in Portland	34	17.6	west of north

New Milford, Litchfield County.—Observations were made in the Pickett District Cemetery, across the Housatonic River and about three-fourths of a mile downstream from the center of the town, at a point in the northern part of the cemetery on a ridge of ground. The station is at the west side of a pathway on the west side of the ridge, 30 feet south of the wire fence north of the cemetery, 52.5 feet (measured along the slope) west of the wire fence east of the cemetery, and 5.5 feet west of the west face of the base of the monument of Charles G. Peck. It is marked with a marble post, 6 by 6 by 30 inches, having a rough face with the letters U. S. roughly cut on it, and set flush with the ground. The following true bearings were determined:

	°	′	
Spire of the graystone Episcopal church (mark)	11	36.7	east of north
Spire of the old church (Congregational)	9	22.8	east of north
Shaft of windmill at top of hill back of New Milford	3	12.8	east of north
North gable of house across the main road from the cemetery	73	35.3	west of south

Norwich, New London County.—The station is on the hill about one-half mile south of town. It is in a pasture belonging to Mr. Edwards and is about 160 feet south of the highest point in north section of the pasture. It is 48 feet west of a stone wall, 50 feet northwest from a corner of a stone wall, 150 feet east of a second stone wall, and just north of a group of large bowlders. The station is marked by a large granite bowlder, rounded on top and roughly lettered U. S. A cross and drill hole mark the exact spot. The following true bearings were determined:

	°	′	
Cross on Catholic Church spire (mark)	24	51.8	west of north
Spire on water tank at leather factory	59	17.6	west of north
Spire on water tank at car sheds	43	14.9	west of south

Plainfield, Windham County.—The station is about one-half mile north and a little east of town's center. It is on the western slope of a rocky hill in a pasture belonging to Mr. Henry Dorrance. It is 108 feet west from the foot of a small cliff, 66 feet south of a trail leading up the hill, and 258 feet east and a little north from a stone fence. Station is marked by a large granite bowlder projecting 6 inches above ground, lettered U. S. The exact spot is marked by a cross and drill hole. The following true bearings were determined:

	°	′	
Weather vane on Congregational Church steeple (mark)	40	15. 6	west of south
Cupola of Congregational Church at Canterbury Green	80	12. 8	west of north
Cupola on Mr. Wilcox's barn	11	02. 6	west of south

Description of stations—Continued.

CONNECTICUT—Continued.

Putnam, Windham County.—The station is on a rocky hill about 1 mile south of town's center. It is in a pasture belonging to Mr. C. M. Kent and is near the top of the hill. It is 240 feet west of the fence along the New York, New Haven & Hartford Railroad, 420 feet east and a little south of the corner of a stone fence, 294 feet south from a wire fence, and 58 feet south of a maple tree near which is a very large bowlder. The station is marked by a granite bowlder set level with the ground, smooth on top, and lettered U. S. A cross and drill hole mark the exact spot. The following true bearings were determined:

	° ′
Cross on Catholic Church steeple (mark)	5 58.4 west of north
South gable of Mr. Wheaton's house	23 28.8 east of north
Flagstaff on large judges' stand at fair grounds	83 03.6 east of north
Weather vane on distant barn	70 25.2 west of north

Waterbury, New Haven County.—The station is about 1 mile southwest of the town's center. It is in an open lot belonging to Mr. George Adams. This lot is just across the street west from the Town Plot School. It is 221 feet west of the west edge of Highland Avenue and 150 feet north of the north edge of Bradley Avenue. Station is marked by a granite post 6 by 6 by 30 inches, lettered U. S. C. S., and set level with the ground. The following true bearings were determined:

	° ′
Cross on north steeple of Catholic Church (mark)	37 46.3 east of north
Sacred Heart (Catholic) Church spire	46 26.0 east of north
Apex of tower of Town Plot School	63 58.8 east of north

Willimantic, Windham County.—The station is about one-half mile south of the town's center and in an open lot belonging to Mr. C. A. Young. This lot is just north of a group of large trees at the south extremity of Lebanon Avenue. It is 68.1 feet west of a stone wall and 156 feet north of the first row of trees in the grove. It is marked by a granite post 6 by 6 by 20 inches, lettered U. S. C. S., and set level with the ground. The following true bearings were determined:

	° ′
Congregational Church spire (mark)	7 18.2 west of north
Cross on St. Joseph's Church	36 28.7 east of north
Cross on St. Mary's Church	24 00.8 east of north

Winsted, Litchfield County.—The station is near the center of town, on the grounds of the soldiers' memorial. This monument is on the highest part of the hill, just east of Main Street. The station is near the edge of a trail leading about the edge of the grounds; 96.4 feet north and a little east from northeast corner of the monument; 183 feet from the stone fence on the west; 22.7 feet east from the east side of the monument produced. It is marked by a granite post 6 by 6 by 24 inches, lettered U. S. C. S., and set level with the ground. The following true bearings were determined:

	° ′
Ball on cupola of the Gilbert Home (mark)	8 16.3 east of north
Weather vane on cupola of Mr. Hale's barn	33 02.5 east of north
Catholic Church steeple	65 18.0 east of south
Apex of tower on Mr. Pinny's house	29 57.0 east of south
Congregational Church steeple	51 53.3 west of north

Descriptions of stations—Continued.

DELAWARE.

Seaford, Sussex County.—The station is about one-fourth mile east of town's center. It is in the open lot south of the mill and northwest from Mr. Ollie William's house; 52 feet northeast from a tree; 109 feet south of the southwest corner of the brick base of smokestack at mill; 112 feet west from a fence along east side of road. The station is marked by a marble post, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	° ′	
Methodist Church spire (mark)	76 55.4	west of south
South edge of top of chimney on Sussex Hotel	87 07.0	west of south
East edge of base of smokestack at gristmill	3 54.0	east of north
North gable of Edward Smith's house	7 15.4	west of south

Wilmington, Newcastle County.—The station of 1905 in Brandywine Park was reoccupied. The station is about midway between the Washington Street Bridge and the Baltimore & Ohio Railroad bridge over the creek, being about half a mile from each. The station will be readily found by following the asphalt path through the park from Washington Street to the end of the path. A low bluff is then in plain sight. On the summit of this bluff there is a small shanty, and the station is about 100 feet to the southeast of this shanty. It is marked by a hole bored in a rock. The following true bearings were determined:

	° ′	
Pole on roof of high school (mark)	23 04.6	west of south
Top of post-office tower	4 24.4	east of south
Top of courthouse tower	13 24.4	east of south
Grace Methodist Church spire	5 05.6	west of south

FLORIDA.

Key West, Monroe County.—The station of 1905 was reoccupied. It is on the grounds of the United States barracks, north of the hospital building. It is 79.0 feet and 98.5 feet, respectively, from the brick posts at the northeast and northwest corners of the porch of the hospital; it is also 66.3 feet from the north fence of the barracks. It is marked by a brass plug lettered U. S. C. & G. S., set in the coral rock about 6 inches below the surface of the ground. The following true bearings were determined in 1905:

	° ′	
Northwest tower of armory (mark)	1 27.3	east of south
Southeast tower of armory	3 26.4	east of south

GEORGIA.

Atlanta, Fulton County.—The station of 1905 in the southwest corner of Grant Park was reoccupied. It is 16.4 feet from a sweet-gum tree to the north, 48.5 feet from the nearest side of a double sweet-gum tree to the southeast, and 27.5 feet from the middle of the road to the south.

As this station was no longer suitable for magnetic observations, a new one was established in the central part of Grant Park on the lawn east of the refreshment and office building, about one-fourth mile northeast of the station occupied in 1905. It is about 222 feet east of the refreshment and office building and about 42 feet south from the center of the road passing this building on the north side. It is marked by a limestone post 5 by 7 by 30 inches, projecting about 6 inches above ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	
Lower southeast corner of refreshment and office building (mark)	74 46.5	west of south
Flagstaff on refreshment and office building	81 03.6	west of south
East lower edge of south stone post at foot of steps to dancing pavilion	7 30.9	east of north

Descriptions of stations—Continued.

GEORGIA—Continued.

Buchanan, Haralson County.—The station is in the southeastern part of a pasture belonging to J. S. Dean, the county surveyor, immediately east of the ground surrounding his residence, and about 1½ miles northwest of the town's center. It is 69.7 feet from the fence on the southeast border of the pasture, and 163.8 feet a little south of east from the northeast corner of the small log smokehouse. It is marked by a granite post 6 inches in diameter and 30 inches long, projecting about 3 inches above ground, with a magnetic station marker set in the top. The following true bearings were determined:

	°	′	
A staple driven in a tree stump (mark)	1	15.9	east of north
Spire of Baptist Church	84	20.7	east of south
Top of cupola on courthouse	79	55.1	east of south

The north meridian stone is a rough field stone about 12 by 12 inches at the bottom and with a smooth top about 4 by 4 inches. It has a cross cut in the top to mark the exact spot and is about 35 inches long. It projects above the ground about 12 inches and is 311.8 feet from the magnetic station.

Observations were also made at a point about 100 feet from the principal station in the direction of the mark.

Calhoun, Gordon County.—The station is in the northern part of John P. King Park, about one-fourth mile southwest of the town's center. It is 182 feet a little south of west of the southwest corner of the cotton gin building and 158 feet southeast of the center of the east gatepost at the north entrance to the park. It is marked by a granite post 6 by 6 by 30 inches, projecting about 4 inches above ground, with a magnetic station marker set in the top. The following true bearings were determined:

	°	′	
Spire of Calhoun Methodist Church (mark)	60	50.2	east of north
Spire of courthouse tower	73	26.0	east of north
West gable of Calhoun Hotel	87	30.9	east of south
Lower north edge of fence surrounding the town reservoir	75	38.0	east of north

The south meridian stone, about 285 feet distant, is a marble post 4 by 8 by 36 inches, projecting about 10 inches above ground, with a hole in the center to mark the exact spot.

Canton, Cherokee County.—The station is in the southeastern corner of Brown Park near the center of the town and about 1 000 feet south of the county courthouse. It is 106.9 feet north of the northeast corner of a wire fence surrounding a small cabin on the south border of the park and 181.5 feet east of the southeast corner of the Baptist Church. It is marked by a blue granite post 6 by 6 by 30 inches, projecting about 3 inches above ground, with a brass station marker in the top. The following true bearings were determined:

	°	′	
South gable of county courthouse (mark)	8	26.5	west of north
Base of rod on cupola of public school	65	12.3	west of north
Rod on pointed top of roof of R. T. Jones's house	6	32.6	east of north
East gable of A. B. Coggins's house	44	50.5	west of north

Cartersville, Bartow County.—The station is in the northeastern corner of the grounds surrounding the Methodist Tabernacle, about one-half mile southwest of the town's center. It is 41.4 feet from the north fence, 151.9 feet northeast from the northeast corner of the tabernacle, and 143 feet from the east fence. It is marked by a granite post 5 by 5 by 30 inches, projecting about 4 inches above ground, with a magnetic station marker in the top. The following true bearings were determined:

	°	′	
Knob at top of courthouse (mark)	73	29.0	east of north
Lower southwest corner of public schoolhouse	17	31.1	west of north
Spire of cupola of house north across the street from schoolhouse	4	35.5	west of north

Descriptions of stations—Continued.

GEORGIA—Continued.

Cedartown, Polk County.—The station is in the southern corner of the grounds surrounding the public school, about one-half mile southwest of the town's center. It is 47.3 feet from the fence on the southeast border of the grounds and 296.5 feet southwest from the southwest corner of the main school building. It is marked by a granite post 6 by 6 by 24 inches, projecting about 2½ inches above the ground, with a magnetic station marker cemented in the top. The following true bearings were determined:

	°	′	
Spire of Peppertown colored church (mark)	8	54.9	west of south
Top of steeple of Canal Street Baptist Church	13	06.6	east of south
Base of rod on cupola of Furnace Co.'s stable	79	52.7	west of north
Center of top of cupola of Furnace Co.'s store	49	20.4	west of north

The meridian line is marked by a stake with a nail in the top about 280 feet due south.

Columbus, Muscogee County.—The station is in the southwestern part of the city common, about 1 mile south of the town's center, and on the north bank of the river. It is 58.9 feet east of a monument (marking the place where Gen. Oglethorpe crossed and signed the famous treaty with the Indians) and about 390 feet a little east of south from a small wooden cabin used by a trap shooting club. It is marked by a limestone post 5 by 6 by 30 inches, projecting about 5 inches above the ground, and lettered U. S. C. & G. S., 1911. The following true bearings were determined:

	°	′	
Lower northwest corner of small brick storehouse at race track (mark)	70	30.5	east of south
Upper north edge of large marking board at baseball grounds	89	16.2	east of south

Cusseta, Chattahoochee County.—The station is in the northern part of the grounds surrounding the Missionary Baptist Church, about 300 feet northeast of the courthouse. It is 74.4 feet a little west of north from the northwest corner of the church, and 90.4 feet northwest from the northeast corner of the church. It is marked by a limestone post 5 by 6 by 34 inches, projecting about 6 inches above the ground, and lettered U. S. C. & G. S., 1911. The following true bearings were determined:

	°	′	
Spire of Primitive Baptist Church (mark)	82	26.3	west of north
Spire of Methodist Church	86	18.4	west of south
Lower northwest corner of jail	42	04.4	east of south

Dalton, Whitfield County.—The station is in the southwestern corner of the city park, about 300 feet north of the courthouse. It is 15 feet east of the center of the path on the west border of the park, 113.4 feet north of the center of the path on the south border, 15.4 feet south of the center of a sugar maple tree, and 41.8 feet north of the center of a sweet gum tree. It is marked by a granite post 6 by 6 by 24 inches, projecting about 2 inches above ground, with a magnetic station marker set in the top. The following true bearings were determined:

	°	′	
East gable of D. J. Oxford's house (mark)	56	15.2	west of north
Southeast edge of date stone on courthouse	35	50.6	east of south
Base of spire on a cupola across the street	41	19.2	west of north
Base of spire on a cupola immediately north of the above cupola	39	59.9	west of north

About 370 feet north a limestone post 4 by 8 by 33 inches, projecting about 7 inches above ground, with a hole in the top, marks the end of a meridian line. Another post of marble 4 by 4 by 20 inches, projecting about 3 inches above ground, is in exact line between the meridian posts about 150 feet north of the south post.

Douglasville, Douglas County.—The station is on the county poor farm, in the northeast corner of a pasture immediately south of the ground surrounding the keeper's house, about 1 000 feet southeast of the poorhouse, and about 1 mile southwest of the town's center. It is about 76 feet northwest

Descriptions of stations—Continued.

GEORGIA—Continued.

of the worm fence on the southeast border of the pasture, and 121.2 feet south of the wire fence bounding the pasture on the north. It is marked by a granite post 8 by 8 by 30 inches, projecting 4 inches above ground, with a magnetic station marker in the top. The following true bearings were determined:

	°	′	
Northeast gable of poorhouse (mark)	37	25.3	west of north
Southeast edge of poor-farm keeper's house, under eaves	6	33.0	east of north

Ellijay, Gilmer County.—The station is in the northwest corner of a pasture belonging to Mr. Gerard, about 1 mile southeast of the town's center, and about 400 feet a little south of east of the Louisville & Nashville Railroad station. It is about 350 feet south of the McHann Hotel, in the next field south to that surrounding the McHann barn and orchard. It is about 85 feet east of a worm fence to the west, and about 126 feet south of a fence to the north. It is marked by a blue granite post 6 by 6 by 30 inches, with a magnetic station marker in the top, and projecting about 3 inches above ground. The following true bearings were determined:

	°	′	
Spire on South Methodist Church (mark)	50	50.6	west of north
Upper northeast corner of courthouse (under eaves)	44	20.5	west of north
Most easterly gable of McHann Hotel	8	39.9	west of north

Fairburn, Campbell County.—The station is in the northwest corner of the grounds surrounding the high school, about 1 000 feet southwest of the county courthouse. It is 105.5 feet southeast of the center of a post oak tree at the northwest corner of the grounds, 118.2 feet northeast of the north edge of the wooden steps on the third terrace from the top, and about 162 feet northwest of the schoolhouse well. It is marked by a granite post 6 by 6 by 30 inches, projecting about 3 inches above the ground, with a magnetic station marker in the top. The following true bearings were determined:

	°	′	
South gable of Atlanta & West Point Railroad freight station (mark)	14	19.2	east of north
South point of roof of Atlanta & West Point Railroad depot	17	24.4	east of north
Extreme upper northeast corner of tallest store on the main street	22	45.8	west of north

A south meridian granite post 6 by 6 by 36 inches is about 155 feet distant, and about 57 feet southwest of the schoolhouse well. This post is about 7 inches above ground and has a hole in the top to mark the exact spot.

Franklin, Heard County.—The station is in the western part of the grounds surrounding the public school, about one-fourth of a mile southeast of the town's center. It is about 215 feet a little north of west of the southwest corner of the school building, and about 141 feet south of the center of the road to the north. It is marked by a limestone post 4 by 6 by 34 inches, projecting about 8 inches above ground, and lettered U. S. C. & G. S., 1911, with a small hole in the center. The following true bearings were determined:

	°	′	
Base of spire on courthouse cupola (mark)	63	22.8	west of north
Lower northwest corner of school building	81	08.3	east of north
East gable of farthest house to be seen to the north	14	44.8	east of north

Greenville, Meriwether County.—The station is in the southwestern corner of the grounds surrounding the high school, about one-fourth mile southeast of the town's center. It is about 177 feet southwest from the southwest corner of the school building, 54 feet from the west fence, and 67.2 feet from the south fence. It is marked by a limestone post 5 by 6 by 26 inches, projecting 4 inches above ground, and lettered U. S. C. & G. S., 1911, with a hole in the center of the top. The following true bearings were determined:

	°	′	
Cupola on a barn (mark)	62	57.1	east of south
West gable point of high school	6	02.0	east of north

Descriptions of stations—Continued.

GEORGIA—Continued.

Hamilton, Harris County.—The station is in the western part of the grounds surrounding the high school, about one-half mile southeast of the town's center. It is 153 feet from the north fence and 109.9 feet a little south of west from the southwest corner of the school building. It is marked by a limestone post 5 by 6 by 30 inches, projecting about 4 inches above the ground, and lettered U. S. C. & G. S., 1911. The following true bearings were determined:

	° ′	
Spire of courthouse cupola (mark)	20 19.2	west of north
Spire on Methodist Church	38 14.9	west of north
Base of spire on church	38 53.3	west of north

Jasper, Pickens County.—The station is in the southwest corner of the grounds surrounding the McHann Hotel, about one-fourth of a mile northeast of the town's center. It is 63.5 feet northeast from the fence bordering the grounds on the southwest, 59.3 feet southeast from the fence on the northwest, and about 223 feet west of the southwest corner of the McHann Hotel. The following true bearings were determined:

	° ′	
North gable on county courthouse (mark)	85 23.6	west of north
Spire on cupola of schoolhouse	60 12.7	west of south
Lower southeast corner of railing surrounding roof of Mr. Carter Yates's house	38 38.8	east of north
Lower northeast corner of a brick building on the main street	70 02.0	west of south

La Fayette, Walker County.—The station is in the western part of the grounds surrounding the town's big spring reservoir and pumping station, on a ridge about 400 feet west of this pumping station. It is 31.2 feet a little west of south from the center of a sweet-gum tree about 2 feet in diameter, and 79 feet a little south of east from the center of another sweet-gum tree about 2½ feet in diameter. It is marked by a granite post about 6 by 6 by 30 inches, projecting about 5 inches above ground, with a magnetic station marker in the top. The following true bearings were determined:

	° ′	
Top of northwest corner of pumping station (mark)	74 09.8	east of north
Blazed cross in sweet-gum tree about 150 feet distant	72 49.9	west of north

A hole in the top of another post, of slate, about 310 feet due south marks a meridian line. This post is 5 by 12 by 34 inches, and projects about 12 inches above ground.

Marietta, Cobb County.—The station is in the open lot in front of Mr. W. W. McCulloch's residence, about one-fourth of a mile south of the town's center. It is 16 feet north of a board fence and 69.2 feet southeast from southeast corner of the McCulloch residence. The station is marked by a marble post 6 by 6 by 36 inches, lettered U. S., 1911, and center-marked, projecting 6 inches above ground. The following true bearings were determined:

	° ′	
Southeast corner of base stone of Texas Heroes' Monument	87 20.2	east of south
Southwest corner of base stone of Georgia Heroes' Monument	75 31.2	east of south

Newnan, Coweta County.—The station is in the southeastern corner of the grounds surrounding the Atkinson High School, about three-fourths of a mile south of the town's center. It is 50.4 feet from the fence on the east border of the grounds, and 46.6 feet from the fence on the south border of the grounds. It is marked by a granite post 6 by 7 by 30 inches, projecting about 3 inches above the ground, with a magnetic station marker in the top. The following true bearings were determined:

	° ′	
Spire on cupola of courthouse (mark)	1 40.8	west of north
North gable of G. E. Park's house	76 35.2	east of north
Lower southeast corner of schoolhouse	9 24.0	west of north

Descriptions of stations—Continued.

GEORGIA—Continued.

Ringgold, Catoosa County.—The station is in the southwestern corner of the grounds surrounding Prof. Ryan's school, about one-fourth mile northwest of the town's center, and about 250 feet southwest of the school building. It is 58.5 feet from the south fence, 83.5 feet from the west fence, and 69.5 feet northwest of the fence on the southeast border. It is marked by a granite post 6 by 6 by 30 inches, projecting about 4 inches above ground, with a magnetic station marker set in the top. The following true bearings were determined:

	°	′	
Base of rod on cupola of Colored Methodist Church (mark)	4	48.9	west of north
Northeast gable of C. Z. Taylor's house	18	50.8	west of north
South edge of schoolhouse cupola just under top eaves	23	52.2	east of north

The north meridian stone is of limestone 6 by 10 by 24 inches, projecting about 2 inches above ground. It is about 240 feet distant, and has a magnetic station marker cemented in the top.

Springplace, Murray County.—The station is in the western corner of the schoolhouse grounds, about 1 000 feet north of the town's center. It is 55.6 feet from the fence on the southwest border of the grounds, 42.2 feet from the northwest fence, and about 200 feet a little north of west from the west corner of the school building. It is marked by a granite post 6 by 6 by 24 inches, projecting about 2 inches above the ground, with a magnetic station marker set in the top. The following true bearings were determined:

	°	′	
North gable on brick Cohutta Bank (mark)	19	17.6	west of south
Center of base of rod on schoolhouse cupola	67	34.2	east of south
West point at top of roof of courthouse	7	18.5	west of south
Lower southwest corner of Bate's general store	2	41.4	west of south

The south meridian stone is in Samplar's pasture, which is immediately southwest of the school ground. It consists of a rough limestone about 24 by 6 inches at the base and about 36 inches long, which comes to a blunt point at the top. It is set with its top about 10 inches above ground, and has a hole in the apex to mark the exact spot. It is 66 feet from the fence on the southeast border of the pasture, 13 feet from the fence on the southwest border, and about 450 feet from the north meridian stone.

Summerville, Chattooga County.—The station is in the northeast corner of the lot surrounding the house of J. S. Brannen, county surveyor, about one-fourth mile east of the town's center. It is about 7 feet northwest of a hedge, 62 feet northeast from the northeast corner of Mr. Brannen's house, and 23 feet from the fence bordering the ground on the northeast. It is marked by a granite post 6 by 6 by 28 inches, projecting about 2 inches above ground, with a magnetic station marker in the top. The following true bearings were determined:

	°	′	
Base of spire on cupola of Mrs. J. S. Kleggin's house (mark)	31	27.1	west of north
Northeast corner of Mr. Henley's house, under eaves	86	19.2	east of north

HAWAII.

Honolulu, Oahu Island.—The station of 1909 was reoccupied. It is on the grounds of the Government building near the survey building. It is 66.1 feet from the northeast corner of the survey building and 68.8 feet from the southwest corner of the judiciary building. It is marked by an iron peg about 4 inches long set in the ground. The true bearing of the triangulation signal on Punch Bowl is 55° 19.′1 east of north.

Honolulu, Quarantine Island.—The station is located on Quarantine Island, which is about a half a mile west of the quarantine wharf in Honolulu Harbor. It is in the center of the circular tract just west of the executive building, about 25 feet to the eastward of a line connecting the red water tank on the grounds and the lowest part of Nuuanu Valley. The station is marked by a concrete monument

Descriptions of stations—Continued.

HAWAII—Continued.

about 6 by 8 inches set about 14 inches deep with the surface about flush with the ground, and lettered U. S. The following true bearings were determined:

	°	′	
Punch Bowl	78	21.5	east of north
Flagpole in front of executive building	65	24.0	east of south
Large brick chimney across bay	15	18.0	east of north

Honolulu Magnetic Observatory, Oahu.—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.

Kahuku Ranch, Oahu Island.—The station of 1900 was reoccupied. It is in the yard on the north side (i. e., toward the railroad track) of the dwelling house occupied by the manager of the Kahuku ranch, about halfway between the northeast edge of the house and the northwest corner of the stone wall around the yard; 4 paces west of an algaroba tree and 23 paces east of the west stone wall. It is 73.8 feet from the northeast edge of the spring house, 112.5 feet from the northwest edge of a small extension to the dwelling house, and 145.3 feet from the northeast edge of the house. The station is marked by a stone set nearly flush with the ground with a drill hole in the center. The following true bearing was determined:

	°	′	
Left edge of a prominent bowlder in the slope of the mountain ridge to the west (mark)	65	11.8	west of south

Mokuleia, Oahu Island.—Magnetic observations were made at a point 52 feet southeast of the triangulation station Mokuleia, in the direction of the upper and most distant flagpole which shows just to the right of a railroad crossing sign. This flagpole bears 35° 00′.2 east of true south. The triangulation station is near the line of the Oahu Railway & Land Co.'s tracks, about three-fourths of a mile west of the railroad stop called Mokuleia, and about 200 meters west of a prominent barn near the shore line. It is marked by a concrete monument.

Waikane, Oahu Island.—The station of 1906 was reoccupied. It is located in the front yard of Mr. Sol Peck's summer residence, which is just to the north of the native church, and on the east side of the road. It is 34.6 feet from the north wire fence, 67.8 feet from the west wire fence, 36.5 feet from a small 1-inch hydrant, 55.4 feet from a square telephone pole in front of the house, 81.4 feet from the second tree along the south fence of the Government road, and 67.8 feet from a tree in the northwest corner of the yard (twelfth tree from south gate). The station is marked by a lava rock about 6 inches in diameter, buried about 2 inches below the surface and sodded over. The following true bearing was determined:

	°	′	
Right-hand tangent of a deep indentation in the profile of the extreme slope of the mountains to the northward (mark)	19	08.3	east of north

IDAHO.

Pocatello, Bannock County.—The old station was in the southern corner of the grounds of the Idaho State Academy, about 1½ miles east of the town's center. It is 72.7 feet from the fence to the southeast along Terry Street and 62.3 feet from the fence to the southwest along Sixth Avenue.

The old station not being available for future use, a new station was established in the southwestern part of the grounds of the State Academy, on the northeast edge of the athletic field, and about 1½ miles east of the town's center. It is 36 paces southeast of the fence bounding the grounds on the northwest, 68½ paces northwest of the southwest corner of the main building, and 34½ paces southwest from the center of the walk running southeast to the front entrance of the main building. It is also 13 feet southwest from a fence consisting of a single iron wire, which may be removed while observations are taken.

Descriptions of stations—Continued.

IDAHO—Continued.

It is marked by a lava post 6 by 6 by 30 inches, projecting 1 inch above the ground, with a cross in the center. The following true bearings were determined:

	°	′	
Base of flagstaff on courthouse cupola (mark)	50	36.6	west of north
Base of flagstaff of weather signal on Cook's Block	83	44.1	west of south
Spire of cupola on the Pocatello House	76	42.7	west of north
Upper northwest corner of Presbyterian Church	60	16.6	west of north
Roof gable above front entrance of girls' dormitory	56	25.2	east of north

Shoshone, Lincoln County.—The station of 1905 was reoccupied. Observations were made over a lava block about 10 inches square on top and showing about 8 inches above ground. This stone is set firmly in a slanting position and marks the southeast corner of the township. It is placed where a dry irrigation ditch running along the eastern side of the township turns and runs along the southern side, about half a mile from the town's center. The land to the east belongs to the Oregon Short Line Railroad Co. The following true bearings were determined:

	°	′	
Northwest corner of most easterly of railroad shops (mark)	79	06.8	east of north
Northwestern point at top of large brick smokestack	79	08.6	east of north
Southern gable of roof of middle railroad shop	73	24.9	east of north
Northwestern point at top of smokestack	63	31.1	east of north
Highest point on mountain range	13	37.0	east of north

Weiser, Washington County.—The station of 1905 was reoccupied. It is about 1½ miles north of the center of the town, on the grounds of the Weiser Congregational Academy. The position of the station may be found by referring to the three principal academy buildings, which extend in a line almost east and west. It is 147.3 feet southeast of the southeast corner of the most western of these buildings, and is 180.8 feet southwest of the southwest corner of the central building. The station is marked by a glazed pipe 6 by 30 inches, set flush with the ground and half filled with cement. It is lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
Belfry on Methodist Church (mark)	2	20.4	west of south
Top of steeple of Congregational Church	3	45.6	east of south
Flagstaff on cupola of high school	9	54.3	east of south
Flagstaff on cupola	4	39.1	west of south

ILLINOIS.

Belleville, St. Clair County.—The station is in the southeastern corner of the county fair grounds, between a small pond and a row of horse stalls along the east fence, and about three-fourths of a mile south of the town's center. It is 9 paces west of the fence bordering the grounds on the east, 81 paces north of the fence bordering the grounds on the south, and 7 paces east of the east border of a small pond. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 2 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Only church spire in sight (mark)	5	13.5	west of north
Upper south edge of standpipe under top	79	13.0	west of north
Top of shaft of windmill in northeast corner of fair grounds	8	57.2	west of north

Descriptions of stations—Continued.

IOWA.

Sac City, Sac County.—The station is located in the Baptist College grounds, about 200 feet southeast of the southeast corner of the college building. It is 40 feet from the edge of the street on the east side of the grounds and 68 feet from the edge of the street on the south side of the grounds. The station is marked by a Bedford limestone post 6 by 6 by 20 inches, lettered U. S. C. & G. S., and sunk flush with the ground. The following true bearings were determined:

	°	′	
First Methodist Episcopal Church steeple (mark)	30	04.3	east of north
Cupola of college	10	32.9	west of north
Right (east) edge of standpipe	35	03.7	west of north

KANSAS.

Russell, Russell County.—The station of 1904 was reoccupied. It is on the grounds of the courthouse, northeast of the building. It is 114.2 feet, 140.6 feet, and 107.4 feet, respectively, from the northeast corner of the courthouse, the northwest corner of the steam-heating plant, and the southwest corner of a church that stands on the northeast corner of the block. The station is marked by a limestone post 6 by 6 by 30 inches, set 29 inches in the ground and lettered U. S. C. & G. S., 1904. A one-half inch hole one-half inch deep, in the center, marks the point. The following true bearings were determined:

	°	′	
Base of flagstaff on public school (mark)	66	15.1	west of south
Lutheran Church spire	50	11.0	west of north

KENTUCKY.

Bardstown, Nelson County.—The station is in the southeast corner of the grounds surrounding the Grade School, about 350 feet south of the front steps of the schoolhouse and about one-half mile northwest of the town's center. It is 37.4 feet west of the fence line on the east and 90.7 feet north of the fence on the south. It is marked by a limestone post 6 by 6 by 32 inches, projecting 5 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Base of cross on Catholic Church steeple (mark)	25	36.8	west of south
South gable on James Beam's house	88	11.8	east of south
Tower southwest corner of west wing of school building	21	45.0	west of north

Bardwell, Carlisle County.—The station is in the southwestern corner of a pasture containing the baseball field and owned by W. M. Cambell. The pasture is about one-half mile southwest of the town's center and is immediately west of Mr. Cambell's house. The station is northwest of the grandstand, 62.5 feet northeast from the fence to the southwest, and 119.6 feet west of the center of the home plate of the baseball diamond. It is marked by a limestone post 6 by 6 by 30 inches, projecting 6 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Top of schoolhouse cupola (mark)	39	18.3	east of north
South gable of Mr. W. M. Cambell's house	50	09.5	east of north
North gable of Mrs. Price's barn	36	05.7	west of north

About 800 feet north and against the north fence of the pasture, an iron stake was set to mark the north end of a meridian line.

Catlettsburg, Boyd County.—The station is in the southeast corner of the Government reservation, across the Big Sandy River from the Government lock, about one-half mile southeast of the town's center. It is 25½ paces west from the fence on the east border of the reservation, 57½ paces north of the fence on the south border, and 49 paces northwest from the southeast corner stone of the reser-

Descriptions of stations—Continued.

KENTUCKY—Continued.

vation. It is marked by a limestone post 6 by 6 by 32 inches, projecting 9 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Spire of Presbyterian Church (mark)	37	32.6	west of north
Rod on belfry on city building	34	10.0	west of north
East gable point on workshop of superintendent of Government lock	78	56.2	west of south
Center of top of frontal piece on roof of Alger Hotel	21	35.5	west of north

Clinton, Hickman County.—The station is in the northwest corner of the athletic field belonging to the Marvin Methodist College, about one-half mile south of the town's center. It is 11 paces east of the west edge of the swimming pool, and 16 paces south of the fence bounding the field on the north. It is marked by a limestone post 6 by 6 by 30 inches, projecting 5 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Upper east edge of town water tank (mark)	6	18.7	west of south
Rod at top of cupola on main college building	42	21.2	west of south

Another limestone post 8 by 4 by 38 inches, projecting about 10 inches above ground with a cross in the top marks the south end of a meridian line, about 300 feet long.

Eddyville, Lyon County.—The station is the north stone of a meridian line, on the east side of a road running along the southeast side of the cemetery, about one-fourth mile a little south of east of the town's center. It is 108.7 feet southwest from the southeast corner of the cemetery and 165.5 feet northwest of a worm fence to the southeast. The station is marked by a stone post 6 by 6 by 22 inches, projecting 3 inches above the ground and situated between the cemetery and the schoolhouse. The following true bearings were determined:

	°	′	
Base of flagstaff on courthouse cupola (mark)	71	04.4	west of north
Upper north edge of water tank at prison (below the cover)	50	57.9	west of north
Upper south edge of central tower on prison	58	51.2	west of north
Top of Stacker monument in cemetery	33	39.0	east of north

Three hundred and seventy-eight feet due south another stone 6 by 6 by 30 inches, lettered U. S. C. & G. S., 1910, and projecting 5 inches above the ground marks the south end of the meridian line. This stone is in the eastern part of the schoolhouse grounds about 120 feet northeast from the northeast corner of the schoolhouse.

Frankfort, Franklin County.—The station is in the northern part of the grounds of the new State capitol, about 1¼ miles southeast of the town's center, on the bluff above the Lawrenceburg Turnpike and about 3 feet east of a line of cedar trees on the east edge of the grounds. It is 63.2 feet a little south of east from the center of the trunk of a large sycamore tree and 28.2 feet a little west of south from the center of the trunk of a cedar tree. It is also 70 paces east of the fence between the property of B. B. Sare and the State property. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 6 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined.

	°	′	
East gable point over east entrance to capitol building (mark)	6	29.6	east of north
Center of top of smokestack at asylum for feeble-minded	40	01.5	east of north
Upper east edge of white tower on old distillery under eaves	48	30.4	east of north
Base of flagstaff on city school	22	07.2	west of north

A second limestone post 5 by 8 by 30 inches, with a hole in the top and projecting 6 inches above ground 336 feet north marks the north end of a meridian line.

Descriptions of stations—Continued.

KENTUCKY—Continued.

La Grange, Oldham County.—The station is in a pasture belonging to Mr. John Ellis, about three-fourths of a mile southeast of the town's center. This pasture has its northwest fence on the south bank of a creek called Curry's Fork and its northwest fence along the west side of the road running southeast from town. The station is 66 paces southwest from the fence along the road and 234 paces northwest from the fence bounding the pasture on the southeast. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 5 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Spire on steeple of Baptist Church (mark)	34	31.3	west of north
Top of steeple of colored church	33	17.9	west of north
Center of top of dome on courthouse	26	44.9	west of north

A cement post 25 inches long, 6 inches in diameter at the top and 8 inches in diameter at the bottom was set about 429 feet from the first stone to mark the south end of a meridian line. A hole in the top marks the exact spot.

Owingsville, Bath County.—The station is south of the central part of a field belonging to Mr. William Wright, northeast of the negro cemetery and about one-fourth mile north of the courthouse. It is 134.2 feet north of the northeast corner of this cemetery and 168.3 feet northeast of its northwest corner. The station is marked by a limestone post 6 by 6 by 30 inches projecting 6 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Top of rod on cupola of courthouse (mark)	10	06.7	east of south
Spire on Christian Church	15	49.6	east of south
Center of rod on cupola of schoolhouse	14	17.2	east of south
Center of base of largest monument in private graveyard about a mile north	17	16.5	east of north

Princeton, Caldwell County.—The station of 1901 was reoccupied. It is on the campus of the Princeton College, corner of Fredona Road and Plumb Street, 103.9 feet from fence on south, and 76.4 feet from fence on east. The station is marked by a stone post. The following true bearing was determined:

	°	′	
Peak of roof of house of Mr. Lamb (mark)	0	11.6	west of south

A stone post 359.75 feet north of the station marks the north end of a meridian line.

Springfield, Washington County.—The station is in the northeastern part of the infield of the race track at the Washington County Fair Grounds, about one-half mile north of the town's center. It is about 300 feet from the northeast end of the race track, 37.5 feet north of a white post which marks one-eighth of a mile on the track and 34.6 feet in a direction perpendicular to the fence around the inside of the race track. It is marked by a limestone post 6 by 6 by 32 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
West gable point on long white barn (mark)	34	07.7	west of south
Top of judges' stand in pony ring	12	47.1	east of south
Upper west corner of tallest smokestack at electric power station	42	01.3	west of south

Taylorsville, Spencer County.—The station is in the southern part of the grounds of the Yoder Poignand School, near the top of Schoolhouse Hill and about 1 000 feet northeast of the courthouse. It is 81 paces southwest of the southwest corner of the schoolhouse and 37 paces north of the fence bounding

Descriptions of stations—Continued.

KENTUCKY—Continued.

the grounds on the south. It is marked by a limestone post 6 by 6 by 32 inches, projecting about 6 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Top of dome on Baptist Church (mark)	49	41.1	west of south
Base of rod on steeple of Christian Church	69	26.5	west of south
Base of rod on dome of courthouse	48	24.8	west of south
Base of rod on steeple of Presbyterian Church	43	05.6	east of south
Top of steeple of Catholic Church	26	10.0	west of north

One hundred and sixty-four and four-tenths feet due north and 83.4 feet southwest of the southwest corner of the school building is a hole in the ground filled with cement built up 4 inches above the ground, to mark the north end of a meridian line.

Wickliffe, Ballard County.—The station is in the southwest corner of the grounds surrounding the high school, about three-fourths of a mile east of the town's center. It is 73.8 feet north of the fence on the south and 51.3 feet east of the fence on the west. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 2 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Top of courthouse cupola (mark)	59	36.6	west of north
Base of flagstaff on high school	25	21.3	east of north

Winchester, Clark County.—The station is in the northern corner of the grounds of the Kentucky Wesleyan College, about 1 mile northwest of the town's center. It is 102.8 feet southwest of the fence across the road to the northeast and 98.6 feet southeast of a standpipe of the water main. It is marked by a limestone post 6 by 6 by 30 inches, projecting 3 inches above the ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Lower west corner of boys' dormitory (Thomas L. Clark Hall) (mark)	20	06.2	east of south
Lower west corner of academy building	23	28.8	west of south
Upper west corner of main college building, under eave	12	33.5	east of south

A second post of freestone 5 by 7 by 36 inches, 348 feet south marks the south end of a meridian line. A hole in the top of this last post marks the exact line.

MAINE.

Allagash Falls, Aroostook County.—The station is in a clearing on the south bank of the Allagash River just west of Allagash Falls. It is near an old shed, 28 paces south of a large stone in the road around the falls, 38 paces from the edge of the river. Observations were made over a large flat bowlder. A cross and drill hole mark the exact spot. A blaze on a spruce tree about 300 feet away bears 52° 52′.3 east of north.

Ashland, Aroostook County.—The station is in the southwest corner of the high-school grounds and about one-quarter mile northeast of the town's center. It is 132 feet southwest from southwest corner of school building, 48 feet southwest from a flagpole, 24 feet north of a tree, 30 feet east of a rail fence, and 36 feet northeast from southwest corner of school grounds. Station is marked by an 8-inch cedar post 2 feet long set flush with the ground. A cross and brass screw mark the spot. The following true bearings were determined:

	°	′	
Congregational Church spire (mark)	62	39.4	west of south
Chimney on a house in the valley	87	42.2	west of north
Middle gable of Mrs. Loan's house	83	10.6	east of north
North gable of Mr. Orcutt's barn	1	55.4	east of south

Descriptions of stations—Continued.

MAINE—Continued.

Augusta, Kennebec County.—The station is about 1½ miles north of town's center. It is at the base of a ledge of rock known as Main Top, which is in Mr. Lacomb's pasture. Observations were made over a flat exposure of the ledge, a cross and drill hole marking the spot. This hole is 8 feet from the foot of the ledge, and 195 feet west from the north gatepost. The following true bearings were determined

	° ′	
Apex of statue on capitol dome (mark)	10 11.2	west of south
Spire on gatehouse at reservoir	43 06.5	west of south
Chimney on distant house	63 28.2	east of north
Flagpole on cupola of factory across river	49 28.3	east of south

Bangor, Penobscot County.—The station of 1905 on Thomas Hill, near the center of a vacant lot owned by Mr. Prentiss, was reoccupied. It is 76.3 feet northeast of a tree, 126.1 feet from the fence on the north side of Highland Avenue, and 133.9 feet from the fence on the west side of Gov. Davis's yard. The station is marked by a granite bowlder smoothed on the top and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′	
Spire of East Bangor meetinghouse	20 03.0	west of north
Flag pole on reservoir	24 29.7	east of north

Chamberlain Lake, Piscataquis County.—The station is near the center of the south end of Chamberlain Lake, about 2 miles from Mud Pond. Observations were made over a large bowlder on the shore on the north side of a cove, just south of some old lumber camps. This rock is almost in line with a very large rock, about 125 feet out in the lake, and Mount Katahdin. A cross and drill hole mark the exact spot. The following true bearings were determined:

	° ′	
West gable of south storehouse at the Chamberlain farm (mark)	43 10.5	east of north
Mount Katahdin (approximate)	44 00.0	east of south
Rock in lake (approximate)	11 08.0	west of south

Chases Carry, Piscataquis County.—The station is about 1 mile above the beginning of Chases Carry. It is on a point of land at the northeast corner of Lake Churchill, at which point the lake empties into the Allagash River. A pine tree about 8 inches in diameter was cut off square about 6 inches from the ground and observations made over this stump. A cross and large nail mark the exact spot.

A nail driven in a blaze on a tree near the camp grounds bears 65° 54′.6 east of south.

Chesuncook, Piscataquis County.—The station is in a pasture about one-half mile east of the Chesuncook Hotel. Observations were made over a large field stone, near the top of a small ledge of shale and 126 feet southeast of a rail fence, 228 feet south of the north gatepost near the lake, and 234 feet southwest of the edge of the lake. A cross and drill hole mark the exact spot. The following true bearings were determined:

	° ′	
West edge of west chimney on Chesuncook Hotel (mark)	32 03.1	west of north
Southeast gable of Wm. Juro's house	39 42.8	east of north
East gable Juhl Pea's barn	58 34.6	east of north
East gable J. Smith's house	83 07.2	east of south

Depot Farm (Long Lake), Aroostook County.—The station is on Depot Farm, on the clearing along the Allagash River. It is 150 feet east of a camp house, 135 feet southeast from southeast corner of another house, 165 feet north of an old log house, and 109 paces north of a very large bowlder near the south side of the clearing. A hole drilled in the top of this bowlder bears 5° 57′.1 west of south. Observations were made over a large bowlder projecting about 6 inches above ground. A cross and drill hole mark the exact spot.

Eagle Lake (Horse Dam), Piscataquis County.—The station is on the east shore of Eagle Lake and is about in line with the Tramway, an island, and a point extending into the lake from the northwest. Observations were made over a large field stone about 200 feet from the lake shore, in a small clearing

Descriptions of stations—Continued.

MAINE—Continued.

on the camp grounds about 1 mile above the horse dam. The point is marked by a cross and drill hole. The head of a large nail driven into a blaze on a birch tree bears 42° 02′.4 east of true south.

Eastport, Washington County.—The Carnegie Institution station of 1906 was reoccupied. It is about one-sixth mile northeast of the Eastport standpipe and is on a rocky knoll in a pasture belonging to Mr. J. R. Roche. It is south of two prominent ledges known as the "Batteries," 450 feet from a fence on the east and 260 feet from a fence on the south. The station is marked by a very large cross cut on the face of the rock. The following true bearings were determined in 1910:

	°	′	
Spire on Unitarian Church (mark)	26	59.2	east of south
Left edge of standpipe	67	48.4	east of south
Spire on Congregational Church	43	36.1	east of south
Lighthouse on Eastpoint (on the Canadian side)	11	16.2	east of south

Fort Kent, Aroostook County.—The station of 1909 was reoccupied. It is located on the point on which stands the old blockhouse of 1838, on land owned by Mr. Dickey, collector of customs at Fort Kent, and across a small branch from his residence. It is 136 feet slightly east of south from southeast corner of the blockhouse and 24 feet west from edge of bank and just west of the trail leading to the blockhouse. The station is marked by a 4-inch sewer tile projecting about 4 inches above the surface of the ground. The following true bearings were determined in 1910:

	°	′	
Base of cross on Catholic Church (mark)	74	35.7	east of north
Flagstaff on G. H. Page's store	13	20.8	east of south
Southeast corner of blockhouse (indefinite)	5	42.9	east of north
Center of chimney on Fort Kent Hotel	33	23.0	east of north

Fryeburg, Oxford County.—The station is near the northwest corner of the town in a hayfield belonging to Mrs. Bradley. Observations were made over the north monument of a meridian line established by Robert E. Peary about 1887. The magnetic station is 114 feet southeast of a fence and 111 feet southeast of the corner of the fence around the ravine. The following true bearings were determined in 1910:

	°	′	
North corner cupola church where it joins roof (mark)	6	12.9	west of south
Plumb bob over south meridian stone	0	04.0	west of south

North East Carry, Piscataquis County.—The station is on the camp grounds just north of Little Lobster Bay, near the northwest corner of Lobster Lake. It is almost due north of Lobster Mountain, 1 mile south and 2 miles east of North East Carry. It is 180 feet west from the mouth of a small stream, 27 feet west of a spruce tree, 45 feet east of a birch tree, and about 30 feet from edge of lake (at high water). It is marked by a brass tack in a cedar post driven below the surface. The surface mark is a rounded bowlder set flush with the surface of the ground. The following true bearings were determined:

	°	′	
South point of rock extending into lake (mark)	47	36.3	west of south
Prominent crevice in rock projecting into lake	75	18.1	east of south
West end of small island to southwest of Lobster Island	21	56.4	east of south
East end of Spencer Mountain (approximate)	38	00.0	east of south
Lobster Mountain (approximate)	3	00.0	west of south

Portland, Cumberland County.—The station of 1906 (on Western Promenade) was reoccupied. Observations were taken over the middle monument of the meridian line in the city park on Bramhall Hill, and along what is called Western Promenade. The mark used was the south monument of the meridian line.

Rankin Rapids, Aroostook County.—The station is on the north bank of the St. John River just below the rapids. It is near the south edge of a hayfield just west of the camp grounds. Observations were made over a large flint bowlder 34 paces north of the south edge of the field, 24 paces east of

Descriptions of stations—Continued.

MAINE—Continued.

the timber line, and 30 paces west of the timber line. A drill hole marks the exact spot. The following true bearings were determined:

	° ′	
Flagpole on cupola of a house (mark)	17 39.0	east of south
West gable of a house	72 59.8	east of south

Smyrna Mills, Aroostook County.—The station is near the northeast corner of Mr. Levitt's pasture, about one-half mile northeast of town. It is 33 feet northeast of a rock pile; 165 feet southeast of a poplar tree on the edge of the pasture; 108 feet southwest of timber line. Observations were made over a large bowlder projecting a little above ground. A cross and drill hole mark the exact spot. The following bearings were determined:

	° ′	
Flagstaff on school building (mark)	78 50.1	west of south
North gable of distant house	24 49.2	west of south
Flagstaff on opera house	64 27.7	west of south

MARYLAND.

Oakland, Garrett County.—The station of 1897 was reoccupied. It is the south end of a meridian line established in that year by L. A. Bauer. It is in the grounds in front of the courthouse, about 75 feet from the southwest corner, about 90 feet from northwest corner, and about 36 feet from the board walks on the south and west sides of the grounds. The station is marked by a granite post 7 by 7 inches, lettered S. M., 1897. There is another stone in the northwest corner of the courthouse grounds 82.5 feet due north of the magnetic station. The following true bearings were determined:

	° ′	
Northeast gable of Oakland Hotel (mark)	76 49.4	west of north
Lowenstein's house, northeast gable	47 28.5	west of south
Southeast gable of Commercial Hotel	46 39.8	west of north
Proctor's flagpole	25 36.5	west of north

Salisbury, Wicomico County.—Observations were made over the north monument of the meridian line established by the county in 1896. It is on the grounds surrounding the high school, about 175 yards southeast of the courthouse on the opposite side of Lake Humphreys.

MASSACHUSETTS.

Coatue Beach, Nantucket County.—The station is located on the point of land northeast of Brant Point, known as Coatue Beach. It is about 25 feet from the beach, on the northwest point of the shore. It is directly in line with the jetty (east jetty) and, to a person standing at the station, the rear range light is directly in range with the near edge of the center chimney of a greenhouse located between Brant Point Lighthouse and the rear range light on Brant Point. The station is on a high point of the sand beach, amidst moderately high grass. The station is marked by a cement stone sunk in the sand, projecting about 6 inches above ground. The following true bearings were determined:

	° ′	
Brant Point Lighthouse (mark)	21 22.0	west of south
Great Point Lighthouse	18 22.0	east of north
Gilded church tower	33 00.0	west of south
Weather Bureau flagstaff	24 55.0	west of south

Fitchburg, Worcester County.—The station is near the Overlook reservoir about 1 mile northwest of town's center. It is 112 feet east of the east edge of the reservoir, 339 feet northeast of southeast corner of reservoir, 45.7 feet west of a board fence, and about 20 paces southwest from a lone apple tree. The station is marked by a granite bowlder, sunk 4 inches below the surface of the ground, and surface marked by a flat granite slab. The exact spot is marked by a cross and drill hole. The following true bearings were determined:

	° ′	
Cross on Catholic Church spire (mark)	7 31.9	west of south
Spire on gatehouse of reservoir	37 01.0	west of south

Descriptions of stations—Continued.

MASSACHUSETTS—Continued.

Greenfield, Franklin County.—Observations were made on ground belonging to the Green River Cemetery, about 1 mile southwest of the center of the town, at a point near the main entrance of the cemetery, in front of and across the driveway from the office of the cemetery. The point is 10.2 feet east of the edge of the concrete block retaining wall on the east side of the entrance driveway; it is 150 feet south of the south edge of the public road, and 95 feet south of a telegraph pole. It is marked by a white granite post 5 by 5 by 24 inches, lettered U. S. and set flush with the ground. The following true bearings were determined:

	°	′	
Top of the cross on the steeple of the Roman Catholic Church (mark)	23	18.4	east of north
Steeple of the Second Congregational Church	38	43.3	east of north

Pittsfield, Berkshire County.—The station of 1905 was reoccupied. It is on the grounds of the sewer pumping station, southeast of the city, and about 80 yards southwest of the south end of the storage tanks. A meridian line was established with the north stone 397.7 feet distant, near a driveway to the city gravel pit. The north stone is 62 feet west of a small tree across this roadway and 2 feet south of the fence. Both monuments are of marble 6 by 6 by 60 inches, set about 1 foot above the ground, and lettered U. S. C. & G. S. The following true bearings were determined at the south monument:

	°	′	
Southeast gable of concrete house with slate roof (mark)	31	52.5	west of north
North meridian stone	0	00.0	west of north

Worcester, Worcester County.—The station of 1898 was reoccupied. The station is located on the larger of the two small islands in the lake of the institute park, just north of the Worcester Polytechnic Institute. Point marked with a granite post 4½ feet long, projecting 8 inches. The following true bearing was determined in 1898:

	°	′	
Rod on the band stand	18	02.0	east of south

A new building has been constructed between the meridian stones, but the meridian has been carefully marked by a black and white disk just above one of the windows at the southeast corner of the building.

MICHIGAN.

Atlanta, Montmorency County.—The station is in the southwest corner of the 5-acre county property on which the courthouse stands. It is 70 feet east from the west fence and 58.5 feet north from the south fence, and approximately 400 feet from the courthouse. The point is marked by a 6-inch cedar post 2½ feet long, squared at the top, and the letters U. S. cut on the north face. The post stands about 8 inches above ground. The following true bearings were determined:

	°	′	
Cupola on Thompson's barn (mark)	81	12.1	west of north
Courthouse cupola	11	33.9	west of north

Bay City, Bay County.—The station of 1907 was reoccupied. It 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
Cupola on house at the northwest corner of the fair grounds	29	42. 3	west of north

Descriptions of stations—Continued.

MICHIGAN—Continued.

Crystal Falls, Iron County.—The station is in the park west of the new high-school building, just west of the driveway running through the park. It is 192 feet from the north fence, 115 feet from the south fence, and 8.2 and 12.4 feet, respectively, from two trees, one to the northwest and the other to the southeast. It is marked by a Bedford limestone post with a brass station marker in the top, which projects about 4 inches above ground. The following true bearings were determined:

	°	′	
Flagpole on old Central High School (mark)	68	48. 3	east of south
Methodist Church spire	80	55. 6	east of south
Northwest corner of courthouse	71	40. 5	east of north

Frankfort, Benzie County.—The station is near the center of the city park, on top of the hill at the north of the business section of the town, a few rods southeast from the spot where the old water tank used to stand. It is 23 paces east from the east walk line (projected) of Fourth Street and 8 paces north from the edge of the hill where it breaks abruptly down to the south. The spot is marked by a cement block 7 by 7 by 16 inches, set 2 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
West edge of gristmill (mark)	14	58. 0	west of south
East edge of gristmill	14	05. 5	west of south
South pole on Frontenac Hotel	32	06. 7	west of south
Congregational Church belfry	18	09. 7	east of south

Grayling, Crawford County.—The station is in the inclosed baseball park, about one-half mile northeast from the business section of the town. It is in the northeast corner of the grounds, 83.8 feet south from the lower stringer in the north fence, and 85.8 feet west from the lower stringer in the east fence of the grounds. The spot is marked by a cedar block 8 inches in diameter and 27 inches long, with sawed ends, set 1 inch beneath the surface of the ground. The following true bearings were determined:

	°	′	
Danish Lutheran Church belfry (mark)	20	09.0	west of south
Methodist Church belfry	34	28.4	west of south
Presbyterian Church	33	14.0	west of south

Hart, Oceana County.—The station is in the old cemetery, about three-eighths of a mile north from the county courthouse. It is 48.5 feet from the south fence and 48.6 feet northeast from the Gilliland Monument. The station is marked by a Bedford limestone post 5 by 6 by 40 inches, lettered U. S. C. & G. S., 1910, and projecting 8 inches above ground. The following true bearings were determined:

	°	′	
Cross on Catholic Church tower (mark)	40	55.9	west of south
West edge of iron smokestack at canning factory	7	21.5	east of south

Hersey, Osceola County.—The station is at the southwest corner of a small park which belongs to Mr. McIntyre, and is nearly surrounded by the waters of his mill pond. The station is about 400 feet west from the main street. It is marked by a Bedford limestone post 5 by 6 by 40 inches, lettered U. S. C. & G. S., 1910, and projecting 6 inches above ground. The following true bearings were determined:

	°	′	
Upper stone in the southwest corner of the wall of gristmill (mark)	46	31.6	east of south
Congregational Church steeple	11	29.0	east of south
Evangelical Church dome	8	48.0	west of south

Iron Mountain, Dickinson County.—The station is located in Cemetery Park, about 1 mile due south of the courthouse, in a path between the lots about 150 feet due south of the main entrance. It is 26.6 feet northeast of the Spencer Monument, 19.4 feet southeast of the John L. Brown Monument,

Descriptions of stations—Continued.

MICHIGAN—Continued.

and 11.6 feet southwest of the Tregilas Monument. It is marked by a Bedford limestone post 6 by 6 by 30 inches, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Courthouse spire (mark)	0	44.6	east of north
Tip of water tower	3	53.3	west of north
East figure on edge of roof of house	7	16.7	east of north

Kalamazoo, Kalamazoo County.—The station of 1907 on the southern edge of the grounds of Kalamazoo College, about 1½ miles southwest of the center of the town, was reoccupied. 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 (mark)	4	59.8	west of south
Center of top of large tower at the asylum	10	41.3	west of south
Flagstaff on private sanitarium	33	39.8	east of south
Flagstaff on normal school	52	35.1	east of south

Lake City, Missaukee County.—The station is in the county fair grounds, about three-eighths of a mile east from the county courthouse. The station is in the infield of the race track, 48 paces from the inside fence on the east and 66 paces from the inside fence on the west side of the race course. It is 180 feet southwest from the judges' stand, which is in front of the grand stand. The spot is marked by a cement building block 8 by 10 by 20 inches, with a ½-inch hole at the center, and projecting 3 inches above the ground. The following true bearings were determined:

	°	′	
Staff of high school belfry (mark)	87	41.2	west of north
Cross on Catholic Church steeple	68	17.1	west of south

Manistee, Manistee County.—The station is on the county farm, 3 miles northeast from the county courthouse. It is on the north side of the county road, 93 feet north from the fence along the north side of the road, and somewhat more than 300 feet southeast from the brick house or county home. It is 72 paces east from a line along the east wall of the home. The station is marked by a marble post 6 by 6 by 39 inches, projecting 10 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
East cupola on county barn (mark)	35	52.5	west of north
Northeast corner of large smokestack on premises	45	29.7	west of north
Northeast corner of the central chimney on the home	59	56.0	west of north

Mio, Oscoda County.—The station is about three-eighths of a mile south from the county courthouse and at the west side of the principal street of Mio. It is on an open ridge which runs up westward to the cement water tank of the Mio Water Co. The cellar of a house destroyed by fire is about 120 feet east from the station, and the water tank (east edge) is 128 feet west from the station. The point is marked by a cedar post 5 inches in diameter and 3 feet 6 inches long, standing about 1 foot above ground. Above ground the post is hewed square, and the date 1910 is cut in the north face of the post. The following true bearings were determined:

	°	′	
County courthouse tower (mark)	11	20.8	east of north
Belfry on a church (built of cement blocks)	5	33.1	west of north
Center of water tank (approximately)	77	05.0	west of south

Descriptions of stations—Continued.

MICHIGAN—Continued.

Muskegon, Muskegon County.—The station is in Forest Home Cemetery, about 3 miles northeast from the county courthouse. It is 58 paces south from the fence line at the north side of the cemetery (adjoining the public road) and 366 paces from the west fence line of the cemetery. This is a 120-acre tract belonging to the city and is unused. The station is marked by a Bedford limestone post 8 by 8 by 40 inches, projecting 14 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
County courthouse tower (mark)	73	22.7	west of south
South edge of smokestack at electric power station	81	16.6	west of south
Tower on Fire Department House No. 5	89	52.4	west of north

Paw Paw, Van Buren County.—The station is in the public school's 5-acre athletic field, one-half mile due east from the county courthouse. It is 59.3 feet from the south fence and about 380 feet from the west fence of the field. The station is marked by a Bedford limestone post 8 by 8 by 30 inches, lettered U. S. C. & G. S., 1910, and projecting 6 inches above the ground. The following true bearings were determined:

	°	′	
Flagpole on the public-school building (mark)	77	25.2	west of north
Catholic Church steeple	84	43.8	west of south
Free Baptist Church dome	84	04.5	west of north

Saginaw, Saginaw County.—The station is on the golf grounds of the Saginaw Country Club, about 2 miles west from the courthouse at West Saginaw, or about 4 miles southwest from the central part of Saginaw, east side. The station is 100 paces from the west fence of the golf ground and is about 70 rods south from the clubhouse. Three large cottonwood trees are directly west from the station. The station is marked by a Bedford limestone post 7 by 7 by 42 inches, lettered U. S. C. & G. S., 1910, and projecting 8 inches above ground. The following true bearings were determined:

	°	′	
Center post on elevated water tank at Herzog Art Furniture Factory (mark)	75	23.0	east of south
Staff on Durand School belfry	53	38.1	east of south
South end of ridgepole of Saginaw Country Club house	3	32.0	west of north

MINNESOTA.

Blue Earth, Faribault County.—The station is in the southeast corner of the courthouse grounds, about 3 blocks north of the business street. It is 29 feet from a tree to the east, 27.7 feet from a tree to the northeast, and 46 feet from a tree to the northwest. It is marked by a Bedford limestone post 8 by 8 by 30 inches, projecting about 4 inches above the ground, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Northeast corner of jail (mark)	61	28. 8	west of north
Northwest corner of Roski's house	52	08. 2	east of north
Northeast corner of Kinney's house	28	56. 2	east of south

Caledonia, Houston County.—The station is on the grounds of the new school building, 2 blocks west of the main street of the town. It is 113.5 feet southwest of the southwest corner of the building, 105.5 feet south of a large burr oak tree, and 64 feet from the south side of the school ground. It is marked by a Bedford limestone post 8 by 8 by 30 inches, projecting 4 inches above ground, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Spire on courthouse (mark)	67	06. 7	east of south
Spire on jail	74	57. 6	east of south
Cross on German Catholic Church	54	23. 4	east of south
Spire on red brick church	15	03. 4	east of south

Descriptions of stations—Continued.

MISSISSIPPI.

New Albany, Union County.—The station is on the hill southeast of town, in an open lot belonging to Mr. H. H. Phyfer, and just northwest of his house. It is 96.4 feet west of a fence on the west side of Main Street, 30.4 feet north of a fence, 32.6 feet east of a woven fence. It is in the midst of a group of cedar trees. Declination was observed at a second station (B) 60.5 feet to the west of the main station to test for local disturbance. The main station is marked by a limestone post 8 by 8 by 24 inches, lettered U. S., 1911, and projecting 2 inches above ground. The following true bearings were determined:

	°	′	
Apex of main tower on school building (mark)	68	02. 1	west of south
Spire on courthouse dome	54	52. 9	west of north
Methodist Church spire	37	55. 8	west of south
Magnetic Station "B" (test station)	65	34. 6	west of south

MISSOURI.

Farmington, St. Francois County.—The station is north of the western part of the grounds of the Carleton Methodist College, about one-half mile southeast of the town's center. It is 76 paces south of the southeast corner of the brick residence of the professor of science, 109 paces northwest of the northwest corner of the main college building, and 51 paces east of a fence across the road to the west. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 3 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Base of cross on Catholic Church (mark)	12	19. 3	west of north
Spire of Lutheran Church	2	11. 6	east of north
Base of rod at east corner of top of tower of main college building	26	33. 4	east of south

Fredericktown, Madison County.—The station is in the northwestern corner of the grounds of the Marvin Methodist College, about three-fourths of a mile southeast of the town's center. It is 66.5 feet south from the fence bordering the grounds on the north, and 72.9 feet east from the fence bordering the grounds on the west. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 2 inches above ground, and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Spire on courthouse cupola (mark)	41	31. 2	west of north
Flagpole on cupola of high school	53	17. 2	west of north
Spire on Christian Church	51	03. 7	west of north
Cross on Catholic Church steeple	54	26. 9	west of north
Cupola of main college building	44	17. 8	east of south

Hermann, Gasconade County.—The station of 1900 was reoccupied. It is on Blusts Hill, southeast of the depot, on land owned by the city. It is 48.2 feet south of the fence running east and west across the hill, and is marked by a gray limestone post 6 inches square on top and lettered U. S. C. & G. S. (the lettering very faint in 1906), extending 4 inches above the ground. The following true bearings were determined:

	°	′	
Courthouse spire (mark)	62	34.2	west of north
Pole (tree) on distant ridge	21	17.2	west of north
Flagstaff of Stone Hill Wine Co	58	14.8	west of south
Catholic Church cross	87	51.7	west of south
Spire of Methodist Church	70	03.6	west of north

Descriptions of stations—Continued.

MISSOURI—Continued.

Marble Hill, Bollinger County.—The station is in the eastern part of the southern part of the field surrounding the Marble Hill College, south of the main building and about one-fourth mile northwest of the town's center. It is 83.3 feet west of the fence bounding this field on the east and 121.4 feet north of the fence bounding the field on the south. It is marked by a limestone post 6 by 6 by 14 inches, resting on a solid ledge of rock and projecting 2 inches above ground. The top of the post is lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
Spire of Methodist Church at Lutesville (mark)	33	28.0	west of south
West rod at top of cupola of Baptist Church at Marble Hill	37	56.6	east of south
North rod at top of cupola of county courthouse	63	43.5	east of south
Tower of southwest corner of dormitory	36	43.7	west of north

St. Genevieve, St. Genevieve County.—The station is in the southern corner of the pasture at the county farm, about 700 feet southwest of the county farmhouse and about 1¼ miles west of the town's center. It is 84 feet northeast of the fence bordering the pasture on the southwest and 61 feet northwest of the fence bordering the pasture on the southeast. It is marked by a limestone post 6 by 6 by 30 inches, projecting about 5 inches above ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	°	′	
East gable of tallest barn at county farm	43	05.5	east of north
West gable on section house on short railroad bridge across river	52	25.3	east of north

Sedalia, Pettis County.—The station of 1900 was reoccupied. The station is located on the campus of the George R. Smith College, 223.5 feet south and 37.2 feet east of the southeast corner of the building. It is marked by a gray limestone post 8 by 8 by 34 inches, lettered U. S. C. & G. S., and set flush with the ground. The following true bearing was determined:

	°	′	
Tip of courthouse tower (mark)	47	51.8	west of south

MONTANA.

Billings, Yellowstone County.—The old station could not be exactly located, but observations were made as near as possible to the spot occupied in 1906. This was to the east of the cemetery, in a roadway leading through an alfalfa field belonging to Mr. O'Donnell. The station is not marked. The following true bearings were determined:

	°	′	
Courthouse cupola (mark)	65	28.2	east of north
City hall flagpole	68	35.2	east of north
Public-school flagpole	71	20.4	east of north

Boulder, Jefferson County.—The station is located in the cemetery east of town in the first drive from the west side, well toward the north end of the cemetery. It is 44.5 feet from the west fence, 136 feet from the north fence, and 30 feet north and a little west of the Emery W. Burdick Monument. The station is marked by a 5-inch tile, sunk level with the ground. The following true bearings were determined:

	°	′	
Tip of water tank at State institution for deaf and dumb (mark)	26	41.6	west of south
Main cupola on main building of institution	31	11.2	west of south
Main cupola of courthouse	70	40.4	west of south

Helena, Lewis and Clark County.—The station of 1904 was reoccupied. It is located near St. Joseph Catholic Orphan Asylum, about 1 mile north of the city limits. It is 453 feet east of the inner edge of Montana Avenue extended, 78 feet north of the plank fence around the asylum grounds, and 250 feet northeast of the northeast corner of the east asylum building. It is marked by a granite slab 6 by 6 by 24

Descriptions of stations—Continued.

MONTANA—Continued.

inches, with a drill hole in its top, projecting 3 inches above ground. The following true bearings were determined in 1910:

	°	′	
Tip of right (west) one of two water tanks Northern Pacific R. R. (mark)	14	22.6	east of south
Right (west) high iron smokestack Northern Pacific roundhouse	17	10.8	east of south
Right (south) edge of brick smokestack at sewer crematory	83	30.1	east of north

Lima, Beaverhead County.—The station is located on the public-school grounds, north and a little west of the school building. It is 18 feet from the fence along the north side of the grounds and 75.5 feet from the fence along the west side of the grounds and 107.5 feet northwest of the northwest corner of the school building. The station is marked by a native bowlder about 16 inches long and about 4 by 4 inches at the top, round on top, and projecting 2 inches above the surface of the ground. The following true bearings were determined:

	°	′	
Tip of Oregon Short Line R. R. water tank (mark)	65	22.8	east of north
Left edge smokestack at the Oregon Short Line roundhouse	32	40.9	east of north

Livingston, Park County.—The station is located in the Protestant Cemetery northwest of town, 11.8 feet northwest of the base of the Shadoan Monument and 59.2 feet south of the gate at the north side of the cemetery. The station is marked by a marble slab about 3 by 6 by 20 inches sunk level with the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	°	′	
Left edge of chimney of Mr. Alber Trager's house	29	32.3	east of south
Tip of Watson Monument	4	21.6	west of south
Center of cemetery windmill	24	35.6	west of south

NEBRASKA.

Aurora, Hamilton County.—The station is near the northwest corner of the courthouse yard, due north of the G. A. R. Monument. It is marked by a Bedford limestone post 7 by 7 by 36 inches, projecting about 3 inches above ground, with a brass plate in the top. The following true bearings were determined:

	°	′	
Northeast corner of lowest base stone of G. A. R. Monument (mark)	2	33.2	east of south
Northwest corner of base stone of chimney of courthouse heating plant	89	52.1	east of north
Southwest corner of Schrandt & Miller's brick block	32	20.6	west of north

Chadron, Dawes County.—The station of 1906 was reoccupied. It is located on a bench about three-fifths of the way up the hill, which is south from the end of the street that passes by the east side of the county courthouse square. The east walk line of this street, if continued up the hill, would pass about 25 feet east of the station. The station is 54 feet northeast and down the hill from the east one of two pine trees, the station and high school being almost in line. The station is marked by a cement post 7 by 7 by 32 inches, now broken off about 2 inches underground. The following true bearings were determined:

	°	′	
Ball on cupola on Chadron High School (mark)	30	53.6	east of north
Southwest corner of brickwork on cupola of courthouse	3	53.7	east of north
Lower ball on cupola of Chadron Academy	24	05.7	east of north

Clay Center, Clay County.—The station is near the southwest corner of the courthouse yard. It is 30 feet north of the cement walk south of the courthouse and 118 feet east of the cement walk west of

Descriptions of stations—Continued.

NEBRASKA—Continued.

the courthouse. It is marked by a Bedford limestone post 7 by 7 by 30 inches, with brass plate in the top. The stone projects 5 inches above ground. The following true bearings were determined:

	°	′	
East edge of standpipe about 6 feet from the ground (mark)	15	42.7	west of south
Congregational Church spire	31	45.8	west of south
East edge of iron post between front windows of McFadden's store	2	44.9	east of north

David City, Butler County.—The station is in the southwest corner of the courthouse yard, near the town's center. It is marked by a Bedford limestone post 7 by 7 by 36 inches, projecting 6 inches above ground, with a brass plate in the top. The following true bearings were determined:

	°	′	
Northeast corner of Library Building 1 foot from ground (mark)	36	40.7	west of north
Southwest corner of top of Wright's clothing store	89	21.1	east of south
Extreme northeast corner of hotel, near steps	56	28.0	east of south
Southeast corner (at bottom of second-story windows) of I.O.O. F Block	36	43.9	west of south

Hartington, Cedar County.—The station is near the south end of the inclosure of the race track at the fairgrounds, about three-fourths of a mile east of town. It is 62.3 feet north of the inner fence around the race track and 354 feet east of the iron post near the entrance to the fairgrounds. This iron post marks the south end of a meridian line established by the United States Geological Survey. The station is marked by a Bedford limestone post 7 by 7 by 36 inches, sunk level with the ground, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Spire on steel water tank (mark)	79	46.2	west of south
East gable of a house	80	58.4	west of north
East gable of a barn (4 miles away)	75	15.8	west of north
Weather vane on cupola of house	49	38.4	west of south
Cross on Catholic Church spire	59	52.5	west of south

A cement post 6 by 6 by 20 inches about 1 000 feet to the north and near the fence marks the true meridian.

Lincoln, Lancaster County.—The station is situated on the campus of the State University Agricultural School, about 2 miles northeast of the town's center. It is between the roads, just northeast of the Home Economics Building. It is marked by a Bedford limestone post 8 by 8 by 36 inches, with a brass plate in the top. The stone projects about 6 inches above ground. The following true bearing was determined:

	°	′	
Southeast corner of Agricultural Hall just above base stone (mark)	12	30.1	west of south

A similar stone 494 feet to the south marks the true meridian.

Minden, Kearney County.—The station is near the southeast corner of the Central School grounds just south of the town's center. It is 33 paces southeast of the southeast corner of the school building, 20 feet north of the path between the trees, and 40 paces west of the cement walk on the east side of the grounds. It is marked by a Bedford limestone post, 7 by 7 by 36 inches, with a brass plate in the top. The stone projects about one-half inch above the ground. The following true bearings were determined:

	°	′	
Flagstaff on courthouse dome (mark)	1	51.7	west of north
Danish Church spire	71	23.8	west of north
United Presbyterian Church spire	81	44.7	west of north

Descriptions of stations—Continued.

NEBRASKA—Continued.

Newport, Rock County.—The station of 1900 was reoccupied. Observations were made over a sandstone post 27 inches long, set about 2 feet in the ground, 4 by 4 inches on top, with a small hole in the center, which marks the point. This post is located in the schoolhouse grounds. It is distant 106.1 feet due south of the combined porch and bell tower of the schoolhouse, in line with the center of the building, and 40.2 feet from the north side of the road in front of the schoolhouse. This schoolhouse and lot is on the northwestern edge of the town. The following true bearings were determined:

	°	′	
Methodist Church spire	80	35.0	east of south
Tip of Chicago & North Western Ry. water tank	53	31.0	east of south

Osceola, Polk County.—The station is near the town's center, in the northeast corner of the courthouse yard. It is marked by a Bedford limestone post 7 by 7 by 36 inches, projecting about 5 inches above ground, with a brass plate in the top. The following true bearings were determined:

	°	′	
West edge of standpipe 4 feet from the ground (mark)	24	43.3	east of north
Northwest corner of Pratt Hotel, even with top of porch	22	05.6	east of south
Northeast corner of Pulver Building, near cement walk	6	15.6	east of south
Southwest corner of pumping station, near ground	38	56.4	east of north

Pender, Thurston County.—The station is near the northeast corner of the high-school grounds, on the west edge of town. It is 94 feet east of the east side of the school building, 36 feet north of the main walk, 42 feet west of the cement walk on the east side of the campus. It is marked by a Bedford limestone post 7 by 7 by 36 inches, sunk level with the ground, with a brass plate in the top. The following true bearings were determined:

	°	′	
West edge of chimney on Nicholas Fritz's house (mark)	1	26.7	east of north
Methodist Church spire	42	49.8	east of north
Southwest corner of church foundation	79	33.5	east of south
Southeast corner of school building, near ground	50	04.8	west of south

Tekamah, Burt County.—The station is in the northwest corner of the fairgrounds, just back of W. W. Latta's house. It is near the northwest corner of the race track, 50 feet south of the wire fence on the south side of W. W. Latta's house, 32 feet east of a board fence, and 42 feet northwest from the fence around the race track. It is marked by a Bedford limestone post 7 by 7 by 36 inches, projecting 2 inches above ground, with a brass plate in the top. The following true bearings were determined:

	°	′	
Flagpole on north end of grandstand (mark)	6	54.9	west of south
Northeast corner of base of chimney on B. R. Latta's house	67	25.8	west of north
Southwest corner of brick foundation of W. W. Latta's house	12	37.9	east of north

NEW HAMPSHIRE.

Epping, Rockingham County.—The station is just back of the Jordon Block, in an open lot belonging to Mrs. Emma Thompson. It is 48 feet east of a high bank, 28 feet north of a high bank, and 130 feet west of a fence. The station is marked by a 6-inch locust post 36 inches long, set level with the ground. A brass screw marks the exact spot. The following true bearings were determined:

	°	′	
Weather vane on Mr. Fred Knox's barn (mark)	8	24.3	west of south
Spire on water tank at box factory	3	46.9	east of south
Congregational Church spire	34	46.4	west of north

Descriptions of stations—Continued.

NEW HAMPSHIRE—Continued.

Keene, Cheshire County.—The station is about three-fourths of a mile east of the town's center. It is on city property near the reservoir, 45 feet east of a road, 36 feet west from west edge of reservoir, and 130 feet north and a little west from northwest corner of ice house. The station is marked by a granite post 6 by 6 by 20 inches, lettered U. S., center marked and projecting 2 inches above ground. The following true bearings were determined:

	°	′	
Spire on Baptist Church (mark)	83	24.2	west of south
Spire on First Church	81	06.4	west of south
Base of weather vane on steel water tower	79	23.1	east of south

Nashua, Hillsboro County.—The station is about 1 mile north of the town's center. It is near the south edge of an apple orchard, on property belonging to the Nashua Manufacturing Co. This apple orchard is just south of Greeley Park, and is on the north side of Bartlett Avenue and about 3 blocks west of Concord Street. It is 130 feet east of a wire fence and 79 feet north of a fence on the south side of Bartlett Avenue. The station is marked by a granite post 6 by 6 by 20 inches, lettered U. S., center-marked, and set level with the ground. The following true bearings were determined:

	°	′	
Spire on Mount Pleasant School Building (mark)	3	21.0	east of south
Cross on Catholic Church	35	34.4	east of south
Apex of cupola of house on east side of Concord Street	72	25.2	east of south

North Conway, Carroll County.—The station is in a large open lot just south of the Sunset Hotel. It is 112 feet north of a fence, 216.8 feet southeast from southeast corner of Sunset Hotel, 172.8 feet west from a tree on the west side of Main Street, and is about in line with the weather vane on J. L. Gibson's barn and the flagpole on Kearsarge Hotel. Station is marked by a granite post 8 by 8 by 36 inches, center marked by ½-inch drill hole, and set level with the ground. The following true bearings were determined:

	°	′	
Weather vane on J. L. Gibson's barn (mark)	30	11.5	east of south
Flagstaff on Randall Hotel	59	18.2	east of south
Southwest corner Mr. Warren's house, near foundation	29	16.0	east of north
North edge of a ledge near center of top of Moat Range	68	36.1	west of south

Ossipee, Carroll County.—The station is about one-fourth of a mile north of town's center. It is near the center of a large meadow known as the Alonzo Stillings estate. It is 566 feet south of a stone wall, 482 feet west of a fence, 440 feet east of the nearer of two isolated trees, 142 feet northeast of a very large pointed bowlder projecting 4 feet above ground, and 26 feet northwest from the nearest of a group of large bowlders. The station is marked by a large granite bowlder, plain on top, center-marked and lettered U. S., and set level with the ground. The following true bearings were determined:

	°	′	
Weather vane on Boston & Maine station (mark)	36	44.8	east of north
Weather vane on courthouse dome	13	39.3	east of south
Congregational Church spire	9	12.5	west of south

Rochester, Strafford County.—The station is about 1 mile south and one-fourth mile east of town's center. It is near the center of a large meadow owned by Harry Weare, the exact location of the station being known to Mr. Weare. It is 296.2 feet northeast of the east fence along Boston & Maine Railroad, 220 paces southeast of a road, and 70 feet northwest of the edge of a stone pile. Station is marked by a granite bowlder, flat on top, and bearing a cross and half-inch drill hole. The following bearings were determined:

	°	′	
Weather vane on George Trickey's house (mark)	2	30.8	east of south
Congregational Church spire	84	43.6	west of south
Methodist Church spire	88	11.7	west of north
Spire on Harry Weare's house	59	18.9	east of north

Descriptions of stations—Continued.

NEW JERSEY.

Blairstown, Warren County.—The station is on the north edge of town on the campus of the Blair Academy. It is 75 feet north of the boys' tennis courts and about 18 rods northeast of the northeast corner of the gymnasium; 40 feet northwest from a lone elm tree, 40 feet south of a large tree, about 100 feet west of a steep bank, and about 50 feet south of a wooded knoll. The station is marked by a marble post 6 by 6 by 30 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Weather vane on Methodist Church (mark)	21	45.7	west of south
Spire on south end of gymnasium	36	57.2	west of south
Weather vane on the chapel	65	23.5	west of south
South edge of the standpipe at top	68	12.1	west of south
Center of top of Presbyterian Church tower	33	19.6	east of south

Glassboro, Gloucester County.—The station is near the north edge of town in a small pasture belonging to Mr. Palun. This pasture is just south of the Methodist Episcopal Cemetery. The station is 50 feet southwest of a rail fence; 231 feet southeast from cemetery fence; 66 feet south from a tree; 177 feet northeast from fence on northeast side of Broad Street. It is marked by a marble post 6 by 6 by 20 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Base of weather vane on Methodist Church spire (mark)	55	30.4	west of south
North edge of city water tower	28	18.8	west of north
South gable of Harry Wood's barn	15	59.6	east of north
South gable of a house	50	31.9	east of south

Lakewood, Ocean County.—The site for the station was selected by Benjamin H. Fielder, city engineer. It is near the highest point of Cemetery Hill, about 1 mile south of town. It is in a wide street just south of Capt. Bradshaw's lot; 7.8 feet south of a low brick wall; 27.1 feet southwest from a marble post at the corner of the brick wall; 100 feet southwest from southwest corner of Kimball monument; 39.6 feet northwest from northwest corner of Gardner monument. The station is marked by a marble post 6 by 6 by 20 inches, lettered U. S., 1910, and set 1 inch below the surface. The following true bearings were determined:

	°	′	
Apex of tower on George Gould's barn (mark)	39	36.0	west of north
Apex of tower on Lakewood Hotel	23	39.5	west of north
East edge of water tank at Laurel House	26	43.0	west of north
Presbyterian Church spire	28	40.8	west of north
Southeast edge of base stone of large obelisk	24	47.0	west of south

Long Branch, Monmouth County.—The station is about 1 mile southwest of the town's center. It is near the center of the Hollywood golf grounds; about 40 feet north of the west end of a large mound; 90 feet northwest from a lone tree; 158 paces south from a lone pine tree; 260 paces south from a tree at the foot of Oak Ridge. A trail across the grounds passes just north of the station. The station is marked by a marble post 6 by 6 by 20 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Weather vane on school building (mark)	64	18.2	east of north
Flagstaff on golf clubhouse	4	53.2	east of south
Spire on distant church	40	41.9	west of south

New Brunswick, Middlesex County.—The station of 1903 was reoccupied. It is on the athletic field of Rutgers College. It is somewhat southeast of the center of the oval field inclosed by the running track, being about 60 yards from the southeast end of this field. It is 161 feet to inside of track on east; 174.5 feet to inside of track on west; 187.8 feet to inside of track on south; 105.4 feet to the post marking third base of the ball diamond, and 76 feet to the post marking second base. The station

Descriptions of stations—Continued.

NEW JERSEY—Continued.

is marked by a marble block 8 by 7 by 17 inches, sunk 2 inches below the surface of the ground, and lettered on top U. S. C. & G., 1903. The following true bearing was determined:

	°	′	
Church spire about 3 miles away (mark)	68	51.6	east of true north

New Foundland, Passaic County.—The station is about 375 feet north and a little east of the Chamberlain Hotel. It is on a hill sloping toward the river to the west and south; 141 feet west of a stone wall and 95 feet southeast from a very large bowlder. The property on which the station is located is known as the Chamberlain estate. The station is marked by a granite bowlder, flat on top, and marked by a cross and drill hole. The following true bearings were determined:

	°	′	
Northeast corner of large brick chimney at oil station (mark)	25	05.0	west of south
North gable of Red Rock Inn	43	02.3	west of south
Northwest corner of George Monk's house	53	24.4	west of south

Paterson, Passaic County.—The station of 1904 was reoccupied. The station is in the southeast corner of Eastside Park and northeast of Dr. Marsh's house. The station is between two paths which come to a point toward the south, being 15.1 feet from the western edge of the path to the east and 42.6 feet from the eastern edge of the path to the west. It is 17.7 feet from a small lone pine tree a little south of west and 28.3 feet a little west of north from a second pine tree. The station is marked by a brown stone 6 by 6 by 26 inches, sunk 1 inch below the surface of the ground, and lettered U. S. C. & G. S., 1904. The following true bearings were determined:

	°	′	
Spire on the barn of Dr. Marsh (mark)	30	10.3	west of south
West edge of the northwest chimney on the Spenginer House	19	23.6	east of south
Southeast edge of southeast chimney on Dr. Marsh's house	39	21.8	west of south

Sussex, Sussex County.—The station is about three-fourths of a mile northeast of town's center. It is near the northwest corner of a race track on property of Mr. Simon Wilson. This track is about one-fourth mile southeast of the Fairview Cemetery. It is 40 feet south of a board fence and 50 feet east of the south side of the gate, and a fence on the north side of a road leading into the race track, if produced, would pass through the station. It is marked by a marble post 5 by 5 by 30 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Base of weather vane on Presbyterian Church spire (mark)	72	30.0	west of south
Base of weather vane on Simon Wilson's barn	20	17.8	west of north
Spire on cupola of Owen Little's house	42	16.6	west of south
South gable of John Samis's house	83	02.2	east of north

Washington, Warren County.—The station is near the northeast corner of town. It is in the southwest corner of the ball park owned by Mr. John Weller. It is 72.7 feet east from a board fence; 41 feet north from a board fence; and 78 feet northeast from the corner of the park. Station is marked by a marble post 6 by 6 by 20 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Spire on cupola of D. V. Wycoff's house (mark)	83	51.2	west of south
Ball at top of water tank at silk factory	37	21.3	east of north
Apex of ventilator on Faucet factory	72	07.2	east of north
Base of spire on north gable of Mrs. Hummer's house	51	31.6	west of south

Winslow Junction, Camden County.—This station is on a knoll in an old clay pit belonging to the Winslow Hydraulic Pressed Brick Co. It is about midway between the West Jersey Railroad and the Atlantic City Railroad and about 20 rods west of the railroad station. It is 264 feet south of south rail of West Jersey Railroad; 280 feet southeast of east end of railroad bridge; 39 feet southwest from a tree;

Descriptions of stations—Continued.

NEW JERSEY—Continued.

57 feet north of a bank. The station is marked by a marble post 6 by 6 by 20 inches lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	°	′	
Steel flagstaff on water tank at Winslow (mark)	48	25.7	west of south
Spire on water tank of Atlantic City R. R	3	15.9	west of south
Apex of pipe on signal house	36	10.8	east of south
Northwest corner of top stone at east end of railroad bridge	10	42.0	east of north

NEW MEXICO.

Raton, Colfax County.—The station is located in the cemetery northeast of town, about 150 feet north of the south fence of the cemetery. It is in the intersection of two alley ways, at the northeast corner of the Morris lot, the southeast corner of the Dawson lot, and the southwest corner of the Fulghum lot. Station is marked by a cement block 6 by 6 by 18 inches, with a small drill hole in the center of the top, projecting about 2 inches above the surface of the ground. The following true bearings were determined:

	°	′	
Northeast corner (left edge) of school building (mark)	4	20.0	west of south
Cross on Catholic Church steeple	61	36.5	west of south
Left edge of highest of 4 iron smokestacks at Atchison, Topeka & Santa Fe roundhouse	86	02.4	west of south

Tucumcari, Quay County.—The station of 1906 was reoccupied. Observations were made over the stake marking the southwest corner of block 30, which is about one-fourth mile southwest of the county courthouse. The stake is 3 by 3½ inches and shows 1 inch above ground. It may be found by reference to the town map. The following true bearings were determined in 1910:

	°	′	
Tip of railroad water tank (mark)	2	39.9	east of north
Catholic Church cross	14	23.7	east of north
Flagpole on courthouse	23	06.3	east of north

NEW YORK.

Albany, Albany County.—The station of 1905 was reoccupied. The station is on a hill west of the Loudonville road. It is on land of the Van Renssalaer estate, in a field in front of a farmhouse occupied by Mr. Van Wely. It is also 8 feet from the base of a white marble post, 8 by 8 inches, projecting 3 feet above the ground, in the direction of the west tower of the State capitol. This post marks a point on the Albany city line. The station is 95 feet west from a fence and 100 feet east of the driveway to house formerly occupied by Mr. Van Wely. The following true bearings were determined:

	°	′	
West tower of Capitol, apex (mark)	12	09.8	west of south
Tower of city hall	6	20.9	west of south
St. Joseph's Church spire	0	39.7	west of south

Catskill, Greene County.—Observations were made in the waterworks grounds, about one-half mile northeast of the courthouse, at a point on the top of the embankment around the reservoir, near its southeast corner. The station is about 6 feet from the edge of the embankment, and is 29½ feet from the nearest point of the wire fence surrounding the reservoir. It is marked by a stone post 6 by 6 by 30 inches, lettered U. S. C. & G. S., and projecting 9 inches above the ground. The following true bearings were determined:

	°	′	
North tower of Mr. Church's mansion (mark)	65	53.9	east of south
East corner of white hotel on the Catskill Mountains	76	11.8	west of south

Descriptions of stations—Continued.

NEW YORK—Continued.

Ellenville, Ulster County.—Observations were made about one-half mile southwest of town, in the old cemetery, at a point in the upper part. The station is 9½ feet northwest of the northwest face of the base of the Vangorder Monument, 22 feet southwest of the southwest face of the base of the Catherwood Monument, and 61 feet northwest of the fence southeast of the cemetery. It is marked by a granite post 6 by 6 by 20 inches, lettered U. S. C. & G. S., and projecting 2 inches above the ground. The following true bearings were determined:

	° ′	
Belfry of Methodist Church (mark)	35 22.6	east of north
Center of State Reformatory building	42 29.3	east of north
Soldiers' monument in new cemetery	30 34.6	east of north

Fonda, Montgomery County.—Observations were made in St. Cecilia's Cemetery, about three-fourths of a mile north of town, at a point in the western part of a circular plat surrounding the cross at the center of the cemetery. The station is 12.4 feet west from the center of the cross, 37 feet south of the south face of the base of the Cooley Monument, and 32 feet northeast of the northeast corner of the base of the Kane Monument. It is marked by a stone post 5 by 5 by 18 inches, lettered U. S. C. & G. S., and projecting about 2 inches above the ground. The following true bearings were determined:

	° ′	
Nearest corner of top of tower on brick house across the river (mark)	36 42.6	east of south
North gable of green frame house	1 18.4	east of south
East gable of white frame house	76 35.0	west of south

Hancock, Delaware County.—Observations were made in the upper or north part of Riverview Cemetery about 1 mile west of town, at a point in the pathway at the southeast corner of the Johnson lot. The station is 13 feet southeast of the southeast corner of the base of the Johnson Monument and 30 feet southwest of the southwest corner of the base of the tombstone of Jacob Abele. It may be reached by following the main roadway into the cemetery about 210 feet westward from the gate, and then turning northward for about 230 feet. It is marked by a stone post 6 by 4 by 30 inches, unlettered, set flush with the ground, and having a hole five-eighths inch in diameter at its center. The following true bearings were determined:

	° ′	
White stone monument across the Delaware River (mark)	75 57.7	east of south
Belfry of Presbyterian Church	87 04.0	east of north
South gable of house across the Erie R. R.	4 07.1	west of south

Hudson, Columbia County.—Observations were made on ground belonging to the city waterworks system, at a point on an embankment north of the highest reservoir and just beyond the city cemetery. The point is about 50 feet north of the northeast corner of the highest reservoir, 10 feet north of the edge of the embankment on which it is located, and 60 feet south of a barbed-wire fence at the north of the grounds. It is marked by a marble post 5 by 5 by 21 inches, lettered U. S. C. & G. S., and projecting about 4 inches above the ground. The following true bearings were determined:

	° ′	
East edge of top of largest chimney of cement factory (mark)	34 50.7	west of south
Tip of gate house in the lower reservoir	60 18.0	west of south
Tip of large stone monument in nearest corner of cemetery	72 16.0	east of north

Hudson Falls, Washington County.—Observations were made in St. Paul's Cemetery, belonging to the French Catholic Church, about 1 mile north of the courthouse, at a point in the southwest part of the cemetery at the west edge of a roadway. The station is 43 feet east of the west fence of the cemetery, 140 feet north of the south fence, and 10.7 feet west (nearly) of the west edge of the base of the gravestone of Joseph Trombley. It is marked by a marble post 6 by 6 by 21 inches with the letters U. S. roughly chiseled on its face and projecting about 2 inches above the ground. The following true bearings were determined:

	° ′	
Spire of brick church next to courthouse	19 12.0	west of south
Spire of French Catholic Church	26 54.4	west of south

Descriptions of stations—Continued.

NEW YORK—Continued.

Liberty, Sullivan County.—Observations were made in the western part of the cemetery, just northeast of town, and about 150 feet from the highest part, at a point in the middle of one of the pathways. The station is 24½ feet north of the edge of a main roadway, 11 feet northwest of the northwest corner of the base of the Hall Monument, 16 feet southwest of the southwest corner of the Dixon Monument, and 116 feet east of the west fence of the cemetery. It is marked by a stone post 6 by 6 by 26 inches, projecting 2 inches above the surface of the ground. The following true bearings were determined:

	°	′	
Gable at south end of front of yellow wooden hotel (mark)	73	18.2	west of north
Water tank just above railroad station	56	30. 2	west of south
Spire of Presbyterian Church	63	20.2	west of south

Rochester, Monroe County.—The station of 1907 was reoccupied. It 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 West Main and North Fitcher Streets, passes through the station, which is in a saddle of the ridge 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 9 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. Paul's 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
Dome on the Powers Building	17	36.3	west of north

Schenectady, Schenectady County.—Observations were made at a point about 900 feet south of the pumping plant of the city waterworks and about 2¾ miles northwest of the central part of the city. The station is on land belonging to Mrs. S. J. Schermerhorn, and is about 400 feet northeast of her house and about 200 feet north of the south fence of the property, adjoining a public road. It is 106 feet east of the southeast corner of the barn, on the line of the prolongation of the south or front side of the barn. It is marked by a marble post 6 by 6 by 21 inches, lettered U. S. C. & G. S., set flush with the ground. The following true bearings were determined:

	°	′	
Peak of stone water tower in Schenectady (mark)	70	50.2	east of south
Principal tower of Polish Church, Schenectady	81	16.6	east of south
East gable of a house	24	02.9	west of south

NORTH CAROLINA.

Bakersville, Mitchell County.—Observations were made over the north monument of the meridian line established in 1900 in the open space on the courthouse property northwest of the courthouse. This old station being no longer suitable for magnetic observations, a new one was established in the northern part of the grounds surrounding the Bowman Academy, about one-half mile southeast of the town's center. It is 55.7 feet west of the northwest corner of the academy building and 28 feet south of the fence to the north. It is marked by a granite post 7 by 7 inches at the top and 42 inches long, projecting about 12 inches above ground. The post is lettered N. C. G. S. and U. S. C. S., 1900, with a cross in the top to mark the exact spot. The following true bearings were determined:

	°	′	
West gable of storehouse on Charles Stewart's property (mark)	16	32.0	east of south
East gable of Dr. V. R. Butts's house	74	33.9	west of north

A similar post 212 feet distant marks the south end of a meridian line.

Descriptions of stations—Continued.

NORTH CAROLINA—Continued.

Laurinburg, Scotland County.—Observations were taken over the southern of the two meridian stones set about 195 feet apart on the grounds surrounding the grade schoolhouse, about one-fourth mile south of the town's center. The station is 43 feet north of the south border of the grounds, 161 feet west of the east border of the grounds, and 169 feet northwest of the stake at the southeast corner of the grounds. It is marked by a blue granite post 48 inches long and 6 by 6 inches at the top, lettered at the top N. C. G. S. and U. S. C. S., with a cross to mark the exact spot. The post projects about 18 inches above ground. The following true bearings were determined:

	°	′	
Ornamental rod on cupola of James Sanitarium (mark)	26	50.3	west of north
Top of town water tank	26	28.3	west of north
Lower southeast corner of cupola of jail	6	41.2	west of north
Center of top of a factory smokestack	67	15.4	east of north
Center of top of a factory smokestack	77	23.0	east of north

The north meridian stone is of blue granite 60 inches long and 6 by 6 inches at the top, lettered and marked in the same way, and projects about 24 inches above ground.

Observations were also made at the magnetic station of 1899 in the grounds of the Presbyterian Church.

Raeford, Hoke County.—The station is located at the south end of a meridian line about 240 feet long, in a grove of pine trees belonging to State Senator McGlouchlan, immediately east of the property reserved for the county courthouse and jail. The line is about 500 feet east of the main street of the town and about 1 000 feet northeast of the town's center. It is marked by two brownstone posts 6 by 8 by 42 inches, projecting about 9 inches above ground. On the south post is a magnetic station marker, and the north post has a small hole in the top to mark the exact spot. The following true bearings were determined:

	°	′	
Upper northeast corner of Raeford Drug Co. (under eaves) (mark)	50	43.2	west of south
Lower southwest corner of main building of grade school	84	50.7	west of north
East gable of a small wooden church near the north edge of town	51	06.6	west of north

Rutherfordton, Rutherford County.—The old station, on account of local disturbance, was no longer available. At the request of the county commissioners a new station was established 700 feet north of the old one. It is on the grounds surrounding the courthouse near the center of town, 23.5 feet south of the north boundary, 46.5 feet east of the west boundary, and about 198 feet a little north of west of the northwest corner of the courthouse. The station is marked by a granite post 6 by 6 by 45 inches, projecting 12 inches above ground, center-marked and lettered N. C. G. S. and U. S. C. S., 1899. The following true bearings were determined:

	°	′	
Spire on Zion Methodist Church (colored) (mark)	82	29.4	west of south
Ball at top of steeple of Presbyterian Church	9	16.0	east of north
Base of rod on steeple of Methodist Church	61	48.9	east of north
Upper eastern corner of Rutherford Hospital	43	30.3	west of south

A similar stone 141 feet south marks the other end of the meridian line.

Sanford, Lee County.—Observations were taken over the south end of a meridian line about 420 feet long. This line is marked by two brownstone posts 6 by 8 by 36 inches, set with the top about 7 inches above ground. The south stone has a magnetic station marker set in the top, and the north stone has a hole in the top to mark the exact spot. The south stone or magnetic station is in the southern part of the ground surrounding the county courthouse, about 1 mile northeast of the town's center. It

Descriptions of stations—Continued.

NORTH CAROLINA—Continued.

is 10 paces northeast from the southwest border of the grounds and 48 paces northwest from the southeast border of the grounds. The following true bearings were determined:

	°	′	
Lower southwest corner of brick frieze around roof of jail (mark)	29	49.1	west of north
Point on south top of roof of J. L. Brown's house	57	11.6	west of north
North gable of roof of McPhail's (the florist) house	64	11.5	west of north
Lower west edge of west chimney of the Ryan homestead	32	55.2	west of north

Whiteville, Columbus County.—The old station of 1899 was reoccupied. It is in the northwest corner of the courthouse grounds, at the north end of the meridian line. The south meridian stone was moved 23 feet to the north. The following true bearing was determined:

	°	′	
Lower west edge of steeple of Baptist Church (mark)	2	18.3	east of south

OHIO.

Cleveland, Cuyahoga County.—The station of 1907 was reoccupied. It is in about the central part of Woodland Hill Park, about 5½ miles southeast of the center of town. It is north of the park pavilion or shelter and near the south edge of a shallow ravine. It is 115.6 feet northwest of the northwest corner of a row of fence posts surrounding the athletic field and 172.8 feet north of the northwest corner of the steps surrounding the pavilion. A park hydrant is 33 paces south from the station. It is marked by a sandstone post 8 by 8 by 30 inches, set 6 inches above the ground, and lettered U. S. C. & G. S., 1907. The following true bearings were determined:

	°	′	
Base of lamp-post at east end upper fence of reservoir (mark)	37	10.8	east of south
South edge of second highest smokestack in Newburg	82	42.1	west of south

Toledo, Lucas County.—The station of 1907 being unavailable, a new station was established on the Harbor View Beach grounds (old Shepard farm) near the boundary line separating it from the Case farm, about 5½ miles northeast of the center of the city. It is on the shore of Maumee Bay, 60.7 feet slightly west of south from an iron stake 1½ inches square, 6 inches above ground, which remains from an old triangulation station. The station is in line with the west wall of a dancing pavilion, 115.8 feet north from the northwest corner of the concrete foundation, and 130.6 feet from the northeast corner of the foundation, 61.1 feet being the distance from the northwest corner to the northeast corner of the foundation. It is marked by a pine stake 2 by 2 by 15 inches, driven flush with the ground. The following true bearings were determined:

	°	′	
West gable of farmhouse (slate roof) (mark)	50	11.2	east of south
North gable of farmhouse	19	01.1	west of south

OKLAHOMA.

Ada, Pontotoc County.—The station is located on the grounds of the State normal school east of town, near the west boundary of the grounds. It is due west of the eighth window, counting from the south, in the south wing of the normal building. It is 50.5 feet south from the south edge of the cement walk running west from the main entrance of the building to the center of Main (or Eleventh) Street; also 12.5 feet east from the line (projected) of the outer edge of cement walk running north on the east side of Francis Avenue, which is the street bounding the grounds on the west. The station is marked by a marble slab about 2 by 6 by 22 inches, lettered U. S., sunk level with the ground. The following true bearings were determined:

	°	′	
Base of flagpole on yellow brick schoolhouse (mark)	47	30.6	west of north
Spire of Methodist Church	75	12.3	west of south
Left edge of black water tank (city tank)	56	45.0	west of south

Descriptions of stations—Continued.

OKLAHOMA—Continued.

Arapaho, Custer County.—Station is located in the Emerson School grounds in the west part of town, in the northeast part of the grounds. It is 13 feet from the east side fence, 60 feet from the north side fence, and 153.5 feet northeast of the northeast corner of the school building. The station is marked by an irregular limestone, about 17 inches long, tapering to about 2 by 3 inches at the top, sunk flush with the ground. The following true bearings were determined:

	°	′	
Reformed Church steeple (mark)	84	54.4	east of north
Christian Church steeple	79	10.6	east of south
Livery barn water tank	75	34.1	east of south

Bartlesville, Washington County.—The station is located in the cemetery in the southwest part of town, in the intersection of two alleyways, 215.5 feet from the fence on the east side of cemetery and 156.5 feet from the fence on the south side. It is 20 feet southeast of base of Chaney Monument. The station is marked by a Carthage stone, 5 by 9 by 18 inches, lettered U. S. C. & G. S., sunk level with the ground. The following true bearings were determined:

	°	′	
Cross on Catholic Church spire (mark)	53	46.8	east of north
Right (south) edge of standpipe	74	32.5	east of north
Left (east) edge of east chimney on Mr. Lannon's residence	9	37.5	west of south

Cherokee, Alfalfa County.—The station is located in the fair grounds southeast of town, just outside and near the west end of the race track, in a triangular piece of ground bounded by the outside race-track fence and a fence running north and south. It is about 3 feet south of the line of the south side of the grand stand if projected westward. It is 128.5 feet west of the southwest corner of the grand stand, 20.5 feet northwest from the nearest point in outside race-track fence, and 43 feet east of the cross fence running north and south about 120 feet east of the stable, this being the fence above mentioned and described as forming part of the triangle. The station is marked by a cement block, 4 by 7 by 18 inches, with a drill hole in the center sunk flush with the surface of the ground. The following true bearings were determined:

	°	′	
Tip of water tank, Santa Fe Ry. (mark)	42	29.2	west of north
Base of flagpole at entrance to fair grounds on building marked "Secretary"	40	51.6	west of north
Lightning rod on cupola of a barn northwest of fair grounds	25	13.5	west of north

Chickasha, Grady County.—The station is located in the Odd Fellows' Cemetery southwest of town, in the second large drive running east and west, counting from the north side. It is 118.8 feet west of the fence on the east side, dividing this cemetery from the old Catholic Cemetery, 70.6 feet northwest of the Carl Howard Monument (in form of a tree trunk), and 43 feet south and a little west of the Velma Dee Whited Monument. The station is marked by a marble post, 6 by 6 by 24 inches, lettered U. S. C. & G. S., and projecting 3 inches above ground. The following true bearings were determined:

	°	′	
Flagpole on Jefferson or South schoolhouse (mark)	32	13.0	east of north
Tip of water tank (painted white) at the residence owned by Mr. Bigger	21	16.7	west of north
Left edge of large pipe running down from center of city water tank	40	27.5	west of north

Duncan, Stephens County.—The station is in the cemetery west of town, about 100 feet northwest of the south entrance. It is in the first alley north of the fence, about 40 feet west of the center drive running north and south, and 79.5 feet north of the fence on the south side of the cemetery, 12.8 feet north from Capt. B. B. White Monument, and 19.3 feet south from Alice Downes Monument. The

Descriptions of stations—Continued.

OKLAHOMA—Continued.

station is marked by a marble post, 6 by 6 by 20 inches, lettered U. S. C. & G. S., set 1 inch above the level of the ground. The following true bearings were determined:

	° ′
Cupola of school building (mark)	51 03.4 east of north
Right (south) edge of water standpipe	24 06.8 east of north
Iron smokestack at elevator	84 19.9 east of north

El Reno, Canadian County.—The station is located in a drive running east and west near the northeast corner of the cemetery, southeast of town. It is 107.5 feet from the fence along the east side of the cemetery, 158.5 feet from the north fence and 29.1 feet southwest from the base of the Cody Monument. The station is marked by a marble post, 6 by 6 by 20 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′
Courthouse cupola (mark)	49 04.2 west of north
Left (west) edge of standpipe	43 20.6 west of north
Left (west) edge of smokestack at the electric-light plant	31 48.8 west of north

Enid, Garfield County.—The station of 1904 was no longer available and a new station was established. It is located in the cemetery north of town in a driveway, 125 feet from the fence along the west side of the cemetery and 216.5 feet from the fence along the south side; also 10.6 feet southeast of the base of the Allis Monument and 18.3 feet northeast of the base of the Ward Monument. The station is marked by a Bedford limestone, 6 by 6 by 24 inches, lettered U. S. C. & G. S., 1904. The following true bearings were determined:

	° ′
Flagpole on east main cupola of courthouse (mark)	4 27.1 east of south
Flagpole on west main cupola of courthouse	4 11.1 east of south
Flagpole on brick schoolhouse, southwest of station	31 26.0 west of south

Fairview, Major County.—The station is located in the fair grounds southeast of town, in the infield of the race track, 84 feet south of the inside race-track fence and 98 feet southwest of the southwest corner of the judges' stand. Station is marked by a cement block, 8 by 8 by 15 inches, with a drill hole in the center, sunk flush with the surface of the ground. The following true bearings were determined:

	° ′
Schoolhouse cupola (mark)	10 27.9 west of north
Flagpole on mill elevator	75 13.7 west of north
Tip of water tank	89 48.9 west of north

Holdenville, Hughes County.—The station is located in the cemetery north of town at the intersection of the first alley south of the drive running west from the "circle," with the third alley west of the drive running north and south, between the "circle" and entrance to the cemetery. It is 31 feet southeast of the Powell Monument (Hallie B. Powell). The station is marked by a Bedford stone, 3½ by 6 inches on top by 24 inches long, sunk level with the ground, and lettered U. S. C. & G. S. The following true bearings were determined:

	° ′
Tip of city water tank (mark)	5 28.4 west of south
Baptist Church spire	15 00.0 west of south
Catholic Church spire	15 58.7 west of south

Kingfisher, Kingfisher County.—The station is located on the grounds of the college east of town, about 550 feet east of the old Parker Hall or main building, and on a line with the south side of Parker Hall. It is also 112.5 feet south of a point which a fence would pass through if continued west through the campus. This fence is across the road east of the station, on the south side of the yard around two houses. The station is also 67.5 feet east of a fence running north and south through the campus, about the center east and west, along two rows of trees. The station is marked by a cement block, about 4 by

Descriptions of stations—Continued.

OKLAHOMA—Continued.

8 by 18 inches, roughly lettered U. S., projecting 1 inch above ground. The following true bearings were determined:

	° ′
Cupola of a country schoolhouse (mark)	0 44.4 east of south
Courthouse cupola	71 14.2 west of south
Tip of water tank (city)	76 13.0 west of south
Left (southwest) corner of girls' dormitory	60 00.3 west of north

Miami, Ottawa County.—The station is located in the cemetery 2½ or 3 miles north of town, near the south side of the main drive running east and west between the entrance and the "circle." It is about midway between entrance and "circle," at the intersection of this drive with the fifth drive running north and south, counting from the road on the east. It is 32.5 feet northeast of the northeast corner of the base of the Talbot Monument, 24.3 feet northwest of the northwest corner of the base of the Davidson Monument, and 44.5 feet northwest of the northwest corner of the base of the James Monument. The station is marked by a marble slab, 2 by 4 by 22 inches, lettered U. S., and sunk level with the ground. The following true bearings were determined:

	° ′
Steeple of Methodist Church (mark)	0 04.0 east of south
Cupola of schoolhouse	3 57.1 east of south
Tip of McManaman Monument	66 09.6 east of south

Muskogee, Muskogee County.—The station is located in the cemetery east of town, about two-thirds of the distance from the west toward the east end of cemetery, in an alley about 65 feet north of the drive running east from the circular lots and about 40 feet west from this drive at it turns and runs north. The station is 4.5 feet northeast of the northeast corner of the lot in which stands the (Lizzie B.?) Marshall Monument and 21 feet southeast of the copper monument, lettered A. P. Schaefer; also about 95 feet southwest of the tool house. The station is marked by a Carthage limestone 4 by 8 by 20 inches, lettered U. S. C. & G. S., sunk level with the ground. The following true bearings were determined:

	° ′
Cupola on Bacon College (mark)	2 48.5 east of north
Right (north) edge of standpipe	85 33.5 west of south
Cross on Catholic school	20 41.2 east of south

Nowata, Nowata County.—The station is located in the cemetery south of town at the southeast corner of the square in the center of the cemetery. It is 47.2 feet almost due south of the William V. Carey Monument and 23.5 feet almost due north of the Serelda H. Gabriel Monument. The station is a little west of a line drawn between these two monuments. It is marked by a Carthage stone 5 by 5 by 18 inches, lettered U. S. C. & G. S. and sunk level with the ground. The following true bearings were determined:

	° ′
Tip of city water tank (mark)	4 49.8 east of north
Smokestack at brick plant	10 47.0 west of north
Chimney on house on cattle ranch west of brick plant	14 07.1 west of north

Pawnee, Pawnee County.—The station is located in the cemetery 1½ miles north of town, near the entrance on the south side. It is 43.5 feet north of the fence on south side of cemetery, next to the road, and 79.3 feet northwest of the west gatepost at the entrance. This entrance is on the east line of the cemetery as now used (1910). The station is also 11 feet northwest of the Harry J. Coffman Monument. It is marked by a Carthage stone 4 by 6 by 18 inches, lettered U. S., and sunk level with the ground. The following true bearings were determined:

	° ′
Left (east) edge of city standpipe (mark)	7 22.5 west of south
Courthouse cupola	10 35.9 west of south
Flagpole on large schoolhouse	18 34.3 west of south

Descriptions of stations—Continued.

OKLAHOMA—Continued.

Pryor, Mayes County.—The station is located about midway, north and south, in the cemetery east of town. It is in the intersection of two alleyways, 70.5 feet from the west side fence, 76.6 feet southwest of the southwest corner of Harrison lot (iron fence around the lot), and 46.2 feet almost due south of the F. M. Freeman Monument. The station is marked by a Carthage limestone, 4 by 8 by 20 inches, lettered U. S. C. & G. S., and projecting 2 inches above ground. The following true bearings were determined:

	° ′	
Right edge of chimney on Mr. Wickham's residence (mark)	3 19.3	west of north
Smokestack at Snider's elevator	83 23.0	west of north
Baptist Church spire	83 24.2	west of south
Flagpole at orphans' home	41 27.8	west of south

Purcell, McClain County.—The station is located in the cemetery, southwest of town, just east of the inclosed space called the "circle," in the drive around the circle. It is 16 feet east of the circle, as now marked by a row of posts, a little north of a line drawn due east from the center of the circle. It is also 128.5 feet southeast of the base of the Stealey Monument. The station is marked by a cement slab about 3 by 10 by 20 inches, roughly lettered U. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Tip of city water tank (mark)	33 48.5	east of north
Spire of Catholic Church	35 09.5	east of north
Left edge of ice plant smokestack	42 52.1	east of north
Flagpole on schoolhouse near Oklahoma Central Ry. depot	53 37.3	east of north

Ryan, Jefferson County.—The station is in the fair grounds north of town, 72 feet almost due north of the northeast corner of the judges' stand and inside the race track. It is 116 feet northeast of the outside race-track fence in front of the grand stand. The station is marked by a marble post 6 by 6 by 20 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Flagpole on cupola at cotton gin (mark)	55 34.1	east of south
Cupola of schoolhouse	88 06.1	east of north
Tip of city water tank	85 55.1	east of north

Sayre, Beckham County.—The station is located in the northwest corner of the Bryan schoolhouse grounds, in the north part of town. It is 45 feet from the fence along the north side of the grounds, 30 feet from the west fence, and 139 feet from the northwest corner of the schoolhouse. It is marked by a cement block 7 by 7 by 20 inches, sunk flush with the surface of the ground, with a small drill hole in the center of the top. The following true bearings were determined:

	° ′	
Methodist Church spire (mark)	0 14.8	west of south
Baptist Church spire	6 44.6	east of south
Flagpole on cupola of old schoolhouse	12 39.5	east of south
Tip of city water tank	8 52.5	west of south

Stillwater, Payne County.—The station is located on the southwest corner of the athletic field on the campus of the Oklahoma Agricultural and Mechanical College, about 500 feet north and a little west of Morrill Hall. It is 250 feet (approximate, within 1 foot) due east from the first window from the south end of the boys' dormitory and 111.7 feet south and a little east of the southeast corner of the grand stand at the west side of the football field; also 58 feet north of an evergreen shrub hedgerow running east and west at the south end of the athletic field. The station is marked by a Carthage stone

Descriptions of stations—Continued.

OKLAHOMA—Continued.

4 by 6 by 18 inches, lettered U. S., and sunk level with the ground. The following true bearings were determined:

	°	′	
Steam exhaust pipe (inverted conical top) at college power house (mark)	36	25.4	west of south
Cupola on Old Central Building	7	35.6	east of south
Left (northeast) corner of ladies' dormitory	44	14.2	east of south

Tulsa, Tulsa County.—The station is located in the northeast part of the cemetery in the southeast part of town, in an alleyway running east and west and about 5 feet from the west edge of a drive running north and south. It is 76.5 feet from the fence on the north side of cemetery and 224 feet from the east fence; also 29.7 feet east and a little south of the larger McLaughlin Monument and 27.9 feet north and a little east of the Nellie England Monument. The station is marked by a marble slab 4 by 8 by 18 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	°	′	
Right (east) edge of city standpipe (mark)	44	41.3	west of north
Cupola of high school (yellow brick building)	72	27.4	west of north

Vinita, Craig County.—The station of 1904 was reoccupied. It is upon rising ground in the southwestern corner of North Park, almost due west of the town water tank, south of Halsell College, and a short distance (about 200 feet) northeast of the house, which is at this corner of the park, but across the road. It is northeast of the intersection of two roads at the southwest corner of the park, 121 feet from the road to the west and 175 feet from the road to the south. The station is marked by a hard sandstone 6 by 6 by 30 inches, projecting about 4 inches above ground, and lettered U. S. C. & G. S., 1904. The following true bearings were determined:

	°	′	
Bell tower on public school (mark)	34	02.2	west of south
Church steeple on corner of South Smith Street and main street of town	26	47.2	west of south
South Methodist Episcopal Church steeple	18	42.1	west of south
Flagpole on Halsell College	22	58.6	east of north

OREGON.

Pendleton, Umatilla County.—The station of 1905 was reoccupied. It is about one-fourth of a mile southeast of the center of the town, in the grounds surrounding the high school, southeast of the main brick building. It is 37 feet from a wooden fence to the south, 47.6 feet from a wooden fence to the east, and 204 feet southeast of the southeast corner of the main high-school building. The station is marked by a lava post 5 by 8 by 24 inches, set flush with the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
Christian Church spire (mark)	28	13.2	west of north
Methodist Church spire	19	45.8	west of north
Baptist Church spire	12	25.6	west of north
Flagstaff on large central cupola of courthouse	11	25.5	west of north

Portland, Multnomah County.—The station of 1900 is on the hill near the northwest corner of City Park, on the highest ground, within the loop which terminates the driveway. The location of the old station being unsatisfactory, a new station was established on the slope of a hill in the southwestern part of the City Park, about 2 miles southwest of the town's center and nearly due west of the round house between the reservoirs. It is about 500 feet southwest from the edge of a steep bank, which slopes down to the elk and buffalo inclosures, and about 300 feet a little west of south of an old broken-down bridge. It is in an inclosure west of an old road running north and south with a barbed-wire fence on each side and just west of the most western line of white stakes used to measure annual movement

Descriptions of stations—Continued.

OREGON—Continued.

of ground. It is 26 paces west of the fence on the east side of this inclosure and 70 paces south from the fence on the north side. It is marked by a sandstone post 6 by 6 by 14 inches, resting upon a foundation stone about 8 inches thick, with its pyramidal top about 3 inches above ground. The exact spot is the intersection of the diagonals between opposite corners. The following true bearings were determined:

	° ′	
Center of top of tall square brick tower surmounted by a dome (mark)	78 26.1	east of south
Northern of two twin towers of Jewish Synagogue	81 59.1	east of south
Church steeple showing between towers of synagogue	81 44.2	east of south
A small black-topped church steeple	51 07.0	east of north
Gilt tip of a small church steeple	49 57.7	east of north

PENNSYLVANIA.

Carbondale, Lackawanna County.—Observations were made in Brookside Cemetery, about 1½ miles southwest of the center of town, at a point about 500 feet northwest of the gate of the cemetery and about 100 feet south of the little house in the cemetery. The station is in the middle of a pathway, at a curve of the pathway, 35 feet west of the west corner of the base of the Rowlson Monument, 50 feet east of the southeast corner of a small inclosure with a monogram on the posts, and about 50 feet west of the main road into the cemetery. It is marked by a marble slab 2 by 8 by 22 inches, unlettered and set flush with the ground. The following true bearings were determined:

	° ′	
West gable of top of Delaware and Hudson breaker (mark)	35 57.8	east of south
Nearest gable of top of Erie breaker	16 01.0	east of south
North gable of house on hill	32 28.2	west of south

Hamburg, Berks County.—Observations were made at a point in the western one of the two circular plots near the center of the Union Cemetery, belonging to the Reformed Lutheran Church, about one-fourth mile from the center of town. The station is 6 feet west of the west edge of the driveway, 40.7 feet west of the southwest corner of the base of the tombstone of Stephen J. Smith, 49.6 feet south of the south face of the base of the tombstone of David Keller, and about 170 feet south of the gate of the cemetery. It is marked by a marble post 6 by 6 by 24 inches, lettered U. S. C. & G. S., set flush with the ground. The following true bearings were determined:

	° ′	
South gable of stone farmhouse (mark)	20 35.9	west of north
Steeple of Methodist Church	85 59.7	west of south
Cupola of barn	60 48.8	east of north

Harrisburg, Dauphin County.—The new station is within 50 feet of the station of 1907, at the south side of the playground on the eastern end of Island Park, about halfway between the bridge of the Cumberland Valley Railroad and the bridge of the Harrisburg Bridge Co. The station can at any time be found by referring to the Island Park authorities. The following true bearing was determined:

	° ′	
Raised hand on statue at State capitol (mark)	9 37.2	east of north

Hazleton, Luzerne County.—Observations were made in the northwest part of the grounds of the Hazleton Hospital, about one-half mile east of the center of town. The station is 32.5 feet uphill, or southward, from the edge of a retaining wall south of a main entrance road. It is 24 feet east from a small birch tree, 40 feet west from a chestnut tree, and about 100 feet east of the west wall of the grounds. It is marked by a marble post 8 by 8 by 20 inches, lettered U. S. C. & G. S., and projecting 2 inches above the ground. The following true bearings were determined:

	° ′	
Cross on church on highest ground in Hazleton (mark)	15 01.3	west of north
Cross on the church with dome	86 13.6	west of south
Spire of church in line with distant breaker	65 58.7	west of north

Descriptions of stations—Continued.

PENNSYLVANIA—Continued.

McConnellsburg, Fulton County.—Observations were taken over the north stone of the meridian line. This north stone is in the northwest corner of the sheriff's yard, immediately back of the jail and near the center of the town. It is 45 paces northwest of the southwest corner of the high school, 45½ paces a little north of west from the west wall surrounding the jail yard, and 55 paces northwest of the northwest corner of the courthouse. The south stone is in the southern part of the grounds of the county courthouse. These meridian stones are of marble, beveled to about 6 inches square on top and projecting about 18 inches above ground, with crosses on their tops to mark the line. The following true bearings were determined:

	° ′	
Base of rod on cupola of George Daniels's house (mark)	38 24.1	east of north
South meridian stone	0 02.3	west of south
Rod at top of belfry of Methodist Church	3 32.6	east of south
Base of spire on courthouse belfry	26 04.8	east of south

Shamokin, Northumberland County.—The station is in the northeast corner of an inclosed field at the top of Bunker Hill (owned by the Mineral Railroad Mining Co.), about one-half mile a little north of east from the Philadelphia & Reading Railroad station. It is 79.2 feet west of the fence bordering this field on the east and 46.8 feet south of the fence bordering this field on the north. It is marked by a bluestone post 5 by 8 by 30 inches, projecting 6 inches above the ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	° ′	
Cross on Catholic Church steeple (mark)	59 45.2	west of south
Cross on Slavish Church steeple	42 39.6	west of south
Cross on Polish Church steeple	40 46.3	west of south
Rod at top of large red water tank at top of hill on west side of town	65 08.8	west of south

Sunbury, Northumberland County.—The station is in the eastern part of the grounds of the Sunbury Water Co., about 1 200 feet east of the new ice house and about 1½ miles east of the town's center. It is about 108 feet west of the eastern border line of the grounds, about 30 feet south of a gradually shelving bank about 10 feet high, and about 72 feet south of the western of two lone trees at the foot of the above bank and about 15 feet apart. It is marked by a sandstone post 5 by 8 by 30 inches, projecting about 6 inches above the ground and lettered U. S. C. & G. S., 1910. The following true bearings were determined:

	° ′	
East corner at top of smokestack of Pennsylvania Railroad pumping station (mark)	34 38.9	east of south
Spire on Methodist Church	84 54.6	west of north
Central southeast gable on roof of public school	83 32.5	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 in 1907, 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:

	° ′	
Courthouse staff (mark)	89 04.3	west of south
Methodist Church spire	88 06.8	west of south

Descriptions of stations—Continued.

TEXAS.

Amarillo, Potter County.—The station of 1902 was no longer available. A new station was established in the cemetery southeast of town, in the middle of the third driveway running east and west, counting from the north side of the cemetery, and 84.5 feet east of the center of the drive running south from the gateway. It is also 43.5 feet east and a little south of the base of the Keeton Monument. Station is marked by a marble post 6 by 6 by 18 inches, lettered U. S. C. & G. S. and projecting 1 inch above ground. The following true bearings were determined:

	° ′	
Right edge of smokestack at elevator power house (mark)	4 43.3	east of north
Center of windmill 2 or 3 miles east	59 49.7	east of south
Left edge of east chimney of Mr. S. J. Slade's house	0 52.7	east of south

Cleburne, Johnson County.—The station is in about the center of the cemetery east of town. It is on the northeast corner of a lot which lies south of the second alley south of the street running east from the entrance on the west side. It is about 105 feet due north of the tool house, 17.7 feet southeast of the large Walker Monument (with angel), and 38.3 feet southwest of the J. W. Mitchell Monument. The station is marked by a Cedar Park limestone 7 by 7 by 20 inches, lettered U. S. C. & G. S. The following true bearings were determined:

	° ′	
Colored Baptist Church (mark)	26 31.6	west of north
Center of brick smokestack at Santa Fe power house	40 57.3	west of north
Smokestack at cotton compress	53 55.6	west of north

Corsicana, Navarro County.—The station is in the Oakwood Cemetery about 400 feet from the west side. It is in the intersection of the sixth drive from the west and the second drive north of the south line of the fourth addition. The station is at the southeast corner of the Odd Fellows' widows' and orphans' lot and at the northeast corner of the Confederate soldiers' lot. It is 47 feet southeast of the Widows and Orphans Monument, 12.3 feet northwest of the Berry Monument and 93 feet southwest of the Wilson Monument. The station is marked by a marble post lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Cupola of old high school (third ward) (mark)	82 28.0	east of south
Spire of Methodist Episcopal Church	48 41.8	east of south

Decatur, Wise County.—The station is about in the center of the cemetery north of town, about 85 feet southwest of the windmill, and in a driveway running north and south. It is 33.7 feet east and a little south of the Terrell Monument, 30 feet northwest of the large Simmons Monument, and 15.5 feet southwest of the small Joe Bonner Gose Monument. The station is marked by a marble stone 4½ by 5 by 18 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Cupola on the residence owned by Mr. Bellah (mark)	6 26.1	west of south
Windmill at house to east of town	15 44.5	east of south

Daingerfield, Morris County.—The station is located on the school grounds in the northwest part of town, 193.4 feet east from the southeast corner of the school building, and about 5 feet north of the line projected due east of the said corner. It is 94.3 feet north from the fence around the house (across the street), south from the southeast corner of the school grounds and 32 feet southeast of the southwest one of several large oak trees which stand on the eastern part of the grounds. The station is marked by an oak post about 4 by 5 by 18 inches, sunk level with the ground. The following true bearings were determined:

	° ′	
Tip of west gable on house (mark)	4 13.6	east of south
Southeast corner of school building	88 27.0	west of north
Tip of cupola on school building	76 52.2	west of north

Descriptions of stations—Continued.

TEXAS—Continued.

Granbury, Hood County.—The station is on the campus of the Methodist Training School, north of town, 144 feet east and a little north of the northeast corner of the college building, and 105 feet south and a little east of the southwest corner post of the fence around the cemetery. It is 30 or 35 feet south and a little west of the west one of two live oaks standing about 15 feet apart. The station is marked by a marble slab 2 by 8 by 18 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Methodist Church spire (mark)	1 57.4	east of south
Center of courthouse clock dial	3 35.7	west of south
Cupola of Hood County State Bank	6 46.7	west of south

Hillsboro, Hill County.—The station is in the new city cemetery to the northeast of town. It is well toward the south side, in the south side of a drive running east and west, and about 30 feet west of the row of trees which runs through the center, north and south. It is between lot 20 in block 36 and lot 2 in block 44. It is 75.5 feet southeast of the large Pritchett Monument. The station is marked by a limestone post 6 by 6 by 18 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Cupola of Central School (mark)	19 58.0	west of south
Center of courthouse clock dial on north side of cupola	33 07.2	west of south
Left edge of city standpipe	47 04.3	west of south

Longview, Gregg County.—The station is located in Grace Hill Cemetery in the drive running north from the entrance on the south side, 84.5 feet north of the west gatepost at the entrance and 31.2 feet northeast of the Buchanan Visage Monument. The station is marked by a limestone post 6 by 6 by 20 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Cotton-gin smokestack (mark)	36 32.5	east of south
Courthouse flagpole	72 20.1	east of south
Left (north) edge of city standpipe	87 05.9	east of north

Marshall, Harrison County.—The station is in the old Marshall Cemetery, in the north part of town, and about 12 feet west of the west edge of the drive running north from the entrance. It is 43.5 feet north of the cement wall on south side of cemetery, next to the street, and 51.7 feet northwest of the east gatepost at entrance. It is marked by a limestone post 6 by 8 by 20 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Left (southeast) corner of First Methodist Church (mark)	13 01.7	west of south
Red church steeple	40 20.1	east of south
Cross on southwest corner of Catholic School	62 40.2	east of south

Tyler, Smith County.—The station is located in Oakwood Cemetery in northwest part of town, in the new addition in northeast part of cemetery. It is 24.5 feet from the fence on east side, 51 feet from fence on north side of cemetery and 52 feet east and a little south of the Ollie Walters Monument. The station is marked by a tapering marble post about 4 by 4 by 20 inches, lettered U. S. C. & G. S., and sunk level with the ground. The following true bearings were determined:

	° ′	
Cupola of Cotton Journal Building (mark)	12 48.0	west of south
Muzzle of rifle on the Soldiers' Monument in center of cemetery	33 01.4	west of south
Right edge at base of cotton gin smokestack	52 36.8	west of north

Descriptions of stations—Continued.

UTAH.

Green River, Emery County.—The station of 1905 was reoccupied. It is on land owned by the Denver & Rio Grande Railroad, about one-fourth of a mile southwest of the center of the town, and about 700 feet south of the railroad station. It is about 600 feet southeast of the longitude station of 1898 and south of the Palmer Hotel. It is 348.2 feet south of the southeast corner of the fence surrounding the Palmer Hotel and 389 feet southeast of the southwest corner of the same fence. The station is marked by a redwood post 7 by 5 by 30 inches, projecting 6 inches above the ground. The following true bearings were determined:

	° ′
Western water tank (mark)	5 44.2 east of north
Flagstaff on Palmer Hotel cupola	26 34.6 east of north
Eastern water tank	89 14.8 east of north

Ogden, Weber County.—The station of 1905 was reoccupied. It is about half a mile west of the west bank of Weber River, west of the Southern Pacific Railroad station, and just south of two piers. These piers formed part of an observatory which has disappeared. They are about 5 feet high and 1½ feet square, and the eastern pier is inscribed with the latitude, longitude, and elevation. It is also marked with the name Wheeler, U. S. A., 1873. The station is 45.4 feet south of the southeast corner, near the ground, of the eastern pier, and 46 feet a little east of south from the southwest corner near the ground of the western pier. The station is also 99 feet from a fence corner to the south. The following true bearings were determined:

	° ′
First Methodist Episcopal Church spire (mark)	80 31.8 east of north
St. Joseph's Catholic Church spire	81 10.7 east of north
Spire on clock tower of Southern Pacific R. R. station	84 37.8 east of north
Flagstaff on Grand Opera House	88 49.4 east of north

VERMONT.

Barton, Orleans County.—Observations were made in the fair grounds called Roaring Brook Park, about 1 mile southwest of town, in the western part of the grounds and about 250 feet north of the north end of the grand stand, at a point 71 feet south (nearly) from the south end of a stone retaining wall, 44 feet east of a high wire fence, 17 feet west of the west edge of a roadway outside of the running track, and 30 feet southwest of the west end of a small stone culvert under this roadway. The station is marked by a granite post 7 by 7 by 24 inches, lettered U. S. C. & G. S., and projecting 4 inches above the ground. The following true bearings were determined:

	° ′
Cupola of red barn	10 32.3 east of north
Spire of Roman Catholic Church	64 42.0 east of north
Gable of red barn, near bottom of hill	33 01.0 east of south

Burlington, Chittenden County.—The station of 1898 was reoccupied. It is the south end of the meridian line on the campus of the University of Vermont, in the rear of the buildings. It is marked by a granite post. The north stone is 719.3 feet distant and projects about 6 inches above the ground. The following true bearings were determined:

	° ′
Rod on cupola of college barn (mark)	35 33.7 east of south
Northeast corner of granite base wall of Walker Science Hall	52 15.1 west of north

Guildhall, Essex County.—The station is in the northeast part of a meadow owned by Mr. Harley Hall, just west of the courthouse and jail, and north of the main street of the village. Observations were made over a natural bowlder projecting to a height of about 4 inches above the ground, and having a nearly flat exposed surface of about 1½ square feet in area. It is 29.5 feet south of a wire fence, 66 feet west of the fence line on the east of the meadow, and 45 feet west (nearly) from the nearest face of a bowlder projecting 4 feet out of the ground, near the highest point in the meadow. At the exact spot

Descriptions of stations—Continued.

VERMONT—Continued.

a hole one-fourth inch in diameter and one-fourth inch deep was drilled. The following true bearings were determined:

	°	′	
South gable of white house (mark)	85	38.5	west of north
Church steeple	67	09.1	west of south
Wind vane on courthouse	73	19.8	east of south

Newfane, Windham County.—Observations were made in the Newfane Village Cemetery on the hillside east of town, a little way past the railroad station, at a point in the back part of the cemetery at the intersection of the pathways south of and west of the lot containing the De Witt Monument. The point is 11.5 feet southwest of the southwest corner of the base of the De Witt Monument and 5.6 feet southeast of the nearest part of the curved corner of the granite border around the Birchard lot. It is marked by a marble stone, 1½ by 5 by 20 inches, set flush with the ground and having a hole one-fourth inch in diameter and one-fourth inch deep near the center of the face. The following true bearings were determined:

	°	′	
North gable of a barn just south of white house on opposite side of valley (mark)	38	02. 8	west of south
Church steeple	77	56.0	west of south

Rutland, Rutland County.—The station of 1905, on land of the city home for the poor, just south of the graveyard, was reoccupied. From the station northwest to the southwest corner of the graveyard fence is 47.9 feet; northeast to the southeast fence corner is 72 feet. The station is marked by a white sandstone rock, lettered U. S., 1905. The following true bearings were determined:

	°	′	
North gable of barn (mark)	7	06.9	west of south
Highest east gable of city poorhouse	58	02.8	west of south
Top of water tower	4	23.7	east of north
West gable of farmhouse	80	11.3	east of south

St. Johnsbury, Caledonia County.—The station of 1905 was reoccupied. It is in a pasture belonging to the E. & T. Fairbanks Co., on a sand hill south of the village and immediately south of Mr. Stevenson's house and yard. The finial of a small tower on Mr. Fairbank's house and the spire of St. Aloysius Church are in range with the station. To the corner of the fence around Mr. Stevenson's yard is 145 feet, bearing 8° 51′ east of north. The station is marked by a marble post 5 by 5 by 36 inches, projecting 4 inches above ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
St. Aloysius Church spire (mark)	5	01.3	east of north
West gable of house 1½ miles away	26	45.6	east of north
Finial of tower on house across the river	36	05.5	east of north
Cupola of barn 1 mile away	45	51.2	west of north

Woodstock, Windsor County.—Observations were made in the fair grounds, about one-half mile northeast of town, at a point in the northwest part of the grounds and inside of the race track. The point is 18.8 feet west of the west side of the flagpole, and 95 feet east of the east edge (inside) of the race track. It is marked by a marble stone 2½ by 5 by 20 inches, projecting 1 inch above ground. The stone is not lettered, and the exact point is the center of the south edge of its face. The following true bearings were determined:

	°	′	
Northwest gable of red barn, half way up the hill (mark)	28	01.5	east of south
North gable of shingled house	46	12.8	east of north
South gable of south shed of fair grounds	66	53.6	east of north

Descriptions of stations—Continued.

VIRGINIA.

Cape Charles, Northampton County.—The station is west of town and about 360 yards north of the west end of Main Street. It is 50 feet east from the shore of Chesapeake Bay, and 190 feet northeast from the end of a sewer emptying into the bay. It is marked by a marble post 8 by 8 by 40 inches, lettered U. S., 1910, and projecting 4 inches above the ground. The following true bearings were determined:

	° ′	
West edge of the more westerly of two chimneys very close together on Sandy Island	9 19.8	west of north
Apex of light on house at bay end of stone pier	53 45.4	west of south
East edge of cupola of house at junction with roof	6 48.3	east of south

Courtland, Southampton County.—The station is on the high-school grounds a little south of the town's center. It is 107.5 feet east of the east side of high-school building, 62.8 feet north of a steel fence; 56.8 feet south of a wire fence; 72.1 feet west of a board fence. It is marked by a marble post 5 by 5 by 24 inches, lettered U. S., 1910, and set 1 inch below the surface of the ground. The following true bearings were determined:

	° ′	
Apex of Methodist Church cupola (mark)	48 57.6	west of north
North gable of John MacLane's house	83 25.3	east of north
West gable of W. G. Sebrell's house	66 07.3	east of south
East edge of west chimney on hotel	22 51.0	west of south

Eastville, Northampton County.—The station is about one-fourth mile east of Eastville, on the high-school grounds. It is 210 feet north of the north side of the schoolhouse and 75 feet west of the fence east of the school grounds. It is marked by a marble post 6 by 6 by 36 inches, lettered U. S., 1910, and set level with the ground. The following true bearings were determined:

	° ′	
Spire on Mr. Cobb's water tank (mark)	67 15.6	west of north
Northwest corner of steel windmill at base of elevated tank	58 28.2	east of south
Northeast corner of school building, 1 foot above foundation	7 20.1	east of south
North gable of Addison Jarvis's house	26 50.5	west of south

Lawrenceville, Brunswick County.—The station is near the northeast corner of the high-school grounds, one-fourth mile west of the town's center. It is 28.6 feet southeast of a tree, 33.7 feet southwest of a tree in the corner of the grounds, 21.6 feet northwest of a hedge along northwest side of road leading to school building. It is marked by a marble post 5 by 5 by 24 inches, lettered U. S., 1910, set level with the surface of the ground. The following true bearings were determined:

	° ′	
Cross on Episcopal Church steeple (mark)	85 18.4	east of south
Spire on railroad water tank	1 14.8	west of south
North gable, J. H. Ryland's house	89 56.6	west of north
Weather vane on west cupola of J. D. Barkley's residence	24 47.2	east of north
Apex of elevated water tank at normal school	44 47.7	east of north

At the request of Mr. D. S. Hicks, mayor of Lawrenceville, a meridian line was established. A small hole in a cement post 7 inches in diameter and 36 inches long, 212 feet south of the magnetic station, marks the meridian. A similar cement post was set in the meridian 106 feet south of the magnetic station.

Ocean View, Norfolk County.—The station is about 2½ miles southeast from Ocean View. It is about 10 rods southwest of J. W. Parkerson's house and about 15 rods from the shore line, 55 feet southwest from west corner of Mr. Parkerson's pasture, and 24 feet northwest from the center of a road. The

Descriptions of stations—Continued.

VIRGINIA—Continued.

station is marked by a large post 1 foot in diameter and 4 feet long, projecting 4 inches above ground. A cross and brass screw marks the exact spot. The following true bearings were determined:

	° ′
Weather vane on J. W. Parkerson's house (mark)	41 37.7 east of north
North edge of east chimney on Mr. Power's house	41 32.3 east of south
South gable of a house	30 49.2 west of north

Petersburg, Dinwiddie County.—Observations were made at the north end of a meridian line about 1 000 feet long established in 1901, at the city waterworks, to the southeast of the city. It is marked by two granite posts 8½ inches square at the top, the north stone projecting about 4 inches above ground and the south stone being covered to the depth of 1 foot by an embankment. They are on the north and south banks of the lake northwest of the pump house. The south stone, over which declination observations were made, is 43.7 feet east of the center of top of cement manhole covered with an iron cap at the entrance to reservoir. From this point the following true bearing was determined in 1901:

	° ′
Middle of chimney on tobacco stemmery	2 18.2 west of north

Prince George, Prince George County.—The station is in the courthouse yard north of the courthouse. It is in line with the east side of the courthouse, 30.6 feet south of a fence, 243.5 feet north of the northeast corner of the courthouse. It is marked by a blue-stone post 8 by 8 by 24 inches, lettered U. S., 1910, and set flush with the ground. The following true bearings were determined:

	° ′
Tip of west gable of county clerk's office (mark)	11 50.6 west of south
Northeast corner of courthouse (1 foot from ground)	13 19.6 west of south
Spire on Baptist Church	87 34.6 west of north
East edge chimney on house	22 29.5 east of north

Suffolk, Nansemond County.—The station is about one-half mile south of town on property belonging to Mr. O. S. Smith. It is 96 feet south of a ditch surrounding a group of trees, which is the site of an old fort, and 100 feet west from the middle of a road. It is marked by a marble post 6 by 6 by 24 inches, lettered U. S., 1910, and set flush with the surface of the ground. The following true bearings were determined:

	° ′
Apex of water tank at Bane's Peanut Co. (mark)	77 01.0 east of north
Southeast edge of large steel chimney at top	43 04. 5 east of north
Apex of cupola of church	58 55.5 west of north
South edge of standpipe at top	46 10.6 west of north
East edge of chimney on house	4 59.6 east of south

Surry, Surry County.—The station is in the high-school grounds about one-half mile south of the town's center. It is 122.4 feet southwest of southwest corner of the high school, 96.5 feet south of north fence, 33.6 feet east of a tree, 21.1 feet north of a board fence. The station is marked by a marble post 5 by 5 by 24 inches, lettered U. S., 1910, set flush with the ground. The following true bearings were determined:

	° ′
North edge spire on north gable of J. G. Bohannan's house (mark)	18 00.6 east of north
Northeast corner of a house (just below eaves)	21 33.7 west of south

A second post was set near a fence 273.6 feet to the south of the magnetic station to mark the true meridian.

Sussex, Sussex County.—The station is in the court yard, 30.4 feet north of the north side of the courthouse, 34.7 feet south of a fence, 83.7 feet west of a fence, and is marked by a marble post 5 by 5

Descriptions of stations—Continued.

VIRGINIA—Continued.

by 26 inches, lettered U. S., 1910, and projecting about 4 inches above the surface of the ground. The following true bearing was determined:

	°	′	
North edge of north chimney on Mrs. A. R. Dobie's house (mark)	73	07.3	east of north

At the request of the county authorities a meridian line was established in front of the courthouse. This was done by triangulation, the north meridian stone being 68.2 feet due east of the magnetic station, 15.5 feet from a fence, and the second stone 132.3 feet to the south of the north stone.

WASHINGTON.

Brace Point, Kitsap County.—The station is on Brace Point, south of Fauntleroy Cove. It is on a very small mound 10 feet inside of the line of driftwood and on the outer edge of a large flat cleared piece of ground that forms the point. It is about 250 feet south of the wharf at the point. The station is marked by a bottle buried so that its mouth is level with the surface of the ground. Twenty feet north of the bottle is a 2 by 4 inch stake projecting 1½ feet above the ground. The following true bearings were determined:

	°	′	
Outermost tree on Point Pully	10	10.2	east of south
White telegraph pole	30	47.3	east of north

Colby, Kitsap County.—The station is situated 7 feet above high water line on a level grassy strip of land, about one-fourth mile south of the wharf at Colby, and about 60 feet east of the road running from Colby to South Colby. It is 55 feet from a three-plank board walk which runs along the side of the road. The station is marked by a beer bottle buried so that its mouth is three-fourths of an inch below the surface. The bottle's mouth is covered with a piece of tin 1 foot square and covered with gravel. The following true bearing was determined:

	°	′	
The more easterly one of two church spires in South Colby (mark)	21	59.0	east of south

Ellensburg, Kittitas County.—The station of 1906 was reoccupied. It is about 150 feet above the level of the city, on the highest point of the ridge on the eastern side of town. It is about 200 feet north of the old upper reservoir and in the prolongation of the street on which the State normal school building stands. The station is marked by a sandstone monument, set about 30 inches deep, with about 5 inches projecting, and lettered U. S. C. & G. S., 1906, with a cross. It was set over the exact spot marking "Reservoir" station, established by a local surveyor, Mr. Anderson, in his surveys in the Kittitas Valley. This triangulation was connected directly with that of the Geological Survey of 1899. The following true bearings were determined from the above triangulation:

	°	′	
Spire of Mrs. Rowell's house (mark)	45	48.8	west of south
City school, clock tower spire	72	16.6	west of south
State normal school, spire of lower southeast tower	88	30. 1	west of north

Ocosta, Chehalis County.—The triangulation station is in the high-water mark of the rounding point of the shore line in the western part of the town of the same name at the entrance to South Bay of Grays Harbor. It is about a half mile southwest of the railway tank and the same distance west of the prominent cupola of Flowers's house. It is about 300 meters south of the piles of an old wharf. The station is marked by an iron pipe 2½ by 7 inches, sunk 5 inches in the ground. The magnetic station is about 100 feet from the triangulation station in the direction of Triangulation Station Laid, which bears 28° 44′.9 west of south.

Rennie, Chehalis County.—The magnetic station is about 75 feet from the triangulation station in the direction of the mark. The triangulation station is on Rennie Island in Grays Harbor just south of the town of Hoquiam. This island is a low sand bar, partly formed by sand which has been pumped

Descriptions of stations—Continued.

WASHINGTON—Continued.

inside of bulkheads. The station is marked by an iron pipe 2¼ by 4 inches, projecting 8 inches above ground. It is in a row of stakes which probably formed a bulkhead. The mark used was Triangulation Station Tank, which bears 85° 40′.3 east of north.

Seattle, King County.—The station of 1903 was reoccupied. It is in the grounds of the 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.

The old station being unavailable for future use, a new station was established in the eastern part of the grounds of the State university, about 3 miles north of the town's center. It is 208.6 feet northwest from the northwest corner of the girls' dormitory and 198.7 feet southeast from the southeast corner of the boys' dormitory. It is marked by a granite post 48 inches long, 8 by 8 inches on top and 12 by 12 inches at the bottom, projecting 14 inches above ground and lettered U. S. C. & G. S., 1903. The following true bearings were determined:

	°	′	
Center of wooden block at north top end of roof of Science Hall (mark)	76	03.2	west of south
Center of rod at top of north gable window on Denny Hall	80	31.8	west of north
Top of southwest edge of white water tank	41	41.0	west of north
Central point at top of roof of California Building	10	42.9	west of south

WEST VIRGINIA.

Elizabeth, Wirt County.—The station is in the Knights of Pythias Cemetery about one-half mile south of the courthouse, at the east edge of a pathway running north and south through the center of the cemetery. It is 48.7 feet north of the south fence of the cemetery, and 40.1 feet north of the northwest corner of the base of the monument of Thomas Watson. It is marked by a white marble post 5 by 5 by 24 inches, projecting 5 inches above ground with a brass magnetic station marker in the top, The following true bearings were determined:

	°	′	
Small white building on hill (mark)	25	06.1	west of north
West gable of small house	68	43.1	west of south
Peak of public school	33	55.4	east of north
Peak of 3-story house about 600 feet away	83	31.2	east of north

Elkins, Randolph County.—Observations were made in the fair grounds, about one-half mile south of the courthouse, and just south of the first ward school, at a point inside of the ring, 54 feet east of the fence inside the ring, 81 feet north of the north side of the baseball seats inside the ring, and 250 feet north of the north side of a small wooden tower or pavillion. The station is marked with a marble post 6 by 6 by 18 inches, having a brass station marker set into its top, and flush with the ground. The following true bearings were determined:

	°	′	
Gable of white house about 700 feet away (mark)	26	36.0	west of south
Davis and Elkins College, main building	61	15.1	east of south
Courthouse tower	44	37.6	east of north

Fairmont, Marion County.—The station is in Maple Grove Cemetery, about 1 mile east of the courthouse, near the southwest corner of the cemetery. The point is in a pathway between two vacant lots, about 4 feet west of the west edge of a roadway running uphill, and 53 feet north from the northeast corner of the base of the Lloyd Monument. It is marked by a marble post 6 by 6 by 20 inches, projecting about 6 inches above ground and having a C. & G. S. magnetic station marker in the top. The following true bearings were determined:

	°	′	
South gable of reddish-brown house (mark)	4	06.6	west of north
Courthouse dome	61	31.0	west of north
Spire	77	07.0	west of north
Barn (about 1 mile away)	58	22.2	east of south

Descriptions of stations—Continued.

WEST VIRGINIA—Continued.

Glenville, Gilmer County.—The station is in a small cemetery near the center of a field, about 1 mile northwest of town, at a point near the gate of the cemetery. The point is 27 feet from the southeast fence, 48 feet from the northeast fence, and 15 feet south of the south corner of the base of the Lorentz Monument. It is marked by a 2-foot length of 4-inch vitrified pipe, set with its bell end about flush with the ground. The following true bearings were determined:

	° ′	
Gable of white house (mark)	31 42.6	east of south
Gable of unpainted house across the river	63 55.5	west of north
Gable of barn	8 09.4	east of north

Grantsville, Calhoun County.—The station is located on a steep hillside just across a small run south of town, about halfway up the slope. It is about 600 feet from the courthouse, about 200 feet west of a fence, and about 50 feet up the hill from a walnut tree, which is about 10 inches in diameter at its base. It is marked by a United States Geological Survey bench mark, 8 by 8 inches, projecting about 18 inches above ground. The following true bearings were determined:

	° ′	
Peak of schoolhouse cupola (mark)	44 25.4	east of north
Baptist Church steeple	2 09.8	west of north
Courthouse steeple	81 12.3	west of north

Martinsburg, Berkeley County.—Observations were made over the south stone of the meridian line established by the United States Geological Survey in 1898. This stone is at the head of the principal drive of Green Hill Cemetery, 13 feet west of the walk. It is a column of marble 6 by 8 by 40 inches, set 32 inches in the ground, with a copper plate in the center of the top. The mark or range was the north meridian stone 575 feet distant, 30 feet east of the entrance gate and 4 feet from the fence. It is a similar marble column, having an aluminum bolt to mark its center.

As this station was no longer suitable for magnetic observations, a new one was established in the southeast corner of a rocky pasture belonging to Senator Faulkner, immediately north of the house of J. W. Thompson, and about 1¼ miles northwest of the town's center. It is 90.6 feet west of the fence bounding the pasture on the east, and 144.6 feet north of the fence bounding the pasture on the south. It is marked by a marble post 6 by 6 by 30 inches, projecting about 4 inches above ground, with a hole in the top to mark the exact spot. The following true bearings were determined:

	° ′	
Rod at top of water tank of Auburn Wagon Works (mark)	63 50.0	east of south
Center of top of stack of cold-storage plant	78 28.8	east of north
Upper north edge of stack of waterworks	71 06.1	east of south

About 527.7 feet distant is a similar marble post marking the north end of a meridian line.

Parkersburg, Wood County.—The station of 1898 was reoccupied. Observations were made over the north monument of the meridian line at Parkersburg. This north meridian monument is in the city park, formerly the old county fair grounds. It is located in a clump of trees northeast of the old grandstand. The south meridian monument is 697 feet due south of the north monument, and is also in the city park, near the superintendent's house. These monuments are very heavy Cleveland sandstone posts, sunk with their tops extending a few inches out of the ground. The centers of copper disks set in the centers of the tops of these monuments mark the two ends of this meridian line. Mr. J. S. A. Farrar, city engineer, knows the exact location of these monuments.

Parsons, Tucker County.—Observations were made in the Parsons Cemetery, about three-fourths of a mile southeast of the courthouse, at a point on the northeast edge of a pathway running southeast and northwest. The point is 62 feet southeast of the northwest fence of the cemetery and 108 feet northeast of the southwest fence, which runs along the public road. The point is marked by a 2-foot length of 3-inch vitrified pipe, set with the bell end flush with the ground, and having a brass station marker cemented in the top. The following true bearings were determined:

	° ′	
Gable of barn across Blackwater River (mark)	6 53.7	east of north
West edge of top of factory chimney	29 52.3	west of north
Gable of barn about 800 feet away	78 42.7	west of south

Descriptions of stations—Continued.

WEST VIRGINIA—Continued.

Spencer, Roane County.—The station is in the cemetery, about 1 mile northwest of town, near the southeast corner of the cemetery. The point is 9 feet north of the north edge of a road along the south fence of the cemetery, at the west edge of a cement sidewalk west of the Lowe lot. It is 12 feet southwest of the southwest corner of the base of the Lowe Monument. The station is marked by a white marble post 5 by 5 by 24 inches, projecting 4 inches above ground, with a brass magnetic station marker in the top. The following true bearings were determined:

	°	′	
Cupola of most westerly of insane asylum buildings (mark)	24	33.3	east of south
Highest cupola of insane asylum	26	52.3	east of south
North gable of house about 800 feet away	20	59.1	west of south
Nearest gable of unpainted barn	88	26.4	east of north

WISCONSIN.

Florence, Florence County.—The station of 1905 and 1908 was reoccupied. It is in the old Florence Cemetery in the north and south driveway that leads to the entrance. The station is 45 feet from the small headstone of Clarence H. Morrison, 94.2 feet from the headstone marked Jennie E. N. Carlson, and 93.6 feet from the headstone marked Charles Schulte. The station is marked by a Bedford limestone post, 6 by 6 by 28 inches, set flush with the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	°	′	
Courthouse spire (mark)	76	18.4	west of south
Catholic Church cross	87	30.0	west of north
Schoolhouse spire	85	53.5	west of north

Friendship, Adams County.—The station is in the southwest corner of the courthouse yard, 22.5 feet from the west board fence, 13.5 feet from a tree to the north, and 30.5 feet from a tree to the southeast. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, projecting about 2 inches above ground, with a brass station marker in the top. The following true bearings were determined:

	°	′	
Northwest edge of house (mark)	15	31.1	west of south
Cupola on house	24	35.9	east of south
Spire on cupola of house	4	18.7	west of south

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:

	°	′	
Southeast corner of Exposition Building	24	56.4	west of south
Spire on house cupola	3	33.7	east of south
Cupola on dome of Exposition Building	29	52.9	west of south

Manitowoc, Manitowoc County.—The station is on the grounds of the county insane asylum, which is about 1 mile east of the courthouse. It is about 95 yards northeast of the main building, on the northeast corner of the grass plot. It is 33 feet west of a board fence and 15, 17.4, and 11.3 feet, respectively, from trees to the south, west, and north. It is marked by a Bedford limestone post 6 by 6 by 30 inches, with a brass station marker in the top, set to project 2 inches above ground. The following true bearings were determined:

	°	′	
Cross on church (mark)	18	58.2	east of north
Telephone pole	0	50.9	east of south
White fence post (No. 1)	9	57.8	west of south
White fence post (No. 2)	20	17.2	west of south

Descriptions of stations—Continued.

WISCONSIN—Continued.

Pembine, Marinette County.—The station is in the north corner of the schoolhouse yard, 36.5 feet from the fence to the northwest, 39.2 feet from the fence to the northeast, and 86 feet north of the north corner of the schoolhouse. It is marked by a Bedford limestone post 6 by 6 by 30 inches, with a station marker in the top, which projects 2 inches above ground. The following true bearings were determined:

	°	′	
Tip of railroad water tank (mark)	84	30.0	east of north
South edge of false front of Algonquin Hotel	63	16.7	east of south
Southeast corner of schoolhouse	12	20.5	east of south

Sheboygan, Sheboygan County.—The station occupied by the Lake Survey at the foot of Spring Street was considered no longer suited for a magnetic station on account of local magnetic disturbance, and observations were made at North Point, on the bluff about 50 feet above the lake, and about three-fourths of a mile northeast of the center of the city. It is about 900 feet southeast of the standpipe at the pumping station and about 400 feet northeast of the old lighthouse on the extreme northeast corner of the property of Dr. William Gunther. It is 12.5 feet to the edge of the bluff to the north, 18 feet to the edge measured to the east, and 24 feet to the edge measured to the west. The station is marked by a Bedford limestone post 6 by 6 by 30 inches, with a brass station marker in the top, projecting about 4 inches above the ground. The following true bearings were determined:

	°	′	
Courthouse spire (mark)	33	16.8	west of south
Cupola on public schoolhouse	77	54.6	west of south
Cupola on water pumping station	49	00.1	west of north
Cupola on lighthouse at end of pier	11	34.9	east of south

Sturgeon Bay, Door County.—The station is in the northwest corner of the courthouse grounds about 130 feet due west of main entrance to the courthouse, 35 feet from a tree to the north, 38 feet from a tree to the northeast, and 24 feet from a tree to the southeast. It is marked by a Bedford limestone post 6 by 6 by 30 inches, with a station marker in the top, and set so that the top of the stone is about 2 feet below the surface. (The grounds were about to be regraded.) The following true bearings were determined:

	°	′	
Flagpole on Pinney Building (mark)	78	09.9	west of north
Flagpole with brass knob	55	55.2	west of north
Flagpole on schoolhouse	6	38.1	west of north
Church spire	51	47.0	east of south
South edge of chimney on house	21	41.9	east of south

Wautoma, Waushara County.—The station is on the west part of the schoolhouse grounds, 22 feet from the edge of the walk to the west, 53 feet from the south walk, and 54 paces from the school building. It is marked by a Bedford limestone post 6 by 6 by 30 inches, sunk level with the surface of the ground. The following true bearings were determined:

	°	′	
Southwest corner of schoolhouse, granite base (mark)	74	47.7	east of south
Southeast edge of chimney on Putnam House	34	45.6	west of south
Flagstaff on courthouse	65	39.8	west of north

WYOMING.

Cheyenne, Laramie County.—The station of 1906 could not be recovered. A new station was established on the reservation belonging to Fort D. A. Russell, just inside the grounds, used as a target range. It is about 425 feet west and a little north of the northwest corner of the new hospital building and about 225 feet west of the grandstand at the baseball grounds. It is 57.5 feet northeast of the east post of the north one of two fences at the gateway or entrance to the target range and 47.8 feet northwest of the first large post east of the post above mentioned in the same fence. The station is marked by a

Descriptions of stations—Continued.

WYOMING—Continued.

Bedford limestone post about 3 by 6 by 20 inches, projecting 1 inch above the ground, and lettered U. S. The following true bearings were determined:

	° ′
Windmill, several miles away	12 05.9 east of north
Tip of Fort Russell water tank	68 07.9 west of south

Granger, Sweetwater County.—The station is located on the ranch west of the schoolhouse, 96.5 feet from the northwest corner of the schoolhouse and 101.2 feet from the southeast corner of the schoolhouse. It is marked by a rough limestone about 6 by 8 by 10 inches, sunk flush with the surface of the ground. The following true bearings were determined:

	° ′
Tip of east one of two water tanks of the Oregon Short Line R. R.	26 28.0 east of north
Tip of west one of the two water tanks	20 03.2 east of north

Green River, Sweetwater County.—The station of 1905 was reoccupied. It is on Government land about one-fourth mile north of the town center in a V-shaped piece of land between two hills, and east of a peculiar rock formation of nearly cylindrical form, on which stands a flagpole. It is about 60 feet from a hill to the west, 120 feet from a hill to the east, and 360 feet from the hills to the north. It is 434.5 feet north of the northwest corner of the fence surrounding the cemetery and almost in line with this corner and the chimney of the second house east on the south side of the cemetery. It is marked by an oak stake 4 by 6 inches, showing about 4 inches above ground and having a cross sawed in the top. The location is known to Joseph Payne, a local surveyor. The following true bearings were determined:

	° ′
Flagstaff on front of schoolhouse (mark)	24 12.7 west of south
Northwest point on jail cupola	54 38.1 west of south
Flagstaff on southeast corner of Brew House	50 38.4 west of south

Sheridan, Sheridan County.—The station of 1905 was reoccupied. It is on the military reservation at Fort McKenzie, 602 feet nearly south of the building now used as noncommissioned officers' residence, about 100 feet south of the old main drive entering the grounds, and a little to the west of the point of junction with the road to the quartermaster's storehouse. The eastern corner of noncommissioned officers' residence appears in line with the gable of the bakery, and the western corner of the second of the barracks is in line with the commanding officer's residence (a new barracks is planned, which may obscure this line). The station is marked by a sandstone post 7 by 7 by 27 inches, projecting 4 inches above the ground and lettered U. S. C. & G. S., 1905. The following true bearings were determined:

	° ′
Pole on county courthouse (mark)	32 30.8 east of south
Smokestack at electric light plant	42 35.6 east of south
Brick smokestack at Chicago, Burlington & Quincy roundhouse	58 23.0 east of south

BRITISH COLUMBIA.

Union 2.—The new station of 1906 was reoccupied. It is about 1 000 feet north of the old one, in a direct line to the church spire at Comox, on a low shingle spit across the small stream. It is marked by a dressed fir post 3 inches square, set about 30 inches underground, and projecting about 8 inches above the surface. A small heap of stones is placed around the post and the letters U. S. and a cross are cut in the top surface. The following true bearings were determined in 1909:

	° ′
Lighthouse at southeast end of Baynes Sound (mark)	33 34.7 east of south
Church spire at Comox	18 44.8 west of north
Northeast corner of chimney of brick kiln	0 35.5 west of south

APPENDIX 4

REPORT 1911

TRIANGULATION ALONG THE NINETY-EIGHTH MERIDIAN, NEBRASKA TO CANADA, AND CONNECTION WITH THE GREAT LAKES

By

WILLIAM BOWIE

Inspector of Geodetic Work; Assistant, Coast and Geodetic Survey

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TRIANGULATION ALONG THE NINETY-EIGHTH MERIDIAN, NEBRASKA TO CANADA, AND CONNECTION WITH THE GREAT LAKES.

By WILLIAM BOWIE,

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

GENERAL STATEMENT.

In 1907 the arc of primary triangulation was completed which runs approximately along the ninety-eighth meridian and extends from Corpus Christi on the Gulf of Mexico to the United States and Canada boundary, with a spur running across the State of Minnesota, connecting the ninety-eighth meridian triangulation with that of the Lake Survey in the vicinity of Duluth.

Hereafter the term "ninety-eighth meridian triangulation" will be used for all of the primary triangulation extending from Corpus Christi, approximately along the ninety-eighth meridian, to the Canadian boundary and to Duluth, and the Point Isabel base net.

In this publication are given certain data regarding the field and office work connected with that portion of the ninety-eighth meridian triangulation which is north of the Page base net, Nebraska.

Several members of the Computing Division have taken part in the preparation of this appendix. The preparation of the results of the triangulation for publication was made by Mr. H. C. Mitchell.

The greater portion of the work of making the difficult adjustments involved in fitting in the new triangulation between the fixed triangulation at Page, Nebr., and Duluth, Minn., was done by Mr. C. R. Duvall or under his immediate direction. Mr. A. L. Baldwin had immediate direction of the computation and adjustment of the elevations from vertical measures and the discussion of the results.

The engineer intent only upon securing the necessary information to enable him to extend this triangulation or to base other surveys upon it will find the information he desires on pages 233 to 342 of this appendix, commencing with the explanation of the table of positions, lengths and azimuths. The index printed on pages 325 to 342 used in connection with the sketches at the end of the publication, will enable him to find quickly the data for any given locality.

The discussion of the field work and the comparison of the results of the different seasons' work on the ninety-eighth meridian will be confined, as far as is practicable, to that done after 1901, for in the following year some notable changes were made in the field organization and in the methods of making the observations. It would be unfair to the parties working on the ninety-eighth meridian previous to 1902 to make a direct comparison of their progress with the progress made later. Beginning with the season of 1902 observations were made on both heliotropes and acetylene lamps, thus greatly extending the observing period, and trained light keepers or heliotropers were kept throughout a season and frequently the same men were employed during a number of seasons. Besides, the parties were directed to obtain an accuracy represented by an average closing error of a triangle of one second of arc, and no delay was made to get the ideal observing conditions.

The results of the triangulation done along the ninety-eighth meridian, previous to 1902, and extending from Anthony base net, in Kansas, to the Page base net, in Nebraska, are given in Appendix 6, Report for 1901, and Appendix 3, Report for 1902.

The triangulation done in 1902 along the ninety-eighth meridian to the south of the Anthony base net, in Kansas, is published in Appendix 4, Report for 1903, while that done in 1903, on the southern portion of the ninety-eighth meridian, is published in Appendix 5, Report for 1905. The four appendixes mentioned above cover the results of the triangulation along the ninety-eighth meridian from the Seguin base net, in Texas, latitude approximately 29° 25′, to the Page base net, in Nebraska, latitude approximately 42° 30′. The remainder of the work at the south end of the ninety-eighth meridian is published in Appendix 5, Report for 1911, and the results of the triangulation at the northern end of the ninety-eighth meridian, above the Page base net, are contained in this publication.

Thirteen of the fifteen base lines along the ninety-eighth meridian triangulation, on which the length of the triangle sides depend, were measured in two seasons, those of 1900 and 1906, by parties under Computer A. L. Baldwin and Assistant O. B. French, respectively.[1] There were also used to control lengths in this triangulation the Minnesota Point base, in the vicinity of Duluth, which was measured by the United States Lake Survey and the Laguna Madre base, in Texas, which had been measured by the Coast and Geodetic Survey to control the lengths of lines on the coast triangulation of the Gulf of Mexico.

During the season of 1900 the duplex base bars of this Survey and 50 and 100 meter steel tapes were used on each of the nine bases measured, the different pieces of apparatus being standardized on the field, using the iced-bar apparatus. One kilometer of each base, called the test kilometer, was measured with the duplex bars and with each of the four tapes. About one-fifth of the total length of all the bases, after the test kilometers were deducted, was measured with the duplex bars, about two-fifths were measured with the 50-meter tapes, and the remaining two-fifths were measured with the 100-meter tapes. As a result of this season's work it was decided that in future primary base measurements only tapes were necessary and that the most efficient length of tape was about 50 meters. During the season of 1906 six primary bases were measured, four of them being on the ninety-eighth meridian triangulation. Complete measurements were made on each base with 50-meter steel tapes and also with invar tapes of the same length; standardizations of all the tapes were made on the field, using the iced-bar apparatus to determine the length of the comparator. The invar tapes were also standardized at the Bureau of Standards, before and after the work on the field. The invar tapes proved to be very satisfactory and they are now used exclusively to measure primary base lines by the Coast and Geodetic Survey.[2]

RECONNOISSANCE.

The reconnoissance for that portion of the ninety-eighth meridian triangulation between the Page base net, Nebraska, and the line between stations Farmer and Salem in South Dakota (see illustrations Nos. 1 and 2) was done by the triangulation party under Assistant F. D. Granger, in 1900 and 1901, just preceding the erection of signals and the occupation of the stations.

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[1] Appendix 3, Report for 1901, "On the measurement of nine base lines along the ninety-eighth meridian" and Appendix 4, Report for 1907, "Six primary bases measured with steel and invar tapes."

[2] See Appendix 4, Report for 1910, "Primary base lines at Stanton, Tex., and Deming, N. Mex."

The reconnoissance from the line between stations Farmer and Salem to the Canadian border and eastward to the vicinity of the town of Aitkin, Minn., in approximate latitude 46° 30′ and approximate longitude 93° 40′, was done in 1903 by a reconnoissance party under Assistant W. H. Burger. The actual field work was begun on April 23 and ended on October 5, 1903.

The reconnoissance of the northern end of the ninety-eighth meridian triangulation was resumed in 1904 by the triangulation party under Assistant W. H. Burger, with Signalman Jasper S. Bilby in immediate charge of the reconnoissance. This work started in the vicinity of Aitkin, Minn., the point to which it had been carried in 1903, and it was extended eastward to Duluth, Minn., where it was connected with the primary triangulation of the Lake Survey. The actual field work was begun in July and ended on August 31, 1904.

The instructions under which this reconnoissance was done were, in part, as follows:

INSTRUCTIONS FOR RECONNOISSANCE.

CHARACTER OF FIGURES.

(1) The chain of triangulation between base nets shall be made up of completed quadrilaterals and of central-point figures, with all stations occupied. It must not be allowed to degenerate even for a single figure to simple triangles. There must be two ways of computing the lengths through each figure. On the other hand there must be no overlapping of figures and no excess of observed lines beyond those necessary to secure a double determination of every length, except that in a four-sided central-point figure one of the diagonals of the figure may be observed.

STRENGTH OF FIGURES.

(2) In the chain of triangulation between base nets the value of the quantity $R=\left(\frac{Nd-Nc}{Nd}\right)\Sigma[\delta^2_A+\delta_A\delta_B+\delta^2_B]$ for any one figure must not in the selected best chain (call it R_1) exceed 25, nor in the second best (call it R_2) exceed 80, in units of the sixth place of logarithms. These are extreme limits never to be exceeded. Keep the quantities R_1 and R_2 down to the limits 15 and 50 for the best and second best chains, respectively, whenever the estimated total cost does not exceed that for a chain barely within the extreme limits by more than 25 per cent. The values of R may be readily obtained by the use of the "Table for determining relative strength of figures in triangulation." (See p. 166.)

In the above formula the two terms $\frac{Nd-Nc}{Nd}$ and $\Sigma[\delta^2_A+\delta_A\delta_B+\delta^2_B]$ depend entirely upon the figures chosen and are independent of the accuracy with which the angles are measured. The product of these two terms is therefore a measure of the strength of the figures with respect to length, in so far as the strength depends upon the selection of stations and of lines to be observed over.

In the following table the values tabulated are $\Sigma[\delta^2_A+\delta_A\delta_B+\delta^2_B]$. The unit is one in the sixth place of logarithms. The two arguments of the table are the distance angles in degrees, the smaller distance angle being given at the top of the table. The distance angles are the angles in each triangle opposite the known side and the side required. δ_A and δ_B are the logarithmic differences corresponding to one second for the distance angles A and B of a triangle.

The square of the probable error of the logarithm of a side of a triangle is $\frac{4}{3}(d^2)\frac{Nd-Nc}{Nd}\Sigma[\delta^2_A+\delta_A\delta_B+\delta^2_B]$, in which d is the probable error of an observed direction. Nd is the number of directions observed in a figure and Nc is the number of conditions to be satisfied in the figure. The summation indicated by Σ is to be taken for the triangles used in computing the value of the side in question from the side supposed to be absolutely known.

The strength table is to be used in connection with the values of $\frac{Nd-Nc}{Nd}$ [1] to decide during the progress of the reconnoissance which of the two or more possible figures is the strongest and to determine whether a sufficiently strong scheme has been obtained to make it inadvisable to spend more time in reconnoissance.

[1] Some values for this quantity are given on pp. 24 and 25 of General Instructions for the field work of the Coast and Geodetic Survey.

Table for determining relative strength of figures in triangulation.

	10°	12°	14°	16°	18°	20°	22°	24°	26°	28°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	85°	90°
°																							
10	428	359																					
12	359	295	253																				
14	315	253	214	187																			
16	284	225	187	162	143																		
18	262	204	168	143	126	113																	
20	245	189	153	130	113	100	91																
22	232	177	142	119	103	91	81	74															
24	221	167	134	111	95	83	74	67	61														
26	213	160	126	104	89	77	68	61	56	51													
28	206	153	120	99	83	72	63	57	51	47	43												
30	199	148	115	94	79	68	59	53	48	43	40	33											
35	188	137	106	85	71	60	52	46	41	37	33	27	23										
40	179	129	99	79	65	54	47	41	36	32	29	23	19	16									
45	172	124	93	74	60	50	43	37	32	28	25	20	16	13	11								
50	167	119	89	70	57	47	39	34	29	26	23	18	14	11	9	8							
55	162	115	86	67	54	44	37	32	27	24	21	16	12	10	8	7	5						
60	159	112	83	64	51	42	35	30	25	22	19	14	11	9	7	5	4	4					
65	155	109	80	62	49	40	33	28	24	21	18	13	10	7	6	5	4	3	2				
70	152	106	78	60	48	38	32	27	23	19	17	12	9	7	5	4	3	2	2	1			
75	150	104	76	58	46	37	30	25	21	18	16	11	8	6	4	3	2	2	1	1	1		
80	147	102	74	57	45	36	29	24	20	17	15	10	7	5	4	3	2	1	1	1	0	0	
85	145	100	73	55	43	34	28	23	19	16	14	10	7	5	3	2	2	1	1	0	0	0	0
90	143	98	71	54	42	33	27	22	19	16	13	9	6	4	3	2	1	1	1	0	0	0	0
95	140	96	70	53	41	32	26	22	18	15	13	9	6	4	3	2	1	1	0	0	0	0	
100	138	95	68	51	40	31	25	21	17	14	12	8	6	4	3	2	1	1	0	0	0		
105	136	93	67	50	39	30	25	20	17	14	12	8	5	4	2	2	1	1	0	0			
110	134	91	65	49	38	30	24	19	16	13	11	7	5	3	2	2	1	1	1				
115	132	89	64	48	37	29	23	19	15	13	11	7	5	3	2	2	1	1					
120	129	88	62	46	36	28	22	18	15	12	10	7	5	3	2	2	1						
125	127	86	61	45	35	27	22	18	14	12	10	7	5	4	3	2							
130	125	84	59	44	34	26	21	17	14	12	10	7	5	4	3								
135	122	82	58	43	33	26	21	17	14	12	10	7	5	4									
140	119	80	56	42	32	25	20	17	14	12	10	8	6										
145	116	77	55	41	32	25	21	17	15	13	11	9											
150	112	75	54	40	32	26	21	18	16	15	13												
152	111	75	53	40	32	26	22	19	17	16													
154	110	74	53	41	33	27	23	21	19														
156	108	74	54	42	34	28	25	22															
158	107	74	54	43	35	30	27																
160	107	74	56	45	38	33																	
162	107	76	59	48	42																		
164	109	79	63	54																			
166	113	86	71																				
168	122	98																					
170	143																						

LENGTHS OF LINES.

(3) No line of the primary triangulation outside of the base nets should be less than 6 kilometers long. There is little if any advantage in so far as accuracy is concerned, in making the lines much longer than this. Therefore endeavor, in laying out the triangulation scheme, to use the economic length of line; that is, endeavor to use in each region lines of such lengths as to make the total cost of reconnoissance, building, and triangulation a minimum per mile of progress, subject to the limitations stated in these instructions.

FREQUENCY OF BASES.

(4) If the character of the country is such that a base site can be found near any desired location ΣR_1 between base lines should be made about 130. This will be found to correspond to a chain of from 15 to 35 triangles, according to the strength of the figures secured. With strong figures but few base lines will be needed and a corresponding saving will be made on this part of the work. If topographic conditions make it difficult to secure a base site at the desired location, ΣR_1 may be allowed to approach but not exceed 200. There will be danger when this is done that an intervening base may be necessary; for, if in any case the discrepancy between adjacent bases is found to exceed 1 part in 25 000 an intervening base must be measured.

BASE SITES AND BASE NETS.

(5) In selecting base sites keep in mind that a base can be measured with the required degree of accuracy on any site where the grade on any 50-meter tape length does not exceed 10 per cent, and that narrow valleys or ravines less than 50 meters wide in the direction of the base are not obstacles to measurement. The length of each base is to be not less than 4 nor more than 12 kilometers. In each base net great care should be taken to secure as good geometrical conditions as possible. There should be no hesitancy in placing the base on rough ground, provided the roughness is not greater than that indicated above, if by doing so the geometrical conditions in the base net are improved. Each base net should not be longer than two ordinary figures of the main chain between bases. The base net may also be strengthened by observing over as many lines between stations of the net as can be made intervisible without excessive cost for building or cutting. Caution is necessary in thus strengthening a base net by observing extra lines, to avoid making the figure so complicated as to be excessively difficult and costly to adjust.

The 1903 party, working in South Dakota and Minnesota, consisted of the chief, a signalman, and a driver. The outfit consisted of three horses, two light wagons, and the necessary small instruments. The members of the party depended upon the country for meals and lodging. Mr. Bilby worked alone on the reconnoissance in Minnesota in 1904 and in Texas in 1904–5. He had with him a very small outfit carried in a light spring wagon.

In the following table are given the data regarding the progress and cost of the two seasons' work on reconnoissance at the northern end of the ninety-eighth meridian, together with similar data for comparison for the party making the reconnoissance at the southern end of the ninety-eighth meridian during the season of 1904–5.[1]

[1] See Appendix 5, Report for 1911.

Statistics of reconnoissance.

	Locality and year			
	South Dakota and Minnesota, 1903	Minnesota, 1904	Texas, 1904–5	Combinations of two seasons at north end of 98th meridian
	Dates of beginning and closing season			
	Apr. 23–Oct. 5	July 1–Aug. 31	Sept. 20–Nov. 4 and Dec. 26–Jan. 12	
Total length of season by months	5.4	2.0	2.1	7.4
Total cost of work	$3 757.00	$527.00	$587.00	$4 284.00
Total number of stations selected	97	21	31	118
Total length of scheme in miles	541	90	150	631
Total area in scheme in square miles	4 100	800	1 520	4 900
Cost per station selected	$39.00	$25.00	$19.00	$36.00
Cost per mile of progress	$6.90	$5.90	$3.90	$6.80
Cost per square mile covered	$0.90	$0.65	$0.40	$0.85
Progress per month, miles	102	45	71	85

It will be noticed that the reconnoissance at the northern part of the ninety-eighth meridian triangulation cost more than that done in Texas at the southern end of this triangulation. The reason for this probably is that on the southern work Mr. Bilby was alone on the reconnoissance, using a very light outfit. The unit costs for the reconnoissance at the northern end of the ninety-eighth meridian triangulation are less than half the costs of any other reconnoissance of a similar character previously done in the United States in the same kind of country. The cost per mile of progress for this reconnoissance is only about 50 per cent greater than that of the reconnoissance for the arc of primary triangulation between Marysville, Cal., and Tacoma, Wash., done in 1903–5, in a mountainous country.[1] The progress per month on that reconnoissance was 93 miles (150 kilometers), while the average progress per month was 85 miles for the reconnoissance on the northern portion of the ninety-eighth meridian, in South Dakota and Minnesota.

On much of the reconnoissance in South Dakota and Minnesota poles varying in length from 12 to 60 feet, with flags or lozenges, were erected over the stations. The observer climbed these poles to get an outlook ahead and back to the rear stations. They assisted him in selecting the stations as well as in making estimates of the heights of signals to be erected to make the stations intervisible. On a portion of the line running toward Duluth, the poles were frequently placed in trees. The greater portion of the area covered by the reconnoissance was prairie or land under cultivation, gently rolling, with numerous rows of trees and groves in the vicinity of the farmhouses. By using the poles above mentioned, the lines could be made to clear these obstructions. It was seldom found to be necessary to use poles on the reconnoissance in Texas, and this was a factor in reducing the cost of the work there.

[1] The results of this arc of primary triangulation are not yet published.

PROGRESS OF OBSERVING.

The triangulation between the Page base net, Nebraska, and the stations Wieters and Freeman in South Dakota (see illustration No. 1) was done during the season of 1901 by the party under Assistant F. D. Granger. In 1903 the party under Assistant O. W. Ferguson carried the work from the two stations mentioned above to and including the Brown Valley base net, South Dakota. (See illustrations Nos. 2, 3, 4.) In 1904 the triangulation was extended from the Brown Valley base net to the vicinity of Brainerd, Minn. (see illustration No. 5), by a party under Assistant Wm. H. Burger. In 1905 Assistants Burger and H. D. King carried the work from Brainerd to Duluth and made a connection with the triangulation of the Lake Survey. (See illustrations 6, 7, 8.) During this season Mr. Burger was in charge for about one month, with Mr. King in his party. When Mr. King had become familiar with the work he took charge, relieving Mr. Burger. In 1906 the writer carried the triangulation from the line between stations Wahpeton and Western (see illustration No. 9), in approximate latitude 46° 10′ and approximate longitude 96° 20′, to and including the Stephen base line. (See illustration No. 10.) In 1907 he continued this triangulation from the Stephen base net to the Canadian border (see illustration No. 11), thus completing the ninety-eighth meridian arc of primary triangulation.

A connection was made with triangulation stations on the Missouri River where the primary triangulation crosses that river to the westward of Yankton, S. Dak., and stations of the Mississippi River triangulation station were connected with the primary triangulation in the vicinity of Royalton, Minn. Connections were also made with many section corners established by the General Land Survey. The longitudes and latitudes on the United States Standard Datum of the Missouri and Mississippi Rivers triangulation stations connected with and of the section corners are given in the list of geographic positions on pages 237 to 266.

The signals used in all of the triangulation on the northern portion of the ninety-eighth meridian were identical with those used in 1902 and described in Appendix 4, Report for 1903.

During each season of triangulation the building party was organized and equipped in a manner very similar to the building party of 1902.[1] It usually consisted of a signalman or a foreman, and three men.

During each season the building party was in immediate charge of Signalman Bilby.

The outfit of the building party was made as light as possible and consisted principally of the necessary tents and bedding for the members of the party, and the tools and hoisting apparatus required in erecting the signals.

During the season of 1902 the building party had attained a very high efficiency. This efficiency was maintained throughout the succeeding seasons on the ninety-eighth meridian triangulation. The unit costs per vertical foot of signals erected are not given in this publication, but they are probably within 10 per cent of $3.20, the unit cost in 1902.

[1] See p. 841, Appendix 4, Report for 1903.

The organization of the observing parties varied slightly from season to season, consisting of from three to five men, besides the observer. The number of permanent light keepers was four.

The tendency has steadily been to decrease the camp equipage and during the short season of 1907 it was practically at a minimum, consisting of two tents, cots and bedding for four persons, other small articles of camp equipage, and very light hand baggage. The entire outfit was hauled on one 2-horse wagon and the instruments were carried in a spring wagon.

With a small camp the outfit can be prepared for moving in a very short time and, after a move, the camp can be pitched very quickly. On this account it was found that the energies of the party could be put into the technical work, while with a large camp equipment much time and energy are expended in caring for and moving the property. The outfit of instruments necessarily remained about the same in each of the parties.

Each triangulation party on the northern portion of the ninety-eighth meridian triangulation had only one observer. There were two observers in the parties working on the ninety-eighth meridian in 1902 and 1903. (See Appendix 4, Report for 1903, and Appendix 5, Report for 1905.)

LIGHT KEEPERS.

In general, four light keepers were used in the triangulation party and they were directed by letter and by code signals sent in a modified Morse alphabet, using the lamps and heliotropes in signaling.[1] As was the case during the season of 1902, the light keepers lived in tents, prepared their own meals, and moved from station to station in hired wagons. Each was supplied with progress sketches of the work and also descriptions of the stations. With these it was easy for them to move from station to station and to locate from a station all of the other stations to which it was necessary to show lights. As far as practicable, the same light keepers were kept throughout the season, and it was usually the case that at the beginning of the season it was possible to secure the services of light keepers who had been trained during a previous season.

GENERAL INSTRUCTIONS TO CHIEFS OF OBSERVING PARTIES.

The general instructions issued to the chiefs of the observing parties are given below:

INSTRUMENTS.

In general, direction instruments of the highest grade should be used in triangulation of this class. Repeating theodolites are to be used only when the station to be occupied is in such a position as to be difficult of occupation with a direction instrument or when there is doubt of the instrument support being of such a character as to insure that the movement of the observer about the instrument does not disturb it in azimuth. Such stations usually occur on lighthouses and buildings.

[1] See pp. 826–829 of Appendix 4, Report for 1903.

NUMBER OF OBSERVATIONS—MAIN SCHEME—DIRECTION INSTRUMENT.

In making the measurements of horizontal directions measure each direction in the primary scheme 16 times, a direct and reverse reading being considered one measurement, and 16 positions of the circle are to be used, corresponding approximately to the following readings upon the initial signal:

Number.	°	′	″	Number.	°	′	″
1	0	00	40	9	128	00	40
2	15	01	50	10	143	01	50
3	30	03	10	11	158	03	10
4	45	04	20	12	173	04	20
5	64	00	40	13	192	00	40
6	79	01	50	14	207	01	50
7	94	03	10	15	222	03	10
8	109	04	20	16	237	04	20

When a broken series is observed, the missing signals are to be observed later in connection with the chosen initial or with some other one, and only one, of the stations already observed in that series. With this system of observing no local adjustment is necessary. Little time should be spent in waiting for the doubtful signal to show. If it is not showing within, say, one minute of when wanted, pass to the next. A saving of time results from observing many or all of the signals in each series, provided there are no long waits for signals to show, but not otherwise.

STANDARD OF ACCURACY.

In selecting the conditions under which to observe primary directions, proceed upon the assumption that the maximum speed consistent with the requirement that the closing error of a single triangle in the primary scheme shall seldom exceed three seconds, and that the average closing error shall be but little greater than one second, is what is desired rather than a greater accuracy than that indicated with slower progress. This standard of accuracy used in connection with other portions of these instructions defining the necessary strength of figures and frequency of bases will in general insure that the probable error of any base line, as computed from an adjacent base, is about 1 part in 88,000 and that the actual discrepancy between bases is always less than 1 part in 25,000

REJECTIONS—DIRECTION OBSERVATIONS.

The limit for rejection of observations upon directions in the main scheme shall be 5″ from the mean. No observation agreeing with the mean within this limit is to be rejected unless the rejection is made at the time of taking the observation and for some other reason than simply that the residual is large. A new observation is to be substituted for the rejected one before leaving the station, if possible without much delay.

NUMBER OF OBSERVATIONS—SUPPLEMENTARY STATIONS—DIRECTION INSTRUMENT.

In observing upon supplementary stations and in observing from supplementary stations upon stations in the main scheme four measures of the character outlined above shall be made of each direction, using the circle in the first four positions stated in that paragraph. A supplementary station is one which is not in the main scheme but which is observed upon or from which observations are taken for the purpose of connecting with stations which can not be effectively reached from the stations in the main scheme and with which a connection is required by specific instructions.

NUMBER OF OBSERVATIONS—INTERSECTION STATIONS—DIRECTION INSTRUMENT.

An intersection station is a station of which the position is determined by intersections from stations of the main scheme or supplementary stations and which is not occupied. One such measure as is outlined on page 171 shall be made of each direction to each intersection station. A second such measure shall be made if it can be secured under conditions nearly as favorable to accuracy as were the conditions when the first measure was made and without much delay to observations in the main scheme. Each series of observations on intersection station is to contain some one, and only one, of the main scheme or supplementary stations. It is important to have at least three lines to each intersection station in order to secure a check, but a possible intersection station should not be neglected simply because only two lines to it can be secured.

OBSERVING—SUPPLEMENTARY AND INTERSECTION STATIONS.

Observations upon and from supplementary stations and observations upon intersection stations may be taken under any atmospheric conditions whenever the object to be pointed upon is visible, and no delay is likely to be made to secure good seeing before observing.

LAND SECTION CORNERS AND OTHER SURVEY MARKS.

Whenever it is feasible to do so without incurring undue expense and delay, the section corners established by the United States Land Survey, and survey marks of any kind found upon the ground, shall be connected with the triangulation either by direct measurement of a distance and direction from a station or by using them as intersection stations.

VALUE OF INTERSECTION STATIONS.

In selecting intersection stations it should be kept in mind that the geographic value of a piece of triangulation depends upon the number of points determined, the size of the area over which they are distributed, and the permanence with which they are marked. The geographic value of the triangulation is lost for a given area when points can not be recovered within that area. The chance of permanency is increased by increasing the number of points as well as by thorough marking. These considerations should lead to the determination as intersection stations of many artificial objects of a permanent character, such as lighthouses, church spires, cupolas, towers, and large chimneys; should lead occasionally to the determination of specially marked stations established for this particular purpose; and should frequently lead to the permanent marking upon the ground of topographic or hydrographic stations and their determination as intersection stations. The practice of permanently marking such hydrographic points as are in commanding positions—on promontories, for example—and which are so situated that the station is not likely to disappear if permanently marked (on firm ground not likely to be washed away or on rocks), and determining their positions as intersection stations will frequently obviate the necessity which would otherwise exist for new triangulation when a later hydrographic survey is made. It is especially desirable to increase the area effectively covered for geographic purposes by selecting intersection stations which are outside the area covered by the main scheme.

VERTICAL MEASURES IN MAIN SCHEME.

Vertical measures are to be made at each station in the main scheme on each station in the main scheme. These vertical measures should be made on as many days as possible during the occupation of the station, but in no case should the occupation of the station be prolonged in order to secure such measures. Two measures, each with the telescope in both the direct and the reversed positions, on each day, are all that are required. These measures may be made at any time between 11.30 a. m. and 4.30 p. m. It is desirable, however, with a view of avoiding errors due to diurnal variation of refraction, to have a fixed habit of observing the verticals in the main scheme at a certain hour, as, for example, between 3 and 4 p. m. If the vertical measures at a station are made by the micrometric method, double zenith distance measures shall be made on at least two of the lines radiating from that station.

VERTICAL MEASURES—SUPPLEMENTARY AND INTERSECTION STATIONS.

In addition to the vertical measures required in the main scheme, vertical measures must be made ateach station, whether in the main scheme or supplementary, over every line of which the horizontal direction is measured. Two measures each with the telescope in both the direct and reverse positions are all that are required on all lines to or from supplementary or intersection stations, except when the observations upon such stations are made for the purpose of connecting with bench marks of which the elevations are fixed by precise leveling or tidal observations. In the latter case observations should be made on as many days as possible during the occupation of the station, but in no case should the occupation of a station be prolonged in order to obtain measures. Also, in the latter case, the vertical observations are to be made in both directions over every line more than 5 kilometers long, even though horizontal measures may be necessary in but one direction over the line.

MARKING OF STATIONS.

Every station, whether it is in the main scheme or is a supplementary or intersection station, which is not in itself a permanent mark, as are lighthouses, church spires, cupolas, towers, large chimneys, sharp peaks, etc., shall be marked in a permanent manner. At least one reference mark of a permanent character shall be established not less than 10 meters from each station of the main scheme and accurately referred to it by a distance and direction. Such reference marks shall preferably be established on fence or property lines, and always in a locality chosen to avoid disturbance by cultivation, erosion, or building. It is desirable to establish such reference marks at all marked stations. At all stations where digging is feasible both underground and surface marks which are not in contact with each other shall be established. Wood is not to be used in permanent marks.

DESCRIPTIONS OF STATIONS.

Descriptions shall be furnished of all marked stations. For each station which is in itself a mark, as are lighthouses, church spires, cupolas, towers, large chimneys, sharp peaks, etc., either a description must be furnished, or the records, lists of directions, and lists of positions must be made to show clearly in connection with each point by special words or phrases if necessary the exact point of the structure or object to which the horizontal and vertical measures refer. Every land section corner connected with the triangulation must be fully described. The purpose of the description is to enable one who is unfamiliar with the locality to find the exact point determined as the station and to know positively that he has found it. Nothing should be put into the description that does not serve this purpose. A sketch accompanying description should not be used as a substitute for words. All essential facts which can be stated in words should be so stated, even though they are also shown in the sketch.

ABSTRACTS AND DUPLICATES.

The field abstracts of horizontal directions and vertical measures are to be kept up and checked as the work progresses and all notes as to eccentricities of signals or instrument, of height of point observed above ground, etc., which are necessary to enable the computation to be made, are to be incorporated in the abstracts. As soon as each volume of the original record has been fully abstracted and the abstracts checked, it is to be sent to the Office, the corresponding abstracts being retained by the observer. A duplicate of the description of stations is to be made. If the original descriptions of stations are written in the record books, a copy of these descriptions compiled in a separate book may be considered the duplicate and should then be marked as such. A duplicate of the miscellaneous notes mentioned above may also be made if considered desirable. No other duplicates of the original records are to be made. Pencil originals should not be inked over.

NUMBER OF OBSERVATIONS—MAIN SCHEME—REPEATING THEODOLITE.

If a repeating theodolite is used for observations in the main scheme, corresponding to those indicated on page 171, make the observations in sets of six repetitions each. For each angle measured follow each set of six repetitions upon an angle with the telescope in the direct position immediately by a similar set of six on the explement of the angle with the telescope in the reversed position. It is not

necessary to reverse the telescope during any set of six. Make the total number of sets of six repetitions on each angle ten—five directly on the angle and five on its explement. Measure only the single angles between adjacent lines of the primary scheme and the angle necessary to close the horizon. With this scheme of observing no local adjustment is necessary, except to distribute the horizon closure uniformly among the angles measured. The limit of rejection corresponding to that stated on page 171 shall be for a set of six repetitions 4″ from the mean.

NUMBER OF OBSERVATIONS—SUPPLEMENTARY STATIONS—REPEATING THEODOLITE.

If the observations at a supplementary station or upon a supplementary station, corresponding to those indicated on page 171, are made with a repeater, four sets of six repetitions each should be made, two directly upon each angle with the telescope in the direct position and two upon its explement with the telescope in the reversed position. No measures introducing station conditions other than closure of horizon are to be made upon or at supplementary stations.

NUMBER OF OBSERVATIONS ON INTERSECTION STATIONS—REPEATING THEODOLITE.

If the observations upon intersection stations, corresponding to those indicated on page 172, are made with a repeater, two sets of three repetitions each should be made, one directly upon an angle with the telescope in the direct position and one upon its explement with the telescope in the reverse position. Fix the direction to each intersection station by measuring the angle between it and some line in the main scheme or to a supplementary station. No measurements introducing conditions are to be made.

FIELD COMPUTATIONS.

The field computations are to be carried to hundredths of seconds in the angles, azimuths, latitudes, and longitudes, and to seven places in the logarithms. The field computation may be stopped with the completion of the lists of direction for all stations and objects, and the triangle side computation for the main scheme and supplementary stations, unless there are special reasons for carrying it further. The computation to this point should be kept up as closely as possible as the work progresses to enable the observer to know that the observations are of the required degree of accuracy. No least square adjustments are to be made in the field. All of the computation, taking of means, etc., which is done in the record books and the lists of directions should be so thoroughly checked by some person other than the one who originally did it as to make it unnecessary to examine it in the Office. The initials of the person making and checking the computations in the record books and the lists of direction should be signed to the record as the computation and checking progresses.

METHODS OF OBSERVING EMPLOYED.

All the angle measures were made by the direction method, using the 12-inch (30-centimeter) theodolites which had been made in the Instrument Division of the Survey. These instruments are described in Appendix 8, Report for 1904. The telescope used has a clear aperture of 61 millimeters and its focal length is 74 centimeters. The circle is graduated to five-minute spaces and is read by the micrometer microscopes to single seconds.

The telescope of the theodolite has two parallel vertical wires, about 20 seconds apart, for making the pointings for horizontal angles. The results from a number of seasons' work indicate that this arrangement of the wires in the telescope is more satisfactory than either the single vertical wire or the oblique cross. The double wire is especially effective when the image of the light or heliotrope is large and unsteady.

One of the theodolites used during the season of 1903–4 in Texas and all of the theodolites used thereafter on the ninety-eighth meridian primary triangulation had two pairs of lines, about four minutes apart, in the micrometer microscope.[1] This arrangement saved much time, for, when a reading backward or forward was made by placing one pair of lines on a five-minute graduation of the circle, then the other pair of lines would have to be moved through the space of only one minute to bring it in contact with a second graduation to make the forward or backward reading. With the previous arrangement of only one pair of wires it was necessary to move the wires through a space of five minutes to make the second reading.

The readings upon the initial signal were so selected that the mean value of any angle is practically free from errors due to periodic errors of graduation and is almost entirely free from the effects of the run of the micrometers. However, the micrometer microscopes were adjusted whenever tests showed that the mean run of the three was more than one second for a five-minute space or when any one micrometer microscope had a run greater than three seconds.[2]

Practically all the primary horizontal observations were made on heliotropes or acetylene lamps. At the eastern portion of the arc, extending toward Duluth, some observations were made during cloudy days on short poles placed on the light stand of the signal. This was made practicable by the short lines of this section of the triangulation.

PROGRAM OF OCCUPATION OF STATIONS.

In the following tables the primary stations occupied during the several seasons are arranged in the order of their occupation. The second column of each table indicates the days on which horizontal observations on primary stations were taken, the third column the number of such days, and the fourth column the approximate height of the instrument above the ground. In using the heliotrope the point observed upon was placed about 1.6 meters above the instrument. There were some exceptional cases where the heliotrope was placed more than this distance above the instrument.

STATIONS OCCUPIED.

Assistant F. D. GRANGER, Chief of Party and Observer, 1901.

Station	Days on which observation of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Walnut	June 26, 28, 29; July 1, 2, 3, 5	7	4.47
Sparta	July 13, 16, 18, 19, 20, 22, 23, 27, 28	9	4.64
Santee	Aug. 2, 3, 4, 5, 6	5	4.47
Avon	Aug. 13, 14, 15, 16, 17	5	4.64
Vod	Aug. 23, 24, 28, 30, 31; Sept. 2	6	12.47
Yankton	Sept. 12, 13, 14, 15, 16	5	4.47
Wieters	Sept. 28; Oct. 1, 2, 3, 4	5	15.39
Freeman	Oct. 14, 15, 16	3	4.53
Average			6.88

[1] See pp. 248–249, Appendix 5, Report for 1905.
[2] See pp. 821 and 822, Appendix 4, Report for 1903.

Stations occupied—Continued.

Assistant O. W. FERGUSON, Chief of Party and Observer, 1903.

Station	Days on which observation of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Elm Springs	May 15, 16, 18, 19	4	14. 11
Wolf Creek	May 20, 23, 25, 27, 30; June 3, 4	7	18. 35
Silver Lake	June 5, 6	2	14. 25
Salem	June 8, 9, 10	3	14. 23
Farmer	June 11, 12, 13, 15, 16	5	13. 92
Reese	June 18, 19, 20	3	8. 65
Canova	June 22, 23, 24, 25	4	14. 04
Owens	June 26, 27	2	9. 20
Crane	June 29, 30; July 1, 21 [1]	4	14. 21
Caldwell	July 3, 6, 7, 8, 9, 25 [1]	6	18. 48
Hansen	July 11, 13, 14, 15, 16	5	14. 22
Brock	July 17, 18, 20	3	8. 83
Miner	July 22, 23, 24	3	3. 67
Drakola	July 27	1	3. 73
	July 28	1	3. 66
Jeska	July 29, 30, 31	3	9. 20
Larson	Aug. 1, 3, 4	3	14. 15
Oakwood Lake	Aug. 5, 6, 10	3	14. 03
Weiss	Aug. 11, 12, 13, 14	4	14. 21
Horswill	Aug. 15, 17, 18	3	9. 32
Olson	Aug. 20, 21, 22	3	9. 32
Elfring	Aug. 24, 25, 31; Sept. 1	4	3. 63
Franklin	Sept. 2, 3	2	3. 57
Mound	Sept. 6, 8, 9	3	18. 39
Helgen	Sept. 10, 14, 15	3	9. 33
Waubay	Sept. 16, 17, 18	3	9. 23
Boating	Sept. 19, 21, 22, 23	4	18. 40
Preacher Hill	Sept. 24, 26, 28, 29	4	14. 21
Pickerel	Sept. 30; Oct. 1	2	9. 29
Drywood	Oct. 3, 5, 6, 7	4	9. 23
Brown Valley NW. base	Oct. 8, 9	2	3. 72
Brown Valley SE. base	Oct. 10, 13, 14	3	3. 62
Layden	Oct. 15, 17	2	14. 07
Average			10. 92

[1] Reoccupied.

Stations occupied—Continued.

Assistant W. H. BURGER, Chief of Party and Observer, 1904.

Station	Days on which observation of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Drywood	June 4, 6, 7, 8	4	9. 19
Layden	June 9, 10, 11	3	14. 11
Enwiller	June 13, 14	2	9. 37
Hankinson	June 15, 17, 18, 21	4	3. 60
Oscarson	June 28, 29, 30, July 1	4	18. 28
Foss	July 2, 5	2	18. 54
Wahpeton	July 6, 7	2	18. 36
Western	July 9, 11, 12	3	18. 15
Bullis	July 14, 15, 16	3	18. 32
Elbow	July 18, 19	2	18. 38
Dalton	July 20, 21	2	9. 26
Leaf	July 25, 26	2	3. 52
Holmes	July 27, 28	2	9. 10
Alexandria	July 30; Aug. 1	2	18. 41
Parker	Aug. 2, 3	2	3. 52
Leslie	Aug. 5, 6	2	18. 45
Osakis	Aug. 9, 10, 11, 12	4	18. 42
Maple	Aug. 15	1	18. 50
Long	Aug. 16, 17, 18	3	18. 45
Birch	Aug. 20, 23	2	6. 20
Eagle	Aug. 26, 27, 29, 30	4	8. 06
Lone	Sept. 3, 5	2	3. 44
Falls	Sept. 7, 8, 9, 28[1], 29 [1]	5	4. 83
Royalton N. base	Sept. 10, 12, 13	3	8. 21
Alberta	Sept. 14, 15	2	9. 23
Brockway	Sept. 16, 17	2	3. 32
Royalton S. base	Sept. 19, 20, 21	3	3. 74
Johnson	Oct. 1, 3	2	9. 34
Rail	Oct. 4, 5	2	9. 26
Daggett	Oct. 10, 11, 12	3	18. 42
Jones	Oct. 19	1	18. 37
Gull	Oct. 21, 22	2	3. 59
Average			11. 56

[1] Reoccupied.

Stations occupied—Continued.

Assistants W. H. BURGER and H. D. KING,[1] Chiefs of Party and Observers, 1905.

Station	Days on which observation of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Gull	June 8, 9, 12	3	3.59
Jones	June 14	1	18.36
Rabbit	June 17, 19, 20	3	14.03
Brook	June 23, 26, 27	3	15.28
Bethlehem	June 29, 30	2	23.02
French	July 6, 7	2	22.98
Rae	July 8, 10	2	23.00
Kimberly	July 11	1	22.94
Grindle	July 12, 13, 14	3	23.04
Gregor	July 17	1	22.99
Tamarack	July 18, 19	2	23.02
Douglas	July 20, 21	2	23.15
Bachelor	July 24, 25, 26	3	22.85
Wright	July 27, 29, 31	3	23.00
Island	Aug. 3, 4, 5	3	22.93
Cromwell	Aug. 7	1	23.03
Sawyer	Aug. 10, 11, 12	3	22.99
Mahtowa	Aug. 15, 16, 18	3	23.09
Atkinson	Aug. 19, 21	2	15.12
Cloquet	Aug. 22, 23, 24	3	18.43
Carlton	Aug. 25	1	15.24
Annie	Aug. 30; Sept. 4, 5, 6	4	9.86
Dedham	Sept. 9, 11, 12, 13, 15	5	3.10
Superior	Sept. 19, 20, 21	3	24.39
Duluth	Sept. 22, 23, 25	3	3.34
Minnesota Pt. N. base	Sept. 27, 28	2	10.80
Minnesota Pt. S. base	Sept. 29, 30	2	10.70
Average			17.94

[1] Mr. Burger was in charge of the party from June 8 to 30. Mr. King was in charge of the party and was the observer from July 1 to the end of the season.

Stations occupied—Continued.

Assistant W. Bowie, Chief of Party and Observer, 1906.

Station	Days on which observation of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Western	June 1, 2, 4	3	19. 38
Wahpeton	June 5, 6, 7	3	18. 46
Fox	June 8, 9	2	11. 50
Indian	June 11, 12, 13	3	15. 54
Meadows	July 13, 14	2	18. 58
Barnesville	July 17, 18, 20	3	18. 58
Tansem	July 21, 23, 24	3	9. 72
Eglon	July 25, 26, 27, 28, 30	5	3. 86
Riverton	Aug. 2, 3	2	9. 86
Keene	Aug. 4, 6, 7	3	9. 54
Morken	Aug. 8, 9, 10, 11	4	15. 29
Borup	Aug. 14, 15, 16	3	18. 57
Syre	Aug. 17, 18, 20	3	3. 75
Gary	Aug. 21, 22, 23	3	18. 67
Wicklow	Aug. 27, 28	2	18. 52
Beltrami	Aug. 29, 30	2	18. 47
Fertile	Sept. 1, 4	2	3. 56
Tilden	Sept. 5, 6, 8	3	15. 52
Andover	Sept. 11, 12, 15, 17	4	18. 57
Shirley	Sept. 15, 17	2	18. 62
Ives	Sept. 18, 19	2	15. 67
Bray	Sept. 21, 22	2	15. 60
Sherack	Sept. 25, 26	2	18. 54
Warren	Sept. 28, 29	2	18. 64
Viking	Oct. 1, 3	2	18. 56
Wright	Oct. 4, 5, 6	3	18. 52
Argyle	Oct. 9, 10	2	20. 06
Stephen west base	Oct. 12	1	15. 55
Stephen east base	Oct. 13	1	15. 60
Average			15. 22

NOTE.—The triangulation was interrupted for base measurements from June 14 to July 12. See Appendix 4, Report for 1907, p. 109.

Assistant W. Bowie, Chief of Party and Observer, 1907.

Donaldson	July 5, 6, 8	3	20. 00
Deer	July 9, 10	2	20. 03
Jupiter	July 11, 12	2	20. 05
Skane	July 13, 15	2	15. 57
Hallock	July 16	1	9. 67
Hill	July 17, 18	2	15. 58
Granville	July 19, 20	2	15. 59
Canada	July 22	1	15. 55
States	July 23	1	15. 61
Average			16. 41

The average heights of signals for the five seasons at the northern portion of the ninety-eighth meridian between 1903 and 1907, inclusive, are 10.92, 11.56, 17.94, 15.22, and 16.41 meters, respectively.

The following table gives the essential facts for each season's work on the ninety-eighth meridian after the year 1901. Similar facts for the triangulation done on the ninety-eighth meridian previous to 1902, and on the thirty-ninth parallel in Kansas, are given on page 368, Appendix No. 6, Report for 1901; and page 223, Appendix 3, Report for 1902.

Name of observer	Number of observations of each primary direction	Total number of days of primary observations	Number of stations	Average number of days per station of primary observations	Maximum number of days per station of primary observations	Minimum number of days per station of primary observations	Average number of days at station between first and last primary horizontal observations	Average number of days between stations, from last observation at one station to first observation at next station.	Average number of days per station	Rate of progress. Stations occupied per month
Bowie, 1902 [1] S.[2]	16	107	40	2.7	7	1	3.5	1.8	5.3	5.7
Ferguson, 1902 [1] S.	16	133	35	3.8	10	1	4.7	1.4	6.1	4.9
Ferguson, 1903 N.	16	108	32	3.4	7	2	4.4	0.5	4.9	6.1
Ferguson, 1903–4 [1] S.	16	34	15	2.3	3	1	3.0	1.2	4.2	7.1
Burger, 1903–4 [1] S.	16	28	11	2.5	4	1	3.6	0.6	4.2	7.1
Burger, 1904 N.	16	82	32	2.6	5	1	2.9	1.5	4.4	6.8
Burger, 1904–5 S.	16	44	23	1.9	3	1	2.3	1.0	3.3	9.1
Burger and King, 1905 N.	16	66	27	2.4	5	1	3.1	1.2	4.3	7.0
King, 1905 S.	16	24	11	2.2	5	1	2.8	0.2	3.0	10.0
Bowie, 1906 N.	16	72	28	2.6	5	1	3.0	0.8	3.8	7.9
Bowie, 1907 N.	16	16	9	1.8	3	1	2.0	0.1	2.1	14.3
Mean of all by seasons	16			2.6	5	1.1	3.2	0.9	4.1	7.8
Mean of southern work	16			2.6	5	1.0	3.3	1.0	4.3	7.3
Mean of northern work	16			2.6	5	1.2	3.1	0.8	3.9	8.4

[1] There were two observing parties in one organization in 1902 and in 1903–4.
[2] The letters "S" and "N" indicate the southern and northern portions of the ninety-eighth meridian, respectively.

The number of observations of a primary horizontal direction was the same in each of the parties. The work of abstracting the results of the horizontal angles was materially reduced in 1905 by a simple arrangement of the record of observations by which the resulting directions were computed in the record book. A checked copy of the resulting directions was kept by the observer as a duplicate and to guard against loss. In previous seasons the record was practically duplicated in making the abstracts, and this work frequently delayed the progress of the observing party.

The ratio of the observing days at a station to the total number of days at the station, between the first and last observations, gives an idea of the weather conditions encountered, whether favorable or otherwise. The higher the percentage the greater is the amount of time favorable for making observations. These percentages are based upon the whole time at the station, Sunday included, although no observations were made on that day. The percentages for the five seasons' work on the northern portion of the ninety-eighth meridian, 1903 to 1907, inclusive, are 77, 89, 77, 87, and 90, respec-

tively. The percentages for the other seasons on the ninety-eighth meridian triangulation varied from 70 to 86.

The average number of days on which primary observations were made at a station varied from 1.8 to 3.8, with an average of 2.6 for the 11 observing parties. The table shows that there is a tendency toward uniformity. From the fall of 1903 to 1907 the average number of days varied from 1.8 to 2.6, with a mean of 2.3 for 8 observing parties. The maximum number of days on which primary observations were made at a station becomes very uniform beginning with the fall of 1903. The maximum number after that varied from three to five. The minimum number of days of primary observations per station was one, except during one season, in which the minimum number was two. The average number of days at a station between the first and last on which primary horizontal directions were measured is 3.2 for the 11 observing parties considered. There has been a slight but gradual decrease in the time spent at a station. The next column shows the time spent between stations after primary horizontal measures were completed at one station and before they were begun at the next. This is largely a matter of transportation. The party with the light outfit could move to the next station and frequently begin observations the same day or night without overworking the members of the party. The parties of King in 1905 in Texas and of the writer in 1907 in Minnesota were running light, with no cook or mess outfit, and the average number of days between stations was 0.2 and 0.1, respectively.

It is shown in the next column that the number of days per station (obtained by dividing the total number of days during the season, between the dates of the first and last primary horizontal observations of the season, by the number of primary stations occupied) for these two seasons average 3 and 2.1, respectively. The table shows that the number of days per station has a tendency to decrease. The last column is interesting in showing the rates of progress in stations per month. There has been a gradual increase, with an average of 7.8 stations per month for the 11 observing parties. The decreased amount of work involved in making the abstracts of the directions beginning with the seasons of 1905, the saving in time by having two pairs of lines in the micrometer microscope (see pages 175 and 180), and the tendency to reduce the camp equipage were factors in increasing the rate of progress.

STATEMENT OF COSTS.

The following table gives a statement of the unit costs of the different seasons' work on the ninety-eighth meridian, beginning with that of 1902. The weather conditions, ease of access to station and ease of securing supplies, and the amount of building were not very different for the different seasons, except that the last portion of the work done by the party in Minnesota in 1905 extended across a tamarack swamp where travel between stations was very difficult and all the signals were high.

The primary triangulation in the vicinity of the Point Isabel base line, in Texas, was done by Assistant O. B. French, in 1906, while he was there engaged on the measurement of the base.[1] Three of the six stations were occupied during the measurement of the base from the base camp, while the other three stations were occupied after the completion of the base measurements. The observing party used a light camp outfit while occupying the last three stations.

[1] See Appendix 4, Report for 1907; and p. 349, Appendix 5, Report for 1911.

The triangulation of the Point Isabel base net was done at a very small expenditure of time and money. It would be rather difficult to separate the cost of this triangulation from the total cost of all the work done at Point Isabel. As the work was very limited in extent and was done under exceptional conditions, a knowledge of its cost would be of little value for purposes of comparison with that of other seasons' work discussed in this appendix.

Name of observer	Number of months of observations	Number of primary stations occupied	Stations occupied per month	Total field expenses	Cost per station occupied	Total points determined	Cost per point determined	Number of miles of progress	Cost per mile of progress	Area in main scheme, in square miles	Cost per square mile
Ferguson, 1903 N. [1]	5. 1	32	6. 3	$9 256	$290	152	$61	173	$53	2 390	$3. 90
Burger, 1904 N.	4. 6	33	7. 2	8 560	260	67	128	165	52	2 970	2. 90
King, 1905 N.	3. 8	27	7. 1	9 183	340	64	144	109	84	1 010	9. 09
Bowie, 1906–7 N.	4. 1	38	9. 0	11 324	298	202	56	170	67	2 530	4. 50
Bowie and Ferguson, 1902 [2] S.	7. 2	75	10. 4	22 671	300	231	98	444	51	9 780	2. 30
Ferguson and Burger, 1903–4 [2] S.	2. 1	26	12. 4	7 912	300	58	140	112	71	1 480	5. 30
Burger, 1904–5 S.	2. 5	23	9. 2	6 119	270	46	133	112	55	1 100	5. 55
King, 1905 S.	1. 1	11	10. 0	3 162	287	29	109	44	72	395	8. 00
Means by seasons or totals	30. 5	265	9. 0	78 187	293	849	109	1 329	63	21 655	5. 19
Means for northern portion of arc			7. 4		297		97		64		5. 10
Means for southern portion of arc			10. 5		289		120		62		5. 29

[1] The letters "N." and "S." indicate the northern and southern portions of the ninety-eighth meridian, respectively.
[2] There were two observing parties in one organization during the seasons of 1902 and 1903–4.

In the above table the two seasons 1906 and 1907 are considered together, for the signals at the 38 stations were all erected in 1906 and it would be difficult to separate the expenses of building into two seasons.

There is only one season for which the cost per station occupied differs more than 11 per cent from the mean of all. This is also the only season for which the cost per mile of progress differs more than 19 per cent from the mean of all. This is the season of 1905, in Minnesota, where the cost of building signals and of transportation was heavy in working across the tamarack swamp. (See p. 181.) The cost per station occupied and per mile of progress for this season differed 17 and 33 per cent, respectively, from the mean cost for all of the seasons. It will be noticed that the mean cost per square mile of area covers a wide range and does not give a clear idea of the economics of the work.

It is important to note that there are certain more or less fixed costs for each season's work, which are independent of the rate of progress of the building and observing parties. They are the railroad transportation to and from the field, the local transportation between stations of the observing party and of the light keepers by hired teams, the cost of new articles of outfit, the cost of lumber for signals delivered at the stations, and the salary expenses in the period before observations begin and after they end during which

the party is organized and outfitted and is disbanded, respectively. Other things being equal, it appears that the unit cost would be less if the seasons are lengthened, for then some of the fixed expenses would be distributed over more work, and because the members of the party employed only for the season gain in efficiency with experience.

The salaries, pay, and subsistence of the members of the observing party and light keepers and the care and feed of horses are about 35 per cent of the total cost of a season, hence it would require an increase or decrease in the rate of progress of the observing party of 15 per cent to affect the unit costs by 5 per cent.

The statistics for the total work along the ninety-eighth meridian, beginning with the season of 1898, are:

Number of months of observations	62
Number of primary stations occupied [1]	337
Total field expenses (including all salaries)	$125 700.00
Average cost per station occupied	$373.00
Total points determined	1 040
Cost per point determined	$121.00
Number of miles of progress	1 720
Cost per mile of progress	$73.00
Area of main scheme, in square miles	29 200
Cost per square mile	$4.30

The unit costs for the transcontinental triangulation [2] are:

Cost per station occupied	$2 000.00
Cost per mile of progress	200.00
Cost per square mile of area in the main scheme	3.50

It would be very difficult to obtain similar cost data for the eastern oblique arc, but the unit costs are believed to be close to those for the transcontinental arc.

STATEMENT OF ADJUSTMENTS.

No local adjustments of directions were made. The method of supplying missing observations in broken series specified in the general instructions makes such adjustments unnecessary.

The lengths and directions of the three sides of the triangle Walnut-Hall-Page southwest base had been fixed by the adjustment published in Appendix 6 of the Report for 1901, "Triangulation northward along the ninety-eighth meridian in Kansas and Nebraska," and their geographic positions as there printed were held fixed.

At the eastern end, where the triangulation connects with that of the United States Lake Survey, the length of the Minnesota Point base was adopted as measured. The geographic positions of the terminal stations were finally held fixed, but at first a single adjustment was made of the entire chain of triangulation connecting the triangle Walnut-Hall-Page southwest base with the measured base at Minnesota Point on the shore of Lake Superior. In this triangulation there was known, in addition to the fixed triangle and the length of the Minnesota Point base, the lengths of the Brown Valley base and the Royalton base as measured in 1906 by Assistant O. B. French.[3]

[1] A few points were occupied in each of two seasons.

[2] See p. 257, Appendix No. 6, Report for 1898. These costs do not include salaries, and omit some of the other large items of expense included in the costs for the ninety-eighth meridian triangulation.

[3] See Appendix 4, Report for 1907, pp. 142–147.

For convenience, the single adjustment is considered in the three sections into which the base lines naturally divide it. The first section extends from the Page base net to Brown Valley base; the second from the first section to the Royalton base; and the third from the second section to the Minnesota Point base. (See illustrations 1–8.)

In this first adjustment there were 193 angle and side equations and 3 length equations, a total of 196.

The adjustments of the remainder of the triangulation, that between Fergus Falls and Canada, were made in two sections.

The first section extends from the line Wahpeton–Western to the Stephen base, requiring 67 condition equations. (See illustrations 9 and 10.)

The second section extends from the line Donaldson–Deer to the Canadian line, and required the solution of 15 condition equations. (See illustration 11.)

ADJUSTMENT OF THE DISCREPANCIES IN LATITUDE, LONGITUDE, AND AZIMUTH.

After the completion of the adjustment for the primary chain connecting the fixed geographic positions in the Page base net with the triangulation of the United States Lake Survey, the positions were computed through these adjusted triangles. The discrepancy in latitude which developed was 0″.727 (or 30 meters); in longitude, 1″.427 (or 30.3 meters); and in azimuth, 5″.94. In other words, the closure of the loop of triangulation through Lakes Superior and Michigan down to the thirty-ninth parallel, westward to the ninety-eighth meridian and northward to Brown Valley and Duluth, a total of 3 400 kilometers, is 42.6 meters in position, or 1 part in 80 000. This total discrepancy in loop closure was distributed in the chain of triangulation between the Page base net and Minnesota Point base. The whole discrepancy was thus distributed in only about one-fourth of the entire loop, and probably in the strongest portion. The introduction of the whole loop into the adjustment, or of any considerable portion of it, other than the part used, was impracticable on account of the great amount of computation involved. Not only would such a step have greatly increased the work of making the loop adjustment itself which already included 196 conditions, but it would also have made necessary the recomputation of much triangulation based on the previously adjusted portion of the loop. It will be seen on examining the corrections to the directions or angles, arising from the adjustment of the discrepancies in latitude, longitude, and azimuth, which are shown separately from those arising from satisfying the angle, side and length equations, that in no case does the correction amount to as much as four times the probable error of the direction or angle, and in many cases it is less than the probable error. The probable error of a direction, which is the best test of the wisdom of the method adopted, shows that whereas the probable error of a direction was ±0″.38 before distributing the latitude, longitude, and azimuth discrepancies, it was increased to but ±0″.51 after the distribution. The maximum correction 1″.44 to a direction was increased to but 1″.65 by this distribution.

CONDITION EQUATIONS.

PAGE BASE NET TO BROWN VALLEY BASE.

No.

1. $o = -0.89 - (1) + (2) - (6) + (7)$
2. $o = +1.42 + (1) - (5) - (7) + (8)$
3. $o = -2.01 - (4) + (5) - (8) + (10) - (11) + (12)$
4. $o = +0.84 - (3) + (5) - (8) + (9) - (19) + (20)$
5. $o = +0.50 - (3) + (4) - (12) + (13) - (18) + (20)$
6. $o = +0.99 - (13) + (14) - (16) + (18) - (24) + (25)$
7. $o = -0.08 - (13) + (15) - (17) + (18) - (26) + (27)$
8. $o = -0.84 - (14) + (15) - (23) + (24) - (26) + (28)$
9. $o = +0.43 - (21) + (23) - (28) + (29) - (34) + (35)$
10. $o = -0.34 - (22) + (23) - (28) + (30) - (36) + (37)$
11. $o = -1.53 - (29) + (30) - (33) + (34) - (36) + (38)$
12. $o = +1.84 - (32) + (33) - (38) + (40) - (46) + (47)$
13. $o = -2.08 - (31) + (32) - (43) + (44) - (47) + (48)$
14. $o = +0.72 - (40) + (41) - (45) + (46) - (51) + (52)$
15. $o = -3.81 - (42) + (43) - (48) + (49) - (62) + (63)$
16. $o = +0.15 + (45) - (50) - (52) + (53) - (54) + (55)$
17. $o = +0.25 - (49) + (50) - (55) + (56) - (61) + (62)$
18. $o = +0.83 - (56) + (57) - (60) + (61) - (67) + (68)$
19. $o = +1.17 - (59) + (60) - (65) + (66) - (68) + (69)$
20. $o = -0.86 - (57) + (58) + (67) - (72) - (73) + (74)$
21. $o = +1.27 - (64) + (65) - (69) + (70) - (85) + (86)$
22. $o = -0.04 - (71) + (72) - (74) + (75) - (76) + (77)$
23. $o = +0.14 - (70) + (71) - (77) + (78) - (84) + (85)$
24. $o = -0.70 - (78) + (79) - (83) + (84) - (98) + (99)$
25. $o = +2.33 - (82) + (83) - (99) + (100) - (104) + (105)$
26. $o = +2.41 - (79) + (81) - (93) + (94) + (98) - (102)$
27. $o = -0.64 - (91) + (92) - (100) + (101) - (103) + (104)$
28. $o = -1.04 - (89) + (91) - (94) + (95) - (101) + (102)$
29. $o = -0.47 - (79) + (80) - (90) + (91) + (98) - (101)$
30. $o = -1.16 - (88) + (89) - (95) + (96) - (111) + (112)$
31. $o = +0.02 - (87) + (88) - (112) + (113) - (122) + (123)$
32. $o = +0.26 - (96) + (97) - (106) + (107) - (110) + (111)$
33. $o = +0.99 - (107) + (108) - (109) + (110) - (114) + (115)$
34. $o = -0.30 + (109) - (113) - (115) + (116) - (121) + (122)$
35. $o = -0.84 - (116) + (117) - (119) + (121) - (127) + (128)$
36. $o = +0.80 - (117) + (118) - (126) + (127) - (129) + (131)$
37. $o = -0.18 - (116) + (118) - (120) + (121) - (129) + (130)$
38. $o = -0.65 - (125) + (126) - (131) + (133) - (139) + (140)$
39. $o = +0.44 - (132) + (133) - (136) + (137) - (139) + (141)$
40. $o = +0.40 - (140) + (141) - (124) + (125) - (136) + (138)$
41. $o = -0.10 - (134) + (136) - (141) + (142) - (152) + (153)$
42. $o = +2.27 - (134) + (135) - (145) + (146) - (151) + (153)$
43. $o = +0.11 - (142) + (143) - (144) + (146) - (151) + (152)$
44. $o = +2.54 - (146) + (148) - (150) + (151) - (159) + (160)$
45. $o = +1.03 - (146) + (147) - (149) + (151) - (157) + (158)$
46. $o = +0.37 - (149) + (150) - (160) + (161) - (156) + (158)$
47. $o = +2.64 - (155) + (156) - (161) + (162) - (166) + (167)$
48. $o = -2.13 - (154) + (155) - (167) + (168) - (174) + (175)$
49. $o = -1.06 - (168) + (169) - (173) + (174) - (186) + (187)$
50. $o = +0.62 - (163) + (165) - (177) + (179) - (193) + (196)$
51. $o = -1.61 - (162) + (163) + (166) - (170) - (179) + (180)$
52. $o = -0.99 - (163) + (164) - (178) + (179) + (190) - (192)$

No.

53. $o=-0.64-(176)+(177)(183)+(184)-(196)-+(197)$

54. $o=+3.84-(169)+(170)+(176)-(180)-(184)+(186)$

55. $o=+1.41-(169)+(172)-(185)+(186)-(188)+(189)$

56. $o=-1.83-(170)+(172)-(178)+(180)-(188)+(190)$

57. $o=-0.35-(177)+(178)-(190)+(191)-(194)+(196)$

58. $o.=-0.86-(170)+(171)-(177)+(180)-(195)+(196)$

59. $o=+3.4+5.34(1)-3.08(2)-1.77(6)+5.25(7)-3.48(8)$

60. $o=-9.9-0.92(3)+3.38(4)-2.46(5)-4.60(11)+3.45(12)+1.15(13)-3.84(18)+7.54(19)-3.70(20)$

61. $o=-0.7-2.68(13)+4.54(14)-1.86(15)-4.34(16)+4.57(17)-0.23(18)-1.80(26)+7.69(27)-5.89(28)$

62. $o=+1.3-3.02(21)+3.74(22)-0.72(23)-1.80(28)+4.10(29)-2.30(30)-0.31(36)+2.99(37)-2.68(38)$

62½. $o=-7.8-2.60(31)+3.76(32)-1.16(33)-1.44(38)+11.40(39)-9.96(40)+0.90(43)-0.90(44)+4.29(46)-4.29(48)$

63. $o=+5.6-2.60(31)+3.76(32)-1.16(33)-1.44(38)+3.58(40)-2.14(41)-0.38(42)+1.28(43)-0.90(44)-0.47(51)+0.56(52)-0.09(53)-3.12(54)+4.33(55)-1.21(56)-0.38(61)+3.49(62)-3.11(63)$

64. $o=+1.8-0.11(56)+4.17(57)-4.06(58)-3.58(59)+5.45(60)-1.87(61)-0.47(64)+0.25(65)+0.22(66)-0.84(73)+0.72(74)+0.12(75)-3.98(76)+4.62(77)-0.64(78)-1.34(84)+4.52(85)-3.18(86)$

65. $o=+7.9-2.62(78)+3.74(79)-1.12(81)-2.58(82)+4.14(83)-1.56(84)-0.76(89)+3.21(91)-2.45(92)-2.13(93)+4.07(94)-1.94(95)+0.13(103)+1.62(104)-1.75(105)$

66. $o=+4.3-4.12(79)+5.24(80)-1.12(81)-0.76(89)+5.14(90)-4.38(91)-2.13(93)+4.07(94)-1.94(95)$

67. $o=+13.9-2.34(87)+4.02(88)-1.68(89)-0.79(95)+4.15(96)-3.36(97)+0.37(106)+0.27(107)-0.64(108)-4.36(114)+7.30(115)-2.94(116)-1.82(121)+2.97(122)-1.15(123)$

68. $o=+2.3-1.26(116)+3.86(117)-2.60(118)-3.23(119)+3.94(120)-0.71(121)-0.35(129)+2.34(130)-1.99(131)$

69. $o=-2.4-2.26(124)+1.67(125)+0.59(126)-4.43(131)+6.39(132)-1.96(133)-0.30(139)+3.93(140)-3.63(141)$

70. $o=+10.9-0.39(134)+3.26(135)-2.87(136)-3.17(144)+3.17(145)-2.66(151)+5.31(152)-2.65(153)$

71. $o=-1.7-0.50(146)+3.49(147)-2.99(148)-2.24(149)+3.86(150)-1.62(151)-2.29(156)+2.84(157)-0.55(158)$

72. $o=+0.5-2.95(154)+4.04(155)-1.09(156)-1.35(161)+4.43(162)-3.08(163)-1.03(173)+0.98(174)+0.05(175)-1.69(176)-3.09(179)+4.78(180)-0.68(184)+3.47(186)-2.79(187)$

73. $o=-48.5-11.39(163)+35.34(164)-23.95(165)-0.58(177)+2.84(178)-2.26(179)-10.40(193)+13.35(194)-2.95(196)$

74. $o=-7.5-2.12(162)+11.39(163)-9.27(164)-0.01(166)-5.31(170)+5.32(172)-1.79(178)+2.26(179)-0.47(180)$

75. $o=+4.9-6.02(170)+11.33(171)-5.31(172)-0.33(188)+1.10(190)-0.77(191)-2.95(194)+6.63(195)-3.68(196)$

76. $o=-30.8-12.74(183)+20.76(184)-8.02(185)-2.83(189)+3.60(190)-0.77(191)-2.95(194)+11.57(196)-8.62(197)$

77. $o=+27.4-1.39(169)+6.70(170)-5.31(172)-7.34(184)+8.02(185)-0.68(186)-0.33(188)+2.83(189)-2.50(190)$

(L_1) $o=-1.5+3.08(2)-3.07(3)+3.07(4)+1.77(6)-0.71(8)-1.06(10)+3.46(11)-3.46(12)-1.86(14)$
$+1.86(15)-0.23(16)+1.52(18)-1.29(20)-0.72(21)+0.72(23)+1.31(24)-1.31(25)+1.80(26)$
$-1.80(28)-2.30(29)+2.30(30)-1.16(32)+1.16(33)+1.24(34)-1.24(35)+0.31(36)-0.31(38)$
$-2.14(40)+2.14(41)+1.06(46)-1.06(47)-2.51(49)+2.51(50)+0.47(51)-0.56(52)+0.09(53)$
$+3.12(54)-3.12(55)-0.10(56)+0.10(57)-3.58(59)+3.58(60)+0.38(61)-0.38(62)-0.47(64)$
$+0.25(65)+0.22(66)+2.14(67)-2.14(68)-1.80(70)+1.80(71)+0.64(77)-0.64(78)-1.12(79)$
$+1.12(81)-1.56(83)+1.56(84)+3.18(85)-3.18(86)-2.34(87)+2.34(88)+0.76(89)-0.76(91)$
$+2.13(93)-2.13(94)-0.79(95)+0.79(96)+0.08(98)-0.08(99)-1.10(101)+1.10(102)-0.19(109)$
$+1.26(111)-1.26(112)+0.19(113)+2.94(115)-2.94(116)-2.60(117)+2.60(118)-0.71(119)$
$+0.71(121)+1.15(122)-1.15(123)-1.67(124)+1.67(125)+1.80(127)-1.80(128)+0.35(129)$
$-1.02(131)+0.67(133)-0.39(134)+0.01(136)+0.38(138)+1.55(139)-1.55(140)-1.67(142)$
$+1.67(143)-0.50(146)+0.50(148)-2.24(149)+2.24(150)+2.65(152)-2.65(153)-1.09(155)$
$+1.64(156)-0.55(158)+1.70(159)-1.70(160)-2.12(162)+2.12(164)+1.22(166)-1.22(167)$
$-5.31(170)+5.31(172)+0.47(178)-0.47(180)-2.07(188)+2.07(192)$

BROWN VALLEY BASE TO ROYALTON BASE.

No.

1. $o = -0.61 + (183) - (197) - (2) + (6) - (8) + (9)$
2. $o = -0.14 - (6) + (7) + (8) - (11) - (17) + (19)$
3. $o = +0.68 - (1) + (2) - (9) + (10) - (15) + (16)$
4. $o = +0.39 - (1) + (3) - (14) + (16) - (18) + (20)$
5. $o = -0.76 - (10) + (11) - (14) + (15) - (19) + (20)$
6. $o = -1.09 - (13) + (14) - (20) + (21) - (26) + (27)$
7. $o = +2.72 - (12) + (13) - (27) + (28) - (30) + (31)$
8. $o = -1.20 + (24) - (28) - (29) + (30) - (36) + (37)$
9. $o = -0.01 - (21) + (23) - (25) + (26) - (38) + (39)$
10. $o = +1.12 - (24) + (25) - (34) + (36) - (39) + (40)$
11. $o = +2.38 - (22) + (23) - (34) + (35) - (38) + (40)$
12. $o = -0.63 - (33) + (34) - (40) + (42) - (43) + (44)$
13. $o = +0.09 - (32) + (34) - (40) + (41) - (51) + (52)$
14. $o = -0.03 - (32) + (33) - (44) + (45) - (50) + (52)$
15. $o = -0.98 - (45) + (46) - (48) + (50) - (56) + (57)$
16. $o = -0.55 - (45) + (47) - (49) + (50) - (58) + (59)$
17. $o = -1.27 - (46) + (47) - (55) + (56) - (58) + (60)$
18. $o = +0.67 - (54) + (55) - (60) + (62) - (63) + (64)$
19. $o = +0.30 - (53) + (55) - (60) + (61) - (71) + (72)$
20. $o = -0.81 - (61) + (62) - (63) + (65) - (70) + (71)$
21. $o = -0.60 - (65) + (66) - (68) + (70) - (76) + (77)$
22. $o = +0.94 - (65) + (67) - (69) + (70) - (78) + (79)$
23. $o = +0.33 - (66) + (67) - (75) + (76) - (78) + (80)$
24. $o = -0.59 - (74) + (75) - (80) + (81) + (83) - (86)$
25. $o = +0.08 - (81) + (82) - (85) + (86) - (92) + (93)$
26. $o = -0.31 - (73) + (74) - (83) + (84) - (90) + (91)$
27. $o = +1.56 - (84) + (85) - (89) + (90) - (93) + (94)$
28. $o = +0.09 - (88) + (89) - (94) + (96) - (97) + (98)$
29. $o = -0.73 - (87) + (89) - (94) + (95) - (108) + (109)$
30. $o = -0.97 - (95) + (96) - (97) + (99) - (107) + (108)$
31. $o = +1.90 - (99) + (101) - (105) + (107) - (113) + (114)$
32. $o = +1.89 - (99) + (100) - (104) + (107) - (117) + (118)$
33. $o = -0.69 - (104) + (105) - (114) + (115) - (116) + (118)$
34. $o = +2.43 - (99) + (103) - (106) + (107) - (119) + (120)$
35. $o = +2.49 - (101) + (103) - (112) + (113) - (119) + (121)$
36. $o = +3.40 - (102) + (103) - (119) + (122) - (127) + (128)$
37. $o = +0.65 - (110) + (112) - (121) + (123) - (131) + (133)$
38. $o = +0.57 - (110) + (111) + (125) - (129) - (132) + (133)$
39. $o = +0.31 - (122) + (124) - (126) + (127) - (134) + (135)$
40. $o = -2.38 - (125) + (126) - (130) + (132) - (135) + (136)$
41. $o = -1.37 - (123) + (124) - (130) + (131) - (134) + (136)$
42. $o = -0.8 - 2.81(1) + 6.08(2) + 3.86(6) - 3.78(7) - 4.26(14) + 5.71(15) - 1.45(16) - 2.71(17) + 4.56(19) - 185(20) - 3.27(183) + 0.10(197)$
43. $o = +7.4 - 2.81(1) + 34.65(2) - 31.84(3) - 4.26(14) + 5.71(15) - 1.45(16) - 13.55(18) + 15.40(19) - 1.85(20)$
44. $o = -5.2 - 4.97(12) + 7.53(13) - 2.56(14) - 1.13(20) + 3.17(21) - 2.04(22) - 0.99(29) + 2.27(30) - 1.28(31) - 2.74(35) + 6.53(36) - 3.79(37)$
45. $o = -1.0 - 0.43(21) + 3.30(22) - 2.87(23) - 2.89(24) + 4.08(25) - 1.19(26) - 1.58(34) + 1.52(35) + 0.06(36)$
46. $o = -5.0 - 1.83(32) + 3.95(33) - 2.12(34) - 0.63(40) + 3.23(41) - 2.60(42) - 2.98(50) + 3.45(51) - 0.47(52)$
47. $o = +7.5 - 0.31(48) + 3.06(49) - 2.75(50) - 1.31(55) + 4.43(56) - 3.12(57) - 4.86(58) + 6.08(59) - 1.22(60)$
48. $o = +1.6 - 1.77(53) + 1.93(54) - 0.16(55) - 3.73(60) + 5.77(61) - 2.04(62) + 0.25(63) + 3.62(64) - 3.87(65)$
49. $o = +5.0 + 0.84(65) + 1.62(66) - 2.46(67) - 3.42(68) + 7.46(69) - 4.04(70) - 2.70(75) + 2.04(76) + 0.66(77)$
50. $o = -0.7 - 1.86(73) + 4.16(74) - 2.30(75) - 2.56(80) + 4.68(81) - 2.12(82) - 1.90(89) + 3.20(90) - 1.30(91) - 2.30(92) + 5.18(93) - 2.88(94)$

No.

51. o=+6.8−3.82(94)+3.98(95)−0.16(96)−1.58(97)+4.48(98)−2.90(99)−0.78(107)+2.82(108)
−2.4(109)

52. o=+8.0−3.20(99)+3.87(100)−0.67(101)−2.69(113)+5.46(114)−2.77(115)+0.05(116)+3.55(117)
−3.60(118)

53. o=+4.4−0.79(105)+2.72(106)−1.93(107)−1.56(112)+4.25(113)−2.69(114)−3.52(119)+3.64(120)
−0.12(121)

54. o=−14.9−2.53(101)+11.61(102)−9.08(103)−9.94(111)+11.50(112)−1.56(113)−3.88(127)+1.77(128)
+2.11(129)

55. o=+8.7−3.99(110)+13.93(111)−9.94(112)−3.24(121)+6.42(122)−3.18(123)−5.48(131)+7.08(132)
−1.60(133)

56. o=+0.3−2.50(122)+3.18(123)−0.68(124)−1.46(130)+5.48(131)−4.02(132)−2.28(134)+3.28(135)
−1.00(136)

(L_2) o=+7.4−0.58(177)+0.58(178)+4.71(183)−4.71(185)+0.63(189)−0.63(191)+2.95(194)−2.95(196)
+0.10(197)−2.81(1)+2.81(2)−0.10(6)+1.51(8)−1.51(9)+0.56(10)−0.56(11)−2.56(13)
+2.56(14)+1.45(15)−1.45(16)+1.85(19)−1.85(20)−0.43(21)+0.43(23)−2.89(24)+2.89(25)
+0.42(26)−0.42(27)−1.83(32)+1.83(33)−0.06(34)+0.06(36)+2.42(38)−2.42(39)−0.64(40)
+0.64(42)+1.12(43)−1.12(44)−1.12(46)+1.12(47)−0.31(48)+0.78(50)−0.47(52)−1.93(53)
+1.93(54)+3.12(56)−3.12(57)+1.22(58)−1.77(60)+0.55(62)+0.91(63)−0.91(64)−1.62(66)
+1.62(67)−1.26(68)+0.80(70)+0.46(72)−1.86(73)+1.86(74)+1.14(76)−1.14(77)+0.31(78)
−2.87(80)+2.56(81)+0.30(83)+0.22(84)−0.22(85)−0.30(86)−0.59(87)+0.59(88)+1.30(90)
−1.30(91)+2.88(93)−3.04(94)+0.16(96)+1.58(97)−1.58(98)−3.73(101)+3.73(102)−0.79(105)
+1.57(107)−0.78(109)−3.99(110)+3.99(111)+2.69(113)−2.69(114)+0.18(128)−0.18(129)
−1.46(130)+3.06(132)−1.60(133)+1.00(135)−1.00(136)

ROYALTON BASE TO MINNESOTA POINT BASE.

No.

1. o=+0.57−(115)+(116)+(2)−(4)−(10)+(11)
2. o=−0.73−(3)+(4)−(7)+(9)−(11)+(12)
3. o=−0.92−(1)+(2)−(7)+(8)−(10)+(12)
4. o=−0.60−(6)+(7)−(12)+(14)−(15)+(16)
5. o=−0.91−(13)+(14)−(15)+(17)−(22)+(23)
6. o=+0.66−(5)+(6)−(16)+(17)−(22)+(24)
7. o=−0.11−(17)+(19)−(21)+(22)−(30)+(31)
8. o=−3.95−(18)+(19)−(27)+(28)−(30)+(32)
9. o=+0.57−(20)+(21)−(27)+(29)−(31)+(32)
10. o=+0.62−(25)+(27)−(32)+(33)−(38)+(39)
11. o=+1.22−(33)+(34)−(37)+(38)−(40)+(42)
12. o=+0.58−(25)+(26)−(37)+(39)−(41)+(42)
13. o=−0.46−(36)+(37)−(42)+(44)−(45)+(46)
14. o=−0.22−(35)+(36)−(46)+(47)−(52)+(54)
15. o=+1.00−(43)+(44)−(45)+(47)−(52)+(53)
16. o=+0.10−(47)+(48)−(50)+(52)−(63)+(64)
17. o=−0.15−(50)+(51)−(56)+(57)−(62)+(64)
18. o=+0.60−(48)+(49)−(55)+(57)−(62)+(63)
19. o=+0.20−(57)+(59)−(61)+(62)−(65)+(66)
20. o=+0.81−(60)+(61)−(66)+(67)−(72)+(74)
21. o=+2.21−(58)+(59)−(65)+(67)−(72)+(73)
22. o=+0.58−(67)+(68)−(70)+(72)−(78)+(79)
23. o=−0.68−(68)+(69)−(77)+(78)−(80)+(82)
24. o=+2.05−(70)+(71)−(77)+(79)−(81)+(82)
25. o=−0.63−(76)+(77)−(82)+(84)−(90)+(91)
26. o=+0.37−(83)+(84)−(87)+(88)−(90)+(92)
27. o=−0.14−(75)+(76)−(87)+(89)−(91)+(92)

No.

28. $o=+0.94-(86)+(87)-(92)+(94)-(95)+(96)$
29. $o=+0.06-(85)+(86)-(96)+(97)-(102)+(104)$
30. $o=+2.55-(93)+(94)-(95)+(97)-(102)+(103)$
31. $o=-2.02-(97)+(99)-(101)+(102)-(105)+(106)$
32. $o=-2.05-(100)+(101)-(106)+(107)-(113)+(115)$
33. $o=+2.44-(98)+(99)-(105)+(107)-(113)+(114)$
34. $o=-0.09-(107)+(109)-(112)+(113)-(116)+(117)$
35. $o=-0.13-(111)+(112)-(117)+(118)-(123)+(125)$
36. $o=-0.85-(108)+(110)-(122)+(124)-(126)+(128)$
37. $o=-2.62-(109)+(110)+(116)-(119)-(126)+(127)$
38. $o=-0.08-(118)+(119)-(122)+(123)-(127)+(128)$
39. $o=+1.02-(120)+(122)-(128)+(129)-(139)+(140)$
40. $o=-0.94-(120)+(121)-(132)+(133)-(138)+(140)$
41. $o=-0.52-(129)+(130)-(131)+(133)-(138)+(139)$
42. $o=+0.06-(133)+(134)-(136)+(138)-(142)+(143)$
43. $o=-1.10-(134)+(135)-(141)+(142)-(144)+(146)$
44. $o=-1.34-(136)+(137)-(141)+(143)-(145)+(146)$
45. $o=+1.4-7.90(115)+9.30(1)-1.40(2)+0.65(7)+1.10(8)-1.75(9)-0.54(10)+7.85(11)-7.31(12)$
46. $o=-3.1-2.03(12)+1.90(13)+0.13(14)-2.68(15)+4.83(16)-2.15(17)+0.11(22)+2.43(23)$
$-2.54(24)$
47. $o=+4.7+1.36(17)+4.16(18)-5.52(19)-4.25(20)+9.03(21)-4.78(22)-3.31(27)+4.60(28)$
$-1.29(29)$
48. $o=+6.4-3.28(25)+5.71(26)-2.43(27)+0.57(32)+3.02(33)-3.59(34)-1.76(37)+2.08(38)$
$-0.32(39)$
49. $o=-4.1-3.76(35)+3.58(36)+0.18(37)-4.43(42)+8.98(43)-4.55(44)+0.24(45)+3.49(46)$
$-3.73(47)$
50. $o=+1.2-2.29(47)+2.44(48)-0.15(49)-2.01(55)+4.07(56)-2.06(57)-0.21(62)+2.40(63)$
$-2.19(64)$
51. $o=-1.3-2.15(57)+2.63(58)-0.48(59)-2.42(65)+3.83(66)-1.41(67)-0.63(72)+3.80(73)$
$-3.17(74)$
52. $o=+4.4-1.96(67)+4.43(68)-2.47(69)-2.65(70)+2.81(71)-0.16(72)-0.13(80)+2.29(81)$
$-2.16(82)$
53. $o=+1.3-4.04(75)+8.08(76)-4.04(77)+1.34(82)+3.98(83)-5.32(84)-2.63(87)+3.91(88)$
$-1.28(89)$
54. $o=+1.1-1.81(92)+2.66(93)-0.85(94)-3.26(95)+4.84(96)-1.58(97)+0.06(102)+4.13(103)$
$-4.19(104)$
55. $o=+9.6+1.94(100)+2.87(101)-4.81(102)-2.04(105)+1.68(106)+0.36(107)-6.55(113)$
$+13.20(114)-6.65(115)$
56. $o=+1.6-2.63(107)+5.31(109)+2.68(110)-1.40(111)+3.81(112)-2.41(113)-0.26(122)$
$+2.21(123)-1.95(125)-5.89(126)+8.82(127)-2.93(128)$
57. $o=+0.32-6.754(108)+7.022(109)-0.268(110)-0.026(122)+7.319(123)-7.293(124)$
$-0.589(126)+0.882(127)-0.293(128)$
58. $o=+0.6-1.62(120)+1.08(121)+0.54(122)-5.54(128)+10.07(129)-4.53(130)+1.73(131)$
$+2.82(132)-4.55(133)$
59. $o=-1.1-3.68(133)+7.86(134)-4.18(135)-3.42(136)+4.54(137)-1.12(138)+0.97(144)$
$+3.88(145)-4.85(146)$

(L_3) $o=-13.6-2.19\ (100)+5.92\ (101)-3.73\ (103)+3.99\ (110)-3.99\ (111)-1.40\ (115)+1.18\ (116)$
$-1.18\ (117)-0.18\ (128)+0.18\ (129)+1.46\ (130)-3.06\ (132)+1.60\ (133)-1.00\ (135)+1.00\ (136)$
$+1.40\ (2)-1.38\ (3)+1.38\ (4)+0.04\ (5)-0.69\ (7)+0.65\ (9)+0.54\ (10)-0.54\ (11)-2.07\ (13)+2.07\ (14)$
$+0.28\ (15)-0.28\ (17)-4.16\ (18)+4.16\ (19)-1.76\ (20)+1.76\ (22)+2.43\ (23)-2.43\ (24)-0.62\ (25)$
$+0.62\ (27)+3.14\ (28)-3.14\ (29)-1.68\ (30)+1.68\ (32)-3.02\ (33)+3.02\ (34)-3.58\ (35)+3.58\ (36)$
$+2.89\ (38)-2.89\ (39)-0.36\ (40)-1.39\ (42)+1.75\ (44)+0.97\ (45)-0.97\ (46)-0.15\ (47)+0.15\ (49)$
$-1.76\ (50)+1.76\ (51)-1.14\ (52)+1.14\ (54)+2.01\ (55)-2.01\ (56)-0.48\ (57)+0.48\ (59)-1.73\ (60)$
$+1.73\ (61)+0.21\ (62)-0.21\ (64)+2.42\ (65)-2.42\ (66)-2.47\ (68)+2.47\ (69)-0.16\ (70)+0.79\ (72)$

No.

(L_3)—(continued.) −0.63 (74) −1.47 (75) +1.47 (77) +1.94 (78) −1.94 (79) +0.13 (80) −0.13(82) −3.98 (83) +3.98 (84) −2.96 (85) +2.96 (86) +3.59 (88) −3.59 (89) −1.41 (90) +0.56 (92) +0.85 (94) +3.26 (95) −3.26 (96) +0.09 (97) −0.09 (99) +0.24 (100) −0.24 (101) −0.06 (102) +0.06 (104) +1.68 (105) −1.68 (106) −2.51 (108) +2.51 (110) +0.28 (111) +2.69 (113) −2.97 (115) −1.08 (120) +1.08 (121) +2.07 (124) −2.07 (125) +1.46 (126) −3.51 (128) +2.05 (130) −0.10 (131) +0.10 (132) −4.18 (134) +4.18 (135) −1.12 (136) +1.47 (138) −0.35 (140) +0.07 (142) −0.07 (143) −0.97 (144) +0.97 (146)

FERGUS FALLS TO STEPHEN BASE.

No.

1. o = −1.31 −(146) +(147) −(150) +(151) −(152) +(153)
2. o = +1.12 −(138) +(140) −(149) +(151) −(152) +(154)
3. o = +0.78 −(138) +(139) −(145) +(146) −(153) +(154)
4. o = −0.86 −(135) +(137) −(140) +(141) −(148) +(149)
5. o = +0.98 −(136) +(137) +(144) −(147) −(148) +(150)
6. o = −0.84 −(131) +(132) −(133) +(135) −(141) +(142)
7. o = −1.11 −(123) +(124) −(134) +(135) −(141) +(143)
8. o = +0.40 −(123) +(125) −(130) +(131) −(142) +(143)
9. o = −0.32 −(116) +(117) −(125) +(126) −(128) +(130)
10. o = −0.97 −(118) +(119) −(125) +(127) −(129) +(130)
11. o = +0.61 −(115) +(116) −(118) +(120) −(126) +(127)
12. o = −0.08 −(110) +(111) −(114) +(115) −(120) +(121)
13. o = −1.02 −(106) +(107) −(111) +(112) −(113) +(114)
14. o = −0.49 −(103) +(104) −(105) +(106) +(108) −(112)
15. o = +0.03 −(96) +(97) −(102) +(103) −(108) +(109)
16. o = +1.25 −(95) +(96) −(109) +(110) −(121) +(122)
17. o = +0.69 −(88) +(89) −(97) +(98) −(100) +(102)
18. o = −0.53 −(90) +(91) −(97) +(99) −(101) +(102)
19. o = −1.12 −(87) +(88) −(90) +(92) −(98) +(99)
20. o = +0.58 −(83) +(84) −(85) +(87) −(92) +(93)
21. o = +1.02 −(75) +(76) −(86) +(87) −(92) +(94)
22. o = +0.34 −(75) +(77) −(82) +(83) −(93) +(94)
23. o = −2.39 −(68) +(69) −(77) +(78) −(80) +(82)
24. o = −3.07 −(70) +(71) −(77) +(79) −(81) +(82)
25. o = −0.65 −(67) +(68) −(70) +(72) −(78) +(79)
26. o = +2.33 −(63) +(64) −(65) +(67) −(72) +(73)
27. o = +1.52 −(55) +(56) −(66) +(67) −(72) +(74)
28. o = +0.20 −(55) +(57) −(62) +(63) −(73) +(74)
29. o = −1.03 −(48) +(49) −(57) +(58) −(60) +(62)
30. o = −0.95 −(50) +(51) −(57) +(59) −(61) +(62)
31. o = +0.09 −(47) +(48) −(50) +(52) −(58) +(59)
32. o = −0.25 −(43) +(44) −(45) +(47) −(52) +(53)
33. o = −0.60 −(35) +(36) −(46) +(47) −(52) +(54)
34. o = −0.61 −(35) +(37) −(42) +(43) −(53) +(54)
35. o = +2.17 −(26) +(27) −(37) +(38) −(40) +(42)
36. o = −0.23 −(28) +(29) −(37) +(39) −(41) +(42)
37. o = +0.03 −(25) +(26) −(28) +(30) −(38) +(39)
38. o = −0.76 −(11) +(12) −(24) +(25) −(30) +(34)
39. o = −2.12 −(11) +(15) −(16) +(17) −(33) +(34)
40. o = −0.42 −(12) +(15) −(16) +(20) −(21) +(24)
41. o = −0.27 −(13) +(15) −(16) +(18) −(2) +(3)
42. o = −2.13 −(3) +(4) −(11) +(13) −(32) +(34)
43. o = −0.97 +(2) −(5) −(18) +(20) −(21) +(23)
44. o = +0.70 +(6) −(10) −(19) +(20) −(21) +(22)
45. o = −1.50 −(6) +(7) −(14) +(15) −(16) +(19)
46. o = +0.50 −(7) +(8) −(1) +(3) −(13) +(14)

No.

47. $o = -0.24 - (7) + (9) - (11) + (14) - (31) + (34)$

48. $o = -18.9 + 3.43(138) - 8.34(139) + 4.91(140) + 4.47(149) - 7.18(150) + 2.71(151) + 3.30(152) - 6.99(153) + 3.69(154)$

49. $o = +3.4 + 1.07(139) - 2.52(140) + 1.45(141) - 1.90(144) + 0.99(145) + 0.91(147) + 1.53(148) - 2.50(149) + 0.97(150)$

50. $o = +0.3 + 0.22(123) - 1.91(124) + 1.69(125) + 3.33(133) - 3.63(134) + 0.30(135) + 1.36(141) - 4.38(142) + 3.02(143)$

51. $o = +4.7 - 2.57(115) + 2.39(116) + 0.18(117) - 0.19(125) + 2.51(126) - 2.32(127) - 2.50(128) + 4.89(129) - 2.39\ (130)$

52. $o = +5.7 - 3.16(95) + 5.30(96) - 2.14(97) - 0.50(102) + 2.72(103) - 2.22(104) - 0.62(105) + 2.20(106) - 1.58(107) - 3.07(113) + 3.41(114) - 0.34(115) - 1.28(120) + 3.70(121) - 2.42(122)$

53. $o = -0.1 + 0.43(90) + 1.91(91) - 2.34(92) - 2.24(97) + 5.46(98) - 3.22(99) - 2.67(100) + 2.78(101) - 0.11(102)$

54. $o = -9.6 + 2.02(75) - 1.61(76) - 0.41(77) + 3.47(82) - 6.20(83) + 2.73(84) - 0.54(85) - 2.35(86) + 2.89(87)$

55. $o = +5.1 - 2.28(67) + 2.60(68) - 0.32(69) - 0.20(77) + 2.34(78) - 2.14(79) - 1.82(80) + 3.87(81) - 2.05(82)$

56. $o = +8.8 - 0.25(55) + 2.69(56) - 2.44(57) - 3.04(65) + 2.15(66) + 0.89(67) - 3.74(72) + 6.54(73) - 2.80(74)$

57. $o = -0.9 + 2.63(47) - 4.20(48) + 1.57(49) + 2.15(50) - 2.44(51) + 0.29(52) + 0.50(60) - 3.65(61) + 3.15(62)$

58. $o = -0.2 - 1.98(42) + 1.46(43) + 0.52(44) - 3.14(45) + 5.62(46) - 2.48(47) + 0.47(52) + 2.08(53) - 2.55(54)$

59. $o = +4.8 + 2.96(25) - 5.23(26) + 2.27(27) + 1.92(28) - 1.77(29) - 0.15(30) - 0.29(40) - 2.48(41) + 2.77(42)$

60. $o = +2.2 + 2.13(16) - 2.30(17) + 0.17(20) + 2.03(21) - 3.75(24) + 1.72(25) + 0.43(30) - 2.68(33) + 2.25(34)$

61. $o = -1.9 + 4.85(7) - 8.31(8) + 3.46(9) + 1.51(11) - 8.68(13) + 7.17(14) + 7.23(31) - 9.90(32) + 2.67(34)$

62. $o = -8.0 + 0.73(11) - 4.61(14) + 3.88(15) + 0.18(16) - 2.28(17) + 2.10(19) + 5.72(31) - 7.22(33) + 1.50(34)$

63. $o = +0.1 - 32.72(12) + 34.83(13) - 2.11(15) - 2.29(16) + 4.56(18) - 2.27(20) - 2.29(21) + 36.59(23) - 34.30(24)$

64. $o = +149.9 + 5.77(12) - 9.65(14) + 3.88(15) + 0.18(16) - 1039.18(19) - 1039.0(20) + 1034.4(21) - 1036.44(22) + 2.04(24)$

65. $o = +2977.8 + 1.51(11) - 3.62(13) + 2.11(15) + 2.29(16) - 2604.0(17) + 2601.71(18) + 3301.73(32) - 3304.4(33) + 2.67(34)$

(L) $o = +3.6 + 0.17(4) - 0.17(5) - 0.02(8) + 0.02(10) - 2.30(22) + 2.30(23) + 0.44(25) - 0.44(27) + 1.77(28) - 1.77(29) - 2.48(30) + 2.48(32) + 0.40(35) - 0.41(37) + 0.01(39) - 1.34(40) + 1.34(41) + 1.86(43) - 1.86(44) - 0.60(45) + 0.60(47) + 1.57(48) - 1.57(49) + 0.29(50) - 0.29(52) - 2.08(53) + 2.08(54) + 2.09(55) - 2.09(56) - 1.26(58) + 1.26(59) - 0.50(60) + 0.22(62) + 0.28(64) - 2.15(65) + 2.15(66) + 0.32(67) - 0.32(69) + 1.79(70) - 1.79(71) - 0.92(72) + 0.92(74) - 0.41(75) + 0.21(77) + 0.20(79) - 1.82(80) + 1.82(81) + 2.73(83) - 2.73(84) + 0.54(85) - 0.73(87) + 0.19(89) + 1.54(90) - 1.54(91) - 1.92(93) + 1.92(94) + 3.16(95) - 3.16(96) - 0.51(97) + 0.51(99) - 2.78(100) + 2.78(101) + 0.50(102) - 0.50(103) - 1.27(108) + 1.27(109) + 2.47(110) - 2.47(111) - 0.34(114) + 0.34(115) + 1.55(116) - 1.55(117) - 0.32(118) + 0.32(120) - 2.42(121) + 2.42(122) + 2.87(123) - 2.87(124) - 2.51(126) + 2.51(127) - 0.31(128) - 0.14(130) + 0.45(132) - 3.63(133) + 3.63(134) - 0.37(135) + 0.37(137) + 1.49(138) - 1.49(140) + 0.07(141) - 0.07(143) - 2.50(148) + 2.50(149) - 1.11(152) + 1.11(154)$

(α) $o = -2.69 + (8) - (9) - (28) + (31) - (35) + (39) - (50) + (54) - (55) + (59) - (70) + (74) - (75) + (79) - (90) + (94) - (95) + (99) - (118) + (122) - (123) + (127) - (138) + (143) - (152) + (154)$

STEPHEN BASE NET TO CANADA.

No.

1. $o = -1.15 - (2) + (4) - (11) + (12)$
2. $o = -2.38 - (1) + (3) - (9) + (10)$
3. $o = +0.26 - (1) + (2) - (8) + (10) - (12) + (13)$
4. $o = -1.03 - (7) + (8) - (13) + (15) - (25) + (26)$
5. $o = -1.53 - (6) + (8) - (13) + (14) + (16) - (19)$
6. $o = +0.49 - (14) + (15) - (18) + (19) - (25) + (27)$
7. $o = +0.40 - (5) + (6) - (16) + (17) - (23) + (24)$
8. $o = -0.84 - (17) + (18) - (22) + (23) - (27) + (28)$
9. $o = -0.24 - (21) + (22) - (28) + (30) - (34) + (35)$
10. $o = -1.05 - (20) + (21) - (31) + (33) - (35) + (36)$

No.
11. $o=-0.03-(29)+(30)-(31)+(32)-(34)+(36)$
12. $o=+4.6-1.47(1)+3.20(2)+3.24(3)-2.52(4)-2.76(8)+3.70(9)-0.94(10)$
13. $o=+2.3+1.40(5)-2.91(6)+1.51(8)+2.58(13)-5.21(14)+2.63(15)+3.46(22)-5.70(23)+2.24(24)+1.42(25)-3.86(27)+2.44(28)$
14. $o=-5.2-1.94(20)+4.77(21)-2.83(22)-0.36(28)+2.52(29)-2.16(30)-3.29(31)+3.39(32)-0.10(33)$
15. $o=+10.4-1.40(5)+30.97(6)-29.57(7)-3.46(22)+5.70(23)-2.24(24)-28.65(26)+31.09(27)-2.44(28)$

ACCURACY AS INDICATED BY CORRECTIONS TO OBSERVED DIRECTIONS.

There are shown in the following tables the corrections to the observed directions resulting from the figure adjustments. For that portion of the triangulation from Page base net to Duluth there are given the additional corrections resulting from the introduction of latitude, longitude, and azimuth equations and the combination of these two corrections. (See p. 184.) The numbers of the directions are shown on illustrations 1 to 11.

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS.

Page to Brown Valley.

Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total	Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total
	"	"	"		"	"	"
1	−0.797	+0.372	−0.425	32	+0.558	+0.647	+1.205
2	+0.058	+0.533	+0.591	33	−0.308	−0.050	−0.358
3	+0.245	+1.062	+1.307	34	+0.238	−0.630	−0.392
4	−0.130	+0.855	+0.725	35	+0.072	−0.483	−0.411
5	+0.344	+0.392	+0.736	36	−0.330	−0.600	−0.930
6	+0.058	−0.272	−0.214	37	+0.047	−0.599	−0.552
7	+0.094	−0.433	−0.339	38	+0.341	−0.099	+0.242
8	−0.186	−0.413	−0.599	39	+0.250	+0.366	+0.616
9	−0.277	+0.610	+0.333	40	−0.160	+0.341	+0.181
10	+0.311	+0.509	+0.820	41	−0.147	+0.591	+0.444
11	−0.606	−0.460	−1.066	42	−0.813	+0.596	−0.217
12	+0.434	−0.920	−0.486	43	+0.105	−0.075	+0.030
13	+0.168	−0.064	+0.104	44	+0.708	−0.521	+0.187
14	−0.088	+0.720	+0.632	45	+0.185	+0.056	+0.241
15	+0.092	+0.724	+0.816	46	−0.147	−0.646	−0.793
16	+0.074	+0.678	+0.752	47	−0.622	−0.391	−1.013
17	−0.020	+0.744	+0.724	48	−0.261	−0.074	−0.335
18	−0.394	−0.159	−0.553	49	+0.748	+0.587	+1.335
19	+0.594	−0.456	+0.138	50	+0.098	+0.477	+0.575
20	−0.253	−0.808	−1.061	51	+0.203	−0.500	−0.297
21	−0.034	+0.726	+0.692	52	−0.197	−0.047	−0.244
22	+0.054	+0.660	+0.714	53	−0.007	+0.547	+0.540
23	−0.127	−0.083	−0.210	54	+0.076	−0.439	−0.363
24	+0.186	−0.679	−0.493	55	−0.349	−0.611	−0.960
25	−0.080	−0.624	−0.704	56	+0.487	+0.007	+0.494
26	−0.308	−0.658	−0.966	57	−0.254	+0.552	+0.298
27	+0.222	−0.541	−0.319	58	+0.041	+0.491	+0.532
28	+0.038	−0.068	−0.030	59	+0.490	+0.538	+1.028
29	−0.132	+0.593	+0.461	60	−0.266	+0.440	+0.174
30	+0.180	+0.675	+0.855	61	−0.412	+0.013	−0.399
31	−0.560	+0.517	−0.043	62	−0.848	−0.504	−1.352

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Page to Brown Valley—Continued.

Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total	Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total
	"	"	"		"	"	"
63	+1.036	−0.487	+0.549	115	−0.761	−0.210	−0.971
64	+0.480	+0.438	+0.918	116	+0.274	−0.107	+0.167
65	−0.107	−0.002	−0.109	117	+0.088	+0.245	+0.333
66	−0.373	−0.435	−0.808	118	+0.046	+0.387	+0.433
67	+0.190	−0.418	−0.228	119	+0.063	+0.388	+0.451
68	+0.246	−0.537	−0.291	120	−0.340	+0.415	+0.075
69	+0.099	−0.006	+0.093	121	+0.368	−0.027	+0.341
70	−0.128	+0.319	+0.191	122	−0.364	−0.266	−0.636
71	−0.261	+0.630	+0.369	123	+0.273	−0.511	−0.238
72	−0.146	+0.012	−0.134	124	−0.127	+0.297	+0.170
73	−0.078	−0.500	−0.578	125	−0.004	+0.264	+0.260
74	+0.151	−0.010	+0.141	126	+0.198	+0.007	+0.205
75	−0.073	+0.511	+0.438	127	−0.393	−0.315	−0.708
76	+0.044	−0.518	−0.474	128	+0.327	−0.253	+0.074
77	+0.192	−0.422	−0.230	129	+0.088	−0.234	−0.146
78	+0.170	−0.150	+0.020	130	−0.212	−0.286	−0.498
79	−0.070	+0.106	+0.036	131	−0.078	−0.054	−0.132
80	+0.157	+0.460	+0.617	132	+0.164	+0.258	+0.422
81	−0.497	+0.524	+0.027	133	+0.038	+0.317	+0.355
82	+0.632	+0.341	+0.973	134	+0.832	+0.211	+1.043
83	−0.472	+0.298	−0.174	135	−1.443	+0.328	−1.115
84	+0.089	+0.136	+0.225	136	+0.486	−0.024	+0.462
85	+0.104	−0.446	−0.342	137	+0.000	−0.247	−0.247
86	−0.352	−0.329	−0.681	138	+0.124	−0.267	−0.143
87	+0.149	+0.630	+0.779	139	−0.190	−0.191	−0.381
88	−0.471	+0.276	−0.195	140	+0.142	−0.304	−0.162
89	+0.379	−0.008	+0.371	141	−0.018	−0.029	−0.047
90	−0.222	−0.387	−0.609	142	−0.272	+0.146	−0.126
91	+0.017	−0.266	−0.249	143	+0.338	+0.378	+0.716
92	+0.147	−0.244	−0.097	144	+0.211	−0.166	+0.045
93	+0.621	−0.337	+0.284	145	+0.185	−0.219	−0.334
94	−0.751	−0.326	−1.077	146	+0.446	−0.126	+0.320
95	+0.035	−0.020	+0.015	147	+0.086	+0.125	+0.211
96	−0.089	+0.390	+0.301	148	−0.927	+0.387	−0.540
97	+0.184	+0.293	+0.477	149	+0.624	+0.092	+0.716
98	−0.143	−0.201	−0.344	150	+0.144	+0.322	+0.466
99	+0.232	−0.295	−0.063	151	+0.148	+0.023	+0.171
100	−0.404	−0.008	−0.412	152	−0.808	−0.250	−1.058
101	−0.151	+0.275	+0.124	153	−0.108	−0.188	−0.296
102	+0.465	+0.228	+0.693	154	−0.093	+0.006	−0.087
103	+0.026	+0.285	+0.311	155	+0.937	+0.167	+1.104
104	+0.282	−0.021	+0.261	156	−0.165	+0.132	−0.033
105	−0.308	−0.264	−0.572	157	−0.242	−0.061	−0.303
106	+0.051	−0.306	−0.255	158	−0.436	−0.244	−0.680
107	−0.090	+0.013	−0.077	159	+0.908	−0.099	+0.809
108	+0.038	+0.293	+0.331	160	−0.262	−0.312	−0.574
109	+0.071	+0.373	+0.444	161	+0.119	−0.166	−0.047
110	+0.068	−0.012	+0.056	162	−0.338	−0.058	−0.396
111	−0.324	−0.235	−0.559	163	+0.097	+0.311	+0.408
112	+0.110	−0.362	−0.252	164	+0.599	+0.128	+0.727
113	+0.074	+0.236	+0.310	165	−1.122	+0.197	−0.925
114	+0.354	−0.315	+0.039	166	+0.297	−0.053	+0.243

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Page to Brown Valley—Continued.

Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total	Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total
	"	"	"		"	"	"
167	−0.784	−0.126	−0.910	183	+0.085	+0.319	+0.404
168	+0.138	−0.074	+0.064	184	+1.039	+0.241	+1.280
169	+0.961	−0.098	+0.863	185	−0.421	−0.100	−0.521
170	−1.084	+0.344	−0.740	186	−0.555	−0.045	−0.600
171	−0.476	+0.173	−0.303	187	−0.123	−0.130	−0.253
172	+0.948	−0.166	+0.782	188	+0.391	−0.256	+0.135
173	+0.071	−0.001	+0.070	189	−0.873	−0.241	−1.114
174	−0.124	+0.107	−0.017	190	+0.212	+0.067	+0.279
175	+0.054	−0.106	−0.052	191	+0.362	+0.383	+0.745
176	−0.188	−0.033	−0.221	192	−0.092	+0.045	−0.047
177	−0.079	−0.116	−0.195	193	−0.139	−0.123	−0.262
178	+0.036	−0.065	−0.029	194	+0.078	+0.146	+0.224
179	+0.219	+0.094	+0.313	195	+0.002	−0.155	−0.153
180	+0.012	+0.121	+0.133	196	+0.162	−0.220	−0.058
181				197	−0.260	−0.069	−0.329
182							

Brown Valley to Royalton.

1	+0.180	−0.537	−0.357	31	−0.466	−0.156	−0.622
2	−0.139	+0.034	−0.105	32	+0.016	−0.087	−0.071
3	−0.065	+0.217	+0.152	33	+0.284	+0.172	+0.456
4				34	+0.090	+0.050	+0.140
5				35	−0.664	+0.242	−0.422
6	+0.035	+0.070	+0.105	36	+0.325	−0.122	+0.203
7	+0.123	+0.351	+0.474	37	−0.050	−0.254	−0.304
8	−0.023	+0.190	+0.167	38	+0.006	+0.357	+0.363
9	+0.068	−0.234	−0.166	39	+0.473	−0.119	+0.354
10	−0.183	−0.095	−0.278	40	−0.481	−0.311	−0.792
11	+0.138	+0.139	+0.277	41	+0.168	−0.129	+0.039
12	+0.122	−0.222	−0.100	42	−0.166	+0.202	+0.036
13	−0.102	−0.050	−0.152	43	−0.340	+0.221	−0.119
14	−0.282	+0.345	+0.063	44	+0.168	−0.171	−0.003
15	+0.187	+0.318	+0.505	45	−0.076	−0.063	−0.139
16	+0.076	−0.391	−0.315	46	−0.223	+0.038	−0.185
17	−0.377	+0.341	−0.036	47	+0.470	−0.025	+0.445
18	+0.310	−0.180	+0.130	48	−0.074	−0.141	−0.215
19	−0.164	+0.010	−0.154	49	−0.425	−0.002	−0.427
20	−0.194	−0.197	−0.391	50	−0.109	+0.185	+0.076
21	+0.179	−0.160	+0.019	51	+0.710	+0.138	+0.848
22	+0.692	−0.145	+0.547	52	−0.102	−0.181	−0.283
23	−0.447	+0.331	−0.116	53	−0.257	+0.050	−0.207
24	+0.130	−0.145	−0.015	54	+0.231	−0.045	+0.186
25	−0.271	+0.220	−0.051	55	−0.303	−0.014	−0.317
26	−0.101	+0.204	+0.103	56	−0.417	+0.218	−0.199
27	+0.796	−0.226	+0.570	57	+0.745	−0.208	+0.537
28	−0.554	−0.053	−0.607	58	−0.194	+0.112	−0.082
29	−0.213	−0.035	−0.248	59	−0.507	−0.113	−0.620
30	+0.679	+0.190	+0.869	60	+0.496	−0.058	+0.438

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Brown Valley to Royalton—Continued.

Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total	Number of direction	Corrections to directions— From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total
	"	"	"		"	"	"
61	+0.146	+0.024	+0.170	99	+0.979	+0.033	+1.012
62	+0.058	+0.034	+0.092	100	−0.441	−0.252	−0.693
63	−0.301	+0.082	−0.219	101	+0.081	+0.526	+0.607
64	+0.002	−0.040	−0.038	102	+0.432	+0.130	+0.562
65	+0.350	−0.006	+0.344	103	−0.856	−0.612	−1.468
66	−0.076	+0.095	+0.019	104	+0.418	−0.091	+0.327
67	+0.025	−0.131	−0.106	105	+0.463	+0.633	+1.096
68	+0.115	+0.100	+0.215	106	−0.515	−0.510	−1.025
69	−0.548	−0.082	−0.630	107	−0.288	−0.190	−0.478
70	−0.053	−0.052	−0.105	108	−0.396	−0.060	−0.456
71	+0.195	+0.026	+0.221	109	+0.319	+0.218	+0.537
72	+0.290	+0.009	+0.299	110	+0.375	+0.726	+1.101
73	+0.042	+0.113	+0.155	111	−0.027	−0.226	−0.253
74	−0.140	−0.050	−0.190	112	+0.395	−0.710	−0.315
75	+0.037	−0.100	−0.063	113	−0.236	+0.106	−0.130
76	−0.566	−0.007	−0.573	114	−0.487	+0.436	−0.051
77	+0.628	+0.044	+0.672	115	+0.086	−0.249	−0.163
78	+0.256	−0.052	+0.204	116	−0.091	+0.154	+0.063
79	−0.854	+0.042	−0.812	117	−0.256	−0.270	−0.526
80	+0.428	+0.080	+0.508	118	−0.021	+0.114	+0.093
81	+0.362	+0.085	+0.447	119	+0.878	−0.379	+0.499
82	−0.191	−0.154	−0.345	120	+0.056	−0.055	+0.001
83	+0.205	+0.043	+0.247	121	−0.043	−0.059	−0.102
84	+0.354	+0.052	+0.406	122	−0.502	+0.301	−0.201
85	−0.286	−0.093	−0.379	123	−0.308	+0.231	−0.077
86	−0.274	−0.001	−0.275	124	−0.082	−0.038	−0.120
87	+0.002	+0.097	+0.099	125	−0.296	−0.185	−0.481
88	−0.061	−0.122	−0.183	126	+0.526	+0.103	+0.629
89	+0.299	−0.039	+0.260	127	+0.416	−0.035	+0.381
90	−0.291	−0.046	−0.337	128	−0.318	+0.026	−0.292
91	+0.052	+0.111	+0.163	129	−0.328	+0.091	−0.237
92	−0.092	−0.109	−0.201	130	−0.375	+0.231	−0.144
93	+0.369	+0.037	+0.406	131	+0.329	−0.433	−0.104
94	+0.039	+0.189	+0.228	132	+0.123	−0.513	−0.390
95	−0.244	+0.047	−0.197	133	−0.077	+0.715	+0.638
96	−0.072	−0.163	−0.235	134	+0.060	−0.470	−0.410
97	+0.072	−0.046	+0.026	135	−0.560	+0.007	−0.553
98	−0.268	+0.222	−0.046	136	+0.500	+0.463	+0.963

Royalton to Duluth.

1	−0.042	−0.288	−0.330	12	+0.046	−0.209	−0.163
2	−0.064	+0.205	+0.141	13	+0.112	−0.335	−0.223
3	+0.023	−0.106	−0.083	14	−0.012	+0.194	+0.182
4	+0.345	+0.108	+0.453	15	−0.172	+0.480	+0.308
5	+0.308	−0.396	−0.088	16	+0.519	+0.058	+0.577
6	−0.330	+0.071	−0.259	17	+0.402	−0.133	+0.269
7	−0.363	+0.088	−0.275	18	−1.216	−0.434	−1.650
8	+0.452	+0.229	+0.681	19	+0.468	+0.030	+0.498
9	−0.066	+0.008	−0.058	20	+0.895	−0.583	+0.312
10	−0.082	+0.424	+0.342	21	−0.202	+0.030	−0.172
11	−0.065	−0.075	−0.140	22	−0.416	+0.248	−0.168

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Royalton to Duluth—Continued.

Number of direction	Corrections to directions—			Number of direction	Corrections to directions—		
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total		From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total
	"	"	"		"	"	"
23	+0.044	+0.332	+0.376	76	−0.044	−0.430	−0.474
24	−0.321	−0.027	−0.348	77	+0.274	−0.108	+0.166
25	+0.371	−0.344	+0.027	78	+0.095	+0.233	+0.328
26	−0.496	−0.151	−0.647	79	−0.243	+0.322	+0.079
27	−0.297	+0.358	+0.061	80	−0.247	+0.258	+0.011
28	+0.952	+0.334	+1.286	81	+0.223	+0.304	+0.527
29	−0.529	−0.196	−0.725	82	−0.166	+0.025	−0.141
30	−0.367	+0.427	+0.060	83	+0.214	−0.112	+0.102
31	−0.109	+0.045	−0.064	84	−0.024	−0.474	−0.498
32	+0.650	−0.014	+0.636	85	−0.341	−0.040	−0.381
33	−0.280	−0.279	−0.559	86	+0.277	−0.515	−0.238
34	+0.105	−0.178	−0.073	87	−0.009	−0.185	−0.194
35	−0.097	−0.213	−0.310	88	−0.165	+0.256	+0.091
36	−0.169	−0.184	−0.353	89	+0.239	+0.484	+0.723
37	+0.486	+0.021	+0.507	90	−0.091	+0.201	+0.110
38	−0.599	+0.406	−0.193	91	+0.080	+0.378	+0.458
39	+0.379	−0.032	+0.347	92	−0.066	+0.122	+0.056
40	+0.421	+0.399	+0.820	93	+0.488	−0.110	+0.378
41	−0.493	+0.053	−0.440	94	−0.409	−0.590	−0.999
42	−0.098	−0.088	−0.186	95	+0.162	+0.056	+0.218
43	+0.358	−0.266	+0.132	96	−0.148	+0.438	+0.290
44	−0.188	−0.138	−0.326	97	−0.707	+0.206	−0.501
45	+0.124	+0.332	+0.456	98	+0.850	−0.218	+0.632
46	+0.020	+0.177	+0.197	99	−0.156	−0.483	−0.639
47	+0.096	−0.044	+0.052	100	−0.107	−0.079	−0.186
48	−0.014	−0.236	−0.250	101	−0.376	−0.402	−0.778
49	−0.226	−0.228	−0.454	102	+0.462	−0.185	+0.277
50	+0.048	−0.218	−0.170	103	−0.322	+0.145	−0.177
51	+0.171	−0.258	−0.087	104	+0.343	+0.522	+0.865
52	−0.004	0.000	−0.004	105	+0.012	+0.233	+0.245
53	−0.428	+0.286	−0.142	106	+0.641	+0.705	+1.346
54	+0.214	+0.191	+0.405	107	−0.656	+0.005	−0.651
55	+0.164	+0.288	+0.452	108	+0.105	−0.126	−0.021
56	−0.191	+0.214	+0.023	109	−0.576	−0.097	−0.673
57	−0.135	−0.017	−0.152	110	+0.475	−0.721	−0.246
58	+0.584	−0.221	+0.363	111	−0.091	−0.083	−0.174
59	−0.421	−0.264	−0.685	112	−0.114	−0.329	−0.443
60	−0.077	−0.202	−0.279	113	+0.484	−0.368	+0.116
61	−0.010	−0.302	−0.312	114	−0.282	+0.125	−0.157
62	+0.069	−0.020	+0.049	115	+0.002	+0.655	+0.657
63	−0.021	+0.275	+0.254	116	+0.558	+0.090	+0.648
64	+0.039	+0.250	+0.289	117	−0.030	+0.230	+0.200
65	+0.193	+0.293	+0.486	118	−0.025	+0.013	−0.012
66	+0.199	+0.258	+0.457	119	−0.503	−0.334	−0.837
67	−0.328	+0.004	−0.324	120	−0.005	−0.238	−0.243
68	−0.421	−0.220	−0.641	121	+0.353	−0.665	−0.312
69	+0.356	−0.333	+0.023	122	−0.308	+0.198	−0.110
70	+0.525	−0.188	+0.337	123	+0.132	+0.065	+0.197
71	−0.620	−0.339	−0.959	124	−0.454	+0.111	−0.343
72	+0.377	−0.053	+0.324	125	+0.281	+0.528	+0.809
73	−0.308	+0.279	−0.029	126	−0.316	−0.078	−0.394
74	+0.026	+0.300	+0.326	127	+0.192	+0.122	+0.314
75	−0.081	−0.016	−0.097	128	+0.310	+0.603	+0.913

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Royalton to Duluth—Continued.

Number of direction	Corrections to directions—			Number of direction	Corrections to directions—		
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations	Total		From figure adjustment	Due to the introduction of latitude, longitude and azimuth equations	Total
	"	"	"		"	"	"
129	+0.044	−0.032	+0.012	138	−0.382	−0.179	−0.561
130	−0.230	−0.615	−0.845	139	+0.431	−0.428	+0.859
131	+0.028	+0.096	+0.124	140	−0.021	+0.626	+0.605
132	−0.212	+0.453	+0.241	141	−0.412	−0.888	−1.300
133	+0.009	+0.073	+0.082	142	+0.212	+0.286	+0.498
134	+0.110	+0.085	+0.195	143	+0.200	+0.602	+0.802
135	+0.065	−0.706	−0.641	144	−0.251	+0.149	−0.102
136	−0.233	+0.149	−0.084	145	−0.019	+0.085	+0.066
137	+0.206	−1.022	−0.816	146	+0.270	−0.234	+0.036

Fergus Falls to Stephen base.

Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction
	"		"				"
1	+0.146	40	+0.781	79	+0.482	118	−0.041
2	+0.008	41	−0.304	80	−0.090	119	+0.101
3	−0.079	42	−0.322	81	−0.616	120	−0.038
4	+0.458	43	−0.091	82	+0.899	121	+0.004
5	−0.533	44	−0.064	83	−0.621	122	−0.026
6	−0.193	45	+0.069	84	+0.428	123	−0.277
7	−0.231	46	+0.006	85	+0.150	124	+0.156
8	+0.250	47	+0.012	86	−0.066	125	−0.103
9	+0.291	48	−0.156	87	−0.052	126	+0.111
10	−0.117	49	+0.068	88	+0.336	127	+0.114
11	−0.477	50	−0.250	89	−0.369	128	+0.329
12	+0.403	51	+0.064	90	−0.358	129	−0.359
13	+0.205	52	−0.115	91	+0.292	130	+0.251
14	−0.551	53	+0.164	92	+0.536	131	−0.287
15	+0.421	54	+0.136	93	−0.892	132	+0.066
16	−0.325	55	+0.231	94	+0.422	133	+0.024
17	+0.415	56	−0.452	95	+0.280	134	−0.201
18	−0.184	57	−0.180	96	−0.501	135	+0.135
19	+0.242	58	+0.230	97	−0.016	136	−0.059
20	−0.147	59	+0.173	98	+0.199	137	+0.100
21	+0.146	60	−0.060	99	+0.037	138	+0.350
22	−0.089	61	+0.053	100	+0.166	139	−0.607
23	+0.538	62	+0.336	101	+0.139	140	−0.124
24	+0.371	63	−0.009	102	−0.034	141	−0.112
25	−0.288	64	−0.320	103	−0.438	142	+0.264
26	+0.154	65	+0.638	104	+0.166	143	+0.229
27	−0.831	66	+0.014	105	+0.028	144	+0.049
28	−0.017	67	−0.232	106	−0.264	145	−0.062
29	+0.509	68	−0.620	107	+0.236	146	−0.314
30	−0.292	69	+0.200	108	+0.292	147	+0.328
31	+0.455	70	−0.466	109	+0.181	148	−0.044
32	−0.665	71	+0.504	110	−0.258	149	+0.840
33	−0.236	72	+0.568	111	−0.329	150	−0.904
34	+0.246	73	−0.581	112	+0.114	151	+0.107
35	−0.242	74	−0.024	113	+0.083	152	+0.085
36	+0.102	75	+0.031	114	+0.160	153	−0.257
37	+0.166	76	−0.889	115	+0.269	154	+0.172
38	+0.085	77	−0.102	116	−0.348		
39	−0.112	78	+0.478	117	−0.164		

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Stephen base net to Canada.

Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction
	"		"		"		"
1	−0.519	10	+0.636	19	−0.171	28	−0.184
2	−0.379	11	−0.212	20	−0.478	29	+0.552
3	+0.445	12	+0.224	21	+0.241	30	+0.008
4	+0.334	13	−0.355	22	−0.180	31	−0.317
5	−0.202	14	+0.212	23	+0.241	32	+0.046
6	−0.169	15	+0.131	24	+0.176	33	+0.272
7	+0.060	16	+0.168	25	−0.163	34	−0.226
8	+0.456	17	−0.201	26	−0.015	35	+0.242
9	−0.781	18	+0.204	27	−0.198	36	−0.016

The maximum correction to an observed direction resulting from the figure adjustment in each of the six seasons' work at the north end of the ninety-eighth meridian triangulation is shown in the following table:

Maximum correction to an observed direction by seasons.

Limits of season's work	Direction number	Between stations	Correction
			"
Between Page base and the line Wieters-Freeman	1	Page SW. base and Sparta	0.80
Between Wieters - Freeman and Drywood-Layden	135	Elfring and Mound	1.44
Between Drywood - Layden and Gull-Jones	99	Eagle and Lone	0.98
Between Gull-Jones and Duluth	18	Jones and Brook	1.22
Between Fergus Falls and Stephen base	150	Wahpeton and Fox	0.90
Between Stephen base net and Canada	9	Skane and Deer	0.78

In the following table there is shown the maximum correction to an observed direction for each of the five sections in the northern portion of the ninety-eighth meridian triangulation:

Maximum correction to an observed direction by sections.

Section	Direction number	Between stations	Correction
			"
Page base net to Brown Valley base	135	Elfring and Mound	1.44
Brown Valley base net to Royalton base	99	Eagle and Lone	0.98
Royalton base net to Duluth	18	Jones and Brook	1.22
Fergus Falls to Stephen base	150	Wahpeton and Fox	0.90
Stephen base net to Canada	9	Skane and Deer	0.78

In the 12 sections of the ninety-eighth meridian triangulation for which results have been published (including Appendix 5 of this Report) the largest maximum correction in any section was 1.″96 and the smallest maximum correction in any section was 0.″60. The maximum corrections for the 5 sections treated in this publication vary from 1.″44 to 0.″78. Of the 42 sections of primary triangulation not on the ninety-eighth meridian for which statistics are given in this appendix, pages 231 and 232, there are 12 for which the maximum correction was greater than 1.″44 and 6 for which it was less than 0.″78.

The probable error of an observed direction is

$$d = 0.674\sqrt{\frac{\Sigma v^2}{c}}$$

in which Σv^2 is the sum of the squares of the corrections to directions and c is the number of conditions.

The probable errors, resulting from the figure adjustment, of an observed direction for the six seasons' work at the northern portion of the ninety-eighth meridian triangulation are as follows:

	″
Page base net to Wieters-Freeman	±0.29
Wieters-Freeman to Drywood-Layden	±0.44
Drywood-Layden to Gull-Jones	±0.35
Gull-Jones to Duluth	±0.36
Fergus Falls to Stephen base	±0.34
Stephen base net to Canada	±0.33

The probable error, resulting from the figure adjustment, for an observed direction for each of the five sections is given below, preceded, for the purpose of comparison, by the corresponding values for the other sections of the ninety-eighth meridian triangulation, already in print, or in Appendix 5 of this Report.

	″	
Meades Ranch-Waldo to Shelton base net	±0.27	from 76 directions
Shelton base net	±0.33	from 26 directions
Shelton base net to Page base	±0.29	from 96 directions
Wilson-Heath-Iron Mound to Anthony base	±0.35	from 121 directions
Anthony base net to El Reno base net	±0.36	from 54 directions
El Reno base to Bowie base	±0.33	from 150 directions
Bowie base net to Stephenville base	±0.29	from 98 directions
Stephenville base net to Lampasas base	±0.23	from 68 directions
Lampasas base net to Seguin base	±0.45	from 125 directions
Seguin base net to Alice base	±0.41	from 114 directions
Elliff-Nolan to Laguna Madre base	±0.25	from 52 directions
Point Isabel base net	±0.25	from 30 directions
Page base net to Brown Valley base	±0.42	from 195 directions
Brown Valley base net to Royalton base	±0.36	from 136 directions
Royalton base net to Duluth	±0.36	from 146 directions
Fergus Falls to Stephen base	±0.34	from 154 directions
Stephen base net to Canada	±0.33	from 36 directions

The mean for the 5 sections at the northern portion of the ninety-eighth meridian triangulation is ±0.″36 while the mean of the 12 other sections in the ninety-eighth meridian is ±0.″32. There are 6 sections for which the probable error of a direction

is smaller than the section between Fergus Falls and the Stephen base, while the correction for one section is greater than that for the section from Page base net to Brown Valley base, ±0.″45 against ±0.″42.

Four average values of d are as follows:

	″
Eastern oblique arc	±0.51
Transcontinental triangulation	±0.44
Ninety-eighth meridian, all sections	±0.33
Ninety-eighth meridian, 5 sections at northern end	±0.36

These values were obtained by taking straight means of the values of d by sections.

ACCURACY AS INDICATED BY CORRECTIONS TO ANGLES AND CLOSURES OF TRIANGLES.

The correction to each angle is the algebraic sum of the corrections to two directions. In order to make it possible to study the corrections to the separate angles, they are shown in the following table for every triangle in the primary scheme from the Page base net to the United States and Canada boundary and to Duluth. There are two columns of corrections to the angles, one for those resulting from the figure adjustment and the other due to the introduction of latitude, longitude, and azimuth equations. (See p. 184). There are also shown the errors of closure of the triangles, the corrected spherical angles and the spherical excess for each triangle. The plus sign prefixed to the error of closure of a triangle indicates that the sum of the angles is less than 180° plus the spherical excess. The spherical excess is a convenient indication of the size of the triangle, since it is proportional to the area.

Wherever no entry is made in the two columns of "Corrections to angles" the angle in question was not measured.

TABLES OF TRIANGLES.

Page to Brown Valley.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	″	″	″	° ′ ″	″
Sparta	+0.04	−0.16		28 03 00.11	
Hall	+0.06	+0.53	+0.89	82 49 46.65	2.15
Page SW. base	+0.79	−0.37		69 07 15.39	
Sparta	−0.25	−0.14		49 53 34.56	
Hall	+0.06	+0.53	−0.54	34 22 30.13	1.87
Walnut	−0.35	−0.39		95 43 57.18	
Sparta	−0.28	+0.02		21 50 34.46	
Page SW. base	−0.79	+0.37	−1.42	21 31 40.46	0.97
Walnut	−0.35	−0.39		136 37 46.05	

TABLES OF TRIANGLES—Continued.

Page to Brown Valley—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Santee	+1.04	−0.46		31 22 25.33	
Sparta	+0.50	+0.92	+2.01	116 40 30.86	1.26
Walnut	+0.47	−0.46		31 57 05.07	
Avon	+0.99	−0.29		28 45 52.95	
Santee	+0.77	+0.39	+2.35	118 36 42.49	1.41
Sparta	+0.59	−0.10		32 37 25.97	
Avon	+0.14	−0.65		58 21 58.06	
Santee	−0.27	+0.85	−0.50	87 14 17.16	2.71
Walnut	−0.37	−0.20		34 23 47.49	
Avon	−0.85	−0.35		29 36 05.12	
Sparta	−0.09	+1.02	−0.84	84 03 04.89	2.56
Walnut	+0.10	−0.67		66 20 52.55	
Vod	−0.26	+0.05		58 01 34.10	
Santee	−0.26	+0.79	−0.99	38 09 54.82	1.30
Avon	−0.47	−0.84		83 48 32.38	
Yankton	+0.53	+0.12		34 12 18.98	
Santee	−0.08	+0.79	+0.08	86 43 39.26	2.74
Avon	−0.37	−0.91		59 04 04.50	
Yankton	+0.35	+0.60		49 30 19.98	
Santee	+0.18	0.00	+0.84	48 33 44.44	2.41
Vod	+0.31	−0.60		81 55 57.99	
Yankton	−0.19	+0.48		15 18 00.99	
Avon	−0.09	+0.07	−0.23	24 44 27.89	0.97
Vod	+0.05	−0.55		139 57 32.09	
Wieters	−0.17	+0.15		59 32 00.84	
Yankton	−0.17	+0.66	−0.43	49 24 24.21	2.00
Vod	−0.09	−0.81		71 03 36.95	
Freeman	+0.38	0.00		46 21 17.37	
Yankton	+0.14	+0.74	+0.34	91 56 09.86	2.21
Vod	−0.18	−0.74		41 42 34.98	
Freeman	+0.67	+0.49		81 30 23.41	
Yankton	+0.31	+0.09	+1.53	42 31 45.66	1.64
Wieters	+0.55	−0.58		55 57 52.57	
Freeman	+0.29	+0.50		35 09 06.05	
Vod	+0.09	−0.07	+0.76	29 21 01.97	1.43
Wieters	+0.38	−0.43		115 29 53.41	
Wolf Creek	−0.47	+0.25		63 15 19.86	
Freeman	−0.50	+0.44	−1.84	55 34 19.40	1.09
Wieters	−0.87	−0.69		61 10 21.83	

TABLES OF TRIANGLES—Continued.

Page to Brown Valley—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Elm Springs				26 08 02.76	
Wolf Creek	−0.11	+0.57		137 22 51.99	0.57
Freeman	−0.41	−0.02		16 29 05.82	
Elm Springs	+0.60	−0.45		66 52 39.97	
Wolf Creek	+0.36	+0.32	+2.08	74 07 32.13	0.76
Wieters	+1.12	+0.13		38 59 48.66	
Elm Springs				40 44 37.22	
Freeman	−0.09	+0.46		39 05 13.58	1.28
Wieters	+0.25	−0.57		100 10 10.48	
Silver Lake	−0.40	+0.46		77 23 45.05	
Freeman	+0.01	+0.25	−0.72	44 34 16.97	0.79
Wolf Creek	−0.33	−0.71		58 01 58.77	
Salem	−0.43	−0.17		34 01 30.15	
Silver Lake	+0.19	+0.59	−0.15	87 34 52.04	1.02
Wolf Creek	+0.09	−0.42		58 23 38.83	
Farmer	−0.44	−0.51		79 49 59.14	
Salem	+0.84	+0.61	−0.25	60 10 00.37	1.21
Wolf Creek	−0.65	−0.10		40 00 01.70	
Farmer	+1.88	+0.01		34 04 06.18	
Wolf Creek	+1.01	+0.65	+3.81	66 11 28.71	0.87
Elm Springs	+0.92	−0.66		79 44 25.98	
Canova	+0.06	−0.12		44 33 36.24	
Salem	−0.74	+0.55	−0.83	87 01 16.91	0.97
Farmer	−0.15	−0.43		48 25 07.82	
Owens	+0.23	+0.49		68 11 37.77	
Salem	+0.29	−0.06	+0.86	27 23 51.65	0.51
Canova	+0.34	−0.43		84 24 31.09	
Reese	−0.26	−0.44		95 53 59.41	
Canova	−0.15	+0.54	−1.17	53 40 21.49	1.76
Farmer	−0.76	−0.10		30 25 39.86	
Crane	+0.15	+0.09		27 52 26.35	
Owens	−0.22	+0.52	+0.04	93 18 22.81	0.47
Canova	+0.11	−0.61		58 49 11.31	
Caldwell	+0.01	−0.58		57 30 31.83	
Crane	−0.02	+0.27	−0.14	73 03 01.89	1.00
Canova	−0.13	+0.31		49 26 27.28	
Caldwell	−0.45	+0.12		33 32 46.45	
Canova	−0.23	+0.32	−1.27	69 05 52.60	0.79
Reese	−0.59	−0.44		77 21 21.74	

TABLES OF TRIANGLES—Continued.

Page to Brown Valley—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	″	″	″	° ′ ″	″
Miner	+0.38	−0.10		87 48 44.18	
Crane	−0.24	+0.26	+0.70	38 47 53.19	0.48
Caldwell	+0.56	−0.16		53 23 23.11	
Drakola	−0.59	−0.24		50 19 58.12	
Miner	−0.64	+0.28	−2.33	90 27 07.28	0.30
Caldwell	−1.10	−0.04		39 12 54.90	
Hansen	+0.24	+0.11		22 17 19.37	
Crane	+0.22	+0.36	+0.47	21 52 04.87	0.42
Miner	+0.01	−0.47		135 50 36.18	
Hansen	+0.13	+0.02		40 39 58.15	
Miner	+0.25	+0.28	+0.64	45 53 32.35	0.28
Drakola	+0.26	−0.30		93 26 29.78	
Brock	−1.37	+0.01		44 41 02.91	
Crane	−0.43	+0.42	−2.41	61 54 36.61	0.73
Miner	−0.61	−0.43		73 24 21.21	
Brock	−0.59	+0.32		92 05 55.22	
Crane	−0.65	+0.06	−1.84	40 02 31.74	0.98
Hansen	−0.60	−0.38		47 51 34.02	
Brock	+0.78	+0.30		47 24 52.30	
Miner	+0.62	−0.04	+1.04	62 26 14.97	0.67
Hansen	−0.36	−0.26		70 08 53.40	
Larson	+0.43	−0.13		59 00 16.59	
Brock	−0.12	+0.41	+1.16	69 31 12.98	0.73
Hansen	+0.85	−0.28		51 28 31.16	
Jeska	−0.14	+0.32		99 59 57.47	
Brock	+0.27	−0.10	−0.26	32 02 52.37	0.28
Larson	−0.39	−0.22		47 57 10.44	
Weiss	+0.64	−0.24		61 20 25.04	
Larson	−0.04	+0.60	−0.02	76 43 38.19	0.75
Hansen	−0.62	−0.36		41 55 57.52	
Oakwood Lake	−1.12	+0.10		25 46 55.31	
Jeska	+0.13	+0.28	−0.90	73 08 10.12	0.45
Larson	0.00	−0.38		81 04 55.02	
Oakwood Lake	+1.03	+0.10		35 35 40.20	
Larson	0.00	+0.14	+0.30	95 13 59.77	0.76
Weiss	−0.73	−0.24		49 10 20.79	
Horswill	+0.72	+0.06		49 31 29.55	
Oakwood Lake	−0.18	+0.35	+0.84	59 05 10.45	1.85
Weiss	+0.30	−0.41		71 23 21.85	

TABLES OF TRIANGLES—Continued.

Page to Brown Valley—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Olson	−0.30	−0.05		38 39 35.07	
Oakwood Lake	−0.23	+0.49	+0.18	98 03 30.59	1.88
Weiss	+0.71	−0.44		43 16 56.22	
Olson	−0.17	+0.18		80 39 33.08	
Oakwood Lake	−0.04	+0.14	−0.80	38 58 20.15	1.48
Horswill	−0.59	−0.32		60 22 08.25	
Olson	+0.13	+0.23		41 59 58.01	
Weiss	−0.40	+0.03	−0.14	28 06 25.64	1.45
Horswill	+0.13	−0.26		109 53 37.80	
Elfring	+0.16	−0.02		49 01 35.01	
Olson	+0.24	+0.31	+0.70	25 24 56 30	0.60
Horswill	+0.33	−0.29		105 33 29.29	
Franklin	+0.33	−0.12		53 37 05.40	
Olson	+0.12	+0.38	+0.65	72 27 20.33	1.04
Horswill	+0.20	−0.26		53 55 35.31	
Franklin	+0.17	+0.17		81 48 34.42	
Olson	−0.12	+0.06	−0.44	47 02 24.02	1.02
Elfring	−0.49	−0.23		51 09 02.58	
Franklin	−0.16	+0.27		28 11 29.00	
Horswill	+0.12	−0.03	−0.40	51 37 53.97	0.57
Elfring	−0.36	−0.24		100 10 37.60	
Mound	−0.03	−0.05		33 33 32.58	
Franklin	+0.36	+0.40	+2.26	113 34 32.79	0.87
Elfring	+1.93	−0.35		32 51 55.50	
Helgen	−0.96	−0.27		38 24 14.20	
Mound	+0.24	+0.04	−0.11	90 02 59.39	1.18
Franklin	+0.61	+0.23		51 32 47.59	
Helgen	−0.26	−0.20		76 52 48.64	
Mound	+0.26	+0.09	−2.27	56 29 26.80	1.66
Elfring	−2.27	+0.11		46 37 46.22	
Helgen	+0.70	+0.06		38 28 34.43	
Franklin	−0.25	+0.18	+0.10	62 01 45.21	1.35
Elfring	−0.35	−0.24		79 29 41.71	
Boating	−1.17	−0.21		51 01 03.25	
Mound	−1.37	+0.51	−2.54	76 32 20.66	1.47
Helgen	+0.80	−0.30		52 26 37.56	
Waubay	−0.07	−0.20		36 30 32.47	
Boating	−0.78	−0.07	−1.87	112 24 28.81	1.24
Mound	−1.01	+0.27		31 04 59.96	

TABLES OF TRIANGLES—Continued.

Page to Brown Valley—Continued.

Stations	Corrections to angles— From figure adjustment	Corrections to angles— Due to the introduction of latitude, longitude, and azimuth equations	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	"	° ′ ″	"
Waubay	−0.27	−0.37		75 24 33.47	
Boating	+0.38	+0.14	−0.37	61 23 25.56	1.44
Helgen	−0.48	+0.23		43 12 02.41	
Waubay	−0.19	−0.19		38 54 00.99	
Mound	−0.36	+0.25	−1.03	45 27 20.71	1.68
Helgen	−0.48	−0.06		95 38 39.98	
Preacher Hill	−1.08	−0.08		59 53 19.89	
Boating	−0.46	+0.12	−2.64	57 22 43.25	1.01
Waubay	−1.10	−0.04		62 43 57.87	
Pickerel	+0.18	−0.21		91 22 04.76	
Preacher Hill	+0.92	+0.05	+2.13	53 07 02.60	0.51
Waubay	+1.03	+0.16		35 30 53.15	
Drywood	+0.43	−0.09		37 00 44.16	
Preacher Hill	+0.82	−0.02	+1.06	79 05 01.35	0.54
Pickerel	−0.19	+0.11		63 54 15.03	

Brown Valley to Royalton.

Brown Valley SE. base	+0.48	−0.30		45 27 12.33	
Boating	+0.93	+0.18	+0.76	44 52 09.15	1.21
Preacher Hill	−0.65	+0.12		89 40 39.73	
Brown Valley SE. base	−1.27	+0.01		44 21 24.70	
Preacher Hill	−0.01	−0.07	−1.41	78 13 56.43	0.98
Drywood	−0.13	+0.06		57 24 39.85	
Brown Valley NW. base	+0.18	+0.16		43 02 24.32	
Brown Valley SE. base	+0.31	+0.02	+0.99	126 29 04.74	0.52
Boating	+0.50	−0.18		10 28 31.46	
Brown Valley NW. base	−0.02	+0.18		77 21 01.69	
Brown Valley SE. base	−0.18	+0.33	+1.83	81 01 52.41	0.45
Preacher Hill	+2.03	−0.51		21 37 06.35	
Brown Valley NW. base	−0.22	+0.03		128 36 59.87	
Brown Valley SE. base	+1.09	+0.31	−0.59	36 40 27.70	0.32
Drywood	−1.46	−0.34		14 42 32.75	

TABLES OF TRIANGLES—Continued.

Brown Valley to Royalton—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Brown Valley NW. base	−0.21	+0.02		34 18 37.36	
Boating	+0.44	+0.37	+1.61	34 23 37.71	1.15
Preacher Hill	+1.38	−0.39		111 17 46.08	
Brown Valley NW. base	−0.21	−0.15		51 15 58.17	
Preacher Hill	−2.04	+0.44	−3.84	56 36 50.08	0.84
Drywood	−1.59	−0.29		72 07 12.59	
Layden	+0.22	+0.27		11 26 18.93	
Boating	−1.72	+0.07	−1.96	5 01 32.98	0.30
Brown Valley SE. base	−0.46	−0.34		163 32 08.39	
Layden	+0.14	−0.03		29 20 04.54	
Boating	−0.79	+0.25	+0.12	49 53 42.13	1.88
Preacher Hill	+0.77	−0.22		100 46 15.21	
Layden	+0.30	−0.09		46 57 57.90	
Boating	−1.22	−0.11	−0.62	15 30 04.44	1.09
Brown Valley NW. base	+0.30	+0.20		117 31 58.75	
Layden	−0.08	−0.30		17 53 45.61	
Brown Valley SE. base	−0.03	+0.64	+1.31	151 00 39.27	0.36
Preacher Hill	+1.42	−0.34		11 05 35.48	
Layden	+0.08	−0.37		35 31 38.96	
Brown Valley SE. base	+0.15	+0.32	+0.35	69 58 46.87	0.27
Brown Valley NW. base	+0.12	+0.05		74 29 34.44	
Layden	−0.34	−0.21		49 15 05.37	
Brown Valley SE. base	+1.24	+0.63	+0.39	106 39 14.57	0.84
Drywood	−0.51	−0.42		24 05 40.90	
Layden	+0.16	−0.06		17 37 53.36	
Preacher Hill	+0.61	−0.17	+0.86	10 31 30.87	0.35
Brown Valley NW. base	+0.09	+0.23		151 50 36.12	
Layden	−0.26	+0.09		31 21 19.76	
Preacher Hill	−1.44	+0.27	−2.34	67 08 20.94	1.45
Drywood	−0.64	−0.36		81 30 20.75	
Layden	−0.42	+0.16		13 43 26.41	
Brown Valley NW. base	+0.11	−0.08	+0.64	156 53 25.70	0.21
Drywood	+0.95	−0.08		9 23 08.15	

TABLES OF TRIANGLES—Continued.

Brown Valley to Royalton—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Enwiller	+0.09	−0.42		54 21 04.62	
Layden	+0.30	+0.14	+0.61	92 51 01.32	1.73
Drywood	+0.22	+0.28		32 47 55.79	
Oscarson	+0.68	−0.52		29 02 17.10	
Layden	+0.38	+0.42	+1.21	121 56 48.80	2.20
Drywood	+0.15	+0.10		29 00 56.30	
Oscarson	+0.21	−0.33		37 52 22.04	
Layden	+0.09	+0.28	+0.14	29 05 47.49	0.84
Enwiller	−0.16	+0.05		113 01 51.31	
Oscarson	−0.47	+0.19		8 50 04.94	
Drywood	+0.08	+0.18	−0.46	3 46 59.50	0.37
Enwiller	−0.07	−0.37		167 22 55.93	
Hankinson	+0.47	−0.03		26 18 24.11	
Oscarson	−0.03	−0.20	+0.76	48 44 02.88	1.19
Enwiller	+0.32	+0.23		104 57 34.20	
Hankinson	+0.36	−0.73		81 45 54.73	
Oscarson	−0.50	−0.02	−0.39	57 34 07.81	4.41
Drywood	−0.25	+0.75		40 40 01.87	
Hankinson	−0.11	−0.71		55 27 30.61	
Enwiller	−0.25	+0.14	−0.68	87 39 29.87	2.86
Drywood	−0.32	+0.57		36 53 02.38	
Foss	+0.90	−0.43		78 49 27.69	
Oscarson	+0.37	+0.03	+1.09	61 43 01.08	1.96
Hankinson	−0.18	+0.40		39 27 33.19	
Wahpeton	−1.15	−0.34		58 38 31.00	
Foss	−1.35	+0.17	−2.72	98 23 23.68	1.25
Hankinson	−0.22	+0.17		22 58 06.57	
Bullis	+0.47	−0.48		41 03 18.75	
Oscarson	−0.63	+0.49	+0.01	78 24 42.65	1.87
Foss	+0.17	−0.01		60 32 00.47	
Western	−0.75	+0.19		54 13 04.13	
Bullis	−0.49	−0.67	−2.38	93 16 25.19	1.68
Oscarson	−1.14	+0.48		32 30 32.36	
Western	+0.23	−0.17		91 43 49.11	
Bullis	−0.95	−0.19	−1.12	52 13 06.45	1.50
Foss	−0.40	+0.36		36 03 05.94	
Western	+0.99	−0.36		37 30 44.99	
Oscarson	+0.51	+0.01	+1.27	45 54 10.29	1.69
Foss	−0.23	+0.35		96 35 06.41	

TABLES OF TRIANGLES—Continued.

Brown Valley to Royalton—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Western	−0.37	−0.13		29 03 05.07	
Foss	+0.68	−0.09	+1.20	86 12 02.22	1.08
Wahpeton	+0.89	+0.22		64 44 53.79	
Elbow	+0.51	−0.39		61 57 14.51	
Bullis	+0.31	+0.51	+0.63	73 10 32.40	0.85
Western	−0.19	−0.12		44 52 13.94	
Dalton	+0.82	−0.05		31 21 41.06	
Elbow	+0.26	−0.28	+0.75	115 32 15.51	0.68
Bullis	−0.33	+0.33		33 06 04.11	
Dalton	0.00	−0.37		77 24 24.09	
Elbow	−0.24	+0.11	+0.03	53 35 01.01	0.82
Western	+0.27	+0.26		49 00 35.72	
Dalton	−0.81	−0.32		46 02 43.04	
Bullis	+0.65	+0.18	−0.09	40 04 28.30	0.99
Western	+0.07	+0.14		93 52 49.65	
Leaf	+1.16	−0.42		34 01 43.63	
Elbow	−0.15	+0.10	+0.98	64 23 21.28	1.25
Dalton	−0.03	+0.32		81 34 56.34	
Holmes	−0.31	−0.23		19 05 49.91	
Elbow	+0.54	+0.04	+0.55	126 23 43.01	1.09
Dalton	+0.32	+0.19		34 30 28.17	
Holmes	+0.69	−0.16		59 58 55.40	
Elbow	+0.69	−0.07	−1.27	62 00 21.72	2.12
Leaf	−0.11	+0.23		58 00 45.00	
Holmes	+1.00	+0.06		40 53 05.48	
Dalton	−0.35	+0.13	+1.70	47 04 28.17	2.28
Leaf	+1.05	−0.19		92 02 28.63	
Parker	+0.10	−0.01		64 55 42.65	
Holmes	−0.35	+0.08	−0.30	29 27 54.02	1.38
Leaf	−0.05	−0.07		85 36 24.71	
Alexandria	+0.30	−0.13		66 30 57.83	
Holmes	−0.44	+0.09	−0.67	75 23 46.96	1.66
Leaf	−0.53	+0.04		38 05 16.87	
Alexandria	+0.65	−0.09		96 42 32.60	
Holmes	−0.09	+0.01	+0.81	45 55 52.94	1.36
Parker	+0.25	+0.08		37 21 35.82	
Alexandria	+0.35	+0.03		30 11 34.76	
Leaf	+0.49	−0.10	+1.18	47 31 07.86	1.08
Parker	+0.34	+0.07		102 17 18.46	

TABLES OF TRIANGLES—Continued.

Brown Valley to Royalton—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ' "	"
Leslie	+1.19	+0.05		61 34 19.43	
Alexandria	−0.42	+0.10	+0.60	59 15 35.61	1.35
Parker	−0.17	−0.15		59 10 06.31	
Osakis	−1.11	+0.09		40 44 44.92	
Alexandria	−0.32	−0.12	−0.94	111 42 07.50	1.06
Parker	+0.49	+0.03		27 33 08.64	
Osakis	+0.17	+0.14		81 39 30.82	
Alexandria	+0.10	−0.23	−0.33	52 26 31.88	0.89
Leslie	−0.60	+0.09		45 53 58.19	
Osakis	+1.28	+0.04		40 54 45.89	
Parker	−0.66	−0.18	+1.21	31 36 57.67	1.18
Leslie	+0.59	+0.14		107 28 17.62	
Maple	+0.48	+0.05		98 06 13.68	
Osakis	−0.07	+0.00	+0.59	39 23 40.54	0.43
Leslie	+0.18	−0.05		42 30 06.21	
Long	+0.34	+0.15		58 15 10.14	
Maple	+0.15	+0.02	+0.31	73 08 07.08	0.34
Leslie	−0.18	−0.17		48 36 43.12	
Birch	+0.46	+0.14		42 24 58.05	
Osakis	−0.55	−0.23	−0.08	44 44 45.01	0.48
Maple	+0.01	+0.09		92 50 17.42	
Birch	−0.33	+0.15		36 07 51.39	
Maple	−0.64	−0.14	−1.56	95 55 21.84	0.40
Long	−0.59	−0.01		47 56 47.17	
Eagle	−0.34	+0.27		53 08 38.93	
Birch	−0.11	−0.35	−0.09	85 44 18.80	0.74
Long	+0.36	+0.08		41 07 03.01	
Lone	−0.11	+0.13		32 57 17.40	
Eagle	+0.91	+0.08	+0.97	89 09 38.30	0.95
Birch	+0.17	−0.21		57 53 05.25	
Lone	+0.60	+0.40		69 40 04.04	
Eagle	+1.24	−0.19	+1.78	36 00 59.36	0.84
Long	−0.06	−0.21		74 18 57.44	
Lone	+0.71	+0.27		36 42 46.64	
Birch	−0.28	−0.14	+0.73	27 51 13.55	0.64
Long	+0.30	−0.13		115 26 00.45	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Falls	−0.25	+0.33		38 03 09.84	
Eagle	−0.90	+0.49	−1.90	72 27 38.66	2.14
Lone	−0.75	−0.82		69 29 13.64	
Johnson	−0.16	−0.42		60 44 57.85	
Falls	+0.32	−0.36	+0.68	75 19 28.90	2.62
Eagle	+0.52	+0.78		43 55 35.87	
Johnson	+0.07	−0.04		91 23 46.28	
Falls	+0.57	−0.69	+0.69	37 16 19.06	1.67
Lone	+0.05	+0.73		51 19 56.33	
Johnson	+0.23	+0.38		30 38 48.43	
Eagle	−1.42	−0.28	−1.89	28 32 02.80	1.19
Lone	−0.70	−0.10		120 49 09.96	
Brockway	−0.82	+0.33		30 02 47.06	
Eagle	−1.84	−0.65	−2.43	112 11 03.35	1.67
Lone	+0.23	+0.32		37 46 11.26	
Brockway	−0.92	+0.32		86 47 03.05	
Eagle	−0.94	−1.14	−2.49	39 43 24.69	1.75
Falls	−0.63	+0.82		53 29 34.01	
Brockway	−0.10	+0.00		56 44 16.00	
Lone	−0.98	−1.14	−1.96	31 43 02.38	2.22
Falls	−0.88	+1.14		91 32 43.84	
Royalton N. base	−0.73	+0.06		49 56 43.76	
Brockway	−1.38	+0.68	−3.40	119 46 29.45	0.45
Eagle	−1.29	−0.74		10 16 47.24	
Royalton N. base	−0.74	+0.13		135 03 15.36	
Brockway	−0.46	+0.36	−0.78	32 59 26.40	0.22
Falls	+0.42	−0.49		11 57 18.46	
Royalton N. base	−0.01	+0.06		85 06 31.59	
Eagle	+0 35	−0.39	+0.14	29 26 37.46	1.53
Falls	−0.20	+0.33		65 26 52.48	
Royalton S. base	−0.62	+0.48		42 44 50.40	
Brockway	+0.42	−0.34	−0.31	72 06 13.29	0.15
Royalton N. base	−0.11	−0.14		65 08 56.46	
Alberta	+0.70	−0.66		34 10 35.96	
Royalton S. base	+0.44	+0.93	+1.37	107 15 27.57	0.23
Brockway	+0.23	−0.27		38 33 56.70	
Alberta	+0.50	−0.74		55 10 42.79	
Royalton S. base	+1.06	+0.46	+2.38	64 30 37.18	0.23
Royalton N. base	+0.82	+0.28		60 18 40.26	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Alberta	−0.20	−0.08		21 00 06.83	
Brockway	+0.19	−0.07	+0.70	33 32 16.59	0.15
Royalton N. base	+0.71	+0.15		125 27 36.73	
Alberta	−0.41	+1.15		73 42 24.20	
Brockway	−0.26	+0.28	−0.65	66 31 42.99	0.85
Falls	+0.02	−1.43		39 45 53.66	
Alberta	−0.20	+1.23		52 42 17.38	
Royalton N. base	+0.03	−0.28	−0.57	99 29 07.91	0.48
Falls	−0.40	−0.95		27 48 35.19	
Daggett	+0.02	−0.50		75 38 54.09	
Falls	−0.15	+0.46	−0.57	56 27 01.23	1.37
Johnson	−0.44	+0.04		47 54 06.05	
Rail	+0.81	+0.14		44 35 45.78	
Daggett	+0.13	−0.63	+0.92	91 43 00.94	1.24
Falls	+0.02	+0.49		43 41 14.52	
Rail	+0.30	−0.08		107 04 50.09	
Daggett	+0.11	−0.14	+0.73	16 04 06.84	0.38
Johnson	+0.32	+0.22		56 51 03.45	
Rail	−0.51	−0.22		62 29 04.31	
Falls	−0.13	−0.04	−0.75	12 45 46.70	0.52
Johnson	−0.11	+0.26		104 45 09.51	
Gull	−0.37	−0.36		40 57 24.03	
Daggett	+0.06	−0.12	−0.98	47 57 43.90	1.38
Rail	−0.67	+0.48		91 04 53.45	
Jones	+0.69	−0.42		38 06 20.30	
Daggett	−0.06	+0.40	+0.60	93 30 29.31	1.48
Rail	−0.03	+0.02		48 23 11.87	
Jones	+0.57	−0.62		82 30 11.57	
Daggett	−0.12	+0.53	+0.91	45 32 45.42	1.61
Gull	+0.46	+0.09		51 57 04.62	
Jones	−0.12	−0.19		44 23 51.28	
Rail	−0.64	+0.46	−0.66	42 41 41.58	1.52
Gull	+0.10	−0.27		92 54 28.66	
Rabbit	+0.26	−0.38		33 19 44.04	
Jones	+0.07	+0.16	+0.11	122 52 48.02	0.91
Gull	−0.22	+0.22		23 47 28.85	
Brook	+1.25	−0.02		24 36 57.13	
Rabbit	+1.02	−0.44	+3.95	128 31 42.58	0.67
Jones	+1.68	+0.46		26 51 20.96	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ' "	"
Brook	−0.23	−0.55		58 26 43.91	
Rabbit	+0.76	−0.06	−0.57	95 11 58.54	1.78
Gull	−1.10	+0.61		26 21 19.33	
Brook	−1.48	−0.53		33 49 46.78	
Jones	−1.62	−0.30	−4.41	96 01 27.05	2.02
Gull	−1.31	+0.83		50 08 48.19	
Bethlehem	−0.91	−0.34		33 50 24.04	
Rabbit	−0.54	−0.17	−1.25	105 15 08.93	1.06
Brook	+0.20	+0.51		40 54 28.09	
French	−1.09	+0.39		45 17 36.15	
Bethlehem	−0.52	−0.49	−1.22	99 47 02.97	1.02
Rabbit	+0.39	+0.10		34 55 21.90	
French	−0.11	−0.05		81 20 21.46	
Bethlehem	+0.39	−0.15	−0.58	65 56 38.93	1.40
Brook	−0.86	+0.20		32 43 01.01	
French	+0.98	−0.44		36 02 45.31	
Rabbit	−0.93	−0.27	−0.62	70 19 47.03	1.03
Brook	−0.67	+0.71		73 37 29.09	
Kimberly	+0.64	−0.10		59 39 24.93	
Bethlehem	+0.46	−0.14	+1.68	25 26 04.04	0.42
French	+0.58	+0.24		94 54 31.45	
Rae	−0.10	−0.15		65 15 33.87	
Bethlehem	−0.09	−0.05	+0.46	50 15 34.79	0.64
French	+0.65	+0.20		64 28 51.98	
Rae	−0.03	−0.37		96 22 27.21	
Bethlehem	−0.55	+0.09	−1.00	24 49 30.75	0.40
Kimberly	−0.42	+0.28		58 48 02.44	
Rae	+0.07	−0.22		31 06 53.34	
French	−0.07	+0.02	+0.22	30 25 39.45	0.18
Kimberly	+0.22	+0.20		118 27 27.39	
Grindle	−0.36	−0.08		46 16 47.43	
Rae	−0.32	−0.18	−0.86	85 58 09.62	0.20
Kimberly	−0.18	+0.26		47 45 03.15	
Gregor	−0.09	+0.29		43 01 22.85	
Grindle	−0.30	−0.31	−0.60	91 50 34.73	0.22
Rae	−0.21	+0.02		45 08 02.64	
Gregor	−0.03	+0.27		84 20 35.27	
Grindle	+0.06	−0.23	+0.15	45 33 47.30	0.21
Kimberly	+0.12	−0.04		50 05 37.64	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ' "	"
Gregor	+0.06	−0.03		41 19 12.41	
Rae	−0.11	−0.19	−0.10	40 50 06.99	0.20
Kimberly	−0.05	+0.22		97 50 40.80	
Douglas	+0.01	−0.04		41 00 51.05	
Grindle	−0.29	−0.24	−0.20	77 14 53.54	0.30
Gregor	+0.08	+0.28		61 44 15.71	
Tamarack	−0.69	+0.34		44 13 34.54	
Douglas	−0.52	−0.29	−2.21	97 14 20.48	0.36
Grindle	−1.00	−0.05		38 32 05.34	
Tamarack	−0.35	+0.35		73 13 07.55	
Douglas	−0.53	−0.25	−0.81	56 13 29.43	0.33
Gregor	+0.07	−0.10		50 33 23.35	
Tamarack	+0.33	+0.03		28 59 33.02	
Grindle	+0.72	−0.21	+1.20	38 42 48.19	0.27
Gregor	+0.15	+0.18		112 17 39.06	
Wright	−0.34	+0.09		47 23 38.23	
Douglas	−0.09	−0.22	−0.58	47 02 31.23	0.32
Tamarack	−0.15	+0.13		85 33 50.86	
Bachelor	+0.47	+0.05		43 46 09.01	
Douglas	+0.68	−0.34	+2.15	87 29 02.83	0.35
Tamarack	+1.00	+0.29		48 44 48.51	
Bachelor	+0.08	−0.22		86 21 38.65	
Douglas	+0.78	−0.12	+0.68	40 26 31.61	0.31
Wright	−0.18	+0.34		53 11 50.05	
Bachelor	−0.39	−0.28		42 35 29.63	
Tamarack	−1.14	−0.15	−2.05	36 49 02.37	0.28
Wright	−0.52	+0.43		100 35 28.28	
Island	+0.17	+0.17		30 00 22.04	
Bachelor	+0.14	−0.50	+0.63	122 27 02.97	0.20
Wright	+0.32	+0.33		27 32 35.19	
Cromwell	−0.16	+0.44		28 18 41.57	
Island	+0.03	−0.08	−0.37	123 48 13.36	0.18
Bachelor	−0.24	−0.36		27 53 05.25	
Cromwell	+0.25	+0.66		58 42 08.18	
Island	−0.15	−0.25	+0.14	93 47 51.31	0.39
Wright	+0.04	−0.41		27 30 00.90	
Cromwell	+0.40	+0.22		30 23 26.60	
Bachelor	+0.38	−0.13	+1.14	94 33 57.73	0.41
Wright	+0.36	−0.09		55 02 36.08	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Sawyer	+0.66	+0.38		27 00 32.08	
Island	+0.56	−0.24	+1.55	38 21 28.06	0.26
Cromwell	+0.33	−0.14		114 38 00.12	
Mahtowa	−0.31	+0.38		32 50 32.77	
Island	−0.34	−0.71	−0.94	67 56 20.53	0.35
Cromwell	−0.29	+0.33		79 13 07.05	
Mahtowa	−0.87	+0.15		85 54 42.78	
Island	−0.90	−0.48	−2.55	29 34 52.46	0.37
Sawyer	−0.78	+0.33		64 30 25.13	
Mahtowa	−0.56	−0.23		53 04 10.01	
Cromwell	+0.62	−0.47	−0.06	35 24 53.07	0.28
Sawyer	−0.12	+0.70		91 30 57.20	
Atkinson	+0.63	+0.47		51 25 57.76	
Mahtowa	+0.55	−0.69	+2.02	92 20 49.33	0.15
Sawyer	+0.84	+0.22		36 13 13.06	
Cloquet	−0.77	+0.50		17 48 35.63	
Atkinson	−0.67	−0.24	−2.44	99 36 11.73	0.34
Mahtowa	−1.00	−0.26		62 35 12.98	
Cloquet	−0.48	+1.03		35 22 28.01	
Atkinson	−1.30	−0.71	−2.05	48 10 13.97	0.43
Sawyer	−0.27	−0.32		96 27 18.45	
Cloquet	+0.29	+0.53		17 33 52.38	
Mahtowa	+1.56	−0.42	+2.42	29 45 36.37	0.25
Sawyer	+0.57	−0.11		132 40 31.50	
Carlton	−0.59	+0.14		100 11 48.28	
Atkinson	+0.08	−0.10	+0.09	38 41 32.68	0.41
Cloquet	+0.60	−0.04		41 06 39.45	
Annie	−0.59	+0.04		1 39 13.17	
Carlton	−0.59	−0.07	−1.86	176 33 40.49	0.03
Atkinson	−0.68	+0.03		1 47 06.37	
Annie	+0.15	+0.46		47 12 32.45	
Carlton	0.00	−0.21	+0.13	76 21 52.21	0.44
Cloquet	−0.02	−0.25		56 25 35.78	
Annie	+0.74	+0.41		45 33 19.27	
Atkinson	+0.76	−0.13	+2.08	36 54 26.31	0.82
Cloquet	+0.58	−0.28		97 32 15.24	
Dedham	+0.51	+0.20		19 39 33.50	
Atkinson	+1.05	−0.62	+2.62	38 10 07.04	0.68
Carlton	+1.06	+0.42		122 10 20.14	

TABLES OF TRIANGLES—Continued.

Royalton to Duluth—Continued.

Stations	Corrections to angles—		Error of closure of triangle	Corrected spherical angles	Spherical excess
	From figure adjustment	Due to the introduction of latitude, longitude, and azimuth equations			
	"	"	"	° ′ ″	"
Dedham	+0.63	+0.68		55 20 41.50	
Atkinson	+0.37	−0.59	+0.85	39 57 13.41	1.48
Annie	−0.15	−0.09		84 42 06.57	
Dedham	+0.12	+0.48		35 41 08.00	
Carlton	−0.48	−0.35	+0.08	61 15 59.36	0.76
Annie	+0.44	−0.13		83 02 53.40	
Superior	−0.24	+0.36		92 44 26.78	
Dedham	−0.54	−1.22	−1.44	45 43 19.38	0.55
Annie	−0.66	+0.86		41 32 14.39	
Duluth	+0.81	+0.60		25 37 07.68	
Superior	−0.02	−0.02	+0.52	125 28 40.62	0.38
Dedham	−0.27	−0.58		24 54 12.08	
Duluth	+0.36	+0.80		80 27 10.67	
Superior	+0.22	−0.38	+0.94	36 44 13.84	0.32
Annie	+0.36	−0.42		62 48 35.81	
Duluth	−0.45	+0.20		54 50 02.99	
Dedham	−0.27	−0.63	−1.02	20 49 07.31	0.49
Annie	−0.30	+0.43		104 20 50.19	
Minn. Pt. N. base	−0.01	+0.32		88 08 27.08	
Superior	+0.10	+0.01	−0.06	29 47 09.30	0.21
Duluth	−0.15	−0.33		62 04 23.83	
Minn. Pt. S. base	+0.23	−0.06		86 15 45.73	
Superior	+0.05	−0.78	−0.31	56 32 08.51	0.24
Duluth	−0.59	+0.84		37 12 06.00	
Minn. Pt. S. base	+0.52	−0.39		114 45 28.29	
Superior	−0.04	−0.79	+1.10	26 44 59.22	0.12
Minn. Pt. N. base	+0.62	+1.18		38 29 32.61	
Minn. Pt. S. base	+0.29	−0.32		28 29 42.57	
Duluth	+0.44	−1.17	+1.34	24 52 17.83	0.08
Minn. Pt. N. base	+0.61	+1.49		126 37 59.68	

TABLES OF TRIANGLES—Continued.

Fergus Falls to Stephen base.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Fox	+0.64		109 40 51.91	
Western	−0.34	+1.31	32 30 04.14	0.86
Wahpeton	+1.01		37 49 04.81	
Indian	−0.96		31 33 12.99	
Western	+0.43	−0.78	29 43 39.98	0.86
Fox	−0.25		118 43 07.89	
Indian	−0.48		54 44 50.11	
Western	+0.09	−1.12	62 13 44.12	2.36
Wahpeton	−0.73		63 01 28.13	
Meadows	−0.19		52 00 12.89	
Indian	+0.49	+0.19	63 07 17.12	0.95
Fox	−0.11		64 52 30.94	
Meadows	−0.03		99 56 45.53	
Indian	+0.01	+0.86	39 55 40.00	1.20
Wahpeton	+0.88		40 07 35.67	
Meadows	+0.16		47 56 32.64	
Fox	−0.28	−0.98	66 43 29.26	0.89
Wahpeton	−0.86		65 19 58.99	
Indian	+0.48		23 11 37.12	
Fox	−0.39	−1.65	131 36 00.20	0.64
Wahpeton	−1.74		25 12 23.32	
Barnesville	+0.35		41 03 42.78	
Indian	+0.38	+0.84	57 06 24.65	1.55
Meadows	+0.11		81 49 54.12	
Tansem	+0.43		36 17 18.83	
Indian	+0.34	+1.11	92 01 21.72	1.63
Meadows	+0.34		51 41 21.08	
Tansem	+0.17		84 02 11.02	
Indian	−0.03	−0.40	34 54 57.08	1.41
Barnesville	−0.54		61 02 53.31	
Tansem	−0.26		47 44 52.19	
Meadows	−0.22	−0.67	30 08 33.05	1.33
Barnesville	−0.19		102 06 36.09	
Riverton	+0.18		53 36 41.75	
Tansem	+0.22	+0.32	44 53 26.62	0.80
Barnesville	−0.08		81 29 52.43	
Eglon	+0.14		53 40 01.65	
Tansem	+0.22	+0.97	84 53 44.50	0.76
Barnesville	+0.61		41 26 14.61	
Eglon	+0.01		98 36 28.43	
Tansem	0.00	−0.61	40 00 17.88	0.60
Riverton	−0.62		41 23 14.29	

TABLES OF TRIANGLES—Continued.

Fergus Falls to Stephen base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Eglon	−0. 14		44 56 26. 77	
Barnesville	−0. 69	−1. 26	40 03 37. 82	0. 64
Riverton	−0. 43		94 59 56. 05	
Keene	−0. 07		40 27 01. 96	
Eglon	+0. 04	+0. 08	58 45 46. 68	0. 77
Riverton	+0. 11		80 47 12. 13	
Morken	+0. 50		53 02 33. 53	
Keene	+0. 44	+1. 02	92 30 36. 36	0. 72
Riverton	+0. 08		34 26 50. 83	
Borup	+0. 60		43 32 40. 97	
Keene	+0. 18	+0. 49	62 54 30. 58	0. 64
Morken	−0. 29		73 32 49. 09	
Syre	−0. 78		33 40 16. 69	
Eglon	−0. 03	−1. 25	41 03 32. 92	1. 56
Keene	−0. 44		105 16 11. 95	
Syre	+0. 48		44 30 22. 01	
Keene	−0. 11	−0. 03	58 51 39. 15	1. 18
Borup	−0. 40		76 38 00. 02	
Wicklow	−0. 70		49 53 09. 81	
Syre	+0. 21	−0. 69	43 13 52. 16	1. 32
Borup	−0. 20		86 52 59. 35	
Gary	+0. 65		53 47 26. 28	
Syre	+0. 05	+0. 53	76 25 35. 07	1. 36
Borup	−0. 17		49 47 00. 01	
Gary	+0. 89		101 33 31. 95	
Syre	−0. 16	+1. 12	33 11 42. 91	1. 00
Wicklow	+0. 39		45 14 46. 14	
Gary	+0. 25		47 46 05. 68	
Borup	−0. 03	−0. 10	37 05 59. 34	0. 96
Wicklow	−0. 32		95 07 55. 94	
Beltrami	+1. 05		37 38 51. 29	
Gary	−1. 43	−0. 58	37 57 52. 42	0. 77
Wicklow	−0. 20		104 23 17. 06	
Fertile	−0. 92		52 36 29. 31	
Gary	−0. 11	−1. 02	85 35 08. 95	0. 66
Wicklow	+0. 01		41 48 22. 40	
Fertile	−0. 13		101 06 06. 55	
Gary	+1. 31	−0. 34	47 37 16. 52	0. 78
Beltrami	−1. 52		31 16 37. 71	
Fertile	+0. 79		48 29 37. 24	
Wicklow	−0. 22	+0. 10	62 34 54. 65	0. 89
Beltrami	−0. 47		68 55 29. 00	

TABLES OF TRIANGLES—Continued.

Fergus Falls to Stephen base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Andover	+0.82		42 29 06.66	
Fertile	+0.58	+2.39	42 34 50.84	1.12
Beltrami	+0.99		94 56 03.62	
Tilden	+0.97		49 38 43.28	
Fertile	+0.58	+3.07	84 37 17.13	1.05
Beltrami	+1.52		45 44 00.64	
Tilden	+1.04		98 57 52.39	
Fertile	+0.00	+0.65	42 02 26.29	1.04
Andover	−0.39		38 59 42.36	
Tilden	+0.06		49 19 09.10	
Beltrami	−0.52	−0.03	49 12 02.99	1.11
Andover	+0.43		81 28 49.02	
Shirley	−0.31		37 46 18.83	
Tilden	−1.15	−2.33	29 23 27.96	0.83
Andover	−0.87		112 50 14.04	
Ives	−0.68		45 16 28.26	
Tilden	−0.59	−1.52	66 17 53.62	1.35
Andover	−0.25		68 25 39.47	
Ives	−0.41		83 19 21.73	
Tilden	+0.56	−0.20	36 54 25.66	1.33
Shirley	−0.35		59 46 13.94	
Ives	+0.27		38 02 53.47	
Andover	−0.62	−1.01	44 24 34.57	0.81
Shirley	−0.66		97 32 32.77	
Sherack	+0.22		53 20 02.58	
Ives	+0.41	+1.03	50 04 02.94	0.86
Shirley	+0.40		76 35 55.34	
Bray	+0.32		40 49 42.80	
Ives	+0.35	+0.95	109 10 26.57	0.67
Shirley	+0.28		29 59 51.30	
Bray	+0.14		82 13 41.34	
Ives	−0.06	−0.09	59 06 23.63	0.74
Sherack	−0.17		38 39 55.77	
Bray	−0.18		41 23 58.54	
Shirley	+0.11	−0.01	46 36 04.03	0.93
Sherack	+0.06		91 59 58.36	
Warren	+0.03		48 34 47.42	
Bray	+0.28	+0.25	57 16 02.72	1.11
Sherack	−0.06		74 09 10.97	
Viking	+0.34		37 04 31.75	
Bray	+0.25	+0.60	102 35 14.87	1.08
Sherack	+0.01		40 20 14.46	

TABLES OF TRIANGLES—Continued.

Fergus Falls to Stephen base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Viking	+0. 41		79 20 37. 87	
Bray	−0. 03	+0. 61	45 19 12. 15	1. 01
Warren	+0. 23		55 20 10. 99	
Viking	+0. 06		42 16 06. 11	
Sherack	−0. 06	+0. 26	33 48 56. 52	1. 04
Warren	+0. 26		103 54 58. 41	
Argyle	−0. 99		42 51 24. 86	
Viking	−0. 08	−2. 17	39 11 41. 53	0. 82
Warren	−1. 10		97 56 54. 43	
Wright	+0. 53		49 54 16. 46	
Viking	−0. 28	+0. 23	89 44 57. 74	0. 75
Warren	−0. 02		40 20 46. 55	
Wright	−0. 27		94 00 34. 09	
Viking	−0. 20	−0. 03	50 33 16. 21	0. 84
Argyle	+0. 44		35 26 10. 54	
Wright	−0. 80		44 06 17. 63	
Warren	−1. 09	−2. 43	57 36 07. 87	0. 91
Argyle	−0. 54		78 17 35. 41	
Stephen W. base	−0. 41		59 14 05. 17	
Wright	+0. 75	+0. 14	24 04 22. 91	0. 53
Argyle	−0. 20		96 41 32. 45	
Stephen E. base	−0. 99		85 27 25. 73	
Wright	−0. 37	−2. 18	40 18 06. 00	0. 58
Argyle	−0. 83		54 14 28. 85	
Stephen E. base	−0. 31		132 28 33. 89	
Wright	−1. 12	−1. 39	16 13 43. 09	0. 28
Stephen W. base	+0. 04		31 17 43. 30	
Stephen E. base	+0. 68		47 01 08. 16	
Argyle	+0. 63	+0. 94	42 27 03. 60	0. 23
Stephen W. base	−0. 37		90 31 48. 47	
Donaldson	−0. 599		0 02 46. 181	
Wright	+0. 429	+0. 28	0 02 11. 859	0. 01
Stephen E. base	+0. 450		179 55 01. 970	
Donaldson	−0. 17		42 44 13. 54	
Wright	−0. 69	−0. 38	16 15 54. 95	0. 53
Stephen W. base	+0. 48		120 59 52. 04	
Donaldson	−0. 56		42 51 11. 12	
Wright	+0. 06	−0. 94	40 20 17. 86	1. 06
Argyle	−0. 44		96 48 32. 08	
Donaldson	+0. 04		42 48 24. 94	
Stephen E. base	+0. 54	+0. 97	94 37. 32. 30	0. 47
Argyle	+0. 39		42 34 03. 23	

TABLES OF TRIANGLES—Continued.

Fergus Falls to Stephen base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Donaldson	+0.43		42 41 27.36	
Stephen E. base	−0.14	+0.73	47 36 24.14	0.24
Stephen W. base	+0.44		89 42 08.74	
Donaldson	−0.388		0 06 57.582	
Stephen W. base	−0.076	−0.70	179 46 02.784	0.00
Argyle	−0.236		0 06 59.634	
Deer	+0.88		50 45 02.12	
Wright	+0.54	+0.76	78 31 15.78	1.10
Argyle	−0.66		50 43 43.20	
Deer	+0.68		54 25 55.33	
Wright	+0.91	+2.13	38 13 09.78	0.57
Stephen E. base	+0.54		87 20 54.46	
Deer	−0.07		70 47 30.74	
Wright	−0.21	+0.24	54 26 52.87	1.05
Stephen W. base	+0.52		54 45 37.44	
Deer	+0.90		99 18 25.80	
Wright	+0.48	+2.12	38 10 57.92	1.01
Donaldson	+0.74		42 30 37.29	
Deer	−0.20		3 40 53.21	
Argyle	−0.17	−0.82	3 30 45.65	0.05
Stephen E. base	−0.45		172 48 21.19	
Deer	−0.95		20 02 28.62	
Argyle	+0.46	−0.38	45 57 49.25	0.48
Stephen W. base	+0.11		113 59 42.61	
Deer	+0.02		48 33 23.68	
Argyle	+0.22	+0.42	46 04 48.88	0.97
Donaldson	+0.18		85 21 48.41	
Deer	−0.76		16 21 35.40	
Stephen E. base	−0.22	−0.50	140 10 30.66	0.20
Stephen W. base	+0.48		23 27 54.14	
Deer	+0.22		44 52 30.47	
Stephen E. base	−0.09	+0.27	92 34 06.51	0.45
Donaldson	+0.14		42 33 23.47	
Deer	+0.97		28 30 55.06	
Stephen W. base	−0.04	+1.50	66 14 14.60	0.49
Donaldson	+0.57		85 14 50.83	

Stephen base net to Canada.

Jupiter	+0.44		58 20 32.45	
Deer	+0.33	+1.15	71 08 55.42	0.81
Donaldson	+0.38		50 30 32.94	

TABLES OF TRIANGLES—Continued.

Stephen base net to Canada—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Skane	−1. 24		29 38 56. 24	
Jupiter	−0. 14	−1. 49	117 20 29. 93	0. 76
Deer	−0. 11		33 00 34. 59	
Skane	+0. 18		65 55 26. 45	
Jupiter	−0. 58	−0. 26	58 59 57. 48	0. 89
Donaldson	+0. 14		55 04 36. 96	
Skane	+1. 42		36 16 30. 21	
Deer	+0. 44	+2. 38	38 08 20. 83	0. 94
Donaldson	+0. 52		105 35 09. 90	
Granville	+0. 15		51 50 32. 63	
Jupiter	+0. 48	+1. 03	77 51 59. 34	0. 90
Skane	+0. 40		50 17 28. 93	
Hallock	−0. 38		85 16 43. 25	
Granville	−0. 03	−0. 49	56 02 43. 71	0. 47
Jupiter	−0. 08		38 40 33. 51	
Hallock	−0. 04		171 43 28. 10	
Granville	−0. 18	+0. 01	4 12 11. 08	0. 05
Skane	+0. 23		4 04 20. 87	
Hallock	+0. 34		86 26 44. 85	
Jupiter	+0. 57	+1. 53	39. 11 25. 84	0. 48
Skane	+0. 62		54 21 49. 79	
Hill	+0. 42		31 18 24. 93	
Granville	+0. 01	+0. 84	40 45 34. 72	0. 42
Hallock	+0. 41		107 56 00. 77	
Hill	+0. 36		74 30 32. 86	
Granville	−0. 17	+0. 45	44 57 45. 80	0. 92
Skane	+0. 26		60 31 42. 26	
Hill	−0. 06		43 12 07. 93	
Hallock	−0. 37	−0. 40	80 20 31. 13	0. 45
Skane	+0. 03		56 27 21. 39	
Canada	+0. 47		62 56 11. 36	
Granville	+0. 19	+0. 24	80 22 09. 86	0. 78
Hill	−0. 42		36 41 39. 56	
States	+0. 36		31 51 23. 97	
Canada	+0. 21	+0. 03	108 15 44. 59	0. 61
Granville	−0. 54		39 52 52. 05	
States	+0. 59		87 19 27. 25	
Canada	−0. 26	+1. 05	45 19 33. 23	0. 76
Hill	+0. 72		47 21 00. 28	
States	+0. 22		55 28 03. 27	
Granville	+0. 74	+1. 26	40 29 17. 82	0. 93
Hill	+0. 30		84 02 39. 84	

The maximum correction (−2″.04) to any angle (in the second column) is to the angle at Preacher Hill between Drywood and Brown Valley northwest base.

The statistics as to closures of triangles and the mean error of an angle, $a=\sqrt{\frac{\Sigma\Delta^2}{3n}}$, for the six seasons at the northern part of the ninety-eighth meridian are given in the following table. $\Sigma\Delta^2$ is the sum of the squares of the closing errors of the triangles and n is the number of triangles.

Section and year	Triangles	Plus closures	Minus closures	Average closure	Maximum closure	Mean error of an angle
				″	″	″
Page base net to Wieters-Freeman, 1901	16	8	8	0.97	+2.35	0.68
Wieters-Freeman to Drywood-Layden, 1903	58	28	30	1.10	−3.84	0.82
Drywood-Layden to Gull-Jones, 1904	62	33	29	0.98	−3.40	0.70
Gull-Jones to Duluth, 1905	51	25	26	1.14	−4.41	0.87
Wahpeton-Western to Stephen base, 1906	64	31	33	0.84	+3.07	0.62
Stephen base net to Canada, 1907	19	15	4	0.89	+2.38	0.64

Similar statistics for this same triangulation, divided into five sections, are shown in the following table:

Section	Triangles	Plus closures	Minus closures	Average closure	Maximum closure	Mean error of an angle
				″	″	″
Page base net to Brown Valley base	58	26	32	1.03	+3.81	0.77
Brown Valley base net to Royalton base	54	33	21	0.96	−3.84	0.70
Royalton base net to Duluth	75	35	40	1.16	−4.41	0.86
Fergus Falls to Stephen base	68	35	33	0.85	+3.07	0.63
Stephen base net to Canada	15	11	4	0.84	+2.38	0.61
Sums and means for five sections	270	140	130	1.00	−4.41	0.74

The average closure of a triangle for the other 12 sections of the ninety-eighth meridian triangulation is 0″.87. The average closure of a triangle for the 680 triangles on the ninety-eighth meridian triangulation is 0″.92. These average closing errors indicate that the methods employed on the field and the number of observations made give the accuracy called for by the instructions. There are very few closing errors of triangles on the ninety-eighth meridian triangulation greater than 3″. It does not appear to be advisable to cut down the number of observations, at least in the near future. A decrease in the number of positions from 16 to 12 would materially increase the average closing error of the triangles and would also increase the number of triangles for which the closing errors are more than 3″. For all geographic purposes an average accuracy greater than that now obtained is not necessary, while with some Laplace stations in the scheme [1] it is believed to be sufficient for all geodetic purposes.

Greater accuracy could be obtained by making observations over a line on many more days than at present, and the observer could no doubt obtain smaller errors by

[1] See the supplementary investigation in 1909 of the Figure of the Earth and Isostasy, p. 17.

declining to observe on very faint and very unsteady objects, or when the wind causes bad vibrations in the signal on which the instrument is mounted. It is believed, however, that it is more important to accomplish the maximum amount of work of a reasonable accuracy rather than a smaller amount at a greater accuracy. That portion of the general instruction for primary triangulation bearing on this subject states that "In selecting the conditions under which to observe primary directions, proceed upon the assumption that the maximum speed consistent with the requirement that the closing error of a single triangle in the primary scheme shall seldom exceed three seconds, and that the average closing error shall be but little greater than one second, is what is desired rather than a greater accuracy than that indicated with slower progress."

Although the parties on the ninety-eighth meridian primary triangulation were not striving for extreme accuracy at the expense of progress, yet the average accuracy of the results as shown by the triangle closures (see also the comparison of probable errors of an observed direction, p. 231) is greater than that for the other great arcs of the United States, the transcontinental triangulation, and the eastern oblique arc.

The comparisons of the average closing errors are given below:

Arc	Average closing error
	"
Transcontinental triangulation	1.06
Eastern oblique arc	1.19
Ninety-eighth meridian	0.92

No attempt has been made here to set forth the agreement of the separate measures of each direction as a criterion of accuracy, since it is well known that it is of little value for that purpose. A close agreement of the separate measures of a given direction is of little consequence, since such measures are usually subject to constant errors of considerable size, which become evident as soon as the closure of the triangles are studied or an attempt is made to adjust a figure.

ACCORD OF BASES.

There are five bases which serve to fix the length in the triangulation between Page and Canada and Duluth, viz, the Page, Brown Valley, Royalton, Minnesota Point, and Stephen bases. The accord in length between each of these bases as measured and its value as computed from the triangulation through the adjacent triangles furnishes a valuable test of the accuracy of the triangulation.

In solving the normal equations in each section of the figure adjustment the length equation was, as usual, assigned to the last place, so that after all the conditions relating to triangle closures and ratios of length had been satisfied, the discrepancy in length became known. In the following table the discrepancies developed between bases are given in terms of the seventh place of logarithms and are also expressed as ratios. A plus sign before the discrepancy expressed in terms of logarithms means that the first base mentioned is longer as measured, than as computed through the intervening triangulation from the second base mentioned.

Bases	Discrepancy in seventh place of logarithms	Discrepancy expressed as a ratio
Page and Brown Valley	+65	1/67000
Brown Valley and Royalton	+98	1/44000
Royalton and Minnesota Point	+80	1/54000
Wahpeton-Western and Stephen	+24	1/181000

Two of these discrepancies are slightly larger than any others in the ninety-eighth meridian triangulation heretofore published, but they are not as great as the discrepancy between the Seguin and Alice bases. (See p. 370 of Appendix 5 of this Report.)

ACCORD OF AZIMUTHS.

Laplace azimuths[1] were computed at three stations of this triangulation, viz, at Minnesota Point north base, at Dalton Astronomic, and at Stephen west base. At the first of these the Laplace azimuth is 1″.31 larger and at the second 0″.75 smaller than the United States Standard azimuth.

At Stephen west base it was certain that the Laplace azimuth was more accurate than the geodetic azimuth computed through the triangulation and the discrepancy between the United States Standard azimuth and the Laplace azimuth at this station was distributed by means of an azimuth equation. In the solution of the normal equations this azimuth equation was assigned to the last place, and so the discrepancy in azimuth became known after all the conditions relating to triangle closures, ratios of sides, and the length between bases had been satisfied. This discrepancy was 2″.25. In other words, if the equation had not been introduced, the United States Standard azimuth would have been too small by 2″.25 as judged by the Laplace azimuth instead of agreeing with it, as it now does.

STUDY OF ERRORS.

Beginning with the season of 1904 each observer on the northern portion of the ninety-eighth meridian triangulation kept a record called the Error Book in which he made notes of the weather conditions, the character of the line observed over, and the appearance of the object observed upon. For each period of observations of primary horizontal angles there were entered in the record the date, with the hour; the direction of the wind; the strength of the wind; the station observed; the intensity, size, and degree of steadiness of the image of the heliotrope or lamp; the character of the image, whether symmetrical or asymmetrical; and the character of the line, whether high, low, grazing, or clear only at night, as a result of elevation by refraction. In a column or remarks, notes were made regarding the condition of the atmosphere, whether clear, hazy, or smoky.

The object of keeping this record was to accumulate data from which might possibly be learned the cause or causes of the large, and especially of the unusually large, errors of observation in triangulation. It has been impossible for the author, in the limited time at his disposal for such work, to make a complete analysis of all the accumulated data.

[1] See Appendix 5 of this Report, p. 351.

HIGH, LOW, GRAZING, AND REFRACTION LINES.

As considered in the Error Book, a high line is one with its greater portion elevated well above the ground and obstructions. This usually occurs when the line crosses a depression or valley. A low line passes over a very flat country or just over ridges, trees, houses, or other obstructions. Grazing was the term employed to describe a line which was barely clear during the day. A refraction line was one which was clear only at night as a result of great refraction. A refraction line is, strictly speaking, a grazing line.

In the section of 134 directions between Brown Valley base net and Royalton base, 43 per cent of the lines are high, 48 per cent are low, and 9 per cent either grazing or refraction. The average correction to a direction is o".28 for the 134 directions of the section. The average correction to a direction for the 48 per cent of low lines is o".30, for the 9 per cent of grazing and refraction lines is o".46, and for the four directions over two refraction lines is o".52.

Similar data for the 146 directions of the section from Royalton base net to Duluth are: Average correction to a direction for all directions is o".26, for the low lines is o".30, and for the grazing and refraction lines is o".23. There was only one refraction line and the mean correction to the two directions over it was only o".06.

For the section of 154 directions between Fergus Falls and the Stephen base line the average correction to all the directions is o".26, to directions over low lines is o".22, and to directions over grazing and refraction lines is o".25. The mean correction to the two directions over the one refraction line of the section is o".19.

The following table summarizes the data given in the preceding three paragraphs:

	Brown Valley base net to Royalton base line	Royalton base net to Duluth	Fergus Falls to Stephen base line
Total number of directions	134	146	154
Percentage of high lines	45	36	63
Percentage of low lines	43	46	21
Percentage of grazing and refraction lines	12	18	16
Average correction to a direction, for—	"	"	"
All lines	0.28	0.26	0.26
High lines	0.22	0.24	0.28
Low lines	0.30	0.30	0.22
Grazing and refraction lines	0.46	0.23	0.25

In the first section the average correction for a low line is 7 per cent greater than the average for the whole section and 36 per cent greater than the average correction for the high lines. The average correction for the grazing and refraction lines is more than double that for the high lines.

In the second section the average correction for a low line is 15 per cent greater than the average for the section and is 25 per cent greater than the average correction for a high line. The average for the grazing and refraction lines is even less than the average correction for a high line.

In the third section the average correction for a low line is smaller than those for the whole section and for the high lines by 15 and 21 per cent, respectively. For this section the average correction to the grazing and refraction lines is o".01 smaller than the average correction for all the directions.

The following table gives the facts regarding the character of the lines on which the large corrections occur for the section from Brown Valley base net to Royalton base line:

	Total number	Percentage		
		High lines	Low lines	Grazing and refraction lines
All lines in the section	67	45	43	12
Directions with corrections greater than o".349	42	31	52	17
Directions with corrections greater than o".499	21	24	57	19

It will be seen from the above table that the large corrections have a tendency to appear more frequently, proportionately, on the low, grazing and refraction lines. Only 12 per cent of the total number of lines are classed as grazing or refraction, yet 19 per cent of the corrections greater than o".499 appear on such lines.

The facts for the 146 directions of the section between Royalton base net and Duluth are given in the following table:

	Total number	Percentage		
		High lines	Low lines	Grazing and refraction lines
All lines in the section	73	36	46	18
Directions with corrections greater than o".349	46	22	59	19
Directions with corrections greater than o".499	17	18	64	18

For the section between Royalton base net and Duluth large corrections occur more frequently, proportionately, on low lines than on high lines, though such corrections do not appear more frequently, proportionately, on grazing and refraction lines.

The facts for the 154 directions (77 lines) of the section between Fergus Falls and Stephen base line are:

	Total number	Percentage		
		High lines	Low lines	Grazing and refraction lines
All lines in section	77	63	21	16
Directions with corrections greater than o".349	41	71	17	12
Directions with corrections greater than o".499	22	73	14	13

In contrast to the other two sections the large corrections appear more frequently, proportionately, on the high than on either the low or the grazing and refraction lines.

The evidence given above for high and low lines is so conflicting that no safe conclusions can be drawn from it.

The data for the grazing and refraction lines are also conflicting, doubtless due to the small number of directions involved.

SYMMETRICAL AND ASYMMETRICAL OBJECTS.

It is a well-known fact that occasionally the image of the heliotrope or lamp will be asymmetrical. In such an image there is a bright nucleus with a fainter portion of the image extending to the right or left. The records show that in practically every case this less dense or fainter portion of the image is on the side opposite to the direction from which the wind is blowing. If the wind crosses the line from the left, then the image will be asymmetrical toward the right, and vice versa.

Of the 134 directions of the section from Brown Valley base net to the Royalton base line, 48 had asymmetrical images during all or some portion of the observations. The average correction to these directions is o''.29, while the average correction for the whole section is o''.28.

Forty of the 146 directions of the section between Royalton base net and Duluth had asymmetrical images and an average correction of o''.27. The correction for the entire section is o''.26.

The section of 154 directions between Fergus Falls and Stephen base line had 32 directions with asymmetrical images, and the average correction is o''.24, while the average correction for the whole section is o''.26.

For 17 directions on the section between Brown Valley base net and Royalton base line all of the observations were made on asymmetrical images only. The average correction to these directions is o''.34. On the section between Royalton base net and Duluth observations were made on asymmetrical images only, on 12 directions, and the average correction for these directions is o''.36. There were only 4 directions of the section Fergus Falls to Stephen base net for which all observations were made on asymmetrical images only, and the average correction to these 4 directions is o''.34. The average corrections for all directions on these three sections are o''.28, o''.26, and o''.26, respectively. Hence the increases in the corrections are 21, 38, and 31 per cent, respectively, for the directions where only asymmetrical images were observed.

The table below shows the percentage of the directions observed on asymmetrical and symmetrical images and the frequency with which the large corrections occur on each for the section between the Brown Valley base net and the Royalton base line. In getting these percentages a direction having an asymmetrical image for even only one observing period was classed as asymmetrical regardless of whether the image was symmetrical or not at other observing periods.

	Percentage of directions with—	
	Symmetrical images	Asymmetrical images
Total number of directions observed (134)	64	36
Corrections to directions greater than o″.349 (42)	60	40
Corrections to directions greater than o″.499 (21)	57	43

This table indicates that there is a tendency for the large corrections to appear on directions where the image of the heliotrope or lamp is asymmetrical. This tendency is not great, however.

The following table gives the data for the section between Royalton base net and Duluth:

	Percentage of directions with—	
	Symmetrical images	Asymmetrical images
Total number of directions observed (146)	72	28
Corrections to directions greater than o″.349 (46)	72	28
Corrections to directions greater than o″.499 (17)	59	41

The corrections greater than o″.349 appear as frequently in the symmetrical as in the asymmetrical directions, but the corrections greater than o″.499 occur very much more frequently, proportionately, in the asymmetrical directions.

The data for the section between Fergus Falls and Stephen base line are given below:

	Percentage of directions with—	
	Symmetrical images	Asymmetrical images
Total number of directions observed (154)	79	21
Corrections to directions greater than o″.349 (41)	83	17
Corrections to directions greater than o″.499 (22)	82	18

Here the tendency is for the large corrections to appear in the symmetrical directions, but it is slight.

It is not safe to base any definite conclusions on the limited evidence given above regarding the sizes of the errors of observations made on symmetrical and asymmetrical images.

CORRECTIONS TO DIRECTIONS OBSERVED IN A SINGLE PERIOD.

Beginning with the season of 1902 [1] the observer began making all observations at a station in the shortest time practicable. At each of five stations of that season all observations for primary horizontal directions were made in one day. All of the obser-

[1] See p. 869, Appendix 4, Report for 1903.

vations for each of a number of directions were made in only one observing period. No attempt was made to have observations for a direction or station extend through more than one observing period or more than one day. The accuracy of the 1902 work was high and well within the required limits.

On the section between Brown Valley base net and Royalton base line all observations were made over each of 63 directions (46 per cent of all) during only one observing period, afternoon or night, and the average correction for these directions is 0".31. The average correction is 0".25 for the remaining 71 directions for which observations were made in more than one observing period. The average correction for the one-period directions is 24 per cent greater than the average correction for the other directions. Of the forty-two corrections greater than 0".349, twenty-two (52 per cent) occur in the one-period directions, and of the twenty-one corrections greater than 0".499, twelve (62 per cent) occur in the one-period directions.

On the section from Royalton base net to Duluth all observations were made over 37 directions (25 per cent of all) during only one observing period, and the average correction for these directions is 0".32. The average correction is 0".24 for the remaining 109 directions for which observations were made in more than one observing period. The average correction for the one-period directions is 33 per cent greater than the average correction for the other directions. Of the forty-six corrections greater than 0".349, sixteen (35 per cent) occur in the one-period directions, and of the seventeen corrections greater than 0".499, seven (41 per cent) occur in the one-period directions.

On the section from Fergus Falls to Stephen base line, all observations were made over each of 44 directions (29 per cent of all) during only one observing period, and the average correction for these directions is 0".31. The average correction is 0".24 for the remaining 110 directions for which observations were made in more than one observing period. The average correction for the one-period directions is 29 per cent greater than the average correction for the other directions. Of the forty-one corrections greater than 0".349, fourteen (34 per cent) occur in the one-period directions, and of the twenty-two corrections greater than 0".499, nine (41 per cent) occur in the one-period directions.

The data in the preceding paragraphs are summarized in the following two tables:

	Brown Valley base net to Royalton base line	Royalton base net to Duluth	Fergus Falls to Stephen base line
Number of directions in section	136	146	154
Number of directions observed in only one observing period	62	37	44
	"	"	"
Average correction to a direction for whole section	0.28	0.26	0.26
Average correction to directions observed in one observing period only	0.31	0.32	0.31
Average correction to directions observed in more than one observing period	0.25	0.24	0.24
Percentage of increase in corrections to directions observed in only one period over corrections to directions observed in more than one period	24	33	29

	Brown Valley base net to Royalton base line	Royalton base net to Duluth	Fergus Falls to Stephen base line	Means
Number of directions in section with corrections greater than o″.349	42	46	41	
Number of directions observed in only one observing period having corrections greater than o″.349	23	16	14	
Percentage of total number of corrections greater than o″.349	55	35	34	41
Number of directions in section with corrections greater than o″.499	21	17	22	
Number of directions observed in only one observing period having corrections greater than o″.499	12	7	9	
Percentage of total number of corrections greater than o″.499	57	41	41	46
Percentage of total number of directions which were observed in only one observing period	46	25	29	33

As a rule the corrections to directions over which all observations were made in one observing period are about 30 per cent greater than the corrections to the directions for which observations were made in more than one observing period.

Thirty-three per cent of the directions had observations in only one observing period, while 41 per cent of the corrections greater than o″.349 and 46 per cent of the corrections greater than o″.499 occur in these directions.

It is reasonably certain that the average correction to a direction would be materially reduced by distributing the observations of a direction over more than one observing period and that the number of large errors would thereby be considerably reduced.

SUMMARY OF SOURCES OF ERRORS.

Primary horizontal observations were made on the heliotrope as soon as it became sufficiently distinct to make pointings, and observations were made on lights at night whenever they were visible. Observations were also made during winds which caused decided vibrations in the tripod on which the theodolite was mounted. The progress was slow under this condition. Observations were sometimes made during strong winds by making the pointings during the occasional short lulls. The wires placed on an object during one of the lulls would move off as much as 20 seconds during the hard puffs and would vibrate badly, but when there was another let-up in the force of the wind the wires would again cover the object. It was noticed that the twist of the signal caused by wind was least when its direction was normal to a side of the triangle formed by the three legs of the tripod. The tendency of the signal to resume its original position after having been twisted by the wind was due to the fact that the structure was under a strain caused by the bowing of the legs during its erection. (See pp. 829 to 840 and 824, Appendix 4, Report for 1903.)

From the above discussion it would appear that errors in observing horizontal directions are increased by (*a*) low lines, (*b*) asymmetrical images of the object observed, heliotrope or lamp, (*c*) making all observations of a direction in only one observing period.

Other sources of error are, no doubt, large accidental errors of pointing made when the image is very faint or very unsteady and large accidental errors made when the instrument is unsteady from strong wind blowing against the supporting structure.

The instrument was elevated at least 10 feet at each station on the ninety-eighth meridian triangulation. This brought the line of sight well above the disturbed layers of air near the ground in the vicinity of the station and added to the apparent steadiness of the object observed.

Each observer followed strictly the instructions which require that "in selecting the conditions under which to observe primary directions proceed upon the assumption that the maximum speed consistent with the requirement that the closing error of a single triangle in the primary scheme shall seldom exceed three seconds, and that the average closing error shall be but little greater than one second, is what is desired rather than a greater accuracy than that indicated with slower progress." Greater accuracy could be obtained, but it would be at the sacrifice of progress and economy. This does not seem to be justifiable. (See pp. 222 and 223.)

ACCURACY OF THE PRIMARY TRIANGULATION IN THE UNITED STATES.

In the following table 59 sections of triangulation in the United States, for which the required tabular values can be conveniently obtained, have been arranged in order of accuracy, the most accurate being placed first. The most severe, and therefore the best, test of accuracy is believed by the writer to be the quantity d expressing the probable error of the observed direction as derived from the corrections to directions resulting from the figure adjustment; accordingly the various sections of triangulation have been placed in the order of the values of d. In the few cases in which d is the same to the nearest hundredth of the second for several sections, the next column, a, has been used to decide their relative rank. The method of computing d and a has already been explained fully on pages 199 and 222.

Sections of triangulation in order of accuracy.

No.	Section	Probable error of an observed direction $=d$	Mean error of an angle $=a$	Average closing error of a triangle	Maximum correction to a direction	Maximum closing error of a triangle	Discrepancy between bases [1]
		″	″	″	″	″	″
1	Nevada-California series	±0.23	±0.42	0.57	0.60	1.57	+ 83
2	STEPHENVILLE BASE NET TO LAMPASAS BASE	±0.23	±0.45	0.56	0.60	2.09	− 47
3	Yolo base net	±0.24	±0.51	0.68	0.64	2.60	
4	POINT ISABEL BASE NET	±0.25	±0.40	0.50	0.60	1.61	
5	ELLIFF-NOLAN TO LAGUNA MADRE BASE	±0.25	±0.62	0.85	0.62	2.23	+ 73
6	Dauphin Island base net	±0.26	±0.51	0.83	0.49	1.25	
7	New England section	±0.26	±0.53	1.29	1.17	3.35	+[2] 44
8	MEADES RANCH-WALDO TO SHELTON BASE NET	±0.27	±0.35	0.50	0.62	1.42	+ 75
9	SHELTON BASE NET TO PAGE BASE	±0.29	±0.44	0.60	0.87	1.77	− 16
10	Olney base net	±0.29	±0.54	0.78	0.70	1.78	
11	BOWIE BASE NET TO STEPHENVILLE BASE	±0.29	±0.63	0.90	0.70	2.50	− 77
12	Eastern oblique arc to Augusta	±0.30	±0.60	0.78	0.74	2.73	+ 85

[1] The discrepancy between bases in the last column of the table is expressed in terms of the seventh decimal place of logarithms. It is the discrepancy remaining after the angle and side equations have been satisfied. A plus sign before the discrepancy means that the first base mentioned is longer as measured than as computed through the intervening triangulation from the second base mentioned.

[2] There were 3 bases connected by this section, Epping, Massachusetts, and Fire Island. The 3 discrepancies were +44, +3, and +41.

Sections of triangulation in order of accuracy—Continued.

No.	Section	Probable error of an observed direction $=d$	Mean error of an angle $=a$	Average closing error of a triangle	Maximum correction to a direction	Maximum closing error of a triangle	Discrepancy between bases
		″	″	″	″	″	″
13	Rocky Mountain series	±0.32	±0.57	0.84	0.80	2.31	
14	Salt Lake base net	±0.32	±0.66	0.81	0.84	3.18	
15	SHELTON BASE NET	±0.33	±0.45	0.80	0.88	2.07	
16	STEPHEN BASE NET TO CANADA	±0.33	±0.61	0.84	0.78	2.38	−64
17	ELRENO BASE TO BOWIE BASE	±0.33	±0.97	1.19	1.40	4.43	
18	Fire Island base net	±0.34	±0.49	0.70	1.43	1.43	−6
19	Illinois series	±0.34	±0.57	0.79	0.99	1.72	
20	Holton base net	±0.34	±0.58	0.79	0.84	2.28	−71
21	Indiana series	±0.34	±0.60	0.80	1.31	3.20	+2
22	Atlanta base net to Dauphin Island base net, IV	±0.34	±0.63	0.85	0.93	2.19	
23	FERGUS FALLS TO STEPHEN BASE	±0.34	±0.63	0.85	0.90	3.07	+24
24	TRANCONTINENTAL TRIANGULATION TO ANTHONY BASE	±0.35	±0.54	0.79	1.39	1.98	+41
25	Missouri-Kansas series	±0.35	±0.60	0.88	1.12	2.37	+169
26	Atlanta base net to Dauphin Island base net, V	±0.35	±0.68	0.97	1.12	2.87	+2
27	Kent Island base net to Atlanta base net, II	±0.35	±1.31	1.80	2.05	4.64	+24
28	ANTHONY BASE NET TO ELRENO BASE NET	±0.36	±0.69	1.05	0.84	2.17	+7
29	BROWN VALLEY BASE NET TO ROYALTON BASE	±0.36	±0.70	0.96	0.98	3.84	+98
30	Atlanta base net to Dauphin Island base net, III	±0.36	±0.77	1.10	0.84	2.69	+2
31	ROYALTON BASE NET TO DULUTH	±0.36	±0.86	1.16	1.22	4.41	+80
32	Versailles base net	±0.40	±0.64	0.90	0.95	2.71	
33	El Paso base net	±0.40	±0.68	0.94	0.93	2.60	
34	SEGUIN BASE NET TO ALICE BASE	±0.41	±0.78	1.04	1.09	3.25	−144
35	Kent Island base net to Atlanta base net, I	±0.41	±0.88	1.14	1.48	3.60	
36	Yolo base net to Los Angeles base net	±0.41	±0.91	1.16	1.34	5.52	−41
37	Kent Island base net	±0.41	±0.91	1.33	0.75	2.97	
38	PAGE BASE NET TO BROWN VALLEY BASE	±0.42	±0.77	1.03	1.44	3.81	+65
39	Salina base net	±0.44	±0.75	1.13	1.11	2.37	
40	Los Angeles base net	±0.44	±0.91	1.39	1.22	3.09	
41	LAMPASAS BASE NET TO SEGUIN BASE	±0.45	±0.82	1.13	1.96	3.31	−7
42	Ohio series	±0.45	±0.85	1.14	1.32	5.08	−24
43	Allegheny series	±0.45	±0.98	1.37	1.37	4.03	+11
44	Epping base net	±0.47	±0.63	0.90	1.25	2.63	
45	Fire Island base net to Kent Island base net	±0.47	±0.86	1.29	2.02	3.35	+46
46	St. Albans base net	±0.47	±1.04	1.38	1.53	4.94	
47	Kansas-Colorado series	±0.50	±0.75	1.00	1.43	3.92	−92
48	Los Angeles base net to Soledad-Cuyamaca	±0.50	±0.82	1.16	1.15	2.53	
49	Epping base net to Canadian boundary	±0.51	±0.74	1.15	1.12	2.09	
50	Dauphin Island westward, I	±0.53	±0.78	1.12	1.31	2.80	
51	Kent Island base net to Atlanta base net, III	±0.62	±0.78	1.66	1.72	4.03	
52	Atlanta base net	±0.65	±1.00	1.19	1.31	4.35	
53	Missouri series	±0.66	±0.81	1.09	1.89	4.64	+86
54	Atlanta base net to Dauphin Island base net, II	±0.67	±0.78	1.03	1.84	2.88	+2
55	Coast Range series	±0.67	±1.37	1.80	2.73	6.49	
56	Eastern Shore series	±0.72	±1.22	1.75	1.85	5.24	
57	Dauphin Island base net to New Orleans	±0.78	±1.20	1.50	2.65	5.40	
58	Atlanta base net to Dauphin Island base net, I	±0.79	±0.97	1.35	2.19	3.44	+2
59	American Bottom base net	±0.82	±1.59	2.22	1.80	6.36	

Of the 59 sections of triangulation tabulated, the five sections of the northern portion of the ninety-eighth meridian rank as numbers 16, 23, 29, 31, and 38. The mean d for all five sections is 0″.36, which falls between 28 and 31 in the above list. The 12 other sections rank as numbers 2, 4, 5, 8, 9, 11, 15, 17, 24, 28, 34, and 41. The mean d for the 17 sections in the ninety-eighth meridian is 0″.33 which falls between numbers 15 and 17 in the list. The average accuracy of the ninety-eighth meridian triangulation is about equal to that of the best half of the triangulation previously done in the United States.

EXPLANATION OF POSITIONS, LENGTHS, AND AZIMUTHS, AND OF THE UNITED STATES STANDARD DATUM.

The lengths, as already fully explained in connection with the adjustments, all depend upon the Page, Brown Valley, Royalton, Minnesota Point, and Stephen bases. The lengths as given are all reduced to sea level. If the actual length of a line simply reduced to the horizontal is desired, it may be obtained with all the accuracy ordinarily needed by adding to the sea level length as given a correction = (length of line as given) $\left[\frac{\text{mean elevation of the two ends of the line in meters}}{6370000}\right]$. The maximum value of this correction does not exceed $\frac{1}{10000}$ for the length of any portion of the triangulation here published. The maximum error made in the use of the above approximate formula for the correction does not exceed $\frac{1}{40000000}$ for the length of any portion of this triangulation.

The positions—that is, the latitudes, longitudes, and azimuths—need special explanation.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, as expressed in meters, which has been in use in the Coast and Geodetic Survey for many years.

After a spheroid has been adopted and all the angles and lengths in a triangulation have been fully fixed, it is still necessary, before the computation of latitudes, longitudes, and azimuths can be made, to adopt a standard latitude and longitude for a specified station and a standard azimuth of a line from that station. For convenience, the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The primary triangulation in the United States was commenced at various points and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation in California in the latitude of San Francisco, in the vicinity of Santa Barbara Channel, and in the vicinity of San Diego. With the lapse of time these separate pieces have expanded until they have touched or overlapped.

The transcontinental triangulation, of which the office computation was completed in 1899, joins all of the detached portions mentioned and makes them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one for the whole

country, or at least for as much of the country as is covered by continuous triangulation. To do this is a very heavy piece of work, and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the Superintendent adopted what is now known as the United States Standard Datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in The Transcontinental Triangulation and in The Eastern Oblique Arc of the United States, publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum.

As the adoption of such a standard datum is a matter of considerable importance, it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the Coast and Geodetic Survey are, first, the control of the charts published by the Survey; second, the furnishing of geographic positions (latitudes and longitudes) of accurately determined elevations, and of distances and azimuths, to officers connected with the Coast and Geodetic Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered, nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now or may become available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function it is also highly desirable that when a certain spheroid and geodetic datum have been adopted for a country they be rigidly adhered to, without change, for all time, unless shown to be largely in error.

In striving to attain the third object, the determination of the figure of the earth, the conditions are decidedly different. This problem concerns itself primarily with astronomic observations of latitude, longitude, and azimuth, and with the geodetic positions of the points at which the astronomic observations were made, but is not concerned with the geodetic positions of other points fixed by the triangulations. The geodetic positions (latitudes and longitudes) of comparatively few points are therefore concerned in this problem. However, in marked contrast to the statements made in preceding paragraphs, it is desirable in dealing with this problem that, with each new important accession of data, a new spheroid fitting the geoid with the greatest possible accuracy, and new values of the geodetic latitudes, longitudes, and azimuths of the highest degree of accuracy, should be derived.

The United States Standard Datum was adopted with reference to positions furnished for geographic purposes, but has no reference to the problem of the determination of the figure of the earth. It is adopted with reference to the engineer's problem

of furnishing standard positions and does not affect the scientist's problem of the determination of the figure of the earth.

The principles which guided in the selection of the datum to be adopted were: First, that the adopted datum should not differ widely from the ideal datum for which the sum of the station errors in latitude, longitude, and azimuth should each be zero; second, it was desirable that the adopted datum should produce minimum changes in the publications of the Survey, including its charts; and, third, it was desirable, other things being equal, to adopt that datum which allowed the maximum number of positions already in the office registers to remain unchanged, and therefore necessitated a minimum amount of new computation. These considerations led to the adoption as the United States standard of the datum which had been in use for many years in the northeastern group of States and along the Atlantic coast as far as North Carolina.

An examination of the station errors available in 1903, on the United States Standard Datum, at 246 latitude stations, 76 longitude stations, and 152 azimuth stations, scattered widely over the United States from Maine to Louisiana and to California, indicated that this datum approaches closely the ideal with which the algebraic sum of the station errors of each class would be zero.[1]

The adopted United States Standard Datum, upon which the positions and azimuths given in this publication depend, may be defined in terms of the position of the station Meades Ranch as follows:

	°	′	″
ϕ =	39	13	26.686
λ =	98	32	30.506
α to Waldo =	75	28	14.52

Points are then said to be upon the United States Standard Datum when they are connected with the station Meades Ranch by a continuous triangulation, through which the corresponding latitudes, longitudes, and azimuths have been computed on the Clarke spheroid of 1866, as expressed in meters, starting from the above data.

The principal lists of geographic positions heretofore published on the United States Standard Datum throughout the whole United States are contained in the following publications of the Coast and Geodetic Survey and of other organizations:

Appendix 8 of the Report for 1885, positions in Massachusetts and Rhode Island; Appendix 8 of the Report for 1888, positions in Connecticut; Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland; Appendix 10 of the Report for 1894, positions in Massachusetts; Appendix 6 of the Report for 1901, positions in Kansas and Nebraska; Appendix 3 of the Report for 1902, positions in Kansas, Missouri, Nebraska, and Colorado; Appendix 4 of the Report for 1903, positions in Kansas, Oklahoma, and Texas; Appendix 9 of the Report for 1904, positions in California; Appendix 5 of the Report for 1905, positions in Texas; Appendix 3 of the Report for 1907, positions in California; Appendix 5 of the Report for 1910, positions in California; in Appendix EEE, pages 2905–3031, Annual Report of the Chief of Engineers, 1902, positions of points on and near the Great Lakes; in the publications of the Massachusetts Harbor and Land Commission; and in various bulletins of the United States Geological Survey. In the present report, in addition to this appendix, there are two other appendices giving positions on the standard datum—Appendix 5, positions in Texas, and Appendix 6, positions in Florida.

[1] This is further borne out in the reduction of 765 astronomic stations in connection with the "Supplementary investigation in 1909 of the figure of the earth and isostasy," by J. F. Hayford, published by the Coast and Geodetic Survey.

TABLES OF POSITIONS.

In the tables of positions the latitude and longitude of each point are given on the United States Standard Datum (see p. 233), also the length and azimuth of each line observed over, whether in one or both ways. Along with the latitude and longitude of each point the lengths and azimuths are given of lines from that point to other points of the triangulation. No lengths or azimuths are repeated, and for a given line the length and azimuth will generally be found opposite the position of the last mentioned of the two stations involved.

For the convenience of the draftsman a column of "seconds in meters" is given, in which is placed the length (in meters) of each small arc of a meridian or parallel corresponding to the seconds of the given latitude or longitude. To facilitate further the use of the tables, a column is given of the logarithms of the lengths. It must be remembered that it is the logarithm which is derived first from the computation, the lengths given in this table being then derived from the corresponding logarithms.

The rule followed in recent publications of this Office has been to give latitudes and longitudes to thousandths of seconds for all points the positions of which are fixed by fully adjusted triangulation. Points, the positions of which are given to hundredths of seconds only, are marked by footnotes as being without check (observed from only two stations) or checked by verticals only.

In the columns giving azimuths, distances, and logarithms of distances, the accuracy is indicated to a certain extent by the number of decimal places given, it being understood that in each case two doubtful figures are given. In some cases there is very little doubt of the correctness of the second figure from the right, while in a few cases some doubt may be cast on the third figure from the right.

These tables may be conveniently consulted by using as finders the 11 sketches at the end of this appendix, and the index on pages 325 to 342. In the third column of the index will be found for each point a reference to the page on which its description is given, in the fourth column the number of the sketch on which it appears, and in the fifth column the page on which its elevation above sea level will be found.

For the convenience of those who wish to convert the distances given in this table or the elevations given later on from meters into feet the following conversion table is here inserted:

Meters	Feet	Feet	Meters
1	3. 280833	1	0. 3048006
2	6. 561667	2	0. 6096012
3	9. 842500	3	0. 9144018
4	13. 123333	4	1. 2192024
5	16. 404167	5	1. 5240030
6	19. 685000	6	1. 8288037
7	22. 965833	7	2. 1336043
8	26. 246667	8	2. 4384049
9	29. 527500	9	2. 7432055
10	32. 808333	10	3. 0480061

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Hall	42 18 03.421	105.6	30 10 18.17	210 05 23.35	Deloit	20043.58	4.3019752
	98 14 36.834	843.7	66 46 10.57	246 33 37.90	McClure	27947.41	4.4463415
Page SW. base	42 25 25.518	787.4	311 03 11.69	131 10 51.85	Hall	20743.59	4.3168839
	98 25 59.745	1365.8	349 44 17.87	169 47 02.18	Deloit.	31477.62	4.4980019
			22 03 58.32	201 59 04.48	McClure	26656.61	4.4258050
Old	42 27 47.430	1463.5	344 36 15.64	164 38 41.65	Hall	18688.67	4.2715785
	98 18 13.438	307.0	67 42 25.02	247 37 10.33	Page SW. base	11521.60	4.0615129
Page NE. base	42 28 53.601	1653.9	290 26 27.20	110 29 08.93	Old	5840.12	3.7664217
	98 22 12.960	296.0	38 55 46.01	218 53 12.94	Page SW. base	8250.99	3.9165060
Walnut	42 35 10.185	314.3	359 38 02.40	179 38 08.36	Hall	31682.15	4.5008147
	98 14 45.669	1041.3	19 09 44.77	199 07 24.34	Old	14461.37	4.1602095
			40 31 51.28	220 24 15.84	Page SW. base	23713.36	4.3749931
			41 20 25.31	221 15 22.93	Page NE. base	15466.81	4.1894007
Prairie	42 32 29.669	915.5	304 12 48.15	124 19 06.39	Old	15467.56	4.1894218
	98 27 33.286	759.5	312 19 29.45	132 23 05.91	Page NE. base	9895.82	3.9954517
			350 43 11.18	170 44 14.35	Page SW. base	13260.80	4.1225696
			254 08 00.14	74 16 39.37	Walnut	18196.70	4.2599926
Sparta	42 36 29.448	908.7	34 12 01.19	214 00 38.49	Hall	41216.10	4.6150669
1901	97 57 45.438	1035.7	62 15 01.30	241 55 56.30	Page SW. base	43767.82	4.6411549
			84 05 35.75	263 54 05.22	Walnut	23387.76	4.3689887
Santee	42 48 29.650	915.0	20 50 18.26	200 46 06.62	Sparta	23773.29	4.3760894
1901	97 51 34.427	782.3	52 12 43.59	231 57 00.15	Walnut	40141.90	4.6035979
Avon	42 59 24.772	764.4	319 18 20.47	139 27 00.75	Santee	26634.14	4.4254386
1901	98 04 18.737	424.4	348 04 13.41	168 08 40.64	Sparta	43370.16	4.6371910
			17 40 18.53	197 33 12.66	Walnut	47092.52	4.6729519
Vod	43 05 20.303	626.7	357 36 16.45	177 36 55.57	Santee	31214.37	4.4943545
1901	97 52 31.847	720.3	55 37 50.55	235 29 48.09	Avon	19401.43	4.2878338
Yankton	43 03 39.532	1220.0	46 25 22.65	226 10 40.01	Santee	40640.14	4.6089552
1901	97 29 58.648	1327.1	80 37 41.64	260 14 15.97	Avon	47301.29	4.6748730
			95 55 42.63	275 40 18.46	Vod	30771.37	4.4881468
Wieters	43 18 38.655	1193.0	325 10 23.60	145 20 06.84	Yankton	33767.89	4.5285039
1901	97 44 10.881	245.3	24 42 24.44	204 36 41.51	Vod	27109.21	4.4331168
Freeman	43 18 47.711	1472.3	7 53 50.07	187 51 52.49	Yankton	28293.45	4.4516859
1901	97 27 06.857	154.5	54 15 07.43	233 57 43.48	Vod	42499.62	4.6283850
			89 24 13.48	269 12 31.03	Wieters	23079.06	4.3632182
Wolf Creek	43 28 48.100	1484.3	324 51 55.64	144 58 32.89	Freeman	22641.14	4.3548983
1901	97 36 45.053	1012.5	28 07 15.50	208 02 09.20	Wieters	21316.92	4.3287244
Silver Lake	43 29 16.617	512.8	9 34 29.67	189 32 49.86	Freeman	19681.99	4.2940690
1901	97 24 41.584	934.3	86 58 14.72	266 49 56.87	Wolf Creek	16281.85	4.2117038
Elm Springs	43 30 27.864	859.9	282 07 30.89	102 14 47.63	Wolf Creek	14585.94	4.1639345
1901	97 47 19.594	440.1	349 00 10.86	169 02 20.54	Wieters	22294.93	4.3482062
Farmer	43 42 21.389	660.1	348 23 38.19	168 26 16.34	Wolf Creek	25621.59	4.4086061
1903	97 40 34.412	770.5	22 27 44.37	202 23 04.91	Elm Springs	23822.03	4.3769788
Salem	43 42 35.966	1110.0	354 31 54.29	174 33 06.76	Silver Lake	24781.89	4.3941344
1903	97 26 26.677	597.3	28 33 24.45	208 26 18.04	Wolf Creek	29071.99	4.4634748
			88 43 24.82	268 33 39.05	Farmer	18985.38	4.2784193
Canova	43 53 29.944	924.2	355 43 55.16	175 44 41.73	Salem	20239.79	4.3062059
1903	97 27 33.956	757.9	40 17 31.41	220 08 31.23	Farmer	27021.43	4.4317083
Owens	43 53 22.192	684.9	23 12 57.81	203 08 33.38	Salem	21695.92	4.3363782
1903	97 20 04.670	104.2	91 24 35.58	271 19 24.10	Canova	10031.40	4.0013614
Reese	43 54 00.306	9.4	273 50 46.50	93 57 52.90	Canova	13757.88	4.1385515
1903	97 37 48.943	1092.4	9 44 45.91	189 42 51.37	Farmer	21885.59	4.3401583
Crane	44 03 14.934	460.9	4 43 45.47	184 42 58.39	Owens	18356.75	4.2637957
1903	97 18 56.866	1265.8	32 36 11.82	212 30 12.79	Canova	21420.54	4.3308304

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Caldwell	44 06 02.757	85.1	285 29 32.67	105 39 13.71	Crane	19293.95	4.2854211
1903	97 32 52.133	1159.4	343 00 04.50	163 03 45.51	Canova	24292.47	4.3854718
			16 32 50.95	196 29 24.76	Reese	23257.85	4.3665696
Miner	44 10 03.296	101.7	324 22 24.60	144 27 06.90	Crane	15498.75	4.1902967
1903	97 25 42.439	942.9	52 11 08.78	232 06 09.56	Caldwell	12097.97	4.0827126
Drakola	44 14 19.082	588.9	322 35 06.61	142 38 16.07	Miner	9936.49	3.9972331
1903	97 30 14.174	314.5	12 55 04.73	192 53 14.66	Caldwell	15715.96	4.1963410
Brock	44 13 27.898	861.1	26 26 37.79	206 21 43.51	Crane	21122.46	4.3247444
1903	97 11 54.301	1205.1	71 07 40.70	250 58 03.39	Miner	19444.26	4.2887914
Hansen	44 18 10.958	338.2	298 24 06.08	118 32 33.00	Brock	18326.54	4.2630804
1903	97 24 00.588	13.0	346 15 40.10	166 19 11.77	Crane	28467.01	4.4543419
			8 32 59.47	188 31 48.42	Miner	15220.70	4.1824347
			49 12 57.61	229 08 36.83	Drakola	10948.71	4.0393629
Larson	44 22 24.418	753.7	8 04 59.98	188 03 45.98	Brock	16725.89	4.2233893
1903	97 10 08.342	184.7	67 05 16.57	246 55 34.92	Hansen	20028.07	4.3016391
Weiss	44 29 03.049	94.1	323 44 09.51	143 48 54.77	Larson	15252.56	4.1833429
1903	97 16 55.841	1234.0	25 04 34.55	204 59 37.40	Hansen	22214.76	4.3466417
Jeska	44 18 40.243	1242.1	40 10 54.28	220 06 38.35	Brock	12612.12	4.1007883
1903	97 05 47.680	1056.8	140 10 51.75	320 07 49.56	Larson	9012.11	3.9548263
Oakwood Lake	44 27 54.098	1669.8	33 24 57.66	213 19 01.87	Jeska	20469.48	4.3111067
1903	96 57 19.056	421.3	59 11 52.96	239 02 54.54	Larson	19828.93	4.2972993
			94 47 33.17	274 33 48.72	Weiss	26095.95	4.4165731
Horswill	44 43 39.282	1212.5	333 45 06.91	153 52 43.62	Oakwood Lake	32511.90	4.5120424
1903	97 08 09.515	209.4	23 16 36.46	203 10 26.86	Weiss	29432.32	4.4688245
Olson	44 42 58.592	1808.6	12 54 26.93	192 51 03.76	Oakwood Lake	28639.96	4.4569724
1903	96 52 29.648	652.3	51 34 02.00	231 16 52.50	Weiss	41361.64	4.6165977
			93 34 00.01	273 22 58.66	Horswill	20722.89	4.3164504
Elfring	44 49 52.294	1614.1	298 46 34.70	118 58 56.31	Olson	26441.45	4.4222853
1903	97 10 02.612	57.4	347 48 09.72	167 49 29.38	Horswill	11779.78	4.0711373
Franklin	44 53 52.549	1622.1	345 58 38.94	166 01 20.34	Olson	20804.75	4.3181624
1903	96 56 18.679	409.8	39 35 44.34	219 27 23.35	Horswill	24542.79	4.3899239
			67 47 13.34	247 37 32.11	Elfring	19550.02	4.2911473
Helgen	45 04 31.969	986.9	309 36 11.60	129 48 58.55	Franklin	30894.73	4.4898844
1903	97 14 23.556	515.3	348 04 46.03	168 07 50.40	Elfring	27750.95	4.4432778
Mound	45 04 14.078	434.5	1 22 00.88	181 21 46.13	Franklin	19191.82	4.2831162
1903	96 55 57.813	1264.6	34 55 33.47	214 45 36.62	Elfring	32413.90	4.5107312
			91 25 00.27	271 11 57.39	Helgen	24194.07	4.3837089
Waubay	45 19 18.764	579.3	316 38 07.10	136 52 20.98	Mound	38340.96	4.5836630
1903	97 16 01.271	27.7	355 32 08.09	175 33 17.42	Helgen	27459.00	4.4386847
Boating	45 17 15.683	484.2	347 54 33.35	167 57 20.93	Mound	24673.89	4.3922377
1903	96 59 54.066	1178.2	38 55 36.60	218 45 19.83	Helgen	30269.24	4.4810016
			100 19 02.16	280 07 34.62	Waubay	21411.46	4.3306463
Preacher Hill	45 28 14.847	458.4	337 37 11.81	157 41 45.41	Boating	22001.18	4.3424459
1903	97 06 18.457	400.9	37 30 31.70	217 23 36.75	Waubay	20847.07	4.3190450
Pickerel	45 28 18.757	579.1	270 30 56.77	90 37 34.31	Preacher Hill	12113.76	4.0832791
1903	97 15 36.097	784.0	1 53 01.53	181 52 43.60	Waubay	16679.62	4.2221862
Drywood	45 37 50.765	1567.2	349 40 49.28	169 42 35.65	Preacher Hill	18071.67	4.2569983
1903	97 08 47.492	1028.8	26 41 33.44	206 36 41.74	Pickerel	19758.88	4.2957623
Brown Valley SE. base	45 32 38.723	1195.5	22 40 23.47	202 33 54.56	Boating	30870.60	4.4895450
1903	96 50 48.022	1041.9	68 07 35.80	247 56 32.08	Preacher Hill	21779.22	4.3380424
			112 29 00.51	292 16 09.42	Drywood	25305.73	4.4032189
Brown Valley NW. base	45 36 27.377	845.1	329 07 09.26	149 09 28.21	Brown Valley SE. base	8223.5695	3.9150604
1903	96 54 02.578	55.9	12 09 33.58	192 05 23.11	Boating	36366.50	4.5607015
			46 28 10.95	226 19 25.73	Preacher Hill	22048.10	4.3433711
			97 44 09.13	277 33 36.67	Drywood	19344.02	4.2865467

Page to Fergus Falls—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Layden	45 38 21.132	652.4	27 46 40.05	207 35 27.54	Boating	44117.78	4.6446136
1903	96 44 10.598	229.5	39 12 58.99	219 08 15.08	Brown Valley SE. base	13636.73	4.1347102
			57 06 44.59	236 50 56.60	Preacher Hill	34349.22	4.5359169
			74 44 37.94	254 37 34.82	Brown Valley NW. base	13296.71	4.1237443
			88 28 04.36	268 10 28.53	Drywood	32002.15	4.5051792
Enwiller	45 49 51.921	1603.0	1 19 21.96	181 19 05.68	Layden	21332.91	4.3290501
1904	96 43 47.860	1033.0	55 40 26.58	235 22 32.74	Drywood	39333.51	4.5947627
Hankinson	46 02 15.729	485.6	323 10 24.55	143 19 56.45	Enwiller	28660.11	4.4572778
1904	96 57 03.773	81.1	18 37 55.16	198 29 30.36	Drywood	47711.59	4.6786239
Oscarson	45 53 13.716	423.5	30 33 51.13	210 24 53.16	Layden	31979.57	4.5048727
1904	96 31 39.747	857.0	59 36 08.23	239 09 32.24	Drywood	55945.23	4.7477631
			68 26 13.17	248 17 30.65	Enwiller	16897.92	4.2278333
			117 10 16.05	296 52 00.44	Hankinson	36837.04	4.5662848
Foss	46 06 06.471	199.8	358 53 01.62	178 53 17.13	Oscarson	23863.44	4.3777330
1904	96 32 01.307	28.1	77 42 29.31	257 24 27.25	Hankinson	33066.34	4.5193861
Wahpeton	46 14 14.723	454.6	356 05 18.37	176 05 52.99	Foss	15110.41	4.1792764
1904	96 32 49.298	1056.1	54 43 49.37	234 26 20.68	Hankinson	38308.12	4.5832908
Western	46 08 06.573	202.9	45 02 46.71	224 47 27.42	Oscarson	38930.46	4.5902895
1904	96 10 22.023	472.8	82 33 31.70	262 17 55.21	Foss	28143.93	4.4493847
			111 36 36.77	291 20 24.58	Wahpeton	31049.07	4.4920486
Bullis	45 56 56.474	1743.5	77 35 09.03	257 17 59.78	Oscarson	31633.71	4.5001501
1904	96 07 46.935	1011.0	118 38 27.78	298 21 01.15	Foss	35593.16	4.5513666
			170 51 34.23	350 49 42.59	Western	20956.57	4.3213203

Fergus Falls to Canada.

Fox	46 16 56.724	1751.4	324 00 01.25	144 06 40.91	Western	20219.01	4.3057600
1906	96 19 35.664	763.4	73 40 53.16	253 31 19.77	Wahpeton	17718.20	4.2484196
Indian	46 26 17.627	544.3	353 48 17.76	173 50 20.89	Western	33885.01	4.5300076
1906	96 13 12.371	264.1	25 21 30.75	205 16 53.36	Fox	19159.67	4.2823888
			48 33 07.87	228 18 56.45	Wahpeton	33642.27	4.5268853
Meadows	46 25 57.426	1773.2	268 16 21.05	88 28 47.87	Indian	22012.48	4.3426690
1906	96 30 23.044	492.0	320 16 33.94	140 24 22.42	Fox	21686.23	4.3361841
			8 13 06.58	188 11 20.78	Wahpeton	21921.73	4.3408748
Tansem	46 42 02.704	83.5	0 30 18.35	180 30 09.59	Indian	29183.50	4.4651373
1906	96 13 00.317	6.7	36 47 37.18	216 34 59.98	Meadows	37169.48	4.5701865
Barnesville	46 41 02.927	90.4	264 21 38.68	84 32 29.37	Tansem	19089.48	4.2807941
1906	96 27 54.513	1158.5	325 24 31.99	145 35 12.52	Indian	33171.08	4.5207597
			6 28 14.77	186 26 26.93	Meadows	28138.69	4.4493039
Eglon	46 50 21.930	677.2	349 24 35.02	169 26 13.87	Tansem	15682.25	4.1954082
1906	96 15 15.980	338.6	43 04 36.67	222 55 24.07	Barnesville	23602.36	4.3729555
Riverton	46 50 04.221	130.3	267 52 18.94	88 01 03.45	Eglon	15248.37	4.1832235
1906	96 27 15.069	319.3	309 15 33.23	129 25 55.99	Tansem	23452.65	4.3701919
			2 52 14.98	182 51 46.25	Barnesville	16735.77	4.2236458
Keene	47 00 49.992	1543.9	326 39 30.57	146 46 50.13	Eglon	23199.55	4.3654796
1906	96 25 17.717	374.2	7 06 32.53	187 05 06.81	Riverton	20095.54	4.3030996
Syre	47 11 56.820	1754.8	7 53 34.42	187 50 23.05	Eglon	40367.04	4.6060269
1906	96 10 54.390	1144.8	41 33 51.11	221 23 18.62	Keene	27484.84	4.4390932
Morken	47 02 06.430	198.6	279 29 02.88	99 37 08.89	Keene	14225.09	4.1530551
1906	96 36 21.990	464.4	332 31 36.41	152 38 15.98	Riverton	25124.13	4.4000910
Borup	47 11 01.569	48.4	265 50 12.59	86 04 13.12	Syre	24179.66	4.3834502
1906	96 30 00.110	2.3	342 28 12.61	162 31 39.47	Keene	19802.89	4.2967286
			26 00 53.58	205 56 13.79	Morken	18382.86	4.2644131

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Gary	47 23 43.369	1339.3	342 25 47.01	162 29 48.19	Syre	22883.39	4.3595204
1906	96 16 22.577	473.4	36 13 13.29	216 03 12.58	Borup	29130.48	4.4643477
Wicklow	47 22 42.695	1318.6	263 49 03.43	83 59 18.96	Gary	17642.35	4.2465565
1906	96 30 18.961	397.8	309 03 49.57	129 18 05.28	Syre	31570.41	4.4992802
			358 56 59.38	178 57 13.23	Borup	21655.94	4.3355769
Fertile	47 31 34 744	1073.0	349 32 53.56	169 34 27.91	Gary	14802.53	4.1703360
1906	96 18 30.625	640.7	42 09 22.87	222 00 41.03	Wicklow	22139.73	4.3451723
Beltrami	47 31 41.253	1274.0	270 26 37.50	90 39 00.11	Fertile	21061.59	4.3234912
1906	96 35 17.416	364.3	301 43 15.21	121 57 11.38	Gary	27977.98	4.4468164
			339 22 06.50	159 25 46.38	Wicklow	17768.61	4.2496534
Tilden	47 42 13.392	413.6	355 15 19.44	175 16 17.24	Fertile	19791.62	4.2964813
1905–6	96 19 48.882	1019.1	44 54 02.72	224 42 36.86	Beltrami	27516.39	4.4395914
Andover	47 43 02.346	72.5	274 00 46.30	94 13 11.82	Tilden	21062.42	4.3235083
1906	96 36 36.677	764.5	313 00 28.66	133 13 50.95	Fertile	31068.39	4.4923188
			355 29 35.32	175 30 33.87	Beltrami	21099.94	4.3242812
Ives	47 56 14.667	453.0	340 25 37.16	160 31 05.44	Tilden	27568.59	4.4404145
1906	96 27 11.876	246.5	25 42 05.42	205 35 06.83	Andover	27144.55	4.4336826
Shirley	47 51 39.446	1218.3	243 34 45.45	63 44 58.89	Ives	19161.04	4.2824192
1906	96 40 58.652	1219.1	303 20 59.39	123 36 39.78	Tilden	31691.09	4.5009371
			341 07 18.22	161 10 32.26	Andover	16875.82	4.2272648
Bray	48 04 05.450	168.3	352 54 20.66	172 55 25.46	Ives	14652.57	4.1659139
1906	96 28 39.066	808.8	33 44 03.46	213 34 54.15	Shirley	27681.53	4.4421901
Sherack	48 01 17.211	531.6	254 56 23.90	75 08 02.00	Bray	20125.29	4.3037422
1906	96 44 17.794	368.7	293 36 19.67	113 49 01.83	Ives	23237.25	4.3661848
			346 56 22.25	166 58 50.11	Shirley	18317.10	4.2628567
Viking	48 15 44.481	1374.0	357 42 45.83	177 43 16.87	Bray	21608.15	4.3346177
1906	96 29 20.721	427.4	34 47 17.58	214 36 09.44	Sherack	32580.38	4.5129561
Warren	48 13 28.078	867.2	256 52 25.71	77 03 23.70	Viking	18679.97	4.2713762
1906	96 44 02.772	57.2	312 12 36.70	132 24 04.72	Bray	25818.11	4.4119244
			0 47 24.12	180 47 12.93	Sherack	22576.29	4.3536526
Wright	48 24 02.753	85.0	346 46 10.39	166 48 21.44	Viking	15809.07	4.1989063
1906	96 32 16.152	332.2	36 40 26.85	216 31 39.16	Warren	24418.92	4.3877264
Argyle	48 22 12.286	379.5	260 34 09.49	80 46 44.48	Wright	21056.06	4.3233771
1906	96 49 06.005	123.6	296 00 20.04	116 15 05.23	Viking	27199.89	4.4345671
			338 51 44.90	158 55 31.29	Warren	17355.95	4.2394483
Stephen W. base	48 27 23.134	714.6	284 36 50.82	104 51 07.39	Wright	24337.63	4.3862782
1903–7	96 51 21.101	433.6	343 50 55.99	163 52 37.04	Argyle	9995.42	3.9998009
Stephen E. base	48 28 48.609	1501.5	300 55 55.62	121 04 50.48	Wright	17140.54	4.2340244
1903–7	96 44 10.959	225.1	26 23 21.36	206 19 40.64	Argyle	13662.22	4.1355212
			73 24 29.52	253 19 07.52	Stephen W. base	9221.8333	3.9648173
Deer	48 34 40.062	1237.4	339 13 28.45	159 18 00.26	Wright	21049.48	4.3232414
1907	96 38 19.146	392.5	29 58 30.57	209 50 26.29	Argyle	26646.36	4.4256379
			33 39 23.78	213 35 00.17	Stephen E. base	13036.71	4.1151681
			50 00 59.18	229 51 13.38	Stephen W. base	20968.10	4.3215590
Donaldson	48 32 35.090	1083.9	258 20 24.50	78 31 54.25	Deer	19256.68	4.2845815
1907	96 53 39.231	804.8	300 51 01.79	121 07 02.34	Wright	30741.00	4.4877180
			300 53 47.97	121 00 53.66	Stephen E. base	13600.48	4.1335541
			343 35 15.33	163 36 58.78	Stephen W. base	10044.55	4.0019305
			343 42 12.91	163 45 37.41	Argyle	20039.93	4.3018961
Jupiter	48 42 47.730	1474.4	329 35 26.04	149 40 49.67	Deer	17458.76	4.2420134
1907	96 45 30.284	619.1	27 55 58.49	207 49 51.56	Donaldson	21409.53	4.3306071
Skane	48 42 13.356	412.6	266 44 10.44	86 55 55.97	Jupiter	19226.75	4.2839059
1907	97 01 09.285	189.8	296 23 06.68	116 40 15.08	Deer	31350.02	4.4962378
			332 39 36.89	152 45 14.60	Donaldson	20100.00	4.3031961
Hallock	48 47 46.056	1422.6	305 59 35.89	126 07 21.80	Jupiter	15656.32	4.1946897
1907	96 55 49.937	1025.9	32 26 20.74	212 22 20.65	Skane	12172.80	4.0853905

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Granville	48 52 35.304	1090.6	344 44 53.19	164 47 55.31	Jupiter	18810.80	4.2744072
1907	96 49 32.348	659.1	36 35 25.82	216 26 41.51	Skane	23905.52	4.3784981
			40 47 36.90	220 42 52.64	Hallock	11795.17	4.0717043
Hill	48 50 51.285	1584.2	261 20 02.50	81 33 11.62	Granville	21596.67	4.3343867
1907	97 07 00.138	2.8	292 38 27.43	112 46 51.87	Hallock	14820.23	4.1708548
			335 50 35.36	155 54 59.25	Skane	17529.53	4.2437702
Canada	49 00 01.211	37.4	341 52 34.67	161 55 21.48	Granville	14491.79	4.1611220
1907	96 53 13.582	276.1	44 48 46.03	224 38 22.94	Hill	23910.44	4.3785875
States	49 00 01.687	52.1	269 57 25.56	90 08 19.26	Canada	17605.47	4.2456476
1907	97 07 39.738	807.7	301 48 49.54	122 02 29.44	Granville	26074.25	4.4162119
			357 16 52.81	177 17 22.66	Hill	17021.67	4.2310021
United States-Canada boundary monument No. 54 1875–1907	49 00 01.210	37.4	90 03 22	270 03 21	Canada	25.29	1.4030
	96 53 12.338	250.8					
United States-Canada boundary monument No. 65 1875–1907	49 00 01.699	52.5	270 12 00	90 12 04	States	109.68	2.04014
	97 07 45.134	917.4					

Fergus Falls to Duluth.

Elbow	46 00 53.431	1649.8	64 10 30.10	244 02 06.63	Bullis	16752.20	4.2240720
1904	95 56 06.816	146.6	126 07 44.61	305 57 28.65	Western	22728.58	4.3565722
Dalton	46 10 22.770	703.0	359 42 42.66	179 42 45.62	Elbow	17578.95	4.2449929
1904–7	95 56 10.926	234.5	31 04 23.71	210 56 02.52	Bullis	29044.17	4.4630590
			77 07 06.75	256 56 52.93	Western	18741.08	4.2727947
Leaf	46 08 10.959	338.3	64 21 44.88	244 06 06.90	Elbow	31074.56	4.4924050
1904	95 34 24.534	526.6	98 23 28.51	278 07 46.32	Dalton	28326.67	4.4521955
Holmes	45 51 10.856	335.2	126 20 07.64	306 06 28.63	Elbow	30439.15	4.4834326
1904	95 37 06.983	150.6	145 25 57.55	325 12 14.49	Dalton	43249.88	4.6359849
			186 19 03.03	6 20 59.88	Leaf	31689.27	4.5009122
Alexandria	45 52 49.181	1518.5	81 54 31.95	261 42 49.99	Holmes	21313.51	4.3286550
1904	95 20 48.941	1055.2	148 25 29.78	328 15 43.01	Leaf	33434.85	4.5241994
Parker	46 06 26.310	812.2	358 36 44.15	178 37 04.54	Alexandria	25236.34	4.4020264
1904	95 21 17.283	371.2	35 58 19.97	215 46 57.05	Holmes	34882.85	4.5426120
			100 54 02.61	280 44 35.15	Leaf	17209.09	4.2357578
Osakis	45 49 27.288	842.4	110 28 29.54	290 19 12.04	Alexandria	17884.51	4.2524771
1904–6	95 07 51.988	1122.3	151 13 14.46	331 03 35.51	Parker	35923.81	4.5553824
Leslie	45 59 52.410	1618.1	12 10 18.86	192 08 00.35	Osakis	19742.87	4.2954103
1904	95 04 39.148	842.4	58 04 17.05	237 52 40.15	Alexandria	24641.19	4.3916617
			119 38 36.47	299 26 37.84	Parker	24664.64	4.3920747
Maple	45 53 58.484	1805.8	51 37 32.05	231 31 40.89	Osakis	13473.06	4.1294661
1904	94 59 42.673	919.9	149 43 45.73	329 40 12.65	Leslie	12656.33	4.1023079
Long	45 58 23.413	722.6	42 56 06.32	222 51 52.79	Maple	11166.10	4.0479014
1904	94 53 49.844	1073.1	101 11 16.46	281 03 29.53	Leslie	14243.10	4.1536045
Birch	45 48 15.647	483.1	96 27 24.43	276 16 25.90	Osakis	19950.10	4.2999450
1904	94 52 33.646	726.6	138 52 22.47	318 47 14.63	Maple	14061.37	4.1480276
			175 00 13.86	354 59 19.15	Long	18836.31	4.2749959
Eagle	45 49 35.702	1102.2	80 53 00.26	260 44 32.66	Birch	15480.72	4.1897912
1904	94 40 45.801	988.6	134 01 39.18	313 52 16.14	Long	23476.00	4.3706241
Lone	46 02 24.592	759.2	350 00 19.29	170 02 38.54	Eagle	24103.74	4.3820844
1904	94 43 59.606	1281.8	22 57 36.69	202 51 27.41	Birch	28455.39	4.4541646
			59 40 23.33	239 33 18.70	Long	14721.54	4.1679531
Falls	45 58 40.607	1253.7	62 48 21.05	242 30 17.20	Eagle	36625.52	4.5637838
1904	94 15 36.577	787.3	100 51 30.89	280 31 05.65	Lone	37287.09	4.5715584

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Brockway	45 46 11.260	347.6	102 29 37.96	282 13 41.89	Eagle	29485.31	4.4696056
1904	94 18 32.158	694.8	132 32 25.02	312 14 08.03	Lone	44576.63	4.6491072
			189 16 41.02	9 18 47.04	Falls	23443.62	4.3700246
Royalton N. base	45 48 55.967	1727.9	42 18 40.91	222 16 07.42	Brockway	6874.26	3.8372262
1904–6	94 14 57.995	1251.9	92 15 24.68	271 56 54.65	Eagle	33435.72	4.5242106
			177 21 56.27	357 21 28.57	Falls	18069.69	4.2569507
Alberta	45 48 14.734	454.9	75 56 46.72	255 48 24.01	Brockway	15622.87	4.1937609
1904	94 06 50.762	1096.2	93 27 32.75	273 03 13.44	Eagle	44006.86	4.6435204
			96 56 53.54	276 51 04.18	Royalton N. base	10597.01	4.0251832
			149 39 10.92	329 32 53.38	Falls	22403.63	4.3503184
Royalton S. base	45 44 08.243	254.5	114 26 58.02	294 22 20.71	Brockway	9189.81	3.9633065
1904–6	94 12 04.987	107.8	157 11 48.42	337 09 44.44	Royalton N. base	9637.5508	3.9839667
			221 42 25.60	41 46 10.76	Alberta	10198.62	4.0085415
Johnson	46 10 21.978	678.6	317 56 57.33	138 07 49.95	Falls	29121.69	4.4642166
1904	94 30 42.676	915.5	18 41 55.18	198 34 41.34	Eagle	40608.71	4.6086192
			49 20 43.61	229 11 09.32	Lone	22587.64	4.3538709
Rail	46 13 38.532	1189.6	330 44 57.29	150 53 36.65	Falls	31753.45	4.5017909
1904	94 27 37.343	800.1	33 14 01.60	213 11 47.83	Johnson	7254.03	3.8605791
Daggett	46 10 19.647	606.6	14 37 59.71	194 34 51.18	Falls	22304.19	4.3483864
1904	94 11 14.824	318.0	90 16 53.80	270 02 51.28	Johnson	25052.01	4.3988426
			106 21 00.64	286 09 11.51	Rail	21942.64	4.3412888
Jones	46 23 49.202	1519.2	19 56 35.47	199 51 29.95	Daggett	26583.90	4.4246187
1904–5	94 04 12.128	259.1	58 02 55.76	237 45 59.63	Rail	35490.39	4.5501108
Gull	46 26 35.923	1109.2	282 13 28.48	102 26 47.04	Jones	24096.78	4.3819591
1904–5	94 22 34.480	736.1	334 10 33.10	154 18 44.53	Daggett	33469.38	4.5246477
			15 07 57.14	195 04 18.05	Rail	24862.20	4.3955395
Brook	46 40 49.570	1530.6	18 34 13.63	198 28 14.09	Jones	33227.95	4.5215035
1905	93 55 56.801	1207.1	52 24 00.41	232 04 40.30	Gull	43044.26	4.6339152
Rabbit	46 30 31.617	976.2	45 26 42.97	225 19 35.06	Jones	17692.07	4.2477786
1905	93 54 22.018	469.4	78 46 26.81	258 25 59.63	Gull	36831.35	4.5662176
			173 58 25.35	353 57 16.49	Brook	19187.79	4.2830250
Bethlehem	46 28 33.133	1023.0	99 26 11.47	279 13 34.28	Rabbit	22563.40	4.3534045
1905	93 36 58.024	1237.9	133 16 35.51	313 02 48.40	Brook	33242.56	4.5216944
French	46 37 48.812	1507.1	19 16 38.64	199 13 14.44	Bethlehem	18174.42	4.2594606
1905	93 32 16.764	356.6	64 34 14.79	244 18 12.38	Rabbit	31285.62	4.4953447
			100 37 00.09	280 19 47.39	Brook	30705.50	4.4872161
Rae	46 31 57.376	1771.5	69 38 24.96	249 28 49.23	Bethlehem	18058.99	4.2566934
1905	93 23 44.382	945.8	134 53 58.83	314 47 46.66	French	15387.61	4.1871712
Kimberly	46 36 35.919	1109.1	345 59 39.06	166 00 52.17	Rae	8864.09	3.9476343
1905	93 25 25.048	533.1	44 47 41.51	224 39 18.48	Bethlehem	20981.97	4.3218462
			104 27 06.45	284 22 07.21	French	9044.46	3.9563826
Grindle	46 33 28.112	868.0	72 03 56.02	251 59 01.79	Rae	9078.78	3.9580276
1905	93 16 59.065	1258.1	118 20 43.45	298 14 35.91	Kimberly	12234.50	4.0875864
Gregor	46 38 21.550	665.2	343 53 01.46	163 54 30.75	Grindle	9430.96	3.9745560
1905	93 19 01.966	41.8	26 54 24.31	206 50 59.16	Rae	13299.42	4.1238327
			68 13 36.72	248 08 58.27	Kimberly	8778.46	3.9434183
Tamarack	46 42 26.153	807.6	22 41 15.93	202 37 18.94	Grindle	18003.04	4.2553459
1905	93 11 33.074	702.5	51 40 48.95	231 35 22.40	Gregor	12169.22	4.0852626
Douglas	46 36 45.538	1406.0	61 15 42.78	241 09 24.29	Grindle	12657.89	4.1023614
1905	93 08 18.020	383.5	102 16 33.83	282 08 45.75	Gregor	14016.63	4.1466436
			158 30 03.26	338 27 41.40	Tamarack	11305.83	4.0533023
Bachelor	46 39 27.143	838.0	66 05 29.85	245 59 06.09	Douglas	12287.24	4.0894544
1905	92 59 30.144	640.9	109 51 38.87	289 42 52.89	Tamarack	16327.95	4.2129317
Wright	46 44 12.905	398.5	332 24 30.70	152 27 08.50	Bachelor	9954.36	3.9980134
1905	93 03 06.987	148.3	25 36 20.75	205 32 34.49	Douglas	15314.64	4.1851067
			72 59 58.97	252 53 50.52	Tamarack	11241.74	4.0508335

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Island	46 39 01.440	44.6	94 59 25.09	274 54 11.47	Bachelor	9204.40	3.9639957
1905	92 52 18.879	401.4	124 59 47.13	304 51 55.51	Wright	16796.93	4.2252298
Cromwell	46 42 50.459	1558.0	38 50 53.24	218 47 38.44	Island	9076.89	3.9579370
1905	92 47 51.133	1086.0	67 09 34.81	247 01 06.22	Bachelor	16126.81	4.2075485
			97 33 01.42	277 21 54.61	Wright	19614.34	4.2925737
Sawyer	46 41 11.434	353.1	77 19 12.82	257 09 06.50	Island	18168.49	4.2593188
1905	92 38 25.319	538.0	104 19 44.90	284 12 53.12	Cromwell	12403.62	4.0935486
Mahtowa	46 36 27.475	848.2	106 52 56.79	286 43 58.97	Island	16441.39	4.2159386
1905	92 39 59.023	1256.0	139 43 29.56	319 37 46.19	Cromwell	15511.43	4.1906819
			192 47 39.57	12 48 47.70	Sawyer	8991.88	3.9538502
Atkinson	46 35 29.876	922.5	105 12 12.78	285 08 28.90	Mahtowa	6795.47	3.8322197
1905	92 34 50.885	1083.1	156 38 10.54	336 35 34.64	Sawyer	11490.74	4.0603478
Cloquet	46 45 09.473	292.5	24 53 08.12	204 48 24.51	Atkinson	19722.84	4.2949694
1905	92 28 21.013	446.0	42 41 43.75	222 33 15.93	Mahtowa	21906.31	4.3405692
			60 15 36.13	240 08 16.19	Sawyer	14789.90	4.1699652
Carlton	46 38 39.906	1232.1	63 36 40.17	243 29 57.19	Atkinson	13176.22	4.1197909
1905	92 25 36.423	774.6	163 48 28.45	343 46 28.67	Cloquet	12527.37	4.0978599
Annie	46 42 28.602	883.2	60 17 23.25	240 10 20.67	Carlton	14223.23	4.1529983
1905	92 15 55.548	1179.8	61 56 36.42	241 42 50.82	Atkinson	27387.13	4.4375466
			107 29 55.70	287 20 52.88	Cloquet	16589.92	4.2198442
Dedham	46 31 49.929	1541.6	101 58 30.41	281 40 04.23	Atkinson	33151.63	4.5205049
1905	92 09 27.458	585.1	121 38 03.91	301 26 20.03	Carlton	24203.34	4.3838752
			157 19 11.92	337 14 29.85	Annie	21380.23	4.3300124
Superior	46 38 52.835	1631.2	23 05 41.08	203 02 31.30	Dedham	14193.62	4.1520933
1905	92 05 06.217	132.2	115 50 07.86	295 42 15.46	Annie	15324.94	4.1853988
			182 21 31.00	2 21 48.25	Minn. Pt. N. base	12219.64	4.0870583
			209 06 30.22	29 08 49.78	Minn. Pt. S. base	8375.45	3.9230083
Duluth	46 45 30.056	928.1	270 26 19.51	90 30 15.33	Minn. Pt. N. base	6870.30	3.8369755
1905	92 10 06.237	132.3	295 18 37.34	115 24 35.51	Minn. Pt. S. base	11556.06	4.0628099
			332 30 43.34	152 34 21.70	Superior	13822.92	4.1405908
			358 07 51.02	178 08 19.22	Dedham	25337.89	4.4037705
			52 57 54.01	232 53 39.65	Annie	9295.28	3.9682624
Minnesota Point south base	46 42 49.768	1536.7					
1870–1905	92 01 54.391	1155.3					
Minnesota Point north base	46 45 28.225	871.5	323 52 13.65	143 54 18.08	Minn. Pt. S. base	6056.69	3.7822355
1870–1905	92 04 42.521	902.4					

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Supplementary points.							
Council Hill	42 25 28.708	885.8	57 05 08.3	236 54 45.4	Hall	25226.1	4.401850
1900	97 59 12.320	281.6	89 59 49.6	269 41 45.2	Page SW. base	36747.9	4.565232
			99 25 39.7	279 12 49.6	Old	26428.1	4.422066
			130 11 00.3	310 00 29.7	Walnut	27857.4	4.444940
			185 32 52.9	5 33 51.7	Sparta	20484.1	4.311416
Evans house chimney	42 34 06.515	201.0	264 22 16.8	84 32 17.2	Walnut	20330.9	4.308157
1900	98 29 32.989	752.5	317 33 57.6	137 35 18.5	Prairie	4048.2	3.607257
			343 07 41.5	163 10 05.5	Page SW. base	16797.2	4.225236
Niobrara U. S. E.	42 44 03.835	118.3	54 41 44.46	234 30 15.04	Walnut	28426.1	4.4537172
1891	97 57 48.300	1098.7	162 42 52.15	342 38 26.56	Avon	29768.4	4.4737558
			225 59 06.85	46 03 20.74	Santee	11812.2	4.0723295
Lost Creek U. S. E.	42 46 59.078	1823.0	43 28 35.95	223 26 02.98	Niobrara U. S. E.	7449.3	3.8721174
1891	97 54 02.982	67.8	52 24 24.40	232 10 21.90	Walnut	35761.6	4.5534170
			148 47 25.35	328 40 26.29	Avon	26921.0	4.4300905
			230 21 59.57	50 23 40.50	Santee	4382.7	3.6417489

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Arenson 2	42 48 31.874	983.6	33 18 09.27	213 10 06.33	Walnut	29575.6	4.4709329
1901	98 02 53.517	1215.9	174 31 34.83	354 30 36.80	Avon	20239.8	4.3062071
			270 11 26.44	90 19 07.91	Santee	15429.8	4.1883606
			342 30 42.80	162 34 11.76	Sparta	23368.6	4.3686318
Ponca U. S. E.	42 46 49.911	1540.1	205 26 54.25	25 32 27.35	Avon	25806.5	4.4117290
1891	98 12 28.220	641.5	263 43 01.00	83 57 12.79	Santee	28659.8	4.4572727
			313 31 53.32	133 41 51.92	Sparta	27755.2	4.4433437
			8 15 34.31	188 14 01.13	Walnut	21817.0	4.3387954
Conger U. S. E.	42 55 52.862	1631.2	242 47 48.59	62 54 12.00	Avon	14330.3	4.1562565
1891	98 13 41.331	937.2	294 17 48.38	114 32 51.12	Santee	33078.7	4.5195484
			328 43 14.43	148 54 03.53	Sparta	41965.6	4.6228933
			354 20 06.38	174 20 56.11	Ponca U. S. E.	16836.4	4.2262501
			2 11 27.65	182 10 43.97	Walnut	38373.7	4.5840338
Log schoolhouse	42 55 24.349	751.4	227 15 18.8	47 19 20.4	Avon	10937.7	4.038927
1901	98 10 13.302	301.7	296 38 05.7	116 50 46.8	Santee	28440.2	4.453933
			9 24 46.4	189 21 41.5	Walnut	37974.4	4.579491
Tabor church spire	42 57 01.400	43.2	46 14 31.8	226 06 18.5	Santee	22804.6	4.358022
1901	97 39 29.508	668.9	97 36 34.2	277 19 39.1	Avon	34037.4	4.531956
			131 04 01.0	310 55 07.2	Vod	23470.1	4.370515
			226 24 27.6	46 30 56.9	Yankton	17835.5	4.251286
Tyndall elevator	42 59 27.630	852.6	359 40 10.1	179 40 13.6	Santee	20304.4	4.307591
1901	97 51 39.582	896.7	89 46 41.2	269 38 03.6	Avon	17198.4	4.235488
			173 48 03.4	353 47 27.8	Vod	10947.3	4.039306
Tyndall Catholic Church spire	42 59 44.392	1369.9	88 01 30.1	267 52 59.9	Avon	16960.4	4.229437
1901	97 51 50.525	1144.5	174 50 52.9	354 50 24.6	Vod	10408.0	4.017366
			256 08 50.0	76 23 45.1	Yankton	30575.0	4.485367
Tyndall, flagstaff in courthouse yard	42 59 36.200	1117.1	88 52 03.2	268 43 37.6	Avon	16801.8	4.225355
1901	97 51 57.230	1296.4	175 46 58.6	355 46 35.0	Vod	10647.6	4.027250
			255 45 24.2	76 00 23.9	Yankton	30783.7	4.488321
Tyndall courthouse cupola [1]	42 59 37.49	1156.9	88 43 53.1	268 35 27.5	Avon	16802.5	4.225374
1901	97 51 57.23	1296.4	175 46 02.6	355 45 39.0	Vod	10607.7	4.025622
Lesterville water tower	43 02 26.588	820.5	39 50 22.3	219 39 37.3	Santee	33591.4	4.526228
1901	97 35 47.296	1070.6	81 55 29.2	261 36 01.7	Avon	39159.9	4.592842
			103 21 55.6	283 10 29.6	Vod	23353.6	4.368354
			254 02 43.2	74 06 41.2	Yankton	8205.5	3.914104
Scotland water tower	43 08 58.910	1818.0	63 03 16.1	242 56 35.9	Vod	14858.9	4.171986
1901	97 42 46.222	1044.4	173 54 47.0	353 53 49.0	Wieters	17992.7	4.255096
			229 18 27.0	49 29 10.5	Freeman	27919.5	4.445907
			299 31 00.9	119 39 45.4	Yankton	19959.6	4.300151
Scotland Episcopal Church spire	43 09 02.016	62.2	62 14 54.0	242 08 21.8	Vod	14667.1	4.166345
1901	97 42 57.970	1309.9	174 43 28.4	354 42 38.5	Wieters	17871.0	4.252148
			229 48 25.9	49 59 17.4	Freeman	28059.2	4.448076
			299 22 50.3	119 31 42.8	Yankton	20237.9	4.306165
Scotland Presbyterian schoolhouse cupola [1]	43 09 11.71	361.4	300 10 41.6	120 19 32.8	Yankton	20346.9	4.308499
1901	97 42 55.95	1264.2	61 18 32.4	241 11 58.7	Vod	14848.8	4.171692
Vodnany church spire	43 08 00.577	17.8	210 31 43.0	30 37 35.9	Wieters	22871.6	4.359296
1901	97 52 46.400	1048.8	239 57 53.5	60 15 27.8	Freeman	40075.8	4.602882
			284 28 03.3	104 43 37.9	Yankton	31963.6	4.504656
			356 11 30.7	176 11 40.6	Vod	4956.9	3.695208
			357 24 31.0	177 25 20.1	Santee	36170.0	4.558348
			44 36 37.6	224 28 44.9	Avon	22333.7	4.348960
High Point	43 07 42.083	1298.7	232 34 06.0	52 47 32.3	Wieters	33420.7	4.524016
1901	98 03 48.472	1095.6	247 19 51.9	67 44 59.5	Freeman	53767.9	4.730523
			279 04 04.0	99 27 10.7	Yankton	46512.7	4.667572
			285 53 42.7	106 01 25.1	Vod	15912.4	4.201737
			334 51 40.7	155 00 01.0	Santee	39260.9	4.593960
			2 33 29.6	182 33 08.9	Avon	15361.8	4.186443
Layton	43 11 19.136	590.5	241 42 15.2	61 55 03.9	Wieters	28713.2	4.458081
1901	98 02 52.726	1190.8	253 50 13.3	74 14 43.7	Freeman	50348.0	4.701982
			287 26 40.5	107 49 10.0	Yankton	46823.6	4.670465
			308 13 13.3	128 20 17.8	Vod	17874.9	4.252243
			5 03 04.8	185 02 06.1	Avon	22130.4	4.344989

[1] No check on this position.

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Tripp water tower	43 13 25.844	797.5	243 12 13.5	63 21 56.4	Wieters	21473.2	4.331896
1901	97 58 21.384	482.6	256 35 56.8	76 57 21.6	Freeman	43425.6	4.637746
			295 01 17.3	115 20 41.6	Yankton	42520.8	4.628601
			332 10 29.9	152 14 29.0	Vod	16937.4	4.228846
			348 40 25.5	168 45 03.1	Santee	47081.5	4.672850
Menno schoolhouse cupola	43 14 12.567	387.8	342 02 27.4	162 05 38.7	Yankton	20532.7	4.312446
1901	97 34 38.428	867.0	122 30 56.5	302 24 24.1	Wieters	15299.3	4.184671
			230 08 00.9	50 13 10.5	Freeman	13258.4	4.122492
Menno white spire	43 14 23.058	711.6	342 38 01.7	162 41 09.4	Yankton	20804.4	4.318156
1901	97 34 33.065	746.0	55 36 08.9	235 23 51.0	Vod	29570.9	4.470865
			121 14 42.5	301 08 06.5	Wieters	15231.1	4.182730
Turkey Ridge	43 14 56.048	1729.7	25 37 24.6	205 32 22.1	Yankton	23146.0	4.364475
1901	97 22 36.304	819.0	103 21 59.4	283 07 12.0	Wieters	29987.3	4.476938
			139 33 08.5	319 30 03.1	Freeman	9398.1	3.973039
Catholic Church spire	43 18 50.200	1549.2	271 02 51.3	91 04 57.0	Freeman	4130.5	3.616000
1901	97 30 10.114	227.9	359 28 16.1	179 28 23.9	Yankton	28104.2	4.448771
			89 00 10.7	268 50 33.9	Wieters	18950.7	4.277626
Parkston church spire[1]	43 23 33.40	1030.8	281 19 39.4	101 41 39.0	Freeman	44180.8	4.645234
1901	97 59 09.18	206.6	294 07 24.8	114 17 41.4	Wieters	22181.6	4.345993
Parkston iron smokestack[1]	43 23 32.90	1015.3	281 21 11.6	101 43 06.0	Freeman	44009.2	4.643543
1901	97 59 01.54	34.6	294 16 16.0	114 26 27.4	Wieters	22018.3	4.342784
Freeman church spire	43 21 05.164	159.4	79 35 31.4	259 23 09.1	Wieters	24784.4	4.394178
1901	97 26 09.228	207.8	135 01 29.4	314 54 12.4	Wolf Creek	20217.1	4.305718
			187 23 54.9	7 24 55.1	Silver Lake	15294.3	4.184531
Freeman elevator[1]	43 21 14.55	449.0	134 31 00.9	314 23 45.1	Wolf Creek	19985.3	4.300710
1903	97 26 10.96	246.9	187 41 18.9	7 42 20.3	Silver Lake	15012.3	4.176448
Freeman schoolhouse, squatty spire[1]	43 20 59.65	1840.7	135 18 00.4	315 10 42.4	Wolf Creek	20360.4	4.308786
1903	97 26 07.81	175.8	187 11 59.7	7 12 58.9	Silver Lake	15459.2	4.189187
Dolton highest red elevator, center of three	43 29 22.619	698.0	15 10 23.9	195 07 41.9	Freeman	20299.4	4.307483
1903	97 23 11.091	249.2	84 48 13.3	264 47 11.0	Silver Lake	2041.9	3.310025
			86 44 40.9	266 35 20.7	Wolf Creek	18322.4	4.262982
German Baptist Church spire	43 29 26.111	805.8	282 16 40.7	102 19 25.4	Wolf Creek	5506.3	3.740859
1903	97 40 44.459	999.0	99 06 40.4	279 03 22.5	County Line Mon.	6544.8	3.815898
			102 09 14.4	282 04 42.4	Elm Springs	9079.6	3.958068
County-line monument	43 29 59.593	1839.0	109 52 30.4	289 51 16.4	Elm Springs	2567.6	3.409534
1903	97 45 32.099	721.2	280 30 11.3	100 36 14.0	Wolf Creek	12046.6	4.080863
Bridgewater church No. 1, spire	43 33 06.819	210.4	47 41 08.5	227 36 40.0	Wolf Creek	11852.0	4.073793
1903	97 30 15.082	338.6	196 13 47.1	16 16 24.7	Salem	18296.2	4.262360
			313 27 16.5	133 31 06.1	Silver Lake	10323.4	4.013824
Bridgewater church No. 2, spire	43 33 05.854	180.7	48 39 46.4	228 35 09.6	Wolf Creek	12034.5	4.080427
1903	97 30 02.989	67.1	195 23 15.7	15 25 45.0	Salem	18250.9	4.261284
			314 23 33.7	134 27 15.1	Silver Lake	10107.2	4.004633
Bridgewater elevator	43 32 52.647	1624.7	50 21 53.7	230 17 14.8	Wolf Creek	11821.6	4.072676
1903	97 29 59.956	1345.8	194 51 13.3	14 53 40.5	Salem	18626.6	4.270134
			312 57 55.4	133 01 34.6	Silver Lake	9776.5	3.990184
Church on east end ridge, spire	43 33 26.672	823.1	171 54 15.5	351 53 03.2	Farmer	16669.1	4.221911
1903	97 38 49.569	1112.5	224 25 07.6	44 33 40.2	Salem	23763.7	4.375914
			341 58 08.5	161 59 34.2	Wolf Creek	9040.6	3.956196
Canastota elevator, cupola, highest and only red one	43 35 58.362	1801.2	22 23 53.0	202 17 13.1	Freeman	34388.8	4.536417
1903	97 17 25.403	569.8	38 20 35.8	218 15 35.3	Silver Lake	15799.2	4.198634
			135 23 03.2	315 16 49.5	Salem	17253.9	4.236888
Canastota highest white spire	43 35 57.691	1780.4	22 01 18.8	201 54 46.7	Freeman	34274.9	4.534976
1903	97 17 36.572	820.3	37 40 04.4	217 35 11.6	Silver Lake	15628.6	4.193920
			136 01 43.1	315 55 37.2	Salem	17093.8	4.232839
Canastota high church spire near elevator[1]	43 35 49.81	1537.2	38 24 47.2	218 19 52.4	Silver Lake	15478.0	4.189715
1903	97 17 33.61	753.9	136 25 46.8	316 19 38.8	Salem	17315.3	4.238431

[1] No check on this position.

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Emery elevator, highest 1903	43 36 02.934 97 37 13.765	90.6 308.8	230 01 29.4 306 31 30.4 357 14 49.8 158 57 51.2	50 08 56.1 126 40 08.6 177 15 00.6 338 55 32.7	Salem Silver Lake Wolf Creek Farmer	18904.9 21033.1 13435.2 12515.6	4.276574 4.322904 4.128243 4.097451
Alexandria Baptist Church spire 1903	43 39 20.274 97 46 52.553	625.7 1177.6	236 32 30.3 324 59 49.7 2 07 01.8	56 36 51.5 145 06 48.4 182 06 43.2	Farmer Wolf Creek Elm Springs	10148.2 23801.3 16442.4	4.006389 4.376601 4.215965
Alexandria courthouse dome 1903	43 39 17.729 97 46 39.600	547.1 887.4	235 14 43.9 325 28 04.8 3 08 40.7	55 18 56.1 145 34 54.5 183 08 13.1	Farmer Wolf Creek Elm Springs	9951.9 23571.2 16377.2	3.997907 4.372382 4.214240
Alexandria elevator, in southeastern part of town 1903	43 39 06.470 97 46 55.926	199.7 1253.3	234 49 15.0 324 14 57.8 256 40 02.6	54 53 38.5 144 21 58.8 76 54 11.5	Farmer Wolf Creek Salem	10451.0 23497.7 28283.2	4.019156 4.371026 4.451528
Alexandria belfry on large building (small and open)[1] 1903	43 39 21.20 97 47 04.67	654.2 104.6	237 29 54.0 257 39 00.0	57 34 23.5 77 53 14.9	Farmer Salem	10360.5 28373.0	4.015379 4.452906
Salem Catholic Church spire 1903	43 43 36.131 97 23 23.432	1115.2 524.5	65 39 45.6 84 23 29.1 163 02 03.2 193 46 50.5	245 37 38.9 264 11 36.6 342 59 09.8 13 49 08.1	Salem Farmer Canova Owens	4502.7 23194.5 19163.3 18625.3	3.653471 4.365385 4.282471 4.270104
Salem schoolhouse dome 1903	43 43 40.434 97 23 05.514	1247.7 123.4	84 10 08.8 161 46 28.1 192 40 12.0	263 58 03.9 341 43 22.3 12 42 17.2	Farmer Canova Owens	23606.7 19157.9 18404.3	4.373036 4.282349 4.264919
Farmer Catholic Church spire 1903	43 43 31.901 97 41 15.069	984.5 337.3	193 20 32.7 224 45 31.4 337 17 56.3	13 22 55.4 44 54 59.8 157 18 24.4	Reese Canova Farmer	19934.3 26029.2 2358.8	4.299600 4.415461 3.372695
Farmer reference mark 1903	43 42 34.041 97 40 34.722	1050.6 777.4	358 58 49.8 153 10 25.3	178 58 50.0 333 09 57.4	Farmer Farmer Cath. Ch. spire	390.5 2001.1	2.591636 3.301273
Auxiliary station near Farmer 1903	43 42 54.240 97 40 09.798	1674.0 219.3	28 31 40.5 41 50 00.4 128 30 30.8	208 31 23.5 221 49 43.2 308 29 45.7	Farmer Farmer ref. mark Farmer Cath. Ch. spire	1153.9 836.7 1867.0	3.062183 2.922547 3.271144
Swedish Lutheran Church, low, white, pyramidal spire 1903	43 50 01.133 97 20 48.769	35.0 1089.6	28 50 45.8 125 29 56.3 189 00 48.7	208 46 52.0 305 25 15.6 9 01 19.3	Salem Canova Owens	15680.5 11108.9 6283.1	4.195361 4.045671 3.798171
Church 7 miles N. by W. of Salem, spire 1903	43 49 04.786 97 28 08.379	147.7 187.2	53 20 49.7 185 21 48.6 233 37 27.6 349 15 21.2	233 12 13.7 5 22 12.5 53 43 02.8 169 16 31.5	Farmer Canova Owens Salem	20820.4 8219.7 13410.1 12213.8	4.318490 3.914857 4.127432 4.086852
Orland lone church spire 1903	43 51 40.284 97 10 09.711	1243.3 216.8	98 21 37.5 103 22 42.3 151 19 07.8	278 09 33.7 283 15 49.9 331 13 01.8	Canova Owens Crane	23558.5 13650.8 24450.0	4.372148 4.135158 4.388279
Dover church, toadstool spire[1] 1903	43 49 09.07 97 34 06.67	279.9 149.1	151 06 41.3 227 24 38.7	331 04 07.3 47 29 10.8	Reese Canova	10268.2 11906.1	4.011494 4.075770
Swedish Baptist Church, square, pink, pyramidal spire[2] 1903	43 50 50.42 97 24 29.79	1556.1 665.6	140 08 51.9 231 37 13.4	320 06 44.3 51 40 17.1	Canova Owens	6415.0 7549.0	3.807198 3.877888
Epiphany church spire 1903	43 50 56.696 97 39 39.370	1749.7 879.4	203 30 07.4 253 39 06.9 311 00 20.5 4 25 51.5	23 31 23.9 73 47 29.6 131 09 29.0 184 25 13.4	Reese Canova Salem Farmer	6180.0 16873.9 23517.3 15951.4	3.790986 4.227215 4.371385 4.202800
Epiphany waterworks tank tower 1903	43 50 48.362 97 39 37.087	1492.5 828.4	202 09 54.0 252 46 01.2 310 36 40.8 4 41 22.1	22 11 09.0 72 54 22.4 130 45 47.7 184 40 42.4	Reese Canova Salem Farmer	6397.2 16899.4 23310.5 15699.2	3.805991 4.227871 4.367552 4.195876

[1] No check on this position.

[2] Checked by vertical angles only.

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Canova open belfry 1903	43 52 52.918 97 29 58.609	1633.2 1308.4	36 09 52.2 101 15 03.6 266 02 39.9 250 29 49.7	216 02 32.1 281 09 37.5 86 09 31.6 70 31 30.0	Farmer Reese Owens Canova	24123.8 10702.3 13289.2 3425.3	4.382445 4.029479 4.123499 3.534694
Canova, lead-colored elevator 1903	43 52 51.221 97 30 16.700	1580.8 362.8	35 27 06.6 101 58 14.3 265 56 19.2 251 46 24.6	215 19 59.2 281 53 00.8 86 03 23.5 71 48 17.4	Farmer Reese Owens Canova	23844.9 10317.3 13695.8 3824.4	4.377396 4.013566 4.136587 3.582567
Winfred church spire 1903	43 59 51.190 97 21 49.141	1579.9 1094.9	33 11 53.5 211 22 16.5 349 00 28.2	213 07 54.2 31 24 16.2 169 01 40.8	Canova Crane Owens	14056.6 7366.4 12230.0	4.147880 3.867256 4.087426
Winfred elevator 1903	43 59 45.323 97 21 49.647	1398.8 1106.2	33 34 04.6 210 43 36.6 348 47 27.6	213 30 05.7 30 45 36.7 168 48 40.5	Canova Crane Owens	13899.2 7527.4 12054.4	4.142989 3.876644 4.081147
Howard courthouse dome 1903	44 00 55.075 97 31 35.900	1699.8 799.6	169 52 36.14 255 35 58.70 312 08 15.33 338 32 16.87 33 02 54.68	349 51 43.13 75 44 46.30 132 16 15.08 158 35 04.79 212 58 35.73	Caldwell Crane Owens Canova Reese	9646.87 17444.05 20807.17 14759.74 15266.15	3.9843864 4.2416474 4.3182131 4.1690788 4.1837295
Howard Congregational Church spire 1903	44 00 46.872 97 31 40.990	1446.7 913.1	170 46 52.71 254 53 34.26 311 24 25.98 337 45 27.52 33 12 43.28	350 46 03.24 75 02 25.39 131 32 29.26 157 48 18.98 213 08 27.87	Caldwell Crane Owens Canova Reese	9877.41 17618.17 20723.07 14566.96 14992.17	3.9946431 4.2459607 4.3164541 4.1633688 4.1758644
Howard Catholic Church spire 1903	44 00 52.778 97 31 48.070	1629.0 1070.8	171 31 43.92 255 35 35.70 311 29 40.22 337 27 29.97 32 19 43.96	351 30 59.37 75 44 31.76 131 37 48.41 157 30 26.34 212 15 33.46	Caldwell Crane Owens Canova Reese	9673.04 17724.22 20961.92 14795.56 15060.10	3.9855632 4.2485670 4.3214311 4.1701315 4.1778278
Howard Methodist Church spire 1903	44 00 40.991 97 31 40.951	1265.2 912.2	170 56 31.43 254 19 25.67 311 01 48.93 337 29 14.98 33 35 55.13	350 55 41.93 74 28 16.76 131 09 52.17 157 32 06.40 213 31 39.70	Caldwell Crane Owens Canova Reese	10056.75 17665.50 20602.82 14398.80 14841.13	4.0024575 4.2471259 4.3139266 4.1583260 4.1714670
Howard elevator, center 1903	44 00 29.660 97 31 38.921	915.5 867.0	170 59 59.00 253 11 45.23 310 22 16.08 337 06 44.67 34 30 28.01	350 59 08.09 73 20 34.90 130 30 17.90 157 09 34.68 214 26 11.17	Caldwell Crane Owens Canova Reese	10409.23 17719.89 20340.48 14058.72 14576.70	4.0174184 4.2484611 4.3083612 4.1479456 4.1636592
Howard astronomic station 1906	44 00 54.96 97 31 36.46	1696.3 812.1					
Vilás elevator [1] 1903	44 00 37.71 97 35 51.70	1163.9 1151.7	201 42 20.0 12 02 34.4	21 44 24.8 192 01 13.0	Caldwell Reese	10799.3 12541.1	4.033395 4.098334
Vilas windmill [1] 1903	44 00 44.13 97 35 57.02	1362.0 1270.2	202 41 24.8 11 19 58.7	22 43 33.4 191 18 41.0	Caldwell Reese	10660.6 12711.0	4.027782 4.104181
Fedora highest, largest elevator [1] 1903	44 00 30.73 97 47 36.49	948.5 812.9	238 43 12.6 242 24 52.5	58 58 26.9 62 35 07.4	Miner Caldwell	34160.2 22193.2	4.533521 4.346220
Auxiliary station near Crane 1903	44 03 06.92 97 19 02.22	213.6 49.4	75 43 23 205 44 31	255 34 35 25 44 34	Howard Cong. Ch. Crane	17440.4 274.5	4.241557 2.438492
Roswell church spire 1903	44 00 23.482 97 41 42.416	724.7 944.9	228 22 19.8 303 55 18.4 336 13 07.2	48 28 28.5 124 05 07.2 156 15 49.2	Caldwell Canova Reese	15779.5 22822.5 12921.4	4.198092 4.358364 4.111311
Ramona white spire 1903	44 07 07.181 97 13 05.564	221.6 123.7	47 30 29.4 107 58 48.2 144 41 46.3 187 39 58.1	227 26 25.0 287 50 01.1 324 34 09.6 7 40 47.8	Crane Miner Hansen Brock	10605.1 17679.1 25124.7 11857.1	4.025516 4.247461 4.400093 4.073977

[1] Checked by vertical angles only.

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Ramona elevator	44 07 03.905	120.5	49 16 44.0	229 12 27.5	Crane	10825.1	4.034431
1903	97 12 48.299	1073.9	144 07 30.9	323 59 42.1	Hansen	25429.8	4.405343
			185 46 27.9	5 47 05.5	Brock	11912.6	4.076005
Ramona low dome [1]	44 07 06.00	185.2	47 50 05.9	227 45 59.9	Crane	10617.5	4.026021
1903	97 13 03.32	73.8	187 24 18.7	7 25 06.8	Brock	11886.6	4.075057
German Lutheran Church, square base, octagonal top	44 05 42.153	1301.1	17 16 10.4	197 15 26.3	Crane	4758.2	3.677446
1903	97 17 53.408	1188.1	160 36 13.9	340 31 58.0	Hansen	24508.1	4.389310
			208 59 56.9	29 04 07.1	Brock	16441.4	4.215939
Freedom church spire	44 06 44.486	1373.1	78 32 02.3	258 28 44.1	Caldwell	6463.8	3.810490
1903	97 28 07.325	162.9	207 40 39.4	27 42 20.3	Miner	6930.0	3.840736
			168 39 23.8	348 37 55.4	Drakola	14311.3	4.155680
			297 47 08.0	117 53 31.0	Crane	13850.1	4.141452
Breton Baptist Church spire	44 09 12.996	401.1	42 29 47.1	222 26 58.9	Caldwell	7960.6	3.900947
1903	97 28 50.354	1119.0	168 51 44.2	348 50 45.8	Drakola	9629.1	3.983584
			249 35 08.0	69 37 19.0	Miner	4454.8	3.648824
Oldham schoolhouse, golden dome	44 13 37.290	1151.0	55 10 29.2	235 05 31.6	Miner	11553.9	4.062728
1903	97 18 35.540	788.8	139 32 57.9	319 29 11.1	Hansen	11105.5	4.045538
			271 49 31.5	91 54 11.4	Brock	8910.4	3.949898
Oldham small sharp spire	44 13 43.042	1328.5	54 16 22.3	234 11 26.7	Miner	11603.8	4.064599
1903	97 18 38.444	853.3	139 12 08.1	319 08 23.3	Hansen	10928.8	4.038572
			272 56 37.0	93 01 18.9	Brock	8982.2	3.953383
Oldham highest spire, square base	44 13 35.421	1093.3	214 27 48.6	34 33 42.3	Larson	19815.4	4 297003
1903	97 18 34.810	772.6	271 27 26.4	91 32 05.7	Brock	8892.6	3.949027
			55 27 22.2	235 22 24.0	Miner	11545.0	4.062394
Church, high spire SE. of Hansen	44 13 24.777	764.8	36 24 36.4	216 22 12.5	Miner	7725.2	3.887910
1903	97 22 16.051	356.3	165 18 05.5	345 16 52.5	Hansen	9132.4	3.960587
			269 32 23.2	89 39 36.8	Brock	13800.8	4.139904
Carthage, spire, middle height [2]	44 10 12.26	378.4	245 44 31.8	65 53 24.5	Drakola	18596.4	4.269428
1903	97 42 58.21	1293.2	299 41 35.3	119 48 37.3	Caldwell	15518.3	4.190843
Carthage, highest spire [2]	44 10 16.05	495.4	246 16 28.6	66 25 26.5	Drakola	18699.3	4.271825
1903	97 43 05.62	124.9	299 45 52.6	119 52 59.8	Caldwell	15719.2	4.196431
Round church spire	44 19 09.971	307.8	347 03 24.2	167 04 40.5	Brock	10833.1	4.034753
1903	97 13 43.622	966.8	82 28 20.4	262 21 09.4	Hansen	13794.8	4.139716
			218 26 47.0	38 29 17.5	Larson	7665.5	3.884542
Arlington Baptist Church spire	44 21 47.650	1470.7	330 31 18.2	150 33 01.3	Jeska	6643.8	3.822415
1903	97 08 15.192	336.4	114 22 50.7	294 21 31.6	Larson	2750.4	3.439394
			139 27 16.2	319 21 11.7	Weiss	17699.2	4.247953
Arlington Christian Church, octagonal spire	44 21 43.746	1350.4	331 02 10.5	151 03 49.3	Jeska	6472.9	3.811096
1903	97 08 09.108	201.7	115 26 34.8	295 25 11.4	Larson	2923.3	3.465880
			139 22 42.9	319 16 34.2	Weiss	17878.3	4.252327
Arlington Methodist Church, square spire (with corner minarets)	44 21 46.325	1429.7	331 28 51.1	151 30 29.5	Jeska	6536.0	3.815309
1903	97 08 08.480	187.8	113 54 23.2	293 52 59.4	Larson	2902.8	3.462810
			139 10 41.8	319 04 32.7	Weiss	17827.1	4.251080
Lake Preston schoolhouse, cupola (square yellow building)	44 21 42.178	1301.8	11 37 55.5	191 35 36.0	Miner	22022.2	4.342861
1903	97 22 22.583	500.1	18 25 47.5	198 24 39.1	Hansen	6871.6	3.837058
			37 26 20.6	217 20 51.3	Drakola	17214.4	4.235891
Lake Preston Congregational Church, needle spire	44 21 45.149	1393.5	265 42 39.0	85 51 18.2	Larson	16483.1	4.217038
1903	97 22 30.752	681.0	11 07 21.7	191 05 07.8	Miner	22076.5	4.343930
			16 45 48.0	196 44 45.2	Hansen	6904.3	3.839121
			36 46 20.9	216 40 57.2	Drakola	17178.4	4.234982
Lake Preston flour mill, smokestack [2]	44 21 54.39	1678.8	12 39 20.2	192 38 31.4	Hansen	7067.9	3.849292
1903	97 22 50.73	1123.3	35 00 51.0	214 55 41.3	Drakola	17150.0	4.234264
Desmet highest spire, dark and slender [2]	44 23 10.28	317.3	337 01 49.0	157 07 12.4	Miner	26373.8	4.421173
1903	97 33 25.69	568.6	306 22 30.7	126 29 05.7	Hansen	15557.7	4.191946

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Desmet dome, cylindrical shaft (white top)[1] 1903	44 23 11.36 97 32 46.36	350.6 1026.2	308 28 26.9 338 49 41.0	128 14 34.4 158 54 36.9	Hansen Miner	14886.5 26077.6	4.172792 4.416267
Large church (15 miles from Brock) spire 1903	44 26 24.253 97 18 36.802	748.6 813.8	303 17 40.7 339 32 55.2 25 14 37.2	123 23 36.5 159 37 36.5 205 10 50.8	Larson Brock Hansen	13467.9 25568.5 16829.4	4.129300 4.407705 4.226068
Danish Lutheran Church spire 1903	44 29 05.392 97 23 31.077	166.4 686.8	270 26 09.7 304 48 02.2 331 51 43.7	90 30 46.6 124 57 24.1 151 59 50.8	Weiss Larson Brock	8734.3 21643.6 32794.3	3.941227 4.335329 4.515799
Erwin Methodist Episcopal Church spire 1903	44 29 08.240 97 26 36.246	254.3 800.9	270 39 33.2 299 36 20.2 350 20 51.3	90 46 19.9 119 47 51.8 170 22 40.2	Weiss Larson Hansen	12826.8 25156.4 20578.3	4.108117 4.400648 4.313410
Lutheran Church (3½ miles from Olson) 1903	44 46 33.208 96 50 30.669	1025.1 674.3	21 34 13.3 77 07 23.8 103 32 05.5	201 32 49.5 256 54 58.3 283 18 19.6	Olson Horswill Elfring	7123.1 23902.1 26479.1	3.852671 4.378436 4.422903
Kranzburg Catholic Church spire 1903	44 53 35.243 96 55 03.162	1087.8 69.4	350 14 38.1 70 52 27.0 107 52 36.2 128 41 02.7	170 16 26.3 250 41 52.5 287 51 42.9 308 27 22.3	Olson Elfring Franklin Helgen	19940.0 20912.3 1741.0 32516.0	4.299725 4.320401 3.240795 4.512097
Watertown courthouse spire 1903	44 54 02.520 97 06 57.100	77.8 1252.7	4 44 06.6 27 49 08.0 153 19 31.6 271 11 46.5	184 43 15.6 207 46 57.1 333 14 15.9 91 19 17.1	Horswill Elfring Helgen Franklin	19304.3 8732.1 21753.5 14010.9	4.285653 3.941119 4.337530 4.146466
Watertown Methodist Episcopal Church spire 1903	44 53 53.132 97 06 54.219	1640.1 1189.5	4 59 51.0 29 06 24.7 153 31 02.6 270 00 41.9	184 58 58.0 209 04 11.8 333 25 44.9 90 08 10.5	Horswill Elfring Helgen Franklin	19020.8 8507.5 22041.0 13944.6	4.279229 3.929799 4.343231 4.144407
Watertown water tower 1903	44 54 30.334 97 07 03.004	936.4 65.9	4 09 55.6 24 41 26.7 152 35 09.4 274 39 13.2	184 09 08.8 204 39 20.0 332 29 57.9 94 46 48.0	Horswill Elfring Helgen Franklin	20150.2 9445.1 20929.9 14184.1	4.304279 3.975206 4.320768 4.151803
Waverly, dull heavy spire 1903	45 00 00.589 96 58 17.696	18.2 387.6	39 32 18.0 201 21 21.7 347 03 16.8	219 24 00.3 21 23 00.7 167 04 40.9	Elfring Mound Franklin	24324.3 8402.9 11656.9	4.386041 3.924430 4.066584
Summit high-school spire 1903	45 18 17.035 97 02 19.537	525.9 425.7	96 09 29.2 164 17 42.3 300 50 43.4	275 59 45.0 344 14 52.2 120 52 26.8	Waubay Preacher Hill Boating	18000.9 19173.5 3692.3	4.255293 4.282701 3.567319
Waubay gothic church spire[2] 1903	45 19 57.46 97 18 17.29	1773.8 376.5	192 44 53 291 57 09	12 46 48 111 58 46	Pickerel Waubay	15868.0 3194.1	4.200521 3.504345
Webster waterworks tank 1903	45 20 08.754 97 31 09.446	270.2 205.7	233 12 46.0 245 01 06.5 274 22 19.7	53 23 50.6 65 18 48.2 94 33 05.6	Pickerel Preacher Hill Waubay	25315.4 35730.7 19837.4	4.403385 4.553041 4.297484
Webster high sharp spire (N. part of town) 1903	45 20 10.268 97 31 07.244	317.0 157.7	233 13 59.0 245 03 16.2 274 31 05.4	53 25 02.0 65 20 56.3 94 41 49.7	Pickerel Preacher Hill Waubay	25249.0 35667.4 19793.2	4.402244 4.552272 4.296516
Webster courthouse tower 1903	45 19 58.042 97 31 19.401	1791.9 422.5	232 54 34.8 244 41 08.8 273 22 47.2	53 05 46.4 64 58 57.5 93 33 40.1	Pickerel Preacher Hill Waubay	25687.4 36067.4 20031.3	4.409720 4.557115 4.301709
Wilmot, western and higher white spire[2] 1903	45 24 25.09 96 51 40.94	774.6 890.3	39 02 59.1 110 29 13.8	218 57 08.3 290 18 48.6	Boating Preacher Hill	17058.1 20348.8	4.231930 4.308539
Wilmot, eastern white spire[1] 1903	45 24 30.99 96 51 26.45	956.7 575.2	39 28 51.4 109 42 29.4	219 22 50.3 289 31 53.8	Boating Preacher Hill	17398.5 20582.2	4.240512 4.313492
High sharp spire 1903	45 29 14.176 97 28 07.128	437.6 154.8	273 33 27.0 275 54 48.3 319 16 21.3	93 49 00.1 96 03 43.8 139 24 58.2	Preacher Hill Pickerel Waubay	28482.4 16401.2 24229.6	4.454576 4.214875 4.384346

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[2] No check on this position.

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Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Peaver, open belfry[2]	45 32 29.25	903.0	56 34 25.3	236 27 55.1	Preacher Hill	14237.2	4.153425
	96 57 11.45	248.4	123 24 28.7	303 16 11.5	Drywood	18061.0	4.256742
Wist, church near, spire 1903	45 32 36.417	1124.3	307 31 42.8	127 37 27.6	Preacher Hill	13242.2	4.121959
	97 14 21.907	475.3	5 01 20.8	185 00 10.0	Waubay	24719.7	4.393044
			11 27 11.0	191 26 18.1	Pickerel	8116.0	3.909343
Wist, high chimney on large building[2] 1903	45 32 42.94	1325.7	306 29 24	126 35 31	Preacher Hill	13901.1	4.143049
	97 14 52.95	1148.7	6 33 21	186 32 51	Pickerel	8209.5	3.914319
Indian church spire 1903	45 37 25.172	777.1	260 54 25.1	81 00 23.3	Layden	10991.7	4.041063
	96 52 31.737	687.6	345 43 28.4	165 44 42.5	Brown V. SE. base	9124.9	3.960226
			47 48 54.0	227 47 49.1	Brown V. NW. base	2656.6	3.424330
Brown Valley white spire[1] 1903	45 35 33.85	1045.0	13 08 19	193 07 38	Brown V. SE. base	5551.9	3.744441
	96 49 49.85	1080.6	106 48 49	286 45 49	Brown V. NW. base	5721.2	3.757484
Brown Valley water tower 1903	45 35 40.264	1243.0	105 00 40.5	284 57 41.4	Brown V. NW. base	5624.8	3.750104
	96 49 51.870	1124.4	236 04 39.3	56 08 43.2	Layden	8907.2	3.949742
			12 15 45.9	192 15 05.8	Brown V. SE. base	5735.4	3.758566
Brown Valley, high spire on large building 1903	45 35 34.396	1061.8	13 46 45.6	193 46 01.8	Brown V. SE. base	5584.1	3.746951
	96 49 46.714	1012.5	57 51 48.7	237 40 01.0	Preacher Hill	25441.0	4.405535
			106 27 35.3	286 24 32.5	Brown V. NW. base	5781.5	3.762039
Beardsley water tank 1903	45 33 30.789	950.5	81 17 34.4	261 11 50.9	Brown V. SE. base	10560.9	4.023700
	96 42 46.827	1015.6	110 28 45.0	290 20 42.3	Brown V. NW. base	15631.3	4.193995
			168 33 29.0	348 32 29.2	Layden	9145.8	3.961220
Beardsley square, slender, decorated spire 1903	45 33 13.095	404.3	84 19 59.2	264 14 10.2	Brown V. SE. base	10655.7	4.027584
	96 42 39.244	851.2	112 06 32.8	291 58 24.7	Brown V. NW. base	15983.0	4.203659
			168 14 51.8	348 13 46.6	Layden	9714.0	3.987396
Graceville water tower 1904	45 34 09.164	282.9	97 16 46.6	276 46 16.5	Drywood	55934.8	4.747682
	96 26 05.986	129.8	108 25 11.1	288 12 16.2	Layden	24758.6	4.393726
			168 29 24.0	348 25 25.0	Oscarson	36066.0	4.557098
Graceville Catholic Church spire 1904	45 34 04.426	136.6	97 27 01.8	276 56 37.6	Drywood	55774.5	4.746436
	96 26 14.302	310.2	108 52 24.4	288 39 35.4	Layden	24634.5	4.391543
			168 48 52.2	348 44 59.1	Oscarson	36174.0	4.558396
Large church, spire on west end 1904	45 45 49.009	1513.1	177 51 23.7	357 50 45.6	Hankinson	30486.07	4.4841014
	96 56 10.749	232.3	244 52 20.7	65 01 13.3	Enwiller	17710.22	4.2482241
			311 31 08.3	131 39 43.7	Layden	20830.78	4.3187056
Church, very tall 1904	45 51 00.687	21.2	194 36 16.9	14 39 18.4	Hankinson	21540.23	4.3332503
	97 01 16.350	352.8	275 15 21.7	95 27 53.9	Enwiller	22725.72	4.3565176
			316 30 02.7	136 42 17.4	Layden	32273.61	4.5088476
			21 50 31.5	201 45 08.3	Drywood	26265.75	4.4193898
Swedish Lutheran Church spire (2 miles E. of Enwiller) 1904	45 49 40.039	1236.2	10 00 25.0	189 58 22.8	Layden	21283.1	4.328034
	96 41 19.836	428.2	96 33 53.8	276 32 07.7	Enwiller	3216.0	3.507312
			139 01 05.1	318 49 46.8	Hankinson	30950.7	4.490670
			242 08 44.8	62 15 41.1	Oscarson	14146.9	4.150662
Wheaton water tower 1904	45 48 37.110	1145.7	68 36 17.7	248 08 31.5	Drywood	54143.3	4.733545
	96 30 00.135	2.9	97 26 52.0	277 16 58.4	Enwiller	18017.3	4.255689
			165 53 00.4	345 51 49.0	Oscarson	8806.4	3.944796
Hankinson high school 1904	46 04 10.254	316.6	262 38 46.9	82 54 36.3	Foss	28543.9	4.455514
	96 53 59.317	1274.8	21 32 30.9	201 21 53.6	Drywood	52395.6	4.719295
			48 17 37.6	228 15 24.8	Hankinson	5312.9	3.725334
Hankinson Catholic Church spire[1] 1904	46 04 12.37	381.9	262 48 18.8	83 04 12.2	Foss	28652.7	4.457165
	96 54 04.81	103.4	46 54 28.2	226 52 19.4	Hankinson	5269.9	3.721803
Hankinson schoolhouse (¼ mile N.) chimney 1904	46 02 32.541	1004.7	234 52 10.0	55 09 30.7	Wahpeton	37811.9	4.577628
	96 56 52.598	1131.0	258 12 18.6	78 30 12.6	Foss	32721.9	4.514838
			24 50 31.4	204 50 23.4	Hankinson	572.0	2.757412
Blackmer south elevator[1] 1904	45 58 33.63	1038.3	199 05 16.1	19 07 58.2	Foss	14797.1	4.170178
	96 35 46.59	1003.1	331 40 32.8	151 43 30.1	Oscarson	11218.0	4.049917

[1] No check on this position.

[2] Checked by vertical angles only.

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Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Childs tallest elevator 1904	46 03 57.268 96 32 07.625	1768.2 163.9	177 19 06.5 181 56 53.3 358 16 01.9	357 18 36.6 1 56 57.9 178 16 22.1	Wahpeton Foss Oscarson	19085.5 3991.5 19878.8	4.280703 3.601140 4.298390
Childs, church near 1904	46 01 20.571 96 32 43.129	635.1 927.7	179 40 59.5 185 48 37.8 354 48 18.1	359 40 55.1 5 49 07.9 174 49 03.6	Wahpeton Foss Oscarson	23903.0 8873.0 15093.4	4.378452 3.948071 4.178788
Fairmount Catholic Church spire 1904	46 03 25.102 96 36 08.346	775.0 179.4	342 56 28.4 85 35 18.2 192 00 10.9 226 47 19.7	162 59 41.5 265 20 14.3 12 02 34.4 46 50 17.6	Oscarson Hankinson Wahpeton Foss	19742.5 27076.4 20507.6 7280.2	4.295402 4.432591 4.311914 3.862145
Fairmount National Elevator 1904	46 03 16.945 96 36 22.145	523.2 476.1	192 39 17.1 226 55 56.4 341 53 34.6	12 41 50.5 46 59 04.2 161 56 57.6	Wahpeton Foss Oscarson	20816.9 7668.9 19591.9	4.318416 3.884731 4.292077
Fairmount tall east elevator 1904	46 03 29.536 96 35 59.096	911.9 1270.3	343 36 31.3 85 20 08.1 191 32 13.7 226 29 42.9	163 39 37.8 265 04 57.6 11 34 30.6 46 32 34.2	Oscarson Hankinson Wahpeton Foss	19816.3 27285.4 20332.9 7041.6	4.297023 4.435930 4.308200 3.847674
Fairmount elevator 1904	46 03 29.596 96 36 06.388	913.8 137.3	191 58 08.0 227 22 07.6 343 10 30.0	12 00 30.1 47 25 04.1 163 13 41.7	Wahpeton Foss Oscarson	16302.3 7154.9 19862.9	4.212249 3.854603 4.298043
Campbell church spire 1904	46 05 49.684 96 24 20.186	1534.0 433.6	22 06 23.6 93 02 30.1 256 42 02.1	202 01 07.4 272 56 57.8 76 52 06.2	Oscarson Foss Western	25184.8 9918.3 18487.7	4.401139 3.996436 4.266882
Campbell church, open belfry 1904	46 05 44.941 96 24 18.271	1387.6 392.5	22 19 12.1 93 52 12.5 256 13 47.4	202 13 54.5 273 46 38.8 76 23 50.1	Oscarson Foss Western	25064.8 9968.1 18482.0	4.399064 3.998624 4.266748
Campbell elevator No. 1 1904	46 05 58.577 96 24 08.940	1808.6 192.0	22 22 45.1 91 25 24.2 257 22 10.2	202 17 20.8 271 19 43.8 77 32 06.2	Oscarson Foss Western	25530.4 10149.0 18190.6	4.407058 4.006422 4.259848
Campbell elevator No. 2 1904	46 06 00.143 96 24 10.349	4.4 222.3	22 16 29.6 91 09 12.9 257 32 19.1	202 11 06.3 271 03 32.8 77 42 16.1	Oscarson Foss Western	25563.7 10117.6 18209.7	4.407623 4.005079 4.260302
Wahpeton Catholic Church spire [1] 1904	46 15 51.27 96 36 19.52	1583.1 417.8	304 46 54.2 343 31 54.0	124 49 18.9 163 35 53.1	Wahpeton Foss	5223.2 18824.7	3.717933 4.274729
Wahpeton standpipe 1906	46 15 59.481 96 35 56.382	1836.6 1207.6	201 04 32.1 236 39 36.8 265 05 25.0 293 46 49.9 308 53 24.1	21 08 33.3 56 56 03.9 85 17 13.8 114 05 17.4 128 55 39.3	Meadows Indian Fox Western Wahpeton	19790.9 34854.7 21073.0 35991.9 5149.9	4.296465 4.542261 4.323726 4.556205 3.711802
Wahpeton schoolhouse cupola 1904	46 16 26.627 96 36 28.509	822.2 610.4	203 52 25.0 238 25 12.1 294 31 59.7	23 56 49.4 58 42 02.4 114 50 50.4	Meadows Indian Western	19279.2 34985.2 36962.6	4.285088 4.543885 4.567762
Doran (church east of) spire 1904	46 10 38.499 96 24 33.166	1188.7 711.4	48 55 04.3 122 09 58.6 208 36 01.6	228 49 41.2 302 04 00.5 28 39 36.5	Foss Wahpeton Fox	12769.9 12557.6 13305.1	4.106186 4.098908 4.124017
Nashua elevator (N.) 1904	46 02 11.552 96 18 30.587	356.7 657.8	305 00 55.3 45 44 21.5 112 40 57.5	125 08 38.3 225 34 54.2 292 31 13.6	Bullis Oscarson Foss	16926.8 23759.4 18873.0	4.228574 4.375836 4.275840
Nashua elevator (S.) 1904	46 02 11.553 96 18 27.292	356.7 586.9	305 09 15.1 45 51 32.0 112 36 02.0	125 16 55.7 225 42 02.3 296 26 15.7	Bullis Oscarson Foss	16868.8 23810.2 18938.3	4.227084 4.376762 4.277342
Nashua white church 1904	46 02 09.136 96 18 27.398	282.1 589.1	304 56 31.0 45 59 03.0 112 48 40.7	125 04 11.7 225 49 33.4 292 38 54.5	Bullis Oscarson Foss	16827.8 23756.7 18965.0	4.226028 4.375786 4.277953
Western P. O. church spire 1904	46 09 08.518 96 10 57.192	263.0 1227.3	263 02 10.8 338 27 35.6 78 25 31.4 108 42 21.1	83 12 50.0 158 28 00.9 258 10 20.1 288 26 34.1	Dalton Western Foss Wahpeton	19152.7 2056.2 27715.1 29681.0	4.282229 3.313061 4.442717 4.472478

[1] No check on this position.

Page to Fergus Falls—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Hereford elevator	46 00 50.302	1553.1	171 36 26.7	351 35 20.0	Western	13616.3	4.134059
1904	96 08 49.439	1063.6	349 26 13.5	169 26 58.4	Bullis	7343.7	3.865917
			64 36 18.2	244 19 53.3	Oscarson	32706.8	4.514638
Wendell tallest elevator	46 02 04.878	150.6	153 01 05.7	332 57 54.8	Western	12534.6	4.098109
1904	96 05 57.088	1227.7	279 47 52.1	99 54 56.9	Elbow	12886.2	4.110124
			13 57 14.5	193 55 55.5	Bullis	9811.1	3.991717
Wendell railway water tank[1]	46 02 03.29	101.7	279 38 06.5	99 45 09.0	Elbow	12810.1	4.107554
1904	96 05 53.89	1159.0	14 24 52.9	194 23 31.6	Bullis	9780.5	3.990361
Wendell elevator (W.)	46 02 05.624	173.6	153 10 33.4	333 07 24.3	Western	12491.2	4.096604
1904	96 05 59.434	1278.1	279 51 35.6	99 58 42.1	Elbow	12939.8	4.111928
			13 38 08.2	193 36 50.9	Bullis	9821.4	3.992175
Wendell schoolhouse spire	46 02 08.079	249.4	152 34 00.2	332 30 47.4	Western	12474.2	4.096011
1904	96 05 54.292	1167.5	219 18 14.9	39 25 15.4	Dalton	19755.5	4.295688
			280 16 42.7	100 23 45.5	Elbow	12844.2	4.108707
			14 09 14.0	194 07 53.0	Bullis	9291.6	3.996580
Wendell church spire	46 02 10.434	322.2	152 30 34.5	332 27 22.5	Western	12398.6	4.093374
1904	96 05 55.403	1191.4	219 29 29.0	39 36 30.2	Dalton	19714.5	4.294786
			280 34 39.1	100 41 42.7	Elbow	12880.8	4.109944
			13 55 08.1	193 53 47.9	Bullis	9986.3	3.999404
Herman water tower	45 48 37.672	1163.1	105 57 48.8	285 41 08.9	Oscarson	31253.5	4.494898
1904	96 08 26.165	565.0	183 08 25.8	3 08 53.9	Bullis	15423.5	4.188183
			214 58 27.3	35 07 18.3	Elbow	27747.8	4.443229
Sec. 26, T. 33, R. 5 E. cen.[1]	42 48 30.63	945.2	80 14 33	260 14 28	Santee	179.1	2.25317
	97 51 26.66	605.8					
Sec. 36, T. 96, R. 60 E. cen.[1]	43 05 24.76	764.1	69 10 27	249 10 16	Vod	386.9	2.58763
	97 52 15.86	358.7					
Sec. 36, T. 96, R. 60 SE. corner, and U. S. G. S. B. M.[1]	43 04 58 89	1817.3	151 43 23	331 43 12	Vod	750.3	2.87524
	97 52 16.13	364.9	180 26 42	0 26 42	Sec. 36, T. 96, R. 60 E. cen.	798.4	2.90220
Sec. 17, T. 100 N., R. 57 W., NW. cor.	43 29 12.81	395.3	322 11 03	142 11 21	Wolf Creek	965.2	2.984614
	97 37 11.38	255.7					
Sec. 18, T. 100 N., R. 55 W., NW. cor.	43 29 15.74	485.8	91 50 42	271 50 16	Silver Lake	847.1	2.927924
	97 24 03.91	87.9					
Sec. 21, T. 103 N., R. 55 W., NW. cor.	43 43 02.19	67.6	321 35 07	141 35 27	Salem	1032.9	3.014076
	97 26 55.34	1238.9					
Sec. 14, T. 105 N., R. 57 W., NE. cor.	43 54 26.46	816.6	0 33 40	180 33 40	Reese	807.3	2.907029
	97 37 48.59	1084.3					
Sec. 20, T. 105 N., R. 55 W., NE. cor.	43 53 31.56	974.0	86 27 57	266 27 32	Canova	805.8	2.906250
	97 26 57.92	1292.8					
Sec. 20, T. 105 N., R. 54 W., NE. cor.	43 53 31.64	976.5	58 16 29	238 16 15	Owens	554.6	2.744016
	97 19 43.54	971.8					
Sec. 21, T. 107 N., R. 54 W., ¼ cor., center S. side	44 03 05.20	160.5	224 48 19	44 48 28	Crane	423.5	2.626856
	97 19 10.27	228.6	253 27 21	73 27 27	Aux. sta., near Crane	187.0	2.271805
Sec. 26, T. 110 N., R. 55 W., ¼ cor., center E. side	44 18 12.50	385.8	86 21 03	266 20 39	Hansen	748.9	2.874447
	97 23 26.87	595.6					
Sec. 28, T. 109 N., R. 53 W., NE. cor.	44 13 28.87	891.1	87 36 59	267 36 36	Brock	719.9	2.857262
	97 11 21.90	486.2					
Sec. 15, T. 108 N., R. 55 W., NW. cor.	44 10 03.81	117.6	275 06 30	95 06 36	Miner	177.0	2.247920
	97 25 50.37	1119.1					
Sec. 13, T. 109 N., R. 56 W., SW. cor.	44 14 18.99	586.2	269 44 06	89 44 25	Drakola	596.7	2.775764
	97 30 41.06	911.2					

[1] No check on this position.

Page to Fergus Falls—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Sec. 29, T. 110 N., R. 52 W., NE. ¼ NW. cor.	44 18 40.89 97 05 56.76	1262.2 1258.0	275 41 07	95 41 13	Jeska	202.2	2.305735
Sec. 34, T. 111 N., R. 53 W., SE. cor.	44 22 10.24 97 10 07.73	316.1 171.2	178 13 36	358 13 36	Larson	437.8	2.641281
Sec. 33, T. 112 N., R. 51 W., NE. cor.	44 28 13.26 96 56 50.62	409.3 1118.8	46 45 01	226 44 41	Oakwood Lake	863.2	2.936094
Sec. 26, T. 112 N., R. 54 W., NW. cor.	44 29 05.39 97 17 22.57	166.4 498.7	276 58 17	96 58 36	Weiss	595.1	2.774565
Sec. 36, T. 115 N., R. 53 W., ¼ cor., center, N. side	44 43 52.44 97 08 15.21	1618.7 334.7	342 51 35	162 51 39	Horswill	425.0	2.628411
Sec. 34, T. 113 N., R. 51 W., SW. cor.	44 53 24.52 96 56 36.47	756.9 800.3	204 17 02	24 17 14	Franklin	949.1	2.977300
Sec. 31, T. 119 N., R. 53 W., ¼ cor., center, N. side	45 04 43.38 97 14 19.52	1339.0 427.0	14 04 10	194 04 07	Helgen	363.2	2.560094
Sec. 10, T. 125 N., R. 52 W., NE. cor.	45 37 51.88 97 08 38.30	1601.7 829.6	80 09 43	260 09 37	Drywood	202.2	2.305735
Sec. 18, T. 124 N., R. 49 W., SE. cor.	45 32 36.17 96 50 26.94	1116.5 584.5	99 46 06	279 45 51	Brown V., SE. base	464.2	2.666691
Sec. 17, T. 125 N., R. 48 W., ¼ cor., center, W. side	45 38 12.55 96 44 23.43	387.4 507.5	226 22 28	46 22 38	Layden	384.1	2.584395

Fergus Falls to Canada.

Fergus Falls Northwestern College tower 1906	46 16 33.335 96 04 03.407	1029.3 72.9	318 26 38.8 92 09 56.8 147 00 34.7	138 32 19.9 271 58 43.0 326 53 57.4	Dalton Fox Indian	15314.1 19972.4 21522.9	4.185092 4.300431 4.332900
Fergus Falls Asylum, stack 1906	46 18 01.797 96 04 56.557	55.5 1210.4	321 28 33.1 340 15 01.4 20 49 04.8 57 47 12.5 79 05 34.6 83 59 36.6 145 21 28.6	141 34 52.8 160 21 23.4 200 45 09.8 237 27 39.8 258 45 25.9 263 49 01.1 325 15 29.7	Dalton Elbow Western Foss Wahpeton Fox Indian	18103.0 33725.2 19657.8 41246.6 36499.3 18924.2 18620.0	4.257751 4.527954 4.293534 4.615388 4.562285 4.277018 4.269980
Foxhome white elevator, center 1906	46 16 46.855 96 18 25.955	1447.7 555.7	75 49 59.0 101 32 51.2 200 47 42.3 327 05 49.4	255 39 35.3 281 32 00.9 20 51 29.2 147 11 38.8	Wahpeton Fox Indian Western	19078.2 1523.2 18855.8 19123.1	4.280538 3.182755 4.275446 4.281558
Foxhome red elevator, center 1906	46 16 46.683 96 18 32.109	1441.4 687.4	102 50 35.0 201 09 40.9 326 45 25.1	282 49 49.1 21 13 32.2 146 51 18.8	Fox Indian Western	1395.5 18908.0 19190.5	3.144739 4.276645 4.283087
Foxhome schoolhouse cupola 1906	46 16 27.686 96 18 36.913	854.9 790.3	77 24 44.2 125 29 15.8 325 30 39.9	257 14 28.4 305 28 33.4 145 36 37.1	Wahpeton Fox Western	18713.0 1544.7 18760.8	4.272143 3.188836 4.273252
Everdell elevator, broad 1906	46 16 15.932 96 24 33.644	491.9 720.4	258 48 08.3 309 31 26.6 70 37 53.3	78 51 43.7 129 41 41.3 250 31 55.3	Fox Western Wahpeton	6503.1 23699.4 11257.0	3.813120 4.374737 4.051422
Everdell elevator, slender 1906	46 16 15.109 96 24 42.936	466.5 919.4	258 55 03.8 309 10 14.4 70 24 42.9	78 58 45.9 129 20 35.8 250 18 51.6	Fox Western Wahpeton	6703.3 23837.2 11060.9	3.826286 4.377255 4.043791
Wataseo lone elevator 1906	46 15 57.330 96 28 24.198	1770.2 518.2	172 12 09.9 260 44 31.9 301 57 24.8	352 10 43.9 80 50 53.8 122 10 25.9	Meadows Fox Western	18702.7 11464.4 27379.0	4.271904 4.059352 4.437418

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Breckenridge Hospital cupola	46 15 33.789	1043.3	198 07 39.5	18 11 13.2	Meadows	20265.2	4.306751
	96 35 18.370	393.4	234 49 51.1	55 05 50.2	Indian	34628.3	4.539431
1906			262 40 32.2	82 51 53.4	Fox	20394.8	4.309520
			307 22 57.3	127 24 45.0	Wahpeton	4019.7	3.604189
Breckenridge courthouse cupola	46 15 37.791	1166.9	197 57 27.6	18 00 57.8	Meadows	20115.6	4.303533
	96 35 13.532	289.8	234 54 01.7	55 09 57.7	Indian	34472.4	4.537472
1906			262 59 11.2	83 10 29.0	Fox	20229.7	4.305990
			309 40 59.9	129 42 44.1	Wahpeton	4015.6	3.603751
Carlisle elevator, north gable [1]	46 22 07.22	222.9	47 26 40	227 20 47	Fox	14162.4	4.151137
	96 11 28.37	606.4	106 27 24	286 13 47	Meadows	25260.2	4.402436
1906							
Oscar church spire	46 23 50.963	1573.6	353 49 41.3	173 51 27.5	Western	29328.7	4.467293
1906	96 12 48.916	1045.0	34 15 37.3	214 10 43.0	Fox	15468.2	4.189439
			99 56 46.0	279 44.02.4	Meadows	22848.9	4.358865
			173 41 25.9	353 41 09.0	Indian	4556.2	3.658606
Church (N. of Fox), spire	46 22 10.499	324.2	117 48 32.8	297 41 01.2	Meadows	15050.5	4.177552
1906	96 19 59.513	1272.1	228 41 44.7	48 46 39.6	Indian	11570.0	4.063334
			356 58 59.9	176 59 17.2	Fox	9701.8	3.986854
Church (NW. of Foxhome), spire	46 23 02.015	62.2	116 06 58.6	296 00 43.1	Meadows	12327.1	4.090860
	96 21 44.611	953.3	241 02 47.8	61 08 58.8	Indian	12497.1	4.096810
1906			346 14 47.4	166 16 20.7	Fox	11611.4	4.064885
Brushvale low elevator, center [1]	46 22 13.83	427.0	236 47 34	56 53 33	Meadows	12623.2	4.101170
	96 38 37.74	806.7	256 50 15	77 08 40	Indian	33441.7	4.524288
1906							
Brushvale tall elevator, center [1]	46 22 15.45	477.0	237 00 16	57 06 15	Meadows	12602.6	4.100460
	96 38 38.13	815.0	256 55 29	77 13 54	Indian	33438.2	4.524243
1906							
Church (5 miles N. of Indian), spire	46 30 55.113	1701.8	0 15 52.5	180 15 51.2	Indian	8568.2	3.932892
	96 13 10.517	224.2	67 27 13.6	247 14 45.0	Meadows	23868.6	4.377827
1906			135 01 02.3	314 50 20.1	Barnesville	26575.8	4.424486
			180 36 07.6	0 36 15.1	Tansem	20615.4	4.314192
Lawndale elevator	46 33 19.202	592.9	39 39 11.9	219 32 48.2	Meadows	17703.9	4.248068
1906	96 21 33.883	721.7	214 00 04.4	34 06 17.8	Tansem	19510.8	4.290274
			320 32 38.0	140 38 41.8	Indian	16847.1	4.226526
Barnesville tall elevator	46 38 37.623	1161.7	16 14 08.2	196 10 15.8	Meadows	24444.4	4.388180
1906	96 25 02.932	62.4	140 54 25.8	320 52 21.0	Barnesville	5782.5	3.762118
			247 31 16.7	67 40 02.4	Tansem	16614.2	4.220480
			326 23 58.5	146 32 34.3	Indian	27410.5	4.437917
Barnesville standpipe	46 39 16.505	509.6	14 59 39.6	194 55 54.8	Meadows	25540.1	4.407223
1906	96 25 13.542	287.9	133 51 29.2	313 49 32.1	Barnesville	4744.2	3.676164
			251 41 54.7	71 50 48.2	Tansem	16407.2	4.215035
			327 21 15.1	147 29 58.6	Indian	28539.4	4.455445
Barnesville church spire	46 39 22.317	689.1	14 56 59.1	194 53 13.4	Meadows	25720.5	4.410279
1906	96 25 12.261	260.7	132 01 40.8	311 59 42.8	Barnesville	4641.9	3.666693
			252 15 59.8	72 24 52.4	Tansem	16325.8	4.212875
			327 35 37.3	147 44 19.9	Indian	28676.0	4.457519
Barnesville stack	46 39 05.015	154.9	15 03 01.0	194 59.18.6	Meadows	25179.4	4.401046
1906	96 25 16.800	357.2	137 22 37.5	317 20 42.8	Barnesville	4949.4	3.694555
			250 36 33.5	70 45 29.4	Tansem	16587.4	4.219779
			326 50 51.1	146 59 37.0	Indian	28279.1	4.451466
Rollag church spire [1]	46 44 24.04	742.3	339 17 22	159 18 18	Tansem	4665.6	3 668906
1906	96 14 17.98	381.7	122 35 18	302 25 52	Riverton	19545.6	4.291049
Downer NW. elevator	46 45 08.695	268.5	193 58 43.2	14 00 01.3	Riverton	9404.6	3.973142
1906	96 29 02.267	48.1	241 01 07.9	61 11 10.2	Eglon	20015.9	4.301374
			285 36 24.2	105 48 04.6	Tansem	21218.9	4.326722
			349 15 23.7	169 16 13.0	Barnesville	7724.4	3.887862
Downer SE. elevator	46 45 05.997	185.2	193 37 06.1	13 38 22.8	Riverton	9475.9	3.976619
1906	96 29 00.347	7.4	240 45 15.0	60 55 15.9	Eglon	20020.8	4.301481
			285 25 09.9	105 36 48.9	Tansem	21157.4	4.325462
			349 26 26.0	169 27 13.9	Barnesville	7634.9	3.882805

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Church (3 mi. E. of Eglon) spire 1906	46 50 04.403 96 13 06.436	135.9 136.4	90 04 05.1 101 09 58.5 142 15 35.7	269 53 46.1 281 08 24.0 322 06 41.6	Riverton Eglon Keene	17984.6 2798.1 25235.3	4.254901 3.446860 4.402008
Muscada elevator 1906	46 52 13.627 96 24 24.088	420.8 510.2	286 29 19.0 322 22 36.2 42 12 32.4	106 35 58.9 142 30 54.5 222 10 27.6	Eglon Tansem Riverton	12112.8 23796.0 5393.4	4.083245 4.376504 3.731867
Glyndon elevator [1] 1906	46 52 24.53 96 34 46.71	757.5 989.1	278 33 39 294 19 04	98 47 54 114 24 33	Eglon Riverton	25087.8 10503.2	4.399463 4.021322
Glyndon church spire [1] 1906	46 52 27.85 96 34 35.93	860.0 760.9	278 52 28 295 21 27	99 06 34 115 26 48	Eglon Riverton	24877.6 10339.0	4.395809 4.014479
Fargo Catholic Church spire 1906	46 52 56.600 96 47 17.573	1747.8 372.0	242 13 24.5 276 29 52.2 281 40 53.3 294 37 29.4	62 29 28.9 96 53 14.4 101 55 30.7 115 02 28.9	Keene Eglon Riverton Tansem	31508.4 40982.6 26022.9 48078.5	4.498426 4.612599 4.415356 4.681951
Averill elevator 1906	46 58 01.594 96 32 55.014	49.2 1162.9	149 58 40.9 241 39 59.9 333 56 52.5	329 56 09.6 61 45 34.4 154 01 00.8	Morken Keene Riverton	8734.1 10973.6 16403.7	3.941220 4.040349 4.214941
Hitterdal tall church spire [1] 1906	46 58 33.38 96 15 33.44	1030.8 706.4	193 19 01.4 358 36 13.0	13 22 25.7 178 36 25.8	Syre Eglon	25499.8 15180.5	4.406536 4.181286
Hitterdal elevator [1] 1906	46 58 43.27 96 15 26.96	1336.2 569.8	193 10 31 359 08 20	13 13 51 179 08 28	Syre Eglon	25171.0 15483.3	4.400901 4.189863
Hitterdal low church spire [1] 1906	46 58 28.76 96 15 28.62	888.1 605.0	193 01 21 358 58 47	13 04 42 178 58 56	Syre Eglon	25615.6 15035.7	4.408504 4.177122
Church (NE. of Fargo) spire [1] 1906	46 57 46.10 96 39 36.02	1423.5 761.4	206 59 55.8 252 31 41.2	27 02 17.7 72 42 08.8	Morken Keene	9024.0 19005.7	3.955400 4.278885
Church spire (3 miles NE. of Keene) 1906	47 02 08.147 96 21 51.553	251.6 1088.4	61 02 08.0 148 02 51.8 217 15 35.2	240 58 37.2 327 55 53.9 37 22 36.7	Keene Borup Syre	4977.9 19428.3 22856.0	3.697046 4.288434 4.359001
Felton elevator 1906	47 04 44.435 96 30 24.614	1372.1 519.2	57 08 11.1 182 32 11.3 318 08 46.1	237 03 49.5 2 32 29.2 138 12 30.7	Morken Borup Keene	8983.0 11657.9 9715.1	3.953423 4.066619 3.987447
Felton church spire 1906	47 04 44.169 96 30 05.042	1364.0 106.4	58 33 32.4 180 30 37.5 319 59 03.1	238 28 56.5 0 30 41.2 140 02 33.4	Morken Borup Keene	9328.3 11655.1 9438.3	3.969801 4.066517 3.974895
Felton schoolhouse cupola 1906	47 04 44.462 96 30 02.725	1373.0 57.4	58 40 05.0 180 16 15.0 320 14 52.5	238 35 27.4 0 16 17.0 140 18 21.1	Morken Borup Keene	9374.7 11645.7 9413.9	3.971958 4.066166 3.973771
Borup church spire 1906	47 10 49.940 96 30 05.320	1542.1 112.2	26 12 04.5 196 59 10.7 265 00 38.2 341 50 37.4	206 07 28.5 16 59 14.5 85 14 42.4 161 54 08.0	Morken Borup Syre Keene	18012.1 375.5 24317.7 19494.6	4.255564 2.574032 4.385922 4.289915
Borup elevator, slender top 1906	47 10 50.332 96 30 25.196	1554.2 530.5	265 07 08.0 340 41 26.1 24 58 27.1	85 21 26.9 160 45 11.3 204 54 05.7	Syre Keene Morken	24733.5 19640.5 17842.3	4.393286 4.293153 4.251450
Borup elevator, tall 1906	47 10 52.137 96 30 25.304	1610.0 532.8	265 14 52.4 340 44 17.1 24 53 32.3	85 29 11.4 160 48 02.4 204 49 11.0	Syre Keene Morken	24731.1 19693.9 17891.9	4.393243 4.294331 4.252656
Wheatville elevator, red, slender top [1] 1906	47 13 30.80 96 30 25.23	951.2 530.8	276 35 56 353 27 14	96 50 15 173 27 33	Syre Borup	24808.9 4638.8	4.394607 3.666402
Wheatville elevator, yellow [1] 1906	47 13 32.16 96 30 25.31	993.1 532.5	276 41 42 353 29 26	96 56 01 173 29 45	Syre Borup	24815.6 4680.8	4.394724 3.670321

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Ada standpipe	47 18 05.085	157.1	240 21 24.0	60 32 09.6	Gary	21180.5	4.325937
1906	96 31 00.385	8.1	294 01 51.0	114 16 36.6	Syre	27793.5	4.443943
			347 14 24.3	167 18 35.6	Keene	32770.2	4.515479
			354 27 28.0	174 28 12.3	Borup	13140.4	4.118607
Ada schoolhouse cupola	47 17 51.732	1597.7	238 52 02.9	59 02 35.0	Gary	21057.4	4.323405
1906	96 30 42.080	884.0	293 34 20.5	113 48 52.6	Syre	27275.2	4.435768
			347 44 52.7	167 48 50.5	Keene	32284.3	4.508991
Ada courthouse tower	47 17 54.800	1692.3	239 14 56.5	59 25 32.7	Gary	21108.0	4.324447
1906	96 30 47.592	999.8	293 39 21.1	113 53 57.3	Syre	27419.3	4.438056
			355 31 14.2	175 31 49.1	Borup	12800.4	4.107224
Twin Valley standpipe	47 15 35.700	1102.4	65 10 13.3	244 59 37.6	Borup	20093.2	4.303050
1906	96 15 33.995	714.8	176 07 48.0	356 07 12.3	Gary	15095.0	4.178832
			318 56 31.7	138 59 57.0	Syre	8960.3	3.952324
			24 16 27.4	204 09 19.5	Keene	29990.7	4.476987
Twin Valley white church spire	47 15 34.707	1071.8	65 01 12.0	244 50 42.9	Borup	19908.8	4.299044
1906	96 15 42.993	904.0	176 51 05.5	356 50 36.4	Gary	15113.9	4.179378
			317 54 40.1	137 58 12.0	Syre	9062.9	3.957269
Twin Valley tall elevator, slender top [1]	47 15 33.76	1042.6	175 49 31	355 48 53	Gary	15160.5	4.180714
1906	96 15 29.95	629.7	319 06 14	139 09 36	Syre	8859.4	3.947406
Church spire (5 miles NE. of Borup) [1]	47 15 09.02	278.6	287 00 56	107 12 09	Syre	20175.8	4.304830
1906	96 26 10.96	230.4	32 16 24	212 13 36	Borup	9035.8	3.955966
Gary church spire	47 22 16.410	506.8	92 40 17.2	272 29 46.3	Wicklow	18006.4	4.255428
1906	96 16 01.528	32.1	170 39 58.0	350 39 42.5	Gary	2721.6	3.434824
			341 19 41.8	161 23 27.5	Syre	20193.6	4.305213
Gary north elevator	47 22 23.092	713.2	92 02 07.6	271 51 43.6	Wicklow	17802.5	4.250482
1906	96 16 10.852	227.7	174 20 07.9	354 19 59.3	Gary	2491.4	3.396436
			340 59 32.5	161 03 25.1	Syre	20452.0	4.310736
Gary south elevator	47 22 12.490	385.7	93 05 12.3	272 54 48.1	Wicklow	17822.9	4.250979
1906	96 16 10.576	221.9	174 52 31.7	354 52 22.9	Gary	2817.9	3.449920
			340 42 16.7	160 46 09.1	Syre	20140.9	4.304078
Hadler south elevator	47 22 09.869	304.8	245 40 29.6	65 41 48.3	Wicklow	2462.1	3.391301
1906	96 32 05.908	124.0	261 36 04.1	81 47 38.3	Gary	19997.0	4.300964
			305 11 18.5	125 26 52.7	Syre	32748.1	4.515186
Hadler north elevator	47 22 11.610	358.5	246 54 59.7	66 56 18.7	Wicklow	2449.6	3.389090
1906	96 32 06.381	133.9	261 45 27.4	81 57 01.9	Gary	19999.0	4.301009
			305 15 18.5	125 30 53.0	Syre	32787.2	4.515704
Fleming elevator	47 27 33.087	1021.8	346 51 47.1	166 55 42.8	Syre	29687.3	4.472571
1906	96 16 14.945	313.1	1 17 33.0	181 17 27.4	Gary	7096.2	3.851024
			63 12 20.3	243 01 58.8	Wicklow	19835.1	4.297435
Lockhart church spire	47 25 31.225	964.4	161 32 27.6	341 30 13.2	Beltrami	12048.9	4.080946
1906	96 32 15.040	315.2	236 52 39.3	57 02 46.9	Fertile	20592.0	4.313698
			334 55 28.9	154 56 54.4	Wicklow	5745.7	3.759341
Lockhart elevator	47 26 25.141	776.4	163 01 13.3	342 59 28.3	Beltrami	10208.4	4.008956
1906	96 32 54.901	1150.5	242 03 30.8	62 14 07.8	Fertile	20465.4	4.311021
			334 32 03.1	154 33 57.9	Wicklow	7608.1	3.881274
Rindal church spire [1]	47 27 24.18	746.7	28 13 27	208 11 18	Gary	7738.1	3.888634
1906	96 13 28.07	588.0	67 47 54	247 35 30	Wicklow	22904.1	4.359914
Fertile large elevator [1]	47 32 12.67	391.3	59 25 58	239 24 48	Fertile	2302.5	3.362208
1906	96 16 55.85	1168.1	87 42 06	267 28 33	Beltrami	23061.3	4.362883
Fertile small elevator [1]	47 32 16.98	524.4	57 00 32	236 59 21	Fertile	2395.0	3.379297
1906	96 16 54.60	1141.9	87 22 28	267 08 54	Beltrami	23093.1	4.363483
Fertile standpipe	47 32 02.053	63.4	358 16 44.9	178 17 01.1	Gary	15407.9	4.187744
1906	96 16 44.641	933.7	44 43 14.1	224 33 14.0	Wicklow	24277.0	4.385195
			69 10 52.3	249 09 34.1	Fertile	2371.9	3.375104
			88 31 59.1	268 18 18.2	Beltrami	23284.8	4.367073

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station.	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Beltrami south elevator, slender top 1906	47 32 28.924 96 31 53.636	893.3 1121.6	309 40 46.3 353 44 22.8 70 57 52.8 275 36 25.1	129 52 12.5 173 45 32.6 250 55 22.5 95 46 17.6	Gary Wicklow Beltrami Fertile	25369.6 18212.9 4509.3 16878.8	4.404314 4.260379 3.654109 4.227342
Beltrami north elevator 1906	47 32 34.969 96 31 53.688	1080.3 1122.8	310 00 03.3 353 47 58.6 68 44 54.5 276 14 12.1	130 11 29.5 173 49 08.4 248 42 24.2 96 24 04.6	Gary Wicklow Beltrami Fertile	25490.1 18398.6 4572.6 16899.2	4.406371 4.264784 3.660160 4.227867
Melvin elevator 1906	47 37 13.212 96 23 01.422	408.1 29.7	203 24 31.5 331 32 22.6 56 23 32.0 122 27 27.4	23 26 53.8 151 35 42.5 236 14 28.8 302 17 24.7	Tilden Fertile Beltrami Andover	10103.8 11887.0 18485.6 20138.0	4.004486 4.075073 4.266834 4.304017
Russia elevator 1906	47 37 32.237 96 33 35.954	995.6 750.7	11 04 43.2 159 43 28.5 300 10 19.3	191 03 28.3 339 41 14.9 120 21 27.6	Beltrami Andover Fertile	11045.2 10869.9 21906.5	4.043174 4.036227 4.340571
Climax tall elevator [1] 1906	47 36 27.14 96 48 54.97	838.2 1148.2	231 31 58 297 14 24	51 41 04 117 24 27	Andover Beltrami	19653.8 19235.1	4.293447 4.284094
Eldred southwest low elevator [1] 1906	47 40 52.34 96 46 56.60	1616.5 1180.5	252 40 48 319 17 46	72 48 26 139 26 23	Andover Beltrami	13534.6 22426.8	4.131446 4.350768
Eldred northeast tall elevator [1] 1906	47 40 56.08 96 46 47.89	1732.0 998.9	252 55 21 319 50 33	73 02 53 139 59 03	Andover Beltrami	13327.0 22396.9	4.124734 4.350187
Kittson elevator 1906	47 41 01.451 96 35 35.758	44.8 745.8	358 43 46.6 161 13 08.6 263 28 56.4 309 09 23.8	178 44 00.2 341 12 23.6 83 40 36.7 129 22 00.9	Beltrami Andover Tilden Fertile	17305.4 3943.9 19869.1 27655.4	4.238181 3.595924 4.298179 4.441780
Crookston standpipe 1906	47 46 27.215 96 36 36.928	840.5 768.8	290 21 54.6 359 57 09.9 150 34 40.0 212 52 38.2	110 34 20.6 179 57 10.1 330 31 26.0 32 58 37.2	Tilden Andover Shirley Ives	22417.2 6327.3 11074.1 21613.9	4.350581 3.801220 4.044309 4.334733
Crookston high school cupola 1906	47 46 32.479 96 36 12.453	1003.1 259.3	291 13 44.9 4 26 54.8 147 54 05.3	111 25 52.8 184 26 36.9 327 50 33.2	Tilden Andover Shirley	21998.6 6509.5 11195.1	4.342395 3.813548 4.049027
Crookston Catholic Church spire 1906	47 46 14.973 96 36 25.414	462.4 529.1	2 15 35.3 150 27 55.2 211 47 40.9	182 15 27.0 330 24 32.7 31 54 31.3	Andover Shirley Ives	5953.8 11521.3 21805.2	3.774799 4.061500 4.338561
Crookston courthouse dome 1906	47 46 43.712 96 36 06.638	1350.0 138.2	5 13 57.2 146 24 14.3 292 11 09.9	185 13 35.0 326 20 37.9 112 23 13.5	Andover Shirley Tilden	6865.4 10969.3 22014.4	3.836665 4.040178 4.342707
Crookston brickyard chimney 1906	47 45 53.721 96 35 49.482	1659.1 1030.4	10 31 42.6 148 58 02.5 288 40 42.1	190 31 07.7 328 54 13.4 108 52 32.9	Andover Shirley Tilden	5383.4 12465.5 21140.2	3.731058 4.095708 4.325110
Euclid school belfry 1906	47 58 24.071 96 38 27.181	743.4 563.8	285 51 05.1 14 08 28.6 126 22 44.2 229 04 24.2	105 59 26.7 194 06 36.2 306 18 23.7 49 11 39.5	Ives Shirley Sherack Bray	14570.0 12886.8 9023.8 16114.9	4.163460 4.110144 3.955390 4.207227
Euclid tall elevator, brown 1906	47 58 19.015 96 38 14.426	587.1 299.2	285 32 28.5 15 27 45.8 126 11 23.9 228 02 01.4	105 40 40.5 195 25 43.9 306 06 53.9 48 09 09.1	Ives Shirley Sherack Bray	14273.0 12803.4 9329.4 16019.9	4.154516 4.107325 3.969856 4.204660
Euclid low elevator, red 1906	47 58 21.634 96 38 15.970	668.2 331.2	285 49 05.7 15 13 44.4 125 54 09.4	105 57 18.9 195 11 43.7 305 49 40.6	Ives Shirley Sherack	14325.8 12872.9 9256.0	4.156118 4.109678 3.966422
Sherack tall elevator 1906	48 01 17.548 96 47 00.878	542.0 18.2	257 05 00.3 270 09 33.3 337 07 49.4	77 18 39.7 90 11 34.5 157 12 18.4	Bray Sherack Shirley	23402.5 3379.3 19373.1	4.369262 3.528829 4.287200
Sherack low elevator [1] 1906	48 01 10.22 96 47 00.15	315.6 3.1	256 32 09 266 18 32	76 45 48 86 20 33	Bray Sherack	23439.4 3371.2	4.369947 3.527786

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Angus tall elevator (low top) 1906	48 04 46.317 96 42 04.181	1430.5 86.5	23 12 21.5 171 21 50.3 217 43 50.6	203 10 42.1 351 20 22.0 37 53 19.4	Sherack Warren Viking	7026.3 16301.0 25730.9	3.846729 4.212213 4.410455
Angus tall elevator (tall top) 1906	48 04 51.508 96 42 07.136	1590.7 147.7	22 14 55.2 171 29 33.6 218 03 26.8	202 13 18.0 351 28 07.4 38 12 57.8	Sherack Warren Viking	7150.6 16133.3 25641.9	3.854342 4.207723 4.408950
Tabor west church spire [1] 1906	48 04 44.00 96 52 10.97	1359.1 227.1	211 53 16 303 02 45	31 59 20 123 08 37	Warren Sherack	19074.9 11697.1	4.280462 4.068078
Tabor east church spire [1] 1906	48 04 43.95 96 51 36.39	1357.6 753.2	210 01 50 305 03 41	30 07 28 125 09 07	Warren Sherack	18707.9 11103.0	4.272024 4.045440
Brush farm elevator 1906	48 05 43.208 96 44 25.599	1334.6 529.7	181 52 45.8 225 05 35.8 358 52 20.2	1 53 02.8 45 16 50.1 178 52 26.0	Warren Viking Sherack	14366.2 26350.2 8217.3	4.157342 4.420784 3.914728
Lone elevator (between Warren and Radium) 1906	48 07 06.444 96 42 24.111	199.0 498.7	12 19 11.3 170 11 56.6 225 14 16.0	192 17 46.7 350 10 43.1 45 23 59.9	Sherack Warren Viking	11040.4 11962.5 22755.4	4.042983 4.077822 4.357084
Roon elevator 1906	48 09 02.187 96 44 36.464	67.6 753.7	184 50 24.4 236 35 33.7 294 44 04.9	4 50 49.5 56 46 56.6 114 55 57.6	Warren Viking Bray	8242.0 22625.0 21822.7	3.916035 4.354588 4.338909
Viking west elevator, slender top 1906	48 13 01.711 96 24 18.546	52.8 382.9	18 02 20.6 92 01 51.3 128 54 43.5	197 59 06.6 271 47 08.2 308 50 58.1	Bray Warren Viking	17417.0 24457.5 8009.5	4.240974 4.388412 3.903604
Viking east elevator, large top 1906	48 13 00.731 96 24 14.638	22.6 302.2	18 19 23.0 92 05 44.3 128 43 15.5	198 16 06.1 271 50 58.3 308 39 27.1	Bray Warren Viking	17413.5 24539.2 8091.3	4.240885 4.389860 3.908017
Viking low elevator 1906	48 13 01.318 96 24 16.947	40.7 349.9	18 09 17.8 92 03 24.5 128 49 55.3	198 06 02.6 271 48 40.2 308 46 08.7	Bray Warren Viking	17415.8 24490.9 8042.7	4.240943 4.389005 3.905404
Warren standpipe 1906	48 12 00.330 96 46 29.211	10.2 603.2	228 06 30.4 251 49 39.3 352 11 37.6	48 08 19.6 72 02 26.4 172 13 15.5	Warren Viking Sherack	4060.2 22325.7 20049.0	3.608549 4.348805 4.302093
Warren courthouse, tower 1906	48 11 43.982 96 46 06.100	1358.4 126.0	218 21 48.2 250 11 52.8 353 23 14.0	38 23 20.1 70 24 22.6 173 24 34.6	Warren Viking Sherack	4101.3 22038.6 19488.2	3.612923 4.343185 4.289771
Warren school cupola 1906	48 11 51.327 96 46 05.256	1585.1 108.5	220 13 29.3 250 44 24.1 353 30 49.0	40 15 00.6 70 56 53.3 173 32 09.0	Warren Viking Sherack	3914.7 21946.4 19711.6	3.592697 4.341363 4.294721
Radium east elevator (low) 1906	48 13 40.628 96 36 43.034	1254.9 888.1	87 36 00.1 247 12 37.0 330 33 56.4	267 30 32.2 67 18 07.0 150 39 56.9	Warren Viking Bray	9084.1 9895.0 20388.4	3.958280 3.995416 4.309384
Radium tall elevator 1906	48 13 40.286 96 36 44.627	1244.4 921.0	87 39 27.8 247 13 38.3 330 28 13.4	267 34 01.0 67 19 09.4 150 34 15.0	Warren Viking Bray	9050.8 9929.4 20395.5	3.956686 3.996922 4.309534
Radium west elevator, large top 1906	48 13 39.600 96 36 47.867	1223.2 987.8	87 46 28.0 247 15 47.3 330 16 37.3	267 41 03.7 67 21 20.9 150 22 41.4	Warren Viking Bray	8983.1 9999.3 20410.1	3.953428 3.999968 4.309846
Woodward farm elevator [1] 1906	48 13 27.69 96 49 59.94	855.3 1237.2	183 55 08 269 52 13	3 55 48 89 56 40	Argyle Warren	16241.6 7371.9	4.210629 3.867579
Luna elevator 1906	48 15 15.618 96 47 38.202	482.4 788.1	172 00 26.8 267 37 51.5 306 44 48.1	351 59 21.2 87 51 30.4 126 47 28.8	Argyle Viking Warren	12996.5 22654.4 5549.1	4.113827 4.355152 3.744224
Argyle electric-light plant, smokestack 1906	48 19 56.804 96 48 59.328	1754.6 1221.7	178 06 58.5 249 41 45.2 332 58 58.1	358 06 53.5 69 54 15.0 153 02 39.4	Argyle Wright Warren	4187.1 22001.0 13474.0	3.621909 4.342442 4.129496
Argyle tallest elevator 1906	48 20 00.561 96 49 04.144	17.3 85.4	179 27 38.9 250 04 02.2 332 49 51.8	359 27 37.5 70 16 35.6 152 53 36.7	Argyle Wright Warren	4068.9 22054.4 13622.6	3.609478 4.343495 4.134259

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Argyle tallest church spire 1906	48 20 01.777 96 49 31.208	54.9 642.8	187 19 55.4 250 38 01.9 330 51 15.8	7 20 14.2 70 50 55.5 150 55 20.9	Argyle Wright Warren	4064.4 22566.7 13918.7	3.609000 4.353468 4.143600
Stephen low church spire 1906	48 26 58.384 96 52 39.465	1803.4 811.0	244 35 39.6 251 53 41.9 282 02 42.8 333 33 41.9	64 36 38.3 72 00 02.6 102 17 58.0 153 36 21.6	Stephen W. base Stephen E. base Wright Argyle	1782.5 10987.1 25728.5 9867.4	3.251032 4.040884 4.410415 3.994202
Stephen tall church spire 1906	48 27 03.622 96 52 40.377	111.9 829.7	249 41 15.2 252 43 46.6 282 23 17.1 333 52 39.6	69 42 14.5 72 50 07.9 102 38 33.0 153 55 19.9	Stephen W. base Stephen E. base Wright Argyle	1736.8 10955.7 25781.1 10020.8	3.239760 4.039642 4.411301 4.000901
Stephen school cupola 1906	48 27 00.888 96 52 43.739	27.4 898.8	247 57 34.9 252 25 01.4 282 10 17.7 333 18 25.6	67 58 36.7 72 31 25.2 102 25 36.0 153 21 08.4	Stephen W. base Stephen E. base Wright Argyle	1831.8 11047.0 25830.6 9975.8	3.262874 4.043243 4.412135 3.998949
Church spire (8 miles NW. of Wright) 1906	48 29 07.733 96 40 20.179	238.9 414.4	313 23 25.2 76 40 54.3 82 55 08.6	133 29 27.4 256 32 39.5 262 52 15.8	Wright Stephen W. base Stephen E. base	13700.3 13954.8 4775.9	4.136731 4.144725 3.679054
Church spire (5 miles NE. of Stephen W. base) 1906	48 31 19.337 96 47 38.454	597.3 789.2	317 31 24.5 32 05 39.1 107 34 53.3	137 34 00.0 212 02 52.4 287 30 23.0	Stephen E. base Stephen W. base Donaldson	6310.3 8610.0 7762.6	3.800052 3.935002 3.890010
Donaldson church spire [1] 1906	48 34 20.96 96 53 36.40	647.4 746.2	311 26 51 347 50 48	131 33 54 167 52 30	Stephen E. base Stephen W. base	15491.3 13201.5	4.190088 4.120624
Donaldson tall elevator 1906	48 34 26.096 96 53 49.872	806.1 1024.4	268 36 27.9 311 12 40.3 346 49 51.3 356 21 28.1	88 48 05.8 131 19 54.1 166 51 42.7 176 21 36.1	Deer Stephen E. base Stephen W. base Donaldson	19083.1 15803.8 13416.9 3435.8	4.280648 4.198763 4.127651 3.536032
Kennedy school cupola 1907	48 38 21.696 96 54 28.924	670.2 592.2	131 10 57.9 233 13 47.0 354 33 41.9	311 05 57.3 53 20 31.5 174 34 19.2	Skane Jupiter Donaldson	10876.7 13746.1 10754.7	4.036497 4.138179 4.031600
Kennedy church spire 1907	48 38 21.011 96 54 25.912	649.0 530.5	233 00 19.0 288 54 52.0 354 52 45.7	53 07 01.3 109 06 57.4 174 53 20.8	Jupiter Deer Donaldson	13709.4 20947.2 10728.0	4.137020 4.321126 4.030519
Church spire (7 miles NW. of Deer) 1907	48 39 33.423 96 46 46.925	1032.4 960.3	311 00 51.0 33 12 58.2 105 44 08.0 194 37 44.1	131 07 12.0 213 07 49.0 285 33 20.4 14 38 41.6	Deer Donaldson Skane Jupiter	13793.9 15438.1 18318.7 6203.4	4.139686 4.188595 4.262895 3.792633
Church spire (9 miles NW. of Deer) 1907	48 39 36.003 96 44 07.892	1112.1 161.5	321 57 42.3 103 12 11.2 164 07 31.0	142 02 04.0 282 59 24.1 344 06 29.1	Deer Skane Jupiter	11601.0 21450.8 6157.5	4.064495 4.331444 3.789405
Church spire (5 miles S. of Skane) [1] 1907	48 39 36.81 97 02 08.67	1137.0 177.4	194 05 44 321 14 41	14 06 28 141 21 03	Skane Donaldson	4985.8 16692.3	3.697736 4.222517
Halma elevator [1] 1907	48 39 40.00 96 35 53.22	1235.5 1089.1	17 53 36 116 13 36	197 51 47 296 06 23	Deer Jupiter	9734.9 13150.4	3.988332 4.118938
Chatham elevator [1] 1907	48 42 51.64 96 55 21.21	1595.1 433.6	270 30 40 305 51 55	90 38 04 126 04 42	Jupiter Deer	12080.5 25851.1	4.082086 4.412479
Church spire (8 miles SE. by E. of Hallock) 1907	48 45 37.970 96 49 16.939	1172.9 346.0	116 17 25.4 178 36 17.3 318 36 24.0	296 12 29.8 358 36 05.7 138 39 14.4	Hallock Granville Jupiter	8946.1 12895.6 7007.3	3.951632 4.110440 3.845552
Hallock standpipe 1907	48 46 13.204 96 56 28.590	407.9 583.8	195 22 39.6 295 11 40.0 37 46 24.7	15 23 08.7 115 19 54.9 217 42 53.7	Hallock Jupiter Skane	2974.8 14872.3 9369.5	3.473456 4.172378 3.971717
Hallock courthouse tower 1907	48 46 19.515 96 56 24.421	602.8 498.6	194 44 57.6 296 00 51.0 37 27 44.6	14 45 23.5 116 09 02.7 217 24 10.5	Hallock Jupiter Skane	2764.4 14879.8 9575.9	3.441602 4.172597 3.981179
Hallock tall church spire 1907	48 46 22.779 96 56 36.712	703.6 736.7	200 21 32.8 295 56 16.6 35 53 22.2	20 22 08.0 116 04 37.6 215 49 57.3	Hallock Jupiter Skane	2744.0 15149.6 9506.8	3.438377 4.180400 3.978036

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Church spire (8 miles E. of Hallock) 1907	48 48 14.133 96 50 18.386	436.6 375.2	329 42 07.4 50 05 50.6 82 43 48.1 186 37 56.4	149 45 44.1 229 57 41.2 262 39 38.6 6 38 31.1	Jupiter Skane Hallock Granville	11674.1 17348.3 6821.5 8122.2	4.067225 4.239258 3.833878 3.909673
Joliette tall church spire 1907	48 49 04.714 97 13 33.481	145.6 683.0	230 38 40.2 257 21 55.4 247 38 47.5	50 53 59.6 77 40 00.5 67 43 43.6	Canada Granville Hill	32067.7 30093.7 8671.1	4.506068 4.478475 3.938074
Joliette tall elevator 1907	48 49 15.083 97 13 39.167	465.9 799.0	231 13 09.4 258 00 24.0 249 53 49.0	51 28 33.0 78 18 33.4 69 58 49.4	Canada Granville Hill	31955.8 30138.7 8663.2	4.504550 4.479124 3.937679
Northcote tall elevator 1907	48 50 33.928 96 59 56.117	1048.0 1144.2	253 30 16.1 315 53 35.3 93 35 35.1	73 38 05.8 135 56 40.6 273 30 15.9	Granville Hallock Hill	13255.7 7218.8 8662.0	4.122404 3.858468 3.937620
Northcote church spire 1907	48 50 46.466 96 59 58.500	1435.4 1192.8	205 38 45.2 255 10 34.0 317 40 38.8	25 43 50.5 75 18 25.6 137 43 45.9	Canada Granville Hallock	19016.2 13197.9 7534.4	4.279123 4.120506 3.877047
Lancaster tall elevator 1907	48 51 33.331 96 48 05.332	1029.6 108.7	348 57 11.2 53 30 53.1 137 11 56.4	168 59 07.8 233 25 03.3 317 10 50.9	Jupiter Hallock Granville	16541.7 11793.5 2609.6	4.218579 4.071644 3.416567
Lancaster school cupola [1] 1907	48 51 21.66 96 48 11.11	669.1 226.5	348 17 56 143 57 43	168 19 57 323 56 42	Jupiter Granville	16211.5 2813.5	4.209824 3.449250
Northern Pacific Ry. tall elevator 1907	48 52 30.655 97 13 42.188	947.0 859.7	240 46 09.3 269 34 11.5 290 29 35.6	61 01 35.7 89 52 23.7 110 34 38.4	Canada Granville Hill	28616.6 29543.2 8750.8	4.456618 4.470457 3.942049
Humboldt church spire 1907	48 55 17.398 97 05 42.034	537.5 855.8	164 45 43.0 239 59 09.8 10 57 47.8	344 44 14.2 60 08 34.4 190 56 49.1	States Canada Hill	9102.6 17569.0 8373.1	3.959167 4.244747 3.922885
Humboldt school cupola 1907	48 55 24.950 97 05 34.345	770.8 699.2	240 23 49.3 284 52 25.7 11 41 25.2	60 33 08.0 105 04 30.6 191 40 20.6	Canada Granville Hill	17317.2 20281.6 8632.6	4.238478 4.307102 3.936141
Orleans school cupola 1907	48 55 32.549 96 55 57.910	1005.4 1178.8	304 50 47.0 57 17 13.3 120 17 21.0	124 55 37.6 237 08 54.5 300 08 31.7	Granville Hill States	9572.9 16046.8 16520.5	3.981044 4.205388 4.218023
Grampian lone elevator 1907	48 57 43.709 97 03 27.806	1350.1 565.6	251 09 09.5 299 09 58.4 18 46 11.2	71 16 52.9 119 20 28.1 198 43 31.1	Canada Granville Hill	13192.0 19495.4 13454.0	4.120312 4.289933 4.128853
Pembina square open tower 1907	48 58 03.032 97 14 52.065	93.7 1059.0	247 19 09.7 261 59 28.5 287 57 37.7 324 10 32.1	67 24 35.9 82 15 48.2 108 16 43.2 144 16 27.8	States Canada Granville Hill	9524.0 26652.9 32552.5 16438.8	3.978818 4.425744 4.512584 4.215870
St. Vincent tower, round top 1907	48 58 10.683 97 14 37.528	330.0 763.3	247 58 25.6 262 24 50.9 288 31 24.2 325 29 41.0	68 03 40.8 82 40 59.6 108 50 18.7 145 35 25.7	States Canada Granville Hill	9160.6 26327.9 32345.7 16461.8	3.961925 4.420416 4.509816 4.216477
St. Vincent bell tower 1907	48 58 05.137 97 14 39.672	158.7 806.9	247 05 31.3 288 12 37.6 325 01 40.9	67 10 48.2 108 31 33.8 145 07 27.3	States Granville Hill	9266.4 32333.1 16345.8	3.966910 4.509647 4.213407
St. Vincent Junction elevator 1907	48 58 03.451 97 11 59.312	106.6 1206.4	235 17 17.0 260 51 05.5 335 26 20.5	55 20 32.9 81 05 14.9 155 30 06.1	States Canada Hill	6418.5 23176.4 14674.5	3.807431 4.365046 4.166564
Emerson tall church spire 1907	49 00 22.938 97 12 41.109	708.6 835.5	271 29 52.1 276 05 08.8 296 55 42.6 338 30 26.6	91 44 33.2 96 08 56.3 117 13 09.7 158 34 43.7	Canada States Granville Hill	23739.2 6160.4 31739.2 18974.1	4.375466 3.789606 4.501596 4.278161
Emerson tower, flat top 1907	49 00 20.744 97 12 49.867	640.8 1013.5	271 19 21.1 275 18 11.7 296 40 23.1 337 55 49.8	91 34 08.8 95 22 05.8 116 57 56.8 158 00 13.5	Canada States Granville Hill	23915.5 6330.8 31867.5 18977.2	4.378679 3.801457 4.503348 4.278232

[1] Checked by vertical angles only.

Fergus Falls to Canada—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
C. & G. S. B. M. E_4	46 26 08.78 96 13 04.19	271.1 89.5	147 24 06	327 24 00	Indian	324.3	2.510913
Sec. cor. 2, 3, 10, and 11, T. 137, R. 44, stone	46 42 10.90 96 12 56.32	336.6 1196.4	18 33 25	198 33 22	Tansem	266.9	2.426309
¼ sec. cor. 23 and 26, T. 139, R. 46	46 49 59.12 96 27 07.52	1825.6 159.4	134 33 01	314 32 55	Riverton	244.4	2.351042
Sec. cor. 10, 11, 14, and 15, T. 141, R. 47	47 02 06.86 96 36 20.60	211.9 434.9	65 21 39	245 21 38	Morken	32.2	1.508395
C. & G. S. B. M. E_5	47 10 48.98 96 30 01.34	1512.6 28.2	183 49 30	3 49 31	Borup	389.6	2.590643
C. & G. S. B. M. K_5	47 22 33.60 96 30 41.91	1037.7 879.3	239 44 49	59 45 06	Wicklow	557.2	2.746038
Sec. cor. 23, 24, 25, and 26, T. 147, R. 47	47 31 40.73 96 36 03.70	1257.9 77.4	269 02 05	89 02 39	Beltrami	968.3	2.986005
Sec. cor. 19, 20, 29, and 30, T. 149, R. 44, nail in stake	47 42 08.08 96 19 49.71	249.5 1036.4	185 58 48	5 58 49	Tilden	164.9	2.217186
Sec. cor. 13 and 24, T. 149, R. 47, and 18 and 19, T. 149, R. 46	47 43 00.80 96 36 36.03	24.7 751.0	164 19 32	344 19 32	Andover	49.7	1.696793
Sec. cor. 31 and 32, T. 153, R. 47, and Ts. 153 and 152	48 01 16.51 96 44 17.06	510.0 353.5	145 06 05	325 06 04	Sherack	26.4	1.421851
C. & G. S. B. M. D_6	48 01 16.15 96 44 27.84	498.8 576.9	261 05 18	81 05 25	Sherack	210.6	2.323520
Sec. cor. 19, 20, 29, and 30, T. 155, R. 47	48 13 27.56 96 44 22.43	851.3 463.0	267 45 32	87 45 47	Warren	406.0	2.608563
C. & G. S. B. M. O_6	48 22 24.95 96 49 05.86	770.7 120.6	0 26 37	180 26 37	Argyle	391.1	2.592288
C. & G. S. B. M. T_6	48 27 22.28 96 51 22.46	688.2 461.5	226 30 28	46 30 29	Stephen W. base	38.4	1.584444
Sec. 6, T. 158, R. 48, NE. corner	48 32 35.86 96 53 22.26	1107.6 456.7	86 06 32	266 06 19	Donaldson	348.9	2.542701
Sec. 8, T. 160, R. 49, NW. corner	48 42 14.06 97 01 09.90	434.3 202.4	330 07	150 07	Skaue	25.2	1.402175

Fergus Falls to Duluth.

Dalton astronomic station 1904	46 10 23.613 95 54 59.592	729.1 1278.3	278 39 41.88 4 41 46.04 89 01 55.96	98 54 32.63 184 40 57.61 269 01 04.50	Leaf Elbow Dalton	26816.67 17663.89 1530.41	4.4284048 4.2470864 3.1848066
Elbow Lake water tower 1904	45 59 33.035 95 58 29.170	1020.0 627.8	68 07 44.6 74 55 21.7 105 53 08.3 230 57 54.7	248 01 03.6 254 31 31.2 285 28 59.7 50 59 37.1	Bullis Oscarson Foss Elbow	12944.8 44450.5 44933.9 3942.5	4.112095 4.647877 4.652574 3.595775
Church (5 miles W. of Elbow Lake) 1905	45 59 10.244 96 03 32.367	316.3 696.6	53 01 33.8 204 30 25.7 251 34 25.7	232 58 30.7 24 35 43.6 71 39 46.2	Bullis Dalton Elbow	6863.0 22828.6 10102.9	3.836511 4.358479 4.004446
Church spire (9 miles SW. of Dalton) 1904	46 06 29.651 96 03 24.251	915.5 520.8	108 29 29.0 232 13 14.3 317 47 17.1	288 24 27.8 52 18 26.8 137 52 32.1	Western Dalton Elbow	9456.0 11760.6 14006.0	3.975708 4.070429 4.146315
Church (5 miles S. by W. of Dalton) 1904	46 05 38.559 95 57 24.508	1190.5 526.4	349 15 00.3 105 23 08.8 190 11 47.4	169 15 56.2 285 13 48.4 10 12 40.4	Elbow Western Dalton	8960.5 17310.3 8916.3	3.952331 4.238305 3.950185

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Evansville water tower	46 00 27.421	846.7	342 17 23.5	162 20 26.2	Holmes	18036.2	4.256145
1904	95 41 21.286	458.0	92 30 08.0	272 19 30.9	Elbow	19068.1	4.280308
			211 59 44.6	32 04 44.8	Leaf	16883.3	4.227457
			246 42 06.4	66 56 33.3	Parker	28153.5	4.449533
Evansville Methodist Church spire	46 00 28.745	887.5	246 49 14.9	67 03 43.7	Parker	28186.8	4.450046
1904	95 41 23.785	511.7	342 09 59.4	162 13 03.9	Holmes	18091.5	4.257475
			92 23 08.7	272 12 33.4	Elbow	19012.7	4.279043
Evansville Catholic Church spire	46 00 28.460	878.8	246 59 41.2	67 14 18.1	Parker	28413.5	4.453524
1904	95 41 35.062	754.3	341 25 36.9	161 28 49.5	Holmes	18159.0	4.259091
			92 26 28.4	272 16 01.2	Elbow	18770.6	4.273479
Alexandria water tower	45 53 04.196	129.5	79 28 16.3	259 17 55.0	Holmes	18996.3	4.278668
1904	95 22 41.337	891.3	151 41 03.7	331 32 37.8	Leaf	31822.6	4.502736
			184 10 08.3	4 11 08.8	Parker	24831.3	4.395000
			280 49 00.9	100 50 21.5	Alexandria	2467.6	3.392276
			289 09 05.8	109 19 44.0	Osakis	20322.4	4.307976
Alexandria Catholic Church spire	45 53 14.620	451.4	78 38 29.8	258 28 01.7	Holmes	19256.2	4.284570
1904	95 22 31.946	688.8	183 45 11.7	3 46 05.4	Parker	24496.3	4.389101
			289 27 51.0	109 29 04.9	Alexandria	2355.9	3.372156
Alexandria courthouse spire	45 53 03.433	106.0	79 23 55.4	259 13 42.5	Holmes	18744.1	4.272864
1904	95 22 53.030	1143.4	184 44 31.1	4 45 40.0	Parker	24874.4	4.395753
			279 19 35.2	99 21 04.3	Alexandria	2711.8	3.433252
Osakis water tower	45 51 59.841	1847.4	95 48 04.1	275 39 38.9	Alexandria	15254.9	4.183410
1904	95 09 05.159	111.3	201 25 05.2	21 28 16.3	Leslie	15675.7	4.195226
			238 55 39.6	59 06 37.2	Long	23006.5	4.361851
			253 08 21.7	73 15 05.5	Maple	12670.2	4.102785
			287 49 33.2	108 01 24.4	Birch	22490.4	4.351997
			341 27 37.7	161 28 30.2	Osakis	4967.6	3.696145
Osakis tall church spire	45 51 58.618	1809.5	203 00 07.0	23 03 34.4	Leslie	15895.2	4.201265
1904	95 09 27.787	599.4	253 35 39.2	73 42 39.3	Maple	13148.7	4.118883
			336 07 26.0	156 08 34.8	Osakis	5109.1	3.708341
Osakis low church spire	45 51 58.037	1792.0	201 20 27.0	21 23 38.2	Leslie	15727.2	4.196651
1904	95 09 05.115	110.3	252 53 50.7	73 00 34.5	Maple	12685.6	4.103311
			341 15 51.9	161 16 44.4	Osakis	4914.5	3.691479
Gordon church spire	45 52 34.266	1058.0	51 49 55.0	231 45 51.1	Osakis	9334.6	3.970098
1904	95 02 12.008	259.0	231 03 47.1	51 05 34.3	Maple	4138.7	3.616863
			302 33 04.0	122 39 58.9	Birch	14816.6	4.170750
Long Bridge church spire	45 51 23.40	722.5	159 31 58.9	339 30 59.4	Maple	5111.0	3.708503
1904	94 58 19.77	426.6	307 46 28.6	127 50 36.9	Birch	9455.9	3.975704
Sauk Center Catholic Church spire	45 44 14.788	456.6	124 21 17.8	304 13 28.4	Osakis	17125.4	4.233641
1904	94 56 57.035	1233.1	168 47 35.6	348 45 36.7	Maple	18372.5	4.264168
			217 24 02.7	37 27 11.4	Birch	9364.1	3.971464
Long Prairie water tank	45 58 27.067	835.7	5 13 30.2	185 12 32.8	Birch	18955.9	4.277744
1904	94 51 13.705	295.0	88 05 36.4	266 03 44.2	Long	3363.3	3.526770
			231 49 03.4	51 54 15.7	Lone	11875.0	4.074632
Long Prairie Catholic Church spire	45 58 27.348	844.3	4 15 24.7	184 14 38.1	Birch	18907.1	4.276626
1904	94 51 28.654	616.9	88 18 22.6	268 16 41.1	Long	3040.9	3.483009
			232 40 16.1	52 45 39.2	Lone	12143.0	4.084326
Catholic Church on ridge tall spire	45 42 05.814	179.5	160 30 47.0	340 29 18.1	Brockway	8038.9	3.905195
1904	94 16 28.047	606.8	182 03 57.8	2 04 34.8	Falls	30733.7	4.487615
			188 43 42.2	8 44 46.7	Royalton north base	12811.7	4.107607
			236 22 27.3	56 25 35.6	Royalton south base	6830.4	3.834448
Gregory M. R. C.	45 55 33.717	1041.0	309 18 23.02	129 27 32.36	Alberta	21360.75	4.3296164
	94 19 36.172	779.4	333 56 00.75	153 59 20.42	Royalton north base	13667.61	4.1356926
			355 26 45.42	175 27 31.37	Brockway	17420.39	4.2410578
Gottwalt M. R. C.	45 47 11.365	350.9	79 54 37.22	259 48 52.97	Brockway	10543.32	4.0229775
	94 10 31.752	685.9	119 20 56.40	299 17 45.53	Royalton north base	6594.49	3.8191812
			247 41 18.81	67 43 57.23	Alberta	5158.25	3.7125027
Swan Creek M. R. C.	45 56 39.808	1229.1	304 54 33.44	125 06 54.32	Alberta	27178.74	4.4342293
	94 24 02.907	62.6	320 34 30.94	140 41 02.12	Royalton north base	18524.81	4.2677538
			339 46 44.30	159 50 41.65	Brockway	20676.30	4.3154727

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Royalton M. R. C.	45 48 44.024	1359.2	254 16 52.93	74 17 36.46	Royalton north base	1361.64	3.1340610
	94 15 58.706	1267.5	274 18 57.91	94 25 30.79	Alberta	11865.98	4.0743034
			35 06 44.27	215 04 54.28	Brockway	5764.60	3.7607689
Back Base M. R. C.	45 43 12.662	390.9	120 54 58.54	300 49 52.96	Brockway	10745.32	4.0312194
	94 11 25.514	551.8	153 33 30.73	333 35 02.47	Royalton south base	1916.56	3.2825215
			156 36 00.23	336 33 27.98	Royalton north base	11550.87	4.0626148
			212 27 19.54	32 30 36.38	Alberta	11055.79	4.0435896
Skounter Hill M. R. C.[1]	45 45 40.01	1235.3	307 30 34.4	127 32 36.6	Royalton south base	4651.4	3.667579
	94 14 55.64	1202.4	101 40 18.7	281 37 43.6	Brockway	4777.1	3.679160
Royalton old Catholic Church, cross[1]	45 49 46.88	1447.4	293 11 56.0	113 13 57.7	Royalton north base	3987.5	3.600701
	94 17 47.76	1030.9	8 12 03.0	188 11 31.1	Brockway	6725.8	3.827742
Rice Catholic Church spire 1904	45 45 13.615	420.3	103 48 00.1	283 43 59.2	Brockway	7478.8	3.873831
	94 12 56.026	1210.9	159 00 55.8	338 59 28.3	Royalton north base	7353.2	3.866474
			234 38 27.3	54 42 49.0	Alberta	9671.5	3.985495
			331 19 51.5	151 20 28.0	Royalton south base	2300.1	3.361752
Rice Protestant Church 1904	45 45 04.615	142.5	106 32 19.3	286 28 29.1	Brockway	7241.7	3.859843
	94 13 10.871	234.9	162 03 34.6	342 02 17.8	Royalton north base	7508.3	3.875542
			234 24 20.2	54 28 52.6	Alberta	10094.1	4.004067
Church (2 miles W. of Alberta) 1904	45 48 06.688	206.5	74 53 59.1	254 46 42.7	Brockway	13626.6	4.134387
	94 08 23.285	502.8	100 09 39.6	280 04 56.6	Royalton north base	8657.4	3.937389
			262 54 11.5	82 55 17.8	Alberta	2013.4	3.303921
Buckman Catholic Church spire 1904	45 53 49.056	1514.6	8 33 55.5	188 33 03.8	Alberta	10438.2	4.018626
	94 05 38.767	835.9	53 11 04.4	233 04 23.1	Royalton north base	15081.2	4.178435
			125 00 43.6	304 53 34.0	Falls	15712.3	4.196241
Little Falls Catholic Church spire[1] 1904	45 58 38.50	1188.6	269.28 19.4	89 32 31.8	Falls	7559.3	3.878481
	94 21 27.72	596.7	350 39 44.1	170 41 50.1	Brockway	23379.4	4.368833
Little Falls courthouse spire[1] 1904	45 58 32.07	990.2	350 05 56.6	170 08 09.2	Brockway	23216.8	4.365802
	94 21 36.91	794.7	56 20 43.3	236 06 58.2	Eagle	29792.6	4.474109
Little Falls high-school spire 1904	45 58 31.68	978.1	268 00 36.7	88 05 06.8	Falls	8090.6	3.907980
	94 21 52.19	1123.4	349 17 34.5	169 19 58.1	Brockway	23263.7	4.366678
Little Falls Pine Tree Lumber Co.'s stack[1] 1904	45 58 57.26	1767.8	273 35 03.6	93 39 34.8	Falls	8136.8	3.910454
	94 21 53.82	1158.5	349 33 35.4	169 36 00.1	Brockway	24046.3	4.381049
Rich Prairie Catholic Church spire 1904	45 58 48.301	1491.3	31 49 08.5	211 42 51.3	Royalton north base	21510.3	4.332647
	94 06 12.694	273.2	34 22 47.1	214 13 56.3	Brockway	28295.6	4.451719
			69 18 37.5	248 53 48.7	Eagle	47833.3	4.679730
			88 56 06.8	268 49 21.4	Falls	12140.7	4.084243
Lake Alexander, tallest island, highest point[1] 1904	46 12 12.27	378.9	248 02 08	68 05 51	Rail	7130.6	3.853127
	94 32 45.93	984.7	322 10 08	142 11 37	Johnson	4310.8	3.634560
Big Mound M. R. C. 1904	46 13 52.458	1619.7	82 11 50.23	262 10 04.69	Rail	3161.33	3.4998704
	94 25 11.189	239.8	188 04 33.69	8 06 27.06	Gull	23810.60	4.3767704
			290 02 27.18	110 12 30.84	Daggett	19097.57	4.2809780
Oleson M. R. C. 1904	46 15 44.052	1360.2	338 06 56.94	158 09 12.33	Daggett	10792.90	4.0331381
	94 14 22.358	478.8	77 15 34.77	257 06 00.56	Rail	17466.48	4.2422055
			76 08 32.18	256 00 43.52	Big Mound M. R. C.	14320.23	4.1559499
			221 00 22.34	41 07 43.73	Jones	19868.96	4.2981752
Brainerd railroad shops, tallest stack 1905	46 21 30.231	933.4	123 00 26.0	302 52 12.1	Gull	17359.3	4.239532
	94 11 12.490	267.0	232 07 36.3	52 19 48.7	Rabbit	27292.1	4.436034
			244 25 35.2	64 30 39.5	Jones	9955.9	3.998080
Brainerd Lumber Co.'s stack 1905	46 22 45.580	1407.4	2 32 53.5	182 32 18.9	Daggett	23054.7	4.362759
	94 10 27.043	577.9	114 40 13.7	294 31 26.8	Gull	17087.4	4.232675
			256 11 01.9	76 15 33.3	Jones	8248.3	3.916362
Brainerd Catholic Church spire[1] 1905	46 21 37.64	1162.2	123 36 31.1	303 28 40.2	Gull	16667.9	4.221881
	94 11 44.16	943.9	247 08 51.2	67 14 18.4	Jones	10479.6	4.020344

[1] No check on this position.

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Brainerd other church spire [1] 1905	46 21 39.38 94 10 52.64	1215.9 1125.2	121 29 05.0 232 03 01.3	301 20 36.7 52 14 59.1	Gull Rabbit	17567.6 26783.5	4.244712 4.427868
Aitkin water tower 1904	46 31 52.460 93 42 39.853	1619.8 849.3	80 36 07.0 134 26 19.8 230 15 52.9 248 14 01.2	260 27 37.5 314 16 40.7 50 23 25.5 68 26 32.7	Rabbit Brook French Kimberly	15173.9 23722.0 17236.2 23711.8	4.181098 4.375152 4.236442 4.374964
Aitkin high school 1904	46 32 02.085 93 42 42.099	64.4 897.1	79 27 54.3 134 00 08.5 231 08 00.1	259 19 26.5 313 50 31.0 51 15 34.3	Rabbit Brook French	15178.2 23480.4 17085.0	4.181220 4.370706 4.232615
Aitkin jail [1] 1904	46 31 58.15 93 42 29.12	1795.6 620.6	80 05 55 230 13 46	259 57 18 50 21 11	Rabbit French	15429.0 16947.9	4.188337 4.229116
Bethlehem church spire 1905	46 28 33.923 93 36 58.958	1047.4 1257.8	199 18 18.8 224 44 25.7 320 45 35.8	19 21 43.7 44 52 49.5 140 45 36.5	French Kimberly Bethlehem	18158.0 20978.7 31.5	4.259068 4.321779 1.498433
McGregor, Vaudewater sawmill stack 1905	46 36 24.756 93 18 40.479	764.4 861.5	92 20 00.7 172 46 40.5 338 23 34.2	272 15 06.7 352 46 24.8 158 24 47.9	Kimberly Gregor Grindle	8616.6 3635.3 5866.3	3.935336 3.560537 3.768365
McGregor schoolhouse belfry 1905	46 36 24.005 93 18 29.156	741.2 620.5	92 25 19.7 169 07 01.4 340 32 21.3	272 20 17.5 349 06 37.5 160 33 26.7	Kimberly Gregor Grindle	8858.3 3696.1 5760.1	3.947352 3.567746 3.760427
Peterson's (Wm.) house, chimney [1] 1905	46 34 40.75 92 37 00.36	1258.2 7.7	130 55 38.4 241 09 45.5	310 53 28.6 61 11 19.6	Mahtowa Atkinson	5032.4 3146.4	3.701774 3.497821
Cloquet Catholic Church spire 1905	46 43 10.297 92 27 32.057	318.0 680.9	75 15 06.9 164 13 59.9 343 35 14.3	255 07 11.5 344 13 24.3 163 36 38.5	Sawyer Cloquet Carlton	14355.1 3824.0 8505.4	4.157007 3.582521 3.929696
Cloquet paper mill stack 1905	46 43 30.698 92 25 49.482	947.9 1050.8	133 29 22.6 278 34 59.1 358 13 42.2	313 27 32.2 98 42 11.5 178 13 51.7	Cloquet Annie Carlton	4433.1 12759.3 8983.7	3.646704 4.105827 3.953453
Scanlon (¼ mile SE. of), large stack 1905	46 42 15.248 92 25 07.230	470.8 153.6	142 36 32.8 267 55 44.6 5 20 03.1	322 34 11.7 88 02 26.1 185 19 41.9	Cloquet Annie Carlton	6773.1 11726.6 6678.4	3.830789 4.069171 3.824672
Scanlon schoolhouse cupola [2] 1905	46 42 23.02 92 25 39.13	710.8 831.2	269 08 42.7 359 31 15.6	89 15 47.5 179 31 17.6	Annie Carlton	12397.9 6889.9	4.093349 3.838214
Scanlon sawmill (SE. edge of town) stack [2] 1905	46 42 16.18 92 25 27.90	499.6 592.7	268 08 05.5 1 33 19.3	88 15 02.1 181 33 13.1	Annie Carlton	12164.3 6680.7	4.085088 3.824822
Proctorknott railway shops water tank [2] 1905	46 44 42.01 92 13 32.76	1297.2 695.4	251 16 46.4 36 22 07.5	71 19 16.8 216 20 23.5	Duluth Annie	4627.8 5115.0	3.665371 3.708846
West Duluth, Irving School chimney [1] 1905	46 44 08.700 92 10 07.018	268.6 149.0	180 22 39.9 326 43 57.4	0 22 40.5 146 47 36.3	Duluth Superior	2512.3 11661.2	3.400067 4.066745
Union Match Co.'s water tank 1904	46 44 10.867 92 09 34.760	335.6 738.0	164 43 15.5 248 54 35.2 329 48 52.4	344 42 52.5 68 58 08.0 149 52 07.6	Duluth Minn. Pt. N. base Superior	2534.9 6647.4 11357.9	3.403968 3.822649 4.055298
Union Match Co.'s cupola 1904	46 44 11.384 92 09 36.575	351.5 776.5	165 28 23.2 249 09 22.8 329 41 12.9	345 28 01.6 69 12 57.0 149 44 29.8	Duluth Minn. Pt. N. base Superior	2509.6 6677.6 11391.1	3.399607 3.824622 4.056566
Duluth & Superior interstate bridge, operator's tower, center of draw span 1905	46 44 58.568 92 05 59.304	1808.5 1258.7	100 32 06.3 240 39 33 0 307 23 05.0	280 29 06.4 60 40 28.9 127 26 03.3	Duluth Minn. Pt. N. base Minn. Pt. S. base	5330.4 1869.4 6546.8	3.726756 3.271691 3.816029

[1] No check on this position.

[2] Checked by vertical angles only.

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Superior State Normal School, smaller and higher tower [1] 1905	46 43 02.99 92 05 28.36	92.3 602.3	356 30 41.5 127 37 00.6	176 30 57.6 307 33 38.2	Superior Duluth	7738.8 7445.0	3.888673 3.871862
Superior elevator K, stack 1905	46 42 44.879 92 02 45.580	1385.8 968.2	153 48 13.0 262 05 21.9 22 39 26.8	333 46 47.8 82 05 59.2 202 37 44.4	Minn Pt. N. base Minn. Pt. S. base Superior	5621.9 1097.7 7763.7	3.749886 3.040477 3.890070
Superior elevator T, south gable [1] 1905	46 42 06.84 92 06 47.94	211.2 1018.5	341 52 21.2 143 21 52.2	161 53 35.2 323 19 27.8	Superior Duluth	6952.8 7052.4	3.842159 3.848337
Superior St. Mary's Hospital, spire [2] 1905	46 43 33.303 92 05 25.817	1028.4 548.2	194 30 59 357 14 41	14 31 30 177 14 55	Minn. Pt. N. base Superior	3665.8 8670.6	3.564166 3.938048
Superior Gr. Nor. elevator S., south gable 1905	46 44 29.590 92 06 33.052	913.7 701.7	297 29 15.6 349 55 48.1 112 26 38.7	117 32 38.5 169 56 51.2 292 24 03.3	Minn. Pt. S. base Superior Duluth	6671.9 10561.0 4895.1	3.824250 4.023707 3.689761
Superior pierhead front R. L. H.[2] 1905	46 42 32.58 92 00 34.67	1006.0 736.5	107 24 27.5 114 21 38.8	287 23 29.5 294 14 42.6	Minn Pt. S. base Duluth	1774.6 13315.6	3.249099 4.124361
Superior pierhead rear R. L. H.[2] 1905	46 42 22.87 92 00 55.12	706.2 1170.9	116 20 35.8 123 25 15.0	296 13 54.5 303 24 31.9	Duluth Minn. Pt. S. base	13051.3 1508.2	4.115655 3.178471
South Superior, Webster Chair Mfg. Co.'s stack 1905	46 40 17.980 92 06 34.940	555.2 742.6	13 11 27.1 108 45 44.0 155 02 58.7 324 19 59.4	193 09 21.6 288 38 56.1 335 00 24.8 144 21 03.9	Dedham Annie Duluth Superior	16111.8 12576.9 10630.4 3235.9	4.207145 4.099572 4.026549 3.509994
South Superior, Bryant School Building, NE. corner of NW. chimney 1905	46 39 59.770 92 06 00.151	1845.6 3.2	110 01 22.6 152 53 22.8 330 58 19.3	289 54 09.4 332 50 23.6 150 58 58.5	Annie Duluth Superior	13461.1 11460.3 2363.7	4.129082 4.059197 3.373591
South Superior Billings School, belfry 1905	46 39 29.438 92 06 12.970	909.0 275.8	16 17 08.5 156 02 08.1 308 31 21.3	196 14 47.2 335 59 18.3 128 32 09.9	Dedham Duluth Superior	14780.5 12188.3 1814.4	4.169690 4.085941 3.258743
Superior ore docks, Weather Bureau signal tower 1905	46 42 09.136 92 01 24.493	282.1 520.3	28 18 19.4 37 53 12.0 153 09 18.8	208 12 28.5 217 50 30.7 333 08 57.0	Dedham Superior Minn. Pt. S. base	21706.9 7678.1 1406.3	4.336598 3.885252 3.148068
East Superior Presbyterian Church spire 1905	46 42 30.214 92 03 21.806	933.0 463.2	18 18 16.3 122 55 56.7 162 41 31.0	198 17 00.4 302 51 02.2 342 40 32.2	Superior Duluth Minn. Pt. N. base	7069.8 10226.2 5757.8	3.849404 4.009716 3.760256
East Superior, Lincoln School flagstaff in center of tower 1905	46 43 11.801 92 04 05.368	364.4 114.0	169.23 55.1 283 43 47.5 9 11 31.2	349.23 28.0 103 45 22.9 189 10 46.9	Minn. Pt. N. base Minn. Pt. S. base Superior	4285.9 2863.8 8100.5	3.632039 3.456936 3.908511
Boylston Gr. Nor. signal tower [2] 1905	46 35 47.626 92 07 46.280	1470.6 985.1	210 45 21.5 16 22 22.0	30 47 17.8 196 21 08.5	Superior Dedham	6656.2 7649.4	3.823226 3.883628
Saunders Gr. Nor. water tank 1905	46 38 18.314 92 06 32.507	565.5 691.4	17 16 18.7 161 12 44.7 239 50 27.9	197 14 11.6 341 10 09.2 59 51 30.6	Dedham Duluth Superior	12557.8 14083.9 2122.3	4.098914 4.148722 3.326810
Itasca elevator (C., St. P., M. & O. Ry.), stack 1905	46 41 30.347 92 00 49.026	937.1 1041.7	48 22 05.9 122 05 05.1 150 29 15.0	228 18 58.8 301 58 19.4 330 28 27.5	Superior Duluth Minn. Pt. S. base	7317.5 13957.1 2818.3	3.864362 4.144796 3.449990
Duluth Brewing & Malting Co., dome [1] 1905	46 45 27.598 92 07 52.683	852.2 1118.0	91 32 50 269 42 22	271 31 13 89 44 40	Duluth Minn. Pt. N. base	2835.4 4035.8	3.452613 3.605927
Duluth Catholic (or M. E.) Church spire [2] 1905	46 47 16.168 92 06 18.815	499.3 399.1	328 29 05 354 19 38	148 30 15 174 20 31	Minn. Pt. N. base Superior	3909.5 15618.8	3.592125 4.193647

[1] Checked by vertical angles only.

[2] No check on this position.

Fergus Falls to Duluth—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Duluth elevator B, stack [1] 1905	46 46 19.745 92 06 18.926	609.7 401.7	307 51 43 72 22 37	127 52 53 252 19 52	Minn. Pt. N. base Duluth	2591.5 5061.6	3.413549 3.704292
Duluth house at head of W. 5th Ave. (ch'y in center of 4 pitch roof) 1905	46 47 14.776 92 06 46.366	456.2 983.5	321 22 33.6 52 41 33.9 352 10 33.0	141 24 03.9 232 39 08.3 172 11 45.9	Minn. Pt. N. base Duluth Superior	4210.7 5332.8 15644.8	3.624353 3.726959 4.194369
Duluth high school, spire [1] 1905	46 47 20.876 92 05 59.718	644.6 1266.6	334 46 47 355 51 07	154 47 43 175 51 46	Minn. Pt. N. base Superior	3844.9 15729.0	3.584887 4.196700
Duluth incline pavilion, Weather Bureau signal tower [2] 1905	46 47 08.298 92 06 53.368	256.2 1132.1	318 03 03 351 31 43	138 04 38 171 33 01	Minn. Pt. N. base Superior	4154.1 15467.8	3.618480 4.189429
Duluth elevator H, stack [1] 1905	46 45 57.109 92 06 22.782	1763.5 483.6	292 44 01 80 01 52	112 45 14 259 59 09	Minn. Pt. N. base Duluth	2307.0 4814.9	3.363057 3.682591
Duluth Aerial Bridge, SW. column of N. pier [2] 1905	46 46 46.377 92 05 34.928	1432.1 740.9	335 15 19 67 45 49	155 15 57 247 42 31	Minn. Pt. N. base Duluth	2657.2 6220.4	3.424417 3.793821
Sec. 36, T. 128 N., R. 49 W., east ¼ corner [2] 1904	45 49 38.759 96 43 47.357	1196.6 1022.2	178 28 07	358 28 07	Enwiller.	406.52	2.6090819
Sec. 28, T. 130 N., R. 50 W, SE. corner [2] 1904	46 02 15.438 96 56 56.788	476.7 1221.1	93 25 23	273 25 18	Hankinson	150.473	2.1774586
Sec. 26, T. 131 N., R. 44 W., north ¼ corner [2] 1904	46 08 15.083 96 10 22.256	465.7 477.7	358 54 38	178 54 38	Western	262.79	2.4196088
Sec. 3, T. 129 N., R. 42 W., east ¼ corner, stone [2] 1904	46 00 50.677 95 56 06.537	1564.7 140.6	175 57 47	355 57 47	Elbow	85.252	1.9307046

[1] Checked by vertical angles only.

[2] No check on this position.

DESCRIPTIONS OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this publication or to the index. All azimuths given in these descriptions are reckoned continuously from true south around by west to 360°, south being 0°, west 90°, north 180°, and east 270°. Where magnetic azimuths are given they are indicated as such.

In general the surface and underground marks are not in contact, so that a disturbance of the surface mark will not necessarily affect the underground mark. The underground mark should be resorted to only in cases where there is evidence that the surface mark has been disturbed.

The dates and initials given in each description immediately after the county refer to the date of establishment of the station, the man by whom it was established, and the date when the station was last visited.

Any person who finds that one of the stations herein described has been disturbed, or that the description no longer fits the facts, is requested to send such information to the Superintendent, Coast and Geodetic Survey, Washington, D. C.

GENERAL NOTES REGARDING THE MARKING OF STATIONS.

NOTE 1.—The station was marked as follows: A hole was dug to a depth of 4½ feet, its diameter being 18 inches for the upper 2 feet and 12 inches for the remaining distance. A terra-cotta pipe 2 feet long and 4 inches in diameter was placed in the lower part of this hole, and the pipe and the surrounding hole then filled with concrete made of Portland cement, sand, and broken rock. A 60-penny wire nail was set vertically in the top of this pipe, its point projecting one-fourth inch above the concrete and marking the station.

A 6-inch layer of sand was then placed in the hole. Directly over the underground mark and extending from the sand to the surface of the ground was set a piece of pipe similar to the one already described. The surface mark was the point of a 60-penny wire nail set in the concrete which fills this pipe and the surrounding hole, and covers the pipe to the depth of half an inch.

The reference mark was a piece of terra-cotta pipe 2 feet long and 4 inches in diameter set in a hole 1 foot in diameter, both pipe and hole being filled with concrete. The top of the pipe was level with the surface of the ground. A 60-penny wire nail was set in the top of the pipe and projects one-fourth inch above it.

NOTE 2.—The manner of marking this station was similar to that described in note 1, except that instead of terra-cotta pipes there were used iron pipes, 2 feet long and of the diameter given in the particular description.

NOTE 3.—The station is marked underground by a tack in the center of the cork of a stone jug, buried at a depth below the top of the surface stone varying from 2.25 to 3.2 feet. The surface mark is a marble post, 2.5 feet long and 8 inches square on top. Cut in its top are two V-shaped grooves at right angles to each other, and the letters U.S.C.S.

NOTE 4.—This station was established by the Mississippi River Commission in the survey of the Mississippi River, and was marked by their usual tile and pipe station mark, the underground mark being a vitrified tile with a copper bolt set in its upper end, and the surface mark an iron pipe surmounted by a brass cap, suitably inscribed. This station is published in the Report of the War Department, 1899, part 5, p. 3389 or 3390.

NOTE 5.—This station is marked by a 3-inch red metal cap, somewhat curved, and lettered as follows: "U. S. Coast and Geodetic Survey B. M. $250 fine or imprisonment for disturbing this mark." This cap is screwed on a 4-foot (or 4½-foot) iron pipe set in the ground and usually cemented at the base, from 4 to 6 inches being exposed above the ground. The base of the pipe is split and spread to a diameter of about 1 foot. A square or small circle is cut in outline in the center of the cap.

NOTE 6.—The underground mark at this station is a copper tack in the cork of a stone jug; above this was placed the surface mark, a nail in the top of a 4 by 6 inch pine stub.

NOTE 7.—Marked with the regular station mark of the Missouri River Commission, the underground mark being a block of stone 18 inches square about 3 feet below the surface of the ground, and having a small drilled hole in it. The surface mark is an iron pipe with a cast-iron cap having a raised triangle on it with a small drilled hole in its center. The cap is lettered "U. S. Missouri River Commission."

NOTE 8.—The underground mark at this station is a stone or earthenware crock buried bottom up at between 2 and 3.6 feet below the surface of the ground. In its bottom is a small drilled hole and sometimes a cross. The surface mark is a marble post 8 inches square and 2.3 to 2.6 feet long placed with its top flush with the surface of the ground. In its top are cut two V-shaped grooves and the letters U.S.C.S.

PAGE TO FERGUS FALLS.

PRINCIPAL POINTS.

Hall (Antelope County, Nebr., F. D. G., 1900).—This station is in the NE. ¼ sec. 21, T. 27 N., R. 8 W., on land owned by an eastern loan and trust company. The station is on the highest point in the vicinity, and from it the land slopes more rapidly to the north than in any other direction. It is 403 feet due west of the north-and-south fence line on the east side of the section-line road leading to Orchard. The azimuths and distances to certain points are: To cupola of the schoolhouse at Orchard, 186° 22′ 11″, about 2 miles; to the northeast corner of section 21, 189° 25′, 1 950 feet. Marked according to note 8, above.

Page Southwest Base (Holt County, Nebr., F. D. G, 1900).—This station is in the SW. ¼ sec. 1, T. 28 N., R. 10 W., about 2 miles north and 0.7 mile west of the town of Page, and about 2 miles south and 12 miles east of O'Neill, on land owned by Mr. William Lord and near his dwelling. The azimuths and distances to certain points are: To the northwest corner of a granary, 288° 23′, 143 feet; to the windmill, 305° 08′; to the northwest corner of Mr. Lord's house, 188 feet; to the center of the section-line road to the southward, 393 feet; to precise level bench mark, M_2 320° 07′, 80.93 meters. The bench mark is an Indiana Bedford stone post 4½ feet by 6 by 6 inches, the top 6 inches dressed to 6 by 6 inches. A square cut 1¼ by 1¼ by 1¼ inches is made in the top and lettered U.S.B.M. The surface mark of the station is a stone 24 by 24 by 14 inches set in cement and with a copper bolt, marked with cross lines, set in its upper surface to mark the exact point. The underground mark is a stone 6 by 6 by 8 inches, set in cement and carrying a copper bolt with cross lines to mark the exact point.

Page Northeast Base (Holt County, Nebr., F. D. G., 1900).—This station is in the SE. ¼ sec. 16, T. 29 N., R. 9 W., on the open prairie, on school land now rented by T. S. Roche, of Page. The land is nearly flat, and the only prominent object in the vicinity to which it can be referred is the northern end of a large "blowout" in azimuth 219° and 600 meters distant. The station marks are exact duplicates of those at Page Southwest Base.

Prairie (Holt County, Nebr., F. D. G., 1900).—This station is in the SW. ¼ sec. 26, T. 30 N., R. 10 W., 10 miles north and 2 miles west of Page, and about 12 miles northeast of O'Neill, on the open prairie, on the summit of a small elevation which rises about 15 feet above the general level. There is another similar summit to the southeastward of the station and within about 1 000 feet. The azimuths and distances to certain points are: To the southwest corner of section 26, 27° 04′, about 1 530 feet; to the standpipe at O'Neill, 59° 55′ 55″; to Stanton's house, 100° 54′, 1 mile; to the chimney of Evans' house, 137° 35′ 18″, 2 miles; to the cupola of barn on sheep ranch, 275° 21′, 2.2 miles. Marked according to note 8, above.

Old (Knox County, Nebr., F. D. G., 1900).—This station is on the crest of a small elevation in the NW. ¼ of the NW. ¼ sec. 30, T. 29 N., R. 8 W., 2 miles west and 0.6 mile north of Venus, on land which is under cultivation and owned by John Old. The nearest house, distant about 800 feet to the northwest, is owned and occupied by W. W. Carey. The azimuths and distances to certain points are: To W. W. Carey's windmill, 145° 49′, about 785 feet; to the northwest corner of section 30, 160° 32′; to Venus post office, 281° 01′, 2 miles; to the center of the county-line road to the westward of the station, 376 feet. Marked according to note 3, page 267.

Walnut (Knox County, Nebr., F. D. G., 1901).—This station is in the west center of SW. ¼ sec. 10, T. 30 N., R. 8 W., on land owned by a land company of Norfolk, Nebr., on the highest point of a prominent range of hills in Washington Precinct, about 1.5 miles west and 4.5 miles north of Walnut post office. The nearest house, situated in a ravine about ½ mile to the southwest, is owned and occupied by Frank Vonasek. A trail branches at a point to the southwestward of the station, and the north-and-south branch passes about 270 feet to the westward of the station. The stone marking the southwest corner of sec. 10, T. 30 N., R. 8 W., is about 0.3 mile a little south of west from the station, and is in the second ravine from the station and surrounded by bushes. Marked according to note 3, page 267.

Sparta (Knox County, Nebr., F. D. G., 1901).—Near the west center of the NE. ¼ sec. 1, T. 30 N., R. 6 W., on the crest of a prominent hill, and on the line of an east and west fence which separates the farms of Peter Larson and John Wood. Larson lives in a small frame house with sod foundation, about 800 feet northeast of the station. The azimuth and distance of the stone at the northeast corner of this section (1) are 238° 59′ 42″, 2 600 feet. The station is about 2 miles south of Sparta and about 4 miles nearly due east of Verdigris; and it is marked according to note 3, page 267.

Santee (Knox County, Nebr., F. D. G., 1901).—Near the northeast corner of the SE. ¼ sec. 26, T. 33 N., R. 5 W., on the right bank of the Missouri River, on the crest of a hill forming part of a range which extends for miles along the river, and the highest point of which range visible from the station is about 4 miles east-southeast. The station is on land belonging to John F. Rollins, who lives in a small frame house in a ravine about 0.4 mile to the west-southwest. The nearest towns to the stations are Santee, about 2.5 miles to the north-northeast, and Niobrara, about 13 miles to the west-southwest. The main road between these two towns passes about 100 yards to the south of the station. The station is marked on the surface by an irregular-shaped flat-topped rock about 11 inches in diameter and 9 inches thick, with a cross and the letters U.S.C.S. cut in its top. Underneath this rock and 2.25 feet below its top is a stone jug with a tack in the center of its cork.

Avon (Bon Homme County, S. Dak., F. D. G., 1901).—Situated very near the center of the SE. ¼ NE. ¼ sec. 5, T. 94 N., R. 61 W., on an elevation in a cultivated field belonging to J. T. Campbell of Avon. It is 630 feet north and 598 feet west of a stone post marking the east center of the section. The azimuth of this stone from the station is 315° 46′, of the stone at the northeast corner 195°, and of the stone at the southeast corner 348° 21′. The station is about 1.2 miles southwest of the town of Avon and is marked according to note 3, page 267, the subsurface mark being 2.9 feet below the top of the stone post.

Vod (Bon Homme County, S. Dak., F. D. G., 1901).—In the SE. ¼ sec. 36, T. 96, N., R. 60 W., on a small elevation in the open prairie, 7 miles north and ½ mile west of Tyndall, and 9 miles southwest of Scotland. Vodnany church spire is about 3 miles north and ¼ mile west of the station, its azimuth being 176° 12′; the earth mound at the east center of section 36 is 386.9 meters from the station in azimuth 249° 10′, and the azimuth of the United States Geological Survey's bench mark at the southeast corner of the section is 331° 43′. The station is marked according to note 3, page 267, the stone jug being 3 feet below the top of the marble post. A narrow trench, 4 feet in diameter and 1 foot deep, partly filled with charcoal and covered with earth encircles the station.

Yankton (Yankton County, S. Dak., F. D. G., 1901).—Situated in the SE. ¼ NE. ¼ sec. 7, T. 95 N., R. 56 W., on the crest of a prominent hill in a pasture belonging to George Mueller, whose dwelling house stands in the SW. ¼ sec. 18, T. 95 N., R. 56 W. The station is 2 miles north and 4.7 miles east of the town of Lesterville. From the station the stone marking the east center of section 7 is distant 628 feet in azimuth 281° 09′, the northeast corner is distant 2 567 feet in azimuth 193° 06,′ the azimuth of the southeast corner is 346° 43′, and of Mueller's windmill is 30° 19′. The station is marked according to note 3, p. 267, the subsurface mark being 2.75 feet below the top of the surface stone. A narrow trench, 4 feet in diameter and 1 foot deep, partly filled with soft coal and covered with earth, encircles the station.

Wieters (Hutchinson County, S. Dak., F. D. G., 1901; 1903).—Situated in the NW. ¼ sec. 17, T. 98 N., R. 58 W., on a small elevation on land belonging to William Wieters. The station is 205 feet from the west line of the section and 1 051 feet from its northwest corner; it is 0.7 mile west and 11 miles north of Scotland, Bon Homme County. The station is marked according to note 3, page 267. The azimuth of a well in a pasture is 7° 38′, and its distance 222.5 feet; the azimuth of the stone at the northwest corner of the section is 168° 13′, and its distance 1 051 feet. The azimuth of the water tower at Scotland is 353° 54′ and of the chimney of Hart's house, 158° 47′.

Freeman (Hutchinson County, S. Dak., F. D. G., 1901; 1906).—Situated in the NE. ¼ NW. ¼ sec. 15, T. 98 N., R. 56 W., on the highest point of land in a pasture belonging to John Stahl, of Freeman. The station is 3 miles south and ⅝ mile west of the town of Freeman; it is 26 feet east of a wire fence separating the pasture from a cultivated field and 307 feet south of the road on the north side of the section. A windmill in the pasture is 508 feet from the station in azimuth 293° 31′. The following are azimuths to various points of the section (15) in which the station stands: Northwest corner, 99° 07′; north center, 242° 24′; northeast corner, 264° 34′. The station is marked according to note 3, page 267, the subsurface mark being 3 feet below the top of the surface stone, while a circular trench, 4 feet in diameter, and about 1 foot deep, partly filled with soft coal and covered with earth, encircles the station.

Wolf Creek (Hutchinson County, S. Dak., F. D. G., 1901; 1903).—Situated in the SE. ¼ NW. ¼ sec. 17, T. 100 N., R. 57 W., in an open field belonging to John D. Hofer, and about 400 yards west of the northwest corner of a grove of cottonwood trees belonging to Joseph Pollman, and nearly on an east-and-west line separating Hofer's and Pollman's farms. The station is marked according to note 6, page 267, the reference mark being in the northwest corner of the cottonwood grove mentioned above and 234.342 meters from the station in azimuth 269° 38′ 50″. The northwest corner of sec. 17, T. 100 N.,

R. 57 W., was connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Chimney on house of Powell Pollman, 111° 06′ 18″, about ½ mile; windmill of John D. Hofer, 145° 57′ 28″, about ⅔ mile; windmill tower of Joseph Pollman, 303° 15′ 11″, about ¾ mile.

Silver Lake (Hutchinson County, S. Dak., F. D. G., 1901; 1906).—Situated in the south center of sec. 12, T. 100 N., R. 56 W., on land belonging to Paul Glancer, of Dolton. It is 1¼ miles west of Dolton, Turner County, and is at the southern edge of a clump of small cottonwood trees just north of the section line road. The station is marked according to note 6, page 267, the reference mark being 0.12 meter lower than the station in elevation, and at the quarter-section corner on the south side of the road, in the field side, about 1 foot from either wire fence, and on the east side of the north and south fence. It is 52.41 meters from the station in azimuth 308° 49′ 59″. The following azimuths and distances are from the triangulation station: Paul Glancer's windmill tower in pasture, 108° 07′ 09″, about 800 meters; Henry Unrow's windmill tower (at house), 277° 16′ 55″, about 900 meters; Ben Buller's windmill tower (at house), 326° 02′ 04″, about 500 meters. The northwest corner of sec. 18, T. 100, R. 55, was also connected with the station. (See index.)

Elm Spring (Hanson County, S. Dak., F. D. G., 1901; 1903).—Situated in the NE. ¼ sec. 33, T. 101 N., R. 58 W., on a small hill on land belonging to the Elm Springs Mennonite colony, and about 70 meters west of a wire fence which separates cultivated land on the east from pasture on the west. The station is about 10 miles due south of Alexandria, and about 0.7 mile north-northeast of the aforementioned colony; it is marked according to note 6, page 267, the reference mark being in the north side of section 33, at fence corner formed by the above-mentioned partition fence, 0.15 meter north and 0.25 meter west of the fence corner, and 399.933 meters from the station in azimuth 187° 27′ 41″. The flouring mill of the Mennonite colony is about 1 200 meters from the station in azimuth 35° 50′.

Farmer (Hanson County, S. Dak., O. W. F., 1903).—Situated on the north and south middle line of sec. 21, T. 103 N., R. 57 W., about ¼ mile north of the south line of the section, on land owned by a mortgage company; the agent for the southwest quarter section lives in Alexandria, S. Dak. The agent for the southeast quarter section lives in Salem, McCook County, S. Dak. The station is 1¾ miles S. 24° E. from the village of Farmer, and is marked according to note 1, page 267, the reference mark being at the fence corner in the center of the section and 390.513 meters from the station in azimuth 178° 58′ 50″ and 2.53 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station. Mr. George's house, south chimney, 55° 02′ 29″, about 550 meters; Mr. Bangham's house, south chimney on main part, 226° 24′ 55″, about 1 000 meters; Mr. Dishworth's house, chimney, 294° 58′ 11″, about 800 meters.

Salem (McCook County, S. Dak., O. W. F., 1903).—Situated in the NW. ¼ sec. 21, T. 103 N., R. 55 W., on land belonging to John Labers, and about 110 meters west of the center line of the section. It is about 2½ miles west and 1 mile south of the town of Salem. It is marked according to note 1, page 267, the reference mark being in the southwest corner of the NW. ¼ sec. 21, 0.26 meter east of the north-and-south fence on the east side of the road and 0.18 meter north of the east-and-west fence through the center of the section; it is 624.805 meters from the station in azimuth 90° 40′ 31″ and

is 4.27 meters lower in elevation than the station. The stake at the northwest corner of the section (21) (see index) is in azimuth 141° 35′ 27″ from the station. The following azimuths and distances are from the triangulation station: House of Barney Heinke, chimney, 143° 18′ 08″, about ¾ mile; house of Barney Rohling, chimney on west end, 242° 34′ 54″, 900 meters; John Laber's windmill tower, 353° 38′ 23″, about 180 meters.

Canova (Miner County, S. Dak., O. W. F., 1903).—Situated in the northwest corner of the NE. ¼ sec. 20, T. 105 N., R. 56 W., on land belonging to Fred Forsberg, being 3 miles north 71° east from Canova village. It is 38.67 meters south of the wire fence on the south side of the wagon road, and 10.57 meters east of the north-and-south fence between Mr. Forsbergs's grove and house grounds and his wheat field. The station is marked according to note 1, page 267. The reference mark is at the intersection of the south road fence and the above-mentioned partition fence, 0.17 meter south of the road fence and 0.17 meter east of the partition fence; it is 39.259 meters from the station in azimuth 166° 11′ 25″ and 0.63 meter lower in elevation than the station. The following azimuths and distances are from the triangulation station: Carl Petersen's windmill tower, 75° 54′ 39″, about 400 meters; S. H. Liljenberg's windmill tower, 116° 50′ 52″, about 900 meters; Fred Forsberg's house, northwest corner of main part, 326° 19′ 44″, 36.605 meters; northeast corner of sec. 20, T. 105 N., R. 55 W., is connected with the station. (See index.)

Owens (Lake County, S. Dak., O. W. F., 1903).—In the NE. ¼ sec. 20, T. 105 N., R. 54 W., on land belonging to Miss Mary Owens; it is in what is known as Clarno Township, 8 miles east of the town of Canova, and 11 miles north and 3 miles east of Salem. It is marked according to note 1, page 267, the reference mark being 540.393 meters from the station in azimuth 238° 39′ 29″; it is 2.90 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: House of Melburne Barus, center chimney, 123° 45′, about 600 meters; windmill tower at house of August Eichman, 261° 52′ 40″, about 800 meters; windmill tower at home of W. Leliger, 341° 49′ 53″, about 400 meters. The northeast corner of sec. 20, T. 105 N., R. 54 W. is connected with the station. (See index.)

Reese (Miner County, S. Dak., O. W. F., 1903).—In the southeast corner of the NE. ¼ sec. 14, T. 105 N., R. 57 W., on the east-and-west line between the northeast and southeast quarter sections, on the west side of the road, 20.15 meters west of the wire fence which is on the east side of the road. The station is marked according to note 1, page 267, the reference mark being just within the fence corner at the northeast corner of this section (14) and 797.549 meters from the station in azimuth 179° 59′ 34″; it is 0.45 meter lower in elevation than the station. The northeast corner of the section (14) is 12.58 meters from the reference mark and is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Bruce Jameson's house, center chimney, 205° 14′ 56″, about 100 meters; T. L. Clark's house, center chimney, 4° 26′ 16″, about 850 meters; T. P. Reese's house, center chimney, 107° 27′ 51″, about 700 meters.

Crane (Lake County, S. Dak., O. W. F., 1903).—Situated near the center of SE. ¼ sec. 21, T. 107 N., R. 54 W., on land belonging to George V. Crane. It is on the north edge of a very dense growth of trees and brush. The station is marked according to note 1, page 267, the reference mark being in the fence corner at the southeast corner of

the section and in azimuth 301° 21′ 58″ from the station. The quarter corner in the center of the south side of the section (21) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: House of Millard Dunarey, chimney, 72° 01′ 23″, about 800 meters; house of George V. Crane, chimney, 265° 44′ 29″, about 480 meters; house of James Gagen, chimney, 221° 29′ 21″, about 700 meters.

Caldwell (Miner County, S. Dak., O. W. F., 1903).—Situated about 300 meters north of the center of the SW. ¼ sec. 3, T. 107 N., R. 56 W., on land belonging to Anton Ortmayer. It is 6½ miles north and ¾ mile west of Howard, and is 8.1 meters west of the wire fence through the center of the section. The station is marked according to note 1, page 267, the reference mark being in the southwest corner of the section, in corner of field, and 629.089 meters from the station in azimuth 19° 16′ 36″; it is 9.96 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Windmill tower of Anton Ortmayer's house, chimney, 1° 00′ 27″, about 750 meters; Rudolph Roxer's house, chimney, 134° 11′ 57″, about 250 meters.

Miner (Miner County, S. Dak., O. W. F., 1903).—In the northeast corner of Miner County, in the northwest corner of the NW. ¼ sec. 15, T. 108 N., R. 55 W. It is 2 miles south of the Miner-Kingsbury county line, and 3 miles west of the Miner-Lake county line. It is 4 miles south and 6 miles west of Oldham, on land owned by a man who lives in Iowa, and rented to Ernest Ruhlman. Marked according to note 2, page 267. The reference pipe was at the corner of a field in the northwest corner of the section, and distant 167.040 meters from the station in azimuth 92° 28′ 13″. The northwest corner of the section, marked by a distinct mound of earth, is 177 meters from the station in azimuth 95° 06′ 36″; it is 7.91 meters lower in elevation than the station. Other distances and azimuths from the station are as follows: Mr. Carmeeson's barn, north end of ridge, 1 900 meters, 333° 52′ 30″; E. Ruhlman's house, chimney, 280 meters, 143° 41′ 42″; McBeeker's house, chimney, 800 meters, 184° 00′ 57″.

Drakola (Kingsbury County, S. Dak., O. W. F., 1903).—Situated in the SW. ¼ sec. 13, T. 109 N., R. 56 W., on land rented to B. Herrick. It is 1 mile north and 9⅝ miles west of Oldham, and on the north line of a wagon road along the south side of the section. The station is marked according to note 2, page 267, the pipes being 2 inches in diameter. The reference mark is under the wire fence on the south side of the road and is 17.173 meters from the station in azimuth 359° 17′ 44′; it is 0.40 meter lower in elevation than the station. The southwest corner of the section is connected with the triangulation station. (See index.) The following azimuths and distances are from the triangulation station: A large new barn, east gable, 43° 44′ 55″, about 150 meters; house chimney, 114° 04′ 45″, about 450 meters; house chimney, 205° 24′ 13″, about 400 meters.

Brock (Kingsbury County, S. Dak., O. W. F., 1903).—Situated in the northwest corner of the NE. ¼ sec. 28, T. 109 N., R. 53 W., in an open field belonging to C. L. Brock; it is 5½ miles east of Oldham, and is 75 meters south of the road. The station is marked according to note 2, page 267. The reference mark is in the northwest corner of the section, being 92.164 meters from the station in azimuth 267° 36′ 36″; it is 2.77 meters lower in elevation than the station. The northeast corner of this section (28) is connected with the station. (See index.) The following azimuths and distances are from

the triangulation station: A. Lygtobo's house, chimney, 82° 38′ 06″, about 900 meters; Thomas Reed's house, chimney, 264° 57′ 58″, about 1 000 meters; Mr. Cheney's red barn, north end of ridge, 321° 47′ 54″, about 1 400 meters.

Hansen (Kingsbury County, S. Dak., O. W. F., 1903).—Situated in the center of sec. 26, T. 110 N., R. 55 W., in the southeast corner of the yard of schoolhouse of district No. 4, and just west of land owned by H. H. Hansen. The station is 3.04 meters north of the south fence of the school yard, and 3.40 meters west of the east fence. The town of Lake Preston is 4.4 miles north 13° east from the station. The station is marked according to note 1, page 267, the reference mark being at the fence on the south of the east-and-west road through the center of the section, and 68.2 meters west of the north-and-south fence through the center of the section. It is 133.381 meters from the station in azimuth 109° 58′ 56″ and 2.21 meters lower in elevation than the station. The stone marking the center of the east side of this section (26) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Miller and Lloyd house, chimney, 56° 20′ 05″, about 225 meters; windmill in pasture, 168° 15′ 39″, about 150 meters; H. H. Hansen's house, chimney, 271° 21′ 33″, about 280 meters.

Larson (Kingsbury County, S. Dak., O. W. F., 1903).—Situated in the SE. ¼ sec. 34, T. 111 N., R. 53 W., on land belonging to John Larson. It is 2.64 meters west of the wire fence on the west side of the north-and-south road, and it is 1½ miles west and ½ mile north of Arlington city. It is marked according to note 1, page 267. The reference mark is in the field side at the southeast corner of the section (34) and is 430.647 meters from the station in azimuth 359° 11′ 05″; it is 9.89 meters lower in elevation than the station. The stone at the southeast corner of the section (34) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: John Larson's large new barn cupola, 70° 47′ 11″, about 350 meters; windmill at house 230° 58′ 33″, about 750 meters; windmill tower, 6° 01′ 01″, about 1 000 meters.

Weiss (Kingsbury County, S. Dak., O. W. F., 1903).—Situated in the NW. ¼ sec. 26, T. 112 N., R. 54 W., on land belonging to Frederic August Weiss; it is 8 miles east of the town of Erwin. It is marked according to note 1, page 267, the reference mark being in the northwest corner of this section (26) and 585.965 meters from the station in azimuth 96° 11′ 59″; it is 4.18 meters lower in elevation than the station. The northwest corner of this section (26) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Schoolhouse, chimney, 94° 23′ 27″, about 600 meters; C. A. Carlston's house, chimney, 194° 26′ 10″, about 950 meters; windmill tower at the home of F. A. Weiss, 22° 33′ 44″, about 650 meters.

Jeska (Brookings County, S. Dak., O. W. F., 1903).—Situated in the northwest corner of the NE. ¼ sec. 29, T. 110 N., R. 52 W., on top of a high, prominent knoll, on land belonging to Otto Jeska. It is 3½ miles south and 1½ miles east of Arlington. It is marked according to note 1, page 267, the reference mark being about in the west line of this quarter section directly south of the stone marking the center of the north side of the section (29) and 201.490 meters from the station in azimuth 92° 40′ 36″; it is 1.05 meters lower in elevation than the station. The northwest corner of this quarter section is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Sam Dahl's house, chimney, 92° 53′ 09″,

about 1 mile; Lewis Olson's house, chimney, in center of south part, 212° 48′ 45″, about ½ mile; Otto Jeska's house, chimney, 280° 02′ 54″, about ½ mile.

Oakwood Lake (Brookings County, S. Dak., O. W. F., 1903).—Situated in the southwestern part of the NE. ¼ sec. 33, T. 112 N., R. 51 W., on land belonging to A. Binford, whose agent is A. E. Bundy, of Bruce. It is on a high ridge in an open field and is 2 miles north and 3 miles west of the town of Bruce. The station is marked according to note 1, page 267, the reference mark being in the southwest corner of the quarter section (33) and 428.913 meters from the station in azimuth 55° 21′ 09″; it is 26.7 meters lower in elevation than the station. The northeast corner of the section (33) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Chimney at west end of Rev. W. Ross's house, 269° 29′ 48″, about 750 meters; William Overocker's house, chimney, 82° 16′ 09″, about ½ mile; chimney at east end of George Bundy's house, 316° 31′ 31″, about 750 meters.

Horswill (Hamlin County, S. Dak., O. W. F., 1903).—Situated near the center of the west half NE. ¼ sec. 36, T. 115 N., R. 53 W., on land belonging to J. Horswill. It is 5 miles west of the town of Castlewood and is on the high point of the rising ground. The station is marked according to note 1, page 267, the reference mark being at the northwest corner of the quarter section at the south edge of the road, 0.39 meter south of the wire fence running west from the corner and 1.11 meters east of the fence running south from the corner and 417.900 meters from the station in azimuth 162° 35′ 16″; it is 7.42 meters lower in elevation than the station. The stone marking the center of the north side of the section is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: J. Horswill's windmill tower, 286° 01′ 25″, about 300 meters; house chimney, 313° 49′ 41″, about 1 mile; A. Parliament's windmill tower, 108° 38′ 57″, about 1 200 meters.

Olson (Deuel County, S. Dak., O. W. F., 1903).—Situated in sec. 6, T. 114 N., R. 50 W., on the half section line between the northwest and northeast quarter sections. It is 7½ miles east of Castlewood and is on land owned by Alfred Olson. It is marked according to note 1, page 267, the reference mark being in the south side of the road, 5.6 meters north of a willow hedge on the south side of the road, and 142.752 meters from the station in azimuth 178° 42′ 20″; it is 1.35 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Windmill tower, 100° 15′ 27″, about 1¼ miles; Alfred Olson's windmill tower, 261° 03′ 35″, about 1 000 meters; square top house, chimney, 342° 28′ 45″, about 1 200 meters.

Elfring (Codington County, S. Dak., O. W. F., 1903; 1906).—Situated in the northwest corner of the NW. ¼ sec. 26, T. 116 N., R. 53 W., on land belonging to the William Elfring heirs. J. D. Hansen, a lawyer, of Watertown, is the administrator of the estate. The station is 2¾ miles west and 4½ miles south of Watertown. The station is marked according to note 1, page 267, except that there is no subsurface mark, none being set because of large bowlders of very hard rock 2 feet below the surface of the ground. The reference mark is at the roadside in the northwest corner of the field and 157.191 meters from the station in azimuth 171° 47′ 04″; it is 3.52 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Hermann Schulke's house, north chimney, 8° 38′ 04″, about 1 300 meters; I. C. Wolcott's house, northeast corner, 102° 24′ 55″, 96.524 meters; E. George's house, 285° 08′ 38″, about 1 mile.

Franklin (Codington County, S. Dak., O. W. F., 1903; 1906).—Situated on high ground, in an open field, near the center of the W. ½ sec. 34, T. 113 N., R. 51 W. The land to the west belongs to Oliver Franklin, and to the east to Nick Marks. It is about 1⅛ miles northwest of Kranzburg, and is marked according to note 1, page 267, the reference mark being in the north line of the railroad right of way and 839.924 meters from the station in azimuth 0° 30′ 01″; it is 4.22 meters lower in elevation than the station. The southwest corner of this section (34) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Oliver Franklin's house, chimney, 10° 51′ 20″, about ½ mile; John Fox's house (square roof), chimney, 203° 09′ 11″, about ½ mile; Kranzburg Catholic Church spire, 287° 51′ 43″, about 1⅛ miles. In 1906 latitude and azimuth observations were made on a wooden pier located 4.28 meters from the triangulation station in line to Elfring triangulation station.

Helgen (Codington County, S. Dak., O. W. F., 1903).—Situated in about the center of the N. ½ sec. 31, T. 119 N., R. 53 W., on land belonging to Fred Mugg. It is on the highest hill of the range. The station is marked as follows: The subsurface mark is a 15-inch piece of tile, with a forty-penny nail set in cement 2½ feet below the surface of the ground. The surface mark and reference mark are similar to those described in note 1, page 267, the reference mark being in the center of the north side of the section (31), 0.71 meter from the corner, and 362.447 meters from the station in azimuth 194° 03′ 37″; it is 18.33 meters lower in elevation than the station. The quarter section corner on the north side of this section is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Ben Wesninger's windmill tower, 6° 56′ 15″, about 1 mile; Seneca Harriett's house or Helgen post-office chimney, 123° 13′ 23″, about 1 mile; windmill tower at Fred Mugg's barn, 295° 30′ 22″, about 450 meters.

Mound (Codington County, S. Dak., O. W. F., 1903).—Situated at about the center of sec. 34, T. 119 N., R. 51 W., on land belonging to John Koehler. It is 2½ miles south of the town of South Shore, upon a high knoll known as Punished Normans Mound. The station is marked according to note 1, page 267, the reference mark being in the center of the section and 89.386 meters from the station in azimuth 102° 30′ 25″; it is 8.71 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Windmill tower in pasture, 109° 23′ 17″, about ⅞ mile; Alvin Munder's house, chimney, 152° 13′ 05″, ¾ mile; John Koehler's house, chimney, 297° 14′ 53″, about 750 meters.

Waubay (Day County, S. Dak., O. W. F., 1903).—Situated in the NW. ¼ sec. 26, T. 122 N., R. 53 W., on land belonging to Mrs. Gassaw. It is 2 miles east and ½ mile south of Waubay, on top of a prominent rocky knoll (covered with bowlders). The underground mark is a 15-inch piece of tile; the surface and reference marks are similar to those described in note 1, page 267, the reference mark being in the east side of the road on the west side of the section (26) and 109.476 meters from the station in azimuth 183° 31′ 29″; it is 8.80 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Schoolhouse chimney, 323° 52′ 43″, about 1 mile; dwelling house chimney, 151° 01′ 27″, about 600 meters; Lena Gassaw's house, chimney, 274° 48′ 07″, about 300 meters.

Boating (Grant County, S. Dak., O. W. F., 1903).—Situated in the NE. ¼ SE. ¼ sec. 13, T. 121 N., R. 50 W., on land belonging to T. E. Thoreson. It is on the highest point of a prominent knoll, 1 mile south and 2 miles east of the town of Summit. The station is marked according to note 1, page 267, the reference mark being in the center of the section and in azimuth 211° 44′ 42″ from the station. The following azimuths and distances are from the triangulation station: Mr. Hong's windmill tower, 10° 27′ 42″, about 1½ miles; cupola of large barn, 75° 27′ 30″, about 1½ miles; chimney of schoolhouse of district No. 4, 240° 07′ 25″, about 2 miles.

Preacher Hill (Roberts County, S. Dak., O. W. F., 1903; 1906).—Situated in the northeast corner of the NE. ¼ sec. 1, T. 123 N., R. 52 W., on a high, rounding hill known in the vicinity as Preacher Hill. It is in Sisseton Indian Reservation, upon dead-Indian land leased to J. E. Aiken. It is 5 miles south and 2 miles west of Sisseton Agency village. The station is marked according to note 1, page 267, the reference mark being on top of a rounding rocky knoll, and is 149.968 meters from the station in azimuth 258° 22′ 56″; it is 3.50 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Kinsman's house, stovepipe chimney, 88° 41′ 18″, about ¾ mile; Mrs. Lentz's house, west gable, 256° 23′ 29″, about ¾ mile; Mrs. Echart's house, west gable, 306° 11′ 16″, about 1¼ miles. In 1906 latitude and azimuth observations were made on a wooden pier with sloping sides placed centrally over the triangulation station.

Pickerel (Day County, S. Dak., O. W. F., 1903).—Situated in the SE. ¼ SW. ¼ sec. 35, T. 124 N., R. 53 W., on land belonging to John Cytlack. It is 1 mile south, 30° east from Pickerel Lake, and on top of Indian Mound, the most prominent knoll in this region. The station is marked according to note 1, page 267, except that, owing to a bowlder, a pipe only 17 inches in length could be used for the subsurface mark, and the reference mark has no spike in the tile, its center being used instead. The reference mark is 205.644 meters from the station in azimuth 282° 22′ 43″, and 5.70 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: Guy St. Cloud's house, chimney, 51° 05′ 08″, about 600 meters; Richard Keeble's house, chimney (on high lake tank), 163° 19′ 41″, about 600 meters; highest point of largest bowlder in the vicinity, 162° 22′ 25″, about 100 meters.

Drywood (Roberts County, S. Dak., O. W. F., 1903; 1904).—Situated in the NE. ¼ NE. ¼ sec. 10, T. 125 N., R. 52 W., in Drywood Lake Township, Sisseton Indian Reservation, on land belonging to Mr. K. Himle. It is on a high, rounding, prominent knoll, about 1¼ miles north of Drywood Lake and 2 miles south and 4¼ miles west of Sisseton. The station is marked according to note 1, page 267, the reference mark being in a road corner of the section and 190.813 meters from the station in azimuth 262° 20′ 22″; it is 18.99 meters lower in elevation than the station. The northeast corner of the section (10) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: W. J. Arfstrom's house, chimney, 49° 03′ 37″, about 1 mile; K. Himle's barn, north gable, 292° 41′ 11″, about 280 meters; Frank G. Wimm's house, chimney, 317° 14′ 27″, about 700 meters.

Brown Valley Southeast Base (Roberts County, S. Dak., O. W. F., 1903; 1906).—Situated near the south side of sec. 18, T. 124 N., R. 49 W., on land belonging to Smith

and Engebritzen, bankers in Brown Valley, and rented to Sanford Allen. It is 4¼ miles south, 22° west from Brown Valley. It is marked by a deep cross cut in a ⅝-inch copper bolt set in the head of a stone block resting in a mass of concrete, its top level with the surface of the ground. The reference mark is similar to the one described in note 1, page 267, and it is in the section line, in azimuth 356° 44′ 13″ from the station; it is 1.49 meters lower in elevation than the station. The southeast corner of this section (18) is connected with the station. (See index.) The following azimuths and distances are from the triangulation station: Windmill at Larson's house, 115° 55′ 08,″ about 1 mile; Dittmann's red barn, south gable, 200° 25′ 22″, about 1 000 meters: Jim Bitner's house, chimney, 351° 46′ 30″, about 800 meters.

Brown Valley Northwest Base (Roberts County, S. Dak., O. W. F., 1903; 1906).—Situated in the NW. ¼ SE. ¼ sec. 15, T. 125 N., R. 50 W., on dead-Indian land; its owner was an Indian boy of the Sisseton and Wahpeton tribe, named Mar-pi-ya-duta, a son of Ta-ho-gan-du-ta-win of Brown Valley post office. The station is 415 meters from the northeast corner of the quarter section and 142.88 meters south of its north line, and is about 4¾ miles north 80° west from Brown Valley, Minn. The station is marked by a drilled hole in a ⅝-inch copper bolt set in a heavy stone block which is embedded in a mass of concrete. The reference mark is similar to the one described in note 1, page 267, being on the half section line through the center of the section and 142.881 meters from the station in azimuth 179° 28′. The following azimuths and distances are from the triangulation station: Mr. Wigg's house, chimney, 191° 33′ 57″, about 1 400 meters; Lena Nelson's house, west gable, 282° 55′ 43″, about 2 200 meters; Seven Brothers' house, stovepipe, 35° 01′ 11″, about 900 meters.

Layden (Traverse County, Minn., O. W. F., 1903; 1904).—Situated in the SW. ¼ NW. ¼ sec. 17, T. 125 N., R. 48 W., on land belonging to James Layden. The station is on a prominent mound 3½ miles north and 4½ miles east of Brown Valley. The station is marked according to note 1, page 267, the reference mark being at the southwest corner of the section, in the southwest corner of a field, and 371.128 meters from the station in azimuth 46° 27′ 31″; it is 6.40 meters lower in elevation than the station. The following azimuths and distances are from the triangulation station: William Cobert's house, chimney, 96° 03′ 51″, about ¾ mile; James Layden's house, chimney, 170° 30′ 20″, about ¾ mile; windmill tower at William Boner's house, 271° 58′ 21″, about ¾ mile. The quarter corner in the center of the west side of this section is connected with the station. (See index.)

Enwiller (Roberts County, S. Dak., W. H. B., 1904).—Near the east side of the NE. ¼ sec. 36, T. 128 N., R. 49 W., in Victor Township, Sisseton Indian Reservation, about ¼ mile due south of the northeast corner of the section, on land belonging to Harry Enwiller, who lives about ¼ mile to the eastward, in section 1. It is 7 miles west and 6¼ miles south of the town of White Rock, and 2 miles east and 1¼ miles south of Crawford post office, and is on a prominent ridge which extends east and west, 13 paces west from the center of the wagon road where it crosses the ridge, and 4.39 meters east of the fence line on the east side of section 36. The station is marked according to note 2, page 267, the iron pipes being 2½ inches in diameter. The reference mark is a nail in cement, 10 inches east from the fence line and 23.366 meters from the station in azimuth 9° 29′ 47″. The following azimuths and distances are from the triangulation station: Harry Enwiller's house, chimney, 258° 29′ 10″, about ¼ mile; William Enwiller's barn,

vane, 230° 41′ 57″, about ⅜ mile; Christopher Schneider's house, chimney, 141° 18′ 52″, about ½ mile; Swedish Lutheran Church, spire, 276° 32′ 08″, about 2 miles; quarter section corner east side section 36, 358° 28′ 07″, 406.52 meters. (See index.)

Hankinson (Richland County, N. Dak., W. H. B., 1904; 1906).—On the high part of a very prominent ridge in the SE. ¼ SE. ¼ sec. 28, T. 130 N., R. 50 W., on land belonging to —— Harrison, who lives in West Concord, Minn. The station is in Brightwood Township, and is 10 paces north of section-line road (center), about 89 paces south of west from the northwest corner of an old deserted barn. It is about 4 miles southwest of Hankinson. To reach the station from Hankinson, go west to the section line, then south 1½ miles, then west 2 miles past the northern end of Lake Hankinson, then south a little more than 1 mile to the southeast corner of section 28, which is 150.473 meters from the station in azimuth 273° 25′ 18″. The station is marked according to note 1, page 267, the reference mark being in the southeast fence corner at the corner of the section, and 141.664 meters from the station in azimuth 270° 29′ 30″. The following azimuths and distances are from the triangulation station: Behle's house, chimney, 77° 12′ 04″, about ½ mile; schoolhouse, chimney, 204° 50′ 23″, about ½ mile; Hankinson High School, spire, 228° 15′ 26″. In 1906 latitude observations were made on a wooden pier placed 6.59 meters due east of the triangulation station. The ground to a depth of 3 feet consisted of loam mixed with sand.

Oscarson (Traverse County, Minn., W. H. B., 1904).—In the NW. ¼ sec. 24, T. 128 N., R. 47 W., on land belonging to E. Oscarson, who lives in White Rock, S. Dak., and rented to Ben Cartwright, who lives just east of the station. It is 2½ miles south and 2 miles east of White Rock, S. Dak. It is about 24 meters south of a grove of trees and about 6 paces north of a road leading from the west side of the section to the home of Ben Cartwright. The station is marked according to note 1, page 267, the reference mark being at the south edge of the timber and 24.213 meters from the station in azimuth 180° 44′ 26″. The following azimuths and distances are from the triangulation station: Ben Cartwright's house, northwest corner, 279° 02′ 17″, 58.5 meters; Adolph Carlson's house, east gable, 94° 03′ 10″, about ⅜ mile; ball on spire at White Rock, S. Dak., 134° 40′ 11″; Alex Johnson's barn, spire, 256° 54′ 27″, about ¼ mile.

Foss (Wilkin County, Minn., W. H. B., 1904).—Close to the quarter-section corner on the west side of sec. 1, T. 130 N., R. 47 W., on the west edge of the wheat field belonging to M. E. Foss, who lives ¾ mile to the southeast. It is in what is called Campbell Township, is 11.3 meters east of the center of the road, and is 2½ miles north of the town of Childs, Minn. The station is marked according to note 1, page 267, the reference mark being across the wagon road, near the southeast corner of section 2, on land owned by Ed. Joy, who lives ⅛ mile north of and across the road from the station. The reference mark is respectively 0.82 meters west and 0.20 meters south of the east and south fences which intersect at the southeast corner of Mr. Joy's land, and is 22.124 meters from the station in azimuth 90° 18′ 17″. The following azimuths and distances are from the triangulation station: Childs, tallest elevator, center of top, 1° 56′ 58″; Ed. Joy's house, chimney, 171° 19′ 15″, about ⅛ mile; M. E. Foss's barn, cupola, 304° 56′ 55″, about ⅜ mile; house in southeast corner of section 1, north gable, 8° 47′ 50″, about ½ mile.

Wahpeton (Wilkin County, Minn., W. H. B., 1904; 1906).—In the E. ½ NW. ¼ sec. 23, T. 132 N., R. 47 W., in an open field belonging to Mrs. William Wagner-Ball, of Wahpeton, N. Dak., and rented to Hermann Degner, who lives a little over ⅛ mile to

the east and across the railway tracks from the station. It is about 2¼ miles southeast of Breckenridge, Minn., from which town it is reached by following the Great Northern Railway (on west side) leading to Doran, Minn., for about 1¾ miles beyond the point where the railway turns at a railway tower (signal). The station is marked according to note 1, page 267, the reference mark being on the edge of the field near the wagon road, 8.30 meters from the center of the road, 36.56 meters from the west rail of the Great Northern Railway, and 44.808 meters from the station in azimuth 188° 12′ 47″. The following azimuths are from the triangulation station: Western of twin spires on Catholic Church at Wahpeton, 124° 49′ 19″; northwest corner post of field of Hermann Degner, east of track at intersection of road to house with railway, 167° 54′ 00″; Hermann Degner's house, chimney, distant about 250 meters, 247° 06′ 05″.

Western (Ottertail County, Minn., W. H. B., 1904; 1906).—In Western Township, in an open cultivated field on a private road along the half section line leading from the north quarter section corner of sec. 26, T. 131 N., R. 44 W., to the house of William B. Dewey, who lives near the center of the section. It is about 75 yards west of the highest ground in the field. The station is reached from Fergus Falls, which is about 10 miles north and 5 miles east by following the main traveled road leading southwest to Western post office, which is about ½ mile west and ¾ mile north of the station. The station is marked according to note 1, page 267, the reference mark being in the northwest corner of Dewey's Grove, 6 feet west of the northwest corner tree (12-inch) of the grove, and 253.495 meters from the station in azimuth 356° 23′ 26″. The following azimuths and distances are from the triangulation station: William Dewey's windmill, center of wheel, 341° 43′, about ¼ mile; F. Swift's house, chimney, 93° 46′ 07″, about ½ mile; Davenport's house, or Western post office, south gable, 145° 02′ 55″, about 1 mile; north quarter corner, sec. 26, T. 131 N., R. 44 W., 178° 54′ 38″, 262.79 meters.

Bullis (Grant County, Minn., W. H. B., 1904).—At the north side of the NW. ¼ sec. 31, T. 129 N., R. 43 W., on grass land belonging to heirs living in Iowa; the agent for the land lives in Herman, Minn. It is in what is called Elbow Lake Township, is 5 miles south and ¾ mile east of Hereford, on the Great Northern Railway; it is 9 paces west of center of old State road leading along the top of small ridge from Hereford to Herman, and 7 paces south from the center of the section line road on the north side of the section. The "grass right" on this land is rented to A. H. Bullis, who lives about ½ mile north of the station. The station is marked according to note 1, page 267, the reference mark being across the section line road from the station and 14.350 meters from it in azimuth 180° 07′ 55″. Other distances and azimuths from the triangulation station are: Wilcox's house, chimney, 83° 02′ 57″, about 1 mile; Hereford, tallest elevator, 169° 27′ 02″, about 5 miles; A. H. Bullis's house, chimney, 179° 46′ 29″, about ⅜ mile; schoolhouse (district 17), chimney, 234° 35′ 04″, 1¼ miles.

FERGUS FALLS TO CANADA.

PRINCIPAL POINTS.

Fox (Wilkin County, Minn., W. B., 1906).—Located in the S. ½ SE. ¼ sec. 34, T. 133 N., R. 45 W., 9 meters north of the center of the section road, near the edge of the field, and about ½ mile west-northwest from the town of Foxhome, on the Northern Pacific Railway. The station is on property belonging to J. A. Jargensen, of Foxhome,

and leased to Otto Zashledorf. The station is marked according to note 2, page 267, the iron pipe being 1½ inches in diameter; the reference mark is just west of the station, near the edge of the field and 9 meters north of the section road, and is 27.70 meters from the station in azimuth 90° 03′ 35″. From the station the east gable of the house of Hans J. Haanson is distant about 278.0 meters in azimuth 80° 29′ 54″, and the center of a bridge over a small stream west of the station is distant 237.0 meters in azimuth 87° 44′ 44″.

Indian (Ottertail County, Minn., W. B., 1906).—Located in the NE. ¼ NE. ¼ sec. 4, T. 134 N., R. 44 W., 4½ miles southeast of Rothsay, a town on the Great Northern Railway. The station is on property belonging to Mrs. Gure Arneson, being 6 meters north of the line fence between her property and that of Seurin Lerbakker, and about 150 meters west of the north and south section road. The station was placed on the north slope of a very prominent hill called Indian Mountain. The station is marked according to note 2, p. 267, the iron pipe being 1¼ inches in diameter; the reference mark is in the fence corner just west of the station, and 52.100 meters from the station in azimuth 84° 08′ 50″. The following azimuths and distances are from the triangulation station: Cupola on Mr. Helgeson's red barn, 183° 42′ 08″, about 500 meters; highest point of a very large rock in corner of field, 266° 11′ 40″, 137.5 meters; and C. & G. S. B. M. E_4 (see index), 327° 24′ 00″, 324.3 meters; highest point of Indian Mountain, 10° 59′ 59″, 144.7 meters.

Meadows (Wilkin County, Minn., W. B., 1906).—In the NW. ¼ SW. ¼ sec. 8, T. 134, N., R. 46 W., on land owned by Albert Russel, of Breckenridge, and farmed by Eugene Van Tassel. The station is in the northeast corner of his pasture, just south of his house, and west of an old abandoned railway grade leading north-northeast from Wahpeton, N. Dak., distant 15 miles. Manston, the nearest post office, is 3½ miles north and 1 mile east. The station is marked according to note 1, p. 267, the reference mark being in the fence corner just west of the railroad grade, and 61.745 meters from the station in azimuth 235° 22′ 21″. The following azimuths and distances are from the triangulation station: Line normal to railroad grade center, 290° 16′ 21″, 44.6 meters; southwest corner of house of Albert Russel, 198° 07′ 21″, 66.3 meters.

Tansem (Clay County, Minn., W. B., 1906).—In the NE. ¼ NE. ¼ sec. 10, T. 137 N., R. 44 W., on one of several bare knolls in the immediate vicinity, on land belonging to Ole Gulbranson, who lives about ½ mile west of the station. The station is about 10 miles east and 3 miles north of the town of Barnesville and is marked according to note 1, p. 267, the reference mark being 78.301 meters from the station in azimuth 274° 08′ 50″. The following azimuths and distances are from the triangulation station: Section corner common to secs. 2, 3, 10, and 11, T. 137 (see index), R. 44, 198° 33′ 22″, 266.9 meters; schoolhouse cupola, 302° 07′ 14″, about 800 meters.

Barnesville (Clay County, Minn., W. B., 1906).—In the NE. ¼ sec. 15, T. 137 N., R. 46 W., 2 miles west and 2¼ miles north of the town of Barnesville, on land owned by J. P. McWilliams, of Illinois, and leased to C. W. Austin. The station is just south of the dwelling house and barns, on top of a slight ridge running north and south, about 300 meters west of the section road, and about 700 meters north of the Fargo Branch of the Great Northern Railway. The station is marked according to note 1, page 267, the reference mark being 13.63 meters south of a large barn, 1.16 meters west of the southwest

corner of a small barn, and 37.480 meters from the station in azimuth 181° 38′. The following azimuths and distances are from the triangulation station: South gable of McWilliams's house, 192° 33′, 88.73 meters; cupola of large red barn, 206° 33′, about 400 meters; signboard, railroad crossing, 339° 36′, about 700 meters.

Eglon (Clay County, Minn., W. B., 1906).—In the NE. ¼ SW. ¼ sec. 21, T. 139 N., R. 44 W., on the southwest corner of a flat-top hill, about 3 miles south and 3 miles east of the town of Hawley, and in a pasture owned by the heirs of Mrs. Mary Hogetvetd. The station is marked according to note 1, page 267, the reference mark being on a north-and-south fence line just west of the station, and 26.275 meters from the station in azimuth 98° 07′ 53″. The following azimuths and distances are from the triangulation station: Windmill, 12° 07′ 43″, about 800 meters; chimney of house, 17° 00′ 43″, about 400 meters.

Riverton (Clay County, Minn., W. B., 1906).—In the SE. ¼ SW. ¼ sec. 23, T. 139 N., R. 46 W., on vacant prairie land said to belong to P. Figi, address unknown. The station is on a low ridge, 2¾ miles south and 1½ miles east of Stockwood, a station on the Northern Pacific Railway. The station is marked according to note 1, page 267, the reference mark being on the north edge of the section road just south of the station, and 145.070 meters from the station in azimuth 4° 51′ 37″. The half section corner common to secs. 23 and 26, of T. 139, R. 46 (see index), is 224.4 meters from the station in azimuth 314° 32′ 55″.

Keene (Clay County, Minn., W. B., 1906).—In the SW. ¼ NW. ¼ sec. 20, T. 141 N., R. 45 W., on land owned by Philip Weisbrod, of Iowa. The station is about 4½ miles south and 4 miles east of the town of Felton, on the Great Northern Railway, and is just north of the half section line, being on a low ridge running north and south, between two deserted dwelling houses. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is on the half section line, 49.700 meters from the station in azimuth 359° 47′ 03″. From the station the chimney of a deserted house is distant 114.3 meters in azimuth 203° 09′ 13″, and the chimney of a deserted frame house is distant 72.0 meters in azimuth 346° 48′ 33″.

Syre (Norman County, Minn., W. B., 1906).—In the NW. ¼ SE. ¼ sec. 18, T. 143 N., R. 43 W., on land belonging to Helge Lee, who lives ¼ mile northeast of the station. The station is in Flour Township, on the highest point of "Frenchman's Bluff," 4½ miles south and 4 miles east of Twin Valley, a large town on the Northern Pacific Railway, and 1¼ miles north and 3½ miles east of the station Syre, on the Northern Pacific Railway. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is in the fence corner just south of the station, being 145.705 meters from the station in azimuth 58° 31′ 57″. The chimney of Helge Lee's dwelling house was distant about 400 meters in azimuth 231° 34′ 32″.

Morken (Clay County, Minn., W. B., 1906).—In the northeast corner of sec. 15, T. 141 N., R. 47 W., on land owned by the Wheeler Land Co., of Moorhead, Minn. The station is about 5 miles west and 3 miles south of the town of Felton, on the Great Northern Railway; it is 13.3 meters south of the center of the east-and-west road, and 30 meters west of the center of the north-and-south road. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is in the extreme northeast corner of section 15, being 9.1 meters south of the center of

the east-and-west road and 10.3 meters west of the center of the north-and-south road; it is 20.070 meters from the triangulation station in azimuth 256° 36′ 11″. The following azimuths and distances are from the triangulation station: Tall chimney on house of Erick Carlson, 139° 19′ 24″, about 150 meters; south gable of barn of Erick Carlson 154° 44′ 59″, about 200 meters; corner of sections 10, 11, 14, and 15 (stone not found), 245° 21′ 38″, 32.2 meters. (See index.)

Borup (Norman County, Minn., W. B., 1906).—In the SW. ¼ SW. ¼ sec. 22, T. 143 N., R. 46 W., on land belonging to T. O. Lian, who lives ⅛ mile southeast of the station. It is in Winchester Township, about ½ mile east and ¼ mile north of the town of Borup, on the Great Northern Railway. The station is 10 meters east of the center of the north-and-south section road and in the northwest corner of Mr. Lian's pasture. It is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is just north of the station in a fence corner, and 7 meters east of the center of the road. It is 26.731 meters from the station in azimuth 172° 48′ 39″. The following azimuths and distances are from the triangulation station: C. & G. S. B. M. E. (see index), 3° 49′ 31″, 389.6 meters; Borup Church spire (see index), 16° 59′ 14″; Borup, tall elevator, 61° 19′ 02″.

Gary (Norman County, Minn., W. B., 1906).—Near the center of the NW. ¼ sec. 9, T. 145 N., R. 44 W., on land belonging to the John Grove Land Co., St. Paul, Minn., and rented to S. S. Vrstad, who lives about 1 000 meters west of the station. The station is in what is known as Strand Township, and is 48 telegraph poles north of Gary and 172 meters west of the center of the railway track. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is in the fence line on the west side of the railroad right of way, and is 116.114 meters from the station in azimuth 288° 16′ 16″. The following azimuths and distances are from the triangulation station: South gable of red barn, 69° 26′ 09″, about 1 000 meters; lone tree just west of railway, 188° 00′ 21″, about 500 meters; chimney of house east of railway, 278° 49′ 48″, about 800 meters.

Wicklow (Norman County, Minn., W. B., 1906).—In the SW. ¼ NE. ¼ sec. 15, T. 145 N., R. 46 W., on land owned by Jacob Hadler, who lives about ½ mile southeast of the station. It is in what is known as Pleasant View Township, ¼ mile east and 5½ miles north of the town of Ada, on the Great Northern Railway, and about ½ mile north and 1½ miles east of the station Hadler, also on the Great Northern Railway. It is 4 meters east of the half section line, and is marked according to note 1, page 267, the reference mark being in the half section line and 30.012 meters from the station in azimuth 7° 38′ 43″. The following azimuths and distances are from the triangulation station: C. & G. S. B. M. K_5 (see index), 59° 45′ 06″, 557.2 meters; chimney of white house, 68° 55′ 53″, about 700 meters; chimney on house of Jacob Hadler, 298° 48′ 41″, about 800 meters.

Fertile (Polk County, Minn., W. B., 1906).—In the NW. ¼ sec. 30, T. 147 N., R. 44 W., on United States land in Garfield Township, 1½ miles west and ¾ mile south of the town of Fertile, on the Northern Pacific Railway, on the top of the third highest point of what are known as the Sand Hills, the highest point of which is very sharp and composed of loose sand, while the second highest point is too sharp to accommodate a signal. The station is marked according to note 1, page 267. The reference mark being

placed on the highest point of the second highest peak of the Sand Hills, 53.00 meters from the station in azimuth 179° 20′ 55″. The highest point of the Sand Hills is distant about 130 meters in azimuth 220° 27′.

Beltrami (Polk County, Minn., W. B., 1906).—In the SW. ¼ SE. ¼ sec. 24, T. 147 N., R. 47 W., on land owned by the firm of Holden & Robinson, of Plymouth, Iowa. Station is in Scandia Township, 1 mile south and 3 miles west of the town of Beltrami on the Great Northern Railway; it is about 11.2 meters north of the center of the section road running east and west. The station is marked according to note 2, page 267, the iron pipes being 1½ inches in diameter; the reference mark is in a fence corner and in the southeast corner of a grove just west of the station on north edge of the section road; it is 163.079 meters from the station in azimuth 89° 30′ 32″. The following azimuths and distances are from the triangulation station: Windmill near large barn, 26° 46′ 01″, about 1 400 meters; section corner common to secs. 23, 24, 25, and 26, T. 147, R. 47 (see index), 89° 02′ 39″, 968.3 meters; chimney on white house, 155° 25′ 55″, about 300 meters; west chimney of Edgewood farmhouse, 279° 24′ 23″, about 700 meters.

Tilden (Polk County, Minn., W. H. B., 1905; 1906).—In the southwest corner of sec. 20, T. 149 N., R. 44 W., 14.9 meters east of the center of the wagon road and 12.8 meters east of the north-and-south section line. It is in Tilden Township, about 14 miles east-southeast of Crookston, about 3 miles west of Dugdale, a railway station on the Great Northern Railway, and 153 meters north of the center of the railroad track. The open field in which the station is located belongs to John Clayton, of Illinois, whose agent in Crookston is John H. Boyd. The station is marked according to note 1, page 267, except that the tile of the surface mark is only 20 inches in length. The reference mark is on the north edge of the railroad cut, 23.7 meters north of the center of the track, 8.5 meters from the center of the first telegraph pole east of the railroad crossing, and 129.217 meters from the station in azimuth 358° 49′ 29″. From the station the signboard at the railroad crossing is distant about 145 meters in azimuth 5° 13′ 44′, and the section corner common to sections 19, 20, 29, and 30 (see index) is distant 164.9 meters in azimuth 5° 58′ 49″. In 1905 latitude observations were made on a triangular-shaped pier built of 4 by 6 inch wooden posts boxed with 2 by 8 inch planks, placed 8.90 meters due west of the triangulation station and 8.9 meters east of the section line.

Andover (Polk County, Minn., W. B., 1906).—In the southeast corner of sec. 13, T. 149 N., R. 47 W., on land belonging to William H. Johnson, of Ames, Iowa. Station is in Andover Township, about 3½ miles due south of Crookston, 49.75 meters a little west of north of the section corner, and 12.7 meters west of the center of the north-and-south road. The station is marked according to note 1, page 267, the reference mark being in the edge of the field west of the station, 8.0 meters east of the center of the railroad track, 25.0 meters north of the center of the east-and-west section road, and 181.946 meters from the station in azimuth 82° 45′ 57″. From the triangulation station the section corner common to secs. 13 and 24, T. 149, R. 47, and secs. 18 and 19, T. 149, R. 46 (see index), is distant 49.7 meters in azimuth 344° 19′ 32″, and the center of the railroad crossing is distant 185.45 meters in azimuth 75° 03′ 22″.

Ives (Red Lake County, Minn., W. B., 1906).—In the center of the SW. ¼ sec. 32, T. 152 N., R. 45 W., on land belonging to E. D. Healy, of Red Lake Falls, Minn. It is in Louisville Township, about ⅝ mile north of the store and elevator at Dorothy, on the

Northern Pacific Railway, about 9 miles northwest of Red Lake Falls, on top of a prominent narrow sand ridge running north from Dorothy, and 19.6 meters west of the center of the road running along the top of the ridge. The station is marked according to note 1, page 267, the reference mark being on the western side of the road, 3.0 meters from its center and 16.840 meters from the station in azimuth 256° 47′ 26″. From the station a windmill distant about 500 meters is in azimuth 286° 20′ 55″, and the elevator at Dorothy, distant about 1 000 meters, is in azimuth 337° 30′ 30″.

Shirley (Polk County, Minn., W. B., 1906).—Near the north edge of the NE. ¼ sec. 33, T. 151 N., R. 47 W., on land belonging to J. W. Hichon, of Algona, Iowa, whose agent is M. Shankey, living on the road about ¼ mile west of the station. The station is in Fanny Township, about 7 miles northwest of Crookston, and 116.10 meters south of the center of the east-and-west section road. The station is marked according to note 1, page 267, the reference mark being 4 meters south of a windmill, about 10 meters south of an old well, and 35.815 meters from the station in azimuth 174° 15′ 05″. From the triangulation station the center of a tree marked with a triangle and located in the southeast corner of a grove is distant 85.53 meters in azimuth 90° 00′ 58″, and the southeast corner of Mr. Hichon's dwelling house is distant 84.00 meters in azimuth 137° 15′ 32″.

Bray (Marshall County, Minn., W. B., 1906).—In the SW. ¼ sec. 17, T. 153 N., R. 45 W., in Bray Township, on the highest part of a high sand ridge lying north and south, along the top of which runs the old "Pembina Trail," now a well-traveled road. Just east of this ridge and opposite the station is a large marsh with some open water, known for miles around as "The Goose Pond." The station is 5 meters east of the center of the wagon road, and between two dwelling houses on the ridge, one of which is about 1 600 meters north and the other about 2 400 meters south. The station is on vacant land said to belong to the Great Northern Railway. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is 5 meters east of the center of the wagon road, and 21.725 meters from the station in azimuth 192° 32′ 59″. From the station the chimney of the house north of the station, which is distant about 1 600 meters, is in azimuth 206° 27′ 50″, and the chimney of the house south of the station, and distant about 2 400 meters, is in azimuth 13° 58′ 38″.

Sherack (Polk County, Minn., W. B., 1906).—In the southeast corner of sec. 31, T. 153 N., R. 47 W., on land owned by James Robbins, of Renova, Pa., whose agent is W. Lemon, of Angus. The station is in Angus Township, 2 miles east of the railroad station at Sherack and 2 miles west and 4 miles south of the town of Angus. It is 16.4 meters west of the center of the north-and-south section road, and is north 21.6 meters from the center of the east-and-west section road. It is marked according to note 2, page 267, the iron pipes being 2 inches in diameter. The reference mark is 8.3 meters west of the center of the north-and-south section road and 28.700 meters from the station in azimuth 194° 50′ 37″. C. & G. S. B. M. D_6, and the corner common to secs. 31 and 32, T. 153, R. 47, and secs. 5 and 6, T. 152, R. 47, were connected with the station. (See index.)

Viking (Marshall County, Minn., W. B., 1906).—In the SW. ¼ sec. 7, T. 155 N., R. 45 W., in Viking Township, on the highest part of a prominent sand ridge, lying approximately north and south, along the top of which runs the "Pembina Trail." The station is 24.2 meters southwest of the center of the trail, and about 150 meters east of the well-defined edge of a strip of low trees and brush along the west edge of the sand ridge. The

station is marked according to note 1, page 267, the reference mark being 2.8 meters southwest of the center of the "Pembina Trail" and 25.843 meters from the station in azimuth 177° 52′ 57″. The azimuth of a large windmill about 2 000 meters from the station is 112° 40′ 36″.

Warren (Marshall County, Minn., W. B., 1906).—In the southeast corner of the SW. ¼ SW. ¼ sec. 20, T. 155 N., R. 47 W., on land belonging to E. P. Hunsted, who lives about 200 meters northeast of the station. The station is in McCrea Township, 1½ miles north and 1¾ miles east of the town of Warren, and 13.8 meters north of the east-and-west section road. Marked according to note 1, page 267, the reference mark being 8.6 meters north of the center of the east-and-west section road and 41.830 meters from the station in azimuth 83° 03′ 15″. The following azimuths and distances are from the triangulation station: Section corner common to secs. 19, 20, 29, and 30, T. 155, R. 47 (see index), 87° 45′ 47″, 406.0 meters; windmill near house of E. P. Hunsted, 198° 18′ 27″, about 200 meters.

Wright (Marshall County, Minn., W. B., 1906).—Near the center of the SW. ¼ sec. 24, T. 157 N., R. 46 W., on school land which has been taken up by Carl Edmon, who lives about 200 meters northeast of the station. The station is in Wright Township, on top of a high sand ridge running north and south, and along which runs the "Pembina Trail." It is 11.9 meters east of the "Pembina Trail" and 221.0 meters north of the center of the east-and-west section road which runs along the south side of section 24. Marked according to note 1, page 267, the reference mark being on the west side of the "Pembina Trail," 2.3 meters from its center, in the edge of the bushes, and 72.050 meters from the station in azimuth 15° 34′ 20″. The azimuth of the chimney of a house distant about 200 meters is 244° 12′ 10″.

Argyle (Marshall County, Minn., W. B., 1906).—In the southeast corner of the SW. ¼ SW. ¼ sec. 35, T. 157 N., R. 48 W., on land owned by parties in Illinois (whose names could not be ascertained), and rented to Edward Fournier, who lives in a grove about 550 meters north of the station. The station is in Tamarack Township, about 3½ miles north and ¼ mile east of the town of Argyle; it is 10.3 meters north of the center of the east-and-west section road and 8.5 meters west of the center of a north-and-south private road. It is marked according to note 1, page 267, the reference mark being on the quarter section line, 3.2 meters west of the center of the north-and-south road, and 27.064 meters from the station in azimuth 191° 13′ 34″. From the station the distance and azimuth of C. & G. S. B. M. O_6 (see index) are 391.1 meters, 180° 26′ 37″, and of the east chimney of a dwelling house, about 461 meters, 184° 59′ 01″

Stephen West Base (Marshall County, Minn., W. H. B., 1905; 1907).—In the southwest corner of the SE. ¼ sec. 33, T. 158 N., R. 48 W., in a cultivated field belonging to Mr. J. Gillespie, of Stephen. The station is 31.0 meters east of the half section line and 15.0 meters north of the center of the east-and-west section line. It is in what is known as Sinnot Township, about ½ mile north and ¾ mile east of the town of Stephen. The station is marked as follows: The underground mark is a ½-inch copper bolt set in a granite block 6 inches square and 1 foot deep, placed 5 feet below the surface of the ground. Above this is placed an empty section of 4-inch sewer pipe. The surface mark is a 1-millimeter drill hole in a bronze station mark set in a granite block 2 feet square and 1 foot deep. The pipe and both stones are surrounded by a mass of concrete 2 feet square at the base and 4 feet square at the surface of the ground.

The reference mark similar to the one described in note 1, page 267, is in the southwest corner of the section, 9.0 meters east of the north-and-south section road, and 9.6 meters north of the east-and-west section road. It is 832.510 meters from the triangulation station in azimuth 89° 40′ 19″. Latitude and azimuth observations were made on a wooden pier, triangular prismatic in shape, placed 101.81 meters from the triangulation station in line to Stephen East Base. Longitude observations were made on a pier of concrete resting on a brick base and placed 9.70 meters east and 1.20 meters north of the station. The following azimuths and distances are from the triangulation station: C. G. & S. B. M. T_6 (see index), 46° 30′ 29″, 38.4 meters; house chimney, 170° 11′ 47″, about 600 meters; house chimney, 267° 11′ 09″, about 800 meters.

Stephen East Base (Marshall County, Minn., O. B. F., 1906; 1906).—Near the center of the west side of the SW. ¼ NW. ¼ sec. 28, T. 158 N., R. 47 W., on land belonging to James Winczewski, of Winona, Minn.; the property is known as the "Old Taylor Farm. The station is in Augsburg Township, about 6½ miles east and 2 miles north of the town of Stephen, and is 12.3 meters east of the section line and 208.8 meters north of the quarter section line. The station is marked in a manner similar to Stephen West Base (p. 286); the reference mark is on the quarter section line, 16.0 meters east of the quarter section corner, and 208.825 meters from the station in azimuth 359° 12′ 09″. From the triangulation station the azimuth of the chimney of a deserted house about 400 meters distant is 190° 31′ 04″, and of the north chimney of a dwelling house on Wheeler farm, distant about 2 200 meters, is 31° 13′ 44″.

Deer (Kittson County, Minn., W. B., 1907).—On the north-and-south half section line of sec. 19, T. 159 N., R. 46 W., on land belonging to the Great Northern Railway, on top of a low ridge running north and south—the ridge being cleared on top for a width of 50 meters and having bushes on its slopes. The station is in Deerwood Township, ⅜ mile north of Deer post office, 12 miles east of Donaldson, on the Great Northern Railway, and 15.60 meters east of the center of a road winding along the top of the ridge. The station is marked according to note 1, page 267, the reference mark 15.30 meters east of the center of the road and 29.357 meters from the station in azimuth 177° 26′ 41″.

Donaldson (Marshall County, Minn., W. B., 1907).—In the NE. ¼ NE. ¼ sec. 6, T. 158 N., R. 48 W., on land belonging to E. A. Kindlee, of Stephen, and G. F. Johnson, of Crookston. The station is in Sinnot Township, just west of the Great Northern Railway and 2 miles south of Donaldson. It is 23.58 meters south of the section line forming the boundary between Marshall and Kittson Counties, and about 175 meters from the railroad. It is marked according to note 1, page 267, the reference mark being on the edge of a field just east of the station and 27.771 meters from the station in azimuth 263° 13′ 34″. The northeast corner of sec. 6, T. 158, R. 48 (see index), is 348.9 meters from the station in azimuth 266° 06′ 19″, and the center of the railroad crossing is 177.37 meters from the station in azimuth 262° 06′.

Jupiter (Kittson County, Minn., W. B., 1907).—Near the eastern edge of the SE. ¼ NE. ¼ sec. 6, T. 160 N., R. 47 W., on land belonging to P. Benson, who lives ¼ mile northwest of the station. Station is in Jupiter Township, about 4½ miles west-southwest of the railroad station Bronson, on the "Soo" Railway, and 10 meters west of the center of the section road. It is marked according to note 1, page 267, the refer-

ence mark being 5.50 meters west of the center of the section road, and 29.377 meters from the station in azimuth 349° 47′ 54″. The cupola of P. Benson's barn is about 450 meters from the station in azimuth 142° 31′.

Skane (Kittson County, Minn., W. B., 1907).—In the northwest corner of sec. 8, T. 160 N., R. 49 W., on land belonging to Charles Lander, who lives ½ mile southeast of the station. The station is in Skane Township, 5 miles south and 3 miles west of Hallock, on the Great Northern Railway, and is 21.50 meters south of the east-and-west section road, and 12.60 meters east of the north-and-south road. It is marked according to note 1, page 267, the reference mark being 12.50 meters east of the north-and-south road and 24.493 meters from the station in azimuth 1° 19′ 31″. The northwest corner of section 8 (intersection of roads) (see index) is 25.2 meters from the station in azimuth 150° 07′.

Hallock (Kittson County, Minn., W. B., 1907).—Near the northeast corner of the NE. ¼ SE. ¼ sec. 1, T. 161 N., R. 49 W., on land belonging to Eugene Glyddon, who lives in Hallock. The station is in Hallock Township, ¾ mile east and 1½ miles north of the town of Hallock. It is 10.90 meters west of the north-and-south section road, and is marked according to note 1, page 267, the reference mark being on the quarter section line of sec. 6, T. 161, R. 48, 10.60 meters east of the center of the north-and-south section road and 70.865 meters from the station in azimuth 197° 12′ 22″. From the station the azimuth of a house chimney distant about 300 meters is 352° 15′. Another house chimney is distant about 160 meters in azimuth 236° 03′.

Granville (Kittson County, Minn., W. B., 1907).—Near the center of the north side of the NE. ¼ sec. 11, T. 162 N., R. 48 W., on land belonging to D. D. Murphy, who lives at Blue Earth, Minn. The station is in Granville Township, ¾ mile west and 1½ miles north of the town of Lancaster on the "Soo" Railroad. It is 10.50 meters south of the center of the east-and-west section road, and is marked according to note 1, p. 267, the reference mark being in section 2, 6.70 meters north of the center of the east-and-west section road, and 17.215 meters from the station in azimuth 177° 16′ 10″. From the station the cupola of Benson Lockwood's barn is distant about 80 meters in azimuth 216° 35′, and the east gable of his house is distant about 85 meters in azimuth 159° 26′.

Hill (Kittson County, Minn., W. B., 1907).—In the southwest corner of the SE. ¼ sec. 15, T. 162 N., R. 50 W., on land belonging to Henry Nolte, who lives ½ mile northeast of the station; in Hill Township, 5 miles west of Northcote, on the Great Northern Railway. The station is 20.38 meters east of the quarter section line, 10.70 meters north of the east-and-west section road, and is marked according to note 1, page 267, the reference mark being on the quarter section line, 10.60 meters north of the east-and-west section road and 20.380 meters from the station in azimuth 90° 06′ 01″.

Canada (United States-Canada, W. B., 1907).—On the boundary between the United States and Canada, just west of the iron boundary monument No. 54, which is the monument 15 miles east of the Red River. This monument is within a few feet of the north end of the line between secs. 28 and 29, T. 164 N., R. 48 W., and has 0.32 meter of its top broken off. The station is 7 miles by road north by east from the town of Orleans on the "Soo" Railroad, and is marked according to note 1, page 267, the reference mark being on or very near the boundary, and 22.065 meters from the station in azimuth 90° 15′ 18″. The top of the boundary monument No. 54 is 25.28

meters from the station in azimuth 270° 03′ 21″ and the center of its base is 25.29 meters from the station.

States (United States-Canada, W. B., 1907).—On the boundary between the United States and Canada, just east of the iron boundary monument No. 65, which is 4 miles east of the Red River. The station is within a very few feet of the line between secs. 27 and 28, T. 164 N., R. 50 W., and is 1½ miles north and 4 miles east of St. Vincent, on the Great Northern Railway. The station is marked according to note 2, page 267, the iron pipes being 2 inches in diameter; the reference mark is 21.871 meters from the station in azimuth 270° 00′ 51″, while the azimuth and distance of the boundary monument from the station are 90° 12′ 04″, 109.68 meters.

Boundary Monument No. 54 (United States-Canada, W. B., 1907).—See description of Canada, page 289.

Boundary Monument No. 65 (United States-Canada, W. B., 1907).—This monument was found in good condition, its top being 1.01 meters above the ground. On one side it is marked with the legend "October 20th, 1818," and on the other "Convention of London." For further description see *States*, above.

FERGUS FALLS TO DULUTH.

PRINCIPAL POINTS.

Elbow (Grant County, Minn., W. H. B., 1904).—In the SE. ¼ NE. ¼ sec. 3, T. 129 N., R. 42 W., on a ridge in a pasture belonging to Niels N. Olson, who lives ⅜ mile west by north. It is in what is known as Sanford Township, 5½ paces west from the east fence line of the section and about 85 meters north of the east quarter section corner of section 3. The station is 2 miles east and 1½ miles north of the town of Elbow Lake, on the Minneapolis, St. Paul & Sault Ste. Marie Railway. The station is marked according to note 1, page 267, the reference mark being in the fence corner at the southeast corner of the pasture, 1 foot west of the east fence, and 1½ feet north of the south fence; it is 2.430 meters west from the stone said to mark the east quarter corner of section 3, and is 84.767 meters from the station in azimuth 357° 34′ 05″. The following azimuths and distances are from the triangulation station: N. N. Olson's house, east gable, 164° 31′ 04″, about ⅜ mile; flagstaff of schoolhouse (district 38), 348° 06′ 04″; east quarter corner of section 3, 355° 57′ 47″, 85.252 meters; E. J. Colmark's barn, west gable, 7° 15′ 48″, about ½ mile.

Dalton (Ottertail County, Minn., W. H. B., 1904; 1907).—In the NE. ¼ SE. ¼ sec. 10, T. 131 N., R. 42 W., on a knoll in a pasture belonging to I. Vik, who lives about ⅜ mile west of south, across a small lake from the station. It is 1 mile due west of Dalton, on the Great Northern Railway, in what is known as Tumuli Township, and is 2.42 meters west of the fence on the east side of the section. The station is marked according to note 1, page 267, the reference mark being in the corner of the pasture, close to the road which leads from Dalton westward along the quarter section line; it is 1 foot west of east fence, 1 foot south of north fence, about 4 paces south from the above-mentioned road, and 85.278 meters from the station in azimuth 181° 11′ 25″. The following azimuths and distances are from the triangulation station: I. Vik's barn, cupola, 17° 38′ 36″, about ⅜ mile; A. Johnson's house, south gable, 162° 26′ 03″,

about ⅜ mile; house, west gable, 225° 23′ 32″, about ⅜ mile; Dalton schoolhouse, spire, 263° 00′ 21″, about 1 mile; Dalton elevator, center of top, 271° 02′ 32″, about 1 mile.

Leaf (Ottertail County, Minn., W. H. B., 1904).—In the NW. ¼ sec. 27, T. 131 N., R. 39 W., on land controlled by an agent named Hoyt, living in Fergus Falls. It is in Leaf Mountain Township, on the highest point of a prominent peak known as Leaf Mountain. The Mountain is covered with fairly heavy timber, but its top is bare. The station is close to its southeast edge, 4 paces from the east slope, 25 paces from the west slope, and about 25 paces from the southeast point of the mountain. It is 5 miles east and 9 miles north of Evansville, on the Great Northern Railway, from which town it can be reached by following the road to Clitherall as far as the signboard "Evansville 13 miles," then proceeding ⅜ mile to the home of George Rots, at the west edge of the mountain. The station is marked according to note 1, page 267, the reference mark being at the extreme southeast edge of the brow of the hill, 2.5 feet below the station in elevation, and 25.131 meters from it in azimuth 352° 11′ 44″. The following azimuths and distances are from the triangulation station: John P. Klenick's house, chimney, 4° 50′ 59″, about ¾ mile; Thomas Klenick's barn, west gable, 64° 38′ 37″, about ⅝ mile; John Christianson's barn, spire, 124° 40′ 30″, about 1 mile.

Holmes (Douglas County, Minn., W. H. B., 1904).—In Moe Township near the center of the N. ½ SE. ¼ sec. 31, T. 128 N., R. 39 W., on the northern part of a high ridge on land belonging to C. G. Rusk, who lives about ⅜ mile to the south. The station is ¾ mile northwest of the main part of Lake Oscar, and 3¾ miles east and 5½ miles north of Kensington, on the "Soo Railway." It is 4½ miles west and 2 miles north of Holmes City. To go to the station from Kensington, follow the road leading toward Brandon as far as schoolhouse (district 45) at the northwest corner of section 31; then turn southeast on road ½ mile to house of John P. Edman; go south from his house and follow around the right-hand edge of the lake along the hillside and through the timber to the station, which is in the clearing at the crest of the hill, the north edge of which is heavily wooded. It is 23 paces east of the north-and-south line which divides in two the southeast quarter section. The station is marked according to note 1, page 267, the reference mark being at the north edge of the clearing, 2 feet lower in elevation than the station, and distant from it 24.547 meters in azimuth 209° 06′ 15″. The following azimuths and distances are from the triangulation station: Flagstaff on schoolhouse (district 45), 121° 41′ 33″, about 1 mile; John P. Edman's barn, spire, 116° 31′ 00″, about ½ mile; Holmes City Swedish Church, spire, 287° 10′ 29″, about 4½ miles; C. G. Rusk's barn, east gable, 9° 34′ 06″, about ⅜ mile.

Alexandria (Douglas County, Minn., W. H. B., 1904).—In the NE. ¼ SE. ¼ sec. 20, T. 128 N., R. 37 W., on land belonging to A. J. Thompson, who lives just west of the station. It is in what is known as Alexandria Township, on a wooded ridge. In 1904 the land around the station was being cleared of timber. The station is 30 paces west of the fence line on the east side of the section, and 133 paces south of Thompson's house; it is about 1¾ miles east of Alexandria on the Great Northern Railway and is marked according to note 1, page 267, the reference mark being just inside the fence line on the east side of the section and 35.58 meters from the station in azimuth 227° 53′ 43″. The water tower at Alexandria is about 1¾ miles from the station in azimuth 100° 50′ 21″

(see index); A. J. Thompson's house chimney is distant 133 paces in azimuth 180° 09′ 54″, and the azimuth of the flagstaff on the Geneva Beach Hotel, distant about ¾ mile, is 239° 21′ 59″.

Parker (Ottertail County, Minn., W. H. B., 1904).—In the southeast corner of sec. 32, T. 131 N., R. 37 W., on the highest point of a prominent hill known as Bear Hill, covered with scrub oak and small brush. The station mark is said to be almost at the corner common to sections 32, 33, 4, and 5. The land in SE. ¼ sec. 32 is owned by a man named Van Cleve, living in Springfield, Ill., while the NE. ¼ sec. 5 belongs to R. W. Zintar, who lives 3 miles to the south. It is 1¾ miles west and 3 miles south of Parkers Prairie, on the "Soo Railway," from which place it can be reached by taking the road to Monmouth Club, on the bank of Lake Miltona. The station is marked according to note 1, page 267, the reference mark being 2½ feet lower in elevation than the station, and 8.280 meters from it in azimuth 282° 24′ 10″. The azimuth from the station of the spire on an open belfry at New Parkers Prairie is 206° 01′ 01″, and of the west gable of Louis Korth's red barn, distant ¾ mile, is 316° 32′ 40″.

Osakis (Todd County, Minn., W. H. B., 1904–1906).—On a hill at the north side of a wheat field near the center of sec. 7, T. 128 N., R. 35 W., on land owned by A. L. Markthaler, living about ⅜ mile to the west. It is in what is known as West Union Township. It is 3.45 meters south of the north fence, and 29.9 meters east from the fence running north to the house of C. A. Markthaler. It is 3 miles south and 1 mile east of Osakis, on the Great Northern Railway, from which place it can be reached by going south 2½ miles, then southeast to the house of A. L. Markthaler, then ⅜ mile east along his pasture lane to the station. This pasture lane is on the east and west quarter-section line. The station is marked according to note 1, page 267; the reference mark is in the northeast corner of the wheat field almost at the center of the section, being 0.60 meter west from the east fence, 1.2 meters south from the north fence, and 52.831 meters from the station in azimuth 263° 58′ 41″. In 1906 latitude observations were made on a wooden pier placed 3 feet 4½ inches west and 3 inches south of the triangulation station. The ground is sticky black loam and clay. A telephone line to the town of Osakis runs about 15 feet north of the station. The following azimuths and distances are from the triangulation station: C. A. Markthaler's barn, cupola, 168° 45′ 13″, about 200 meters; Cath. farm, large house, cupola, 129° 39′ 59″, about ½ mile; A. L. Markthaler's house, low (south) chimney, 86° 21′ 22″, about ⅜ mile.

Leslie (Todd County, Minn., W. H. B., 1904).—In Leslie Township, near the center of sec. 10, T. 129 N., R. 35 W., on land belonging to Benjamin F. Rowe, whose home is in the timber about 125 yards northeast of the station. It is in the clearing in which stood the old house of Mr. Rowe, and is 10 meters north of the center of the east-and-west road running along the quarter-section line, and a little over ½ mile due east of the west quarter-section corner of section 10. It is 1½ miles west and 1½ miles south of Clotho post office, and 10 miles west and 2 miles north of Long Prairie, on the Great Northern Railway. The station is marked according to note 1, page 267, the reference mark being 7.4 meters north of the quarter-section line road, 5.9 meters north of the center of the section, and 91.517 meters from the station in azimuth 90° 28′ 46″. The following azimuths and distances are from the triangulation station: Frank Moore's house, highest chimney, 4° 50′ 11″; William Carbo's house, west gable, 84° 01′ 58″,

about ¼ mile: Mrs. Beach's house, chimney, 100° 12′ 38″, about ¼ mile; B. F. Rowe's house, chimney, 245° 31′ 29″, about 125 yards; west quarter corner, sec. 10, T. 129 N., R. 35 W., 90° 15′ 14″, about ½ mile.

Maple (Todd County, Minn., W. H. B., 1904).—In the NW. ¼ sec. 18, T. 128 N., R. 34 W., on land belonging to Anthony Mennett, of Long Prairie. It is in what is known as Little Sauk Township, 340 paces north of the east quarter corner of sec. 18 (exact corner could not be found), 39 paces west of road on east side of section and 675 paces south of Lake Maple. It is 6½ miles west and 5 miles south of Long Prairie, on the Great Northern Railway, and is marked according to note 1, page 267, the reference mark being 18.731 meters from the station in azimuth 272° 06′ 13″. The following azimuths and distances are from the triangulation station: Manuel Johnson's house, chimney, 3° 54′ 40″, about ⅝ mile; Hans Larson's house, chimney, 92° 41′ 43″, about ⅜ mile; Anthony Mennett's house, chimney, 181° 41′ 38″, about 300 yards; approximate position of east quarter corner, sec. 18, T. 128 N., R. 34 W., 353° 50′, 340 paces.

Long (Todd County, Minn., W. H. B., 1906).—About 62 meters north of the middle of the east side of the NE. ¼ sec. 24, T. 129 N., R. 34 W., on land belonging to Vandyke & Vandyke, real estate agents, living in Long Prairie, Minn. It is in what is called Reynolds Township, about 2 miles west of Long Prairie at the edge of the timber, and on the section line fence at east side of the pasture lane bordering a cornfield, and is marked according to note 1, page 267, the reference mark being 0.33 meter west from the fence at the east side of the section, 1.19 meters from the fence corner said to be the center of the east side of the NE. ¼ sec. 24, in the pasture lane, and 61.714 meters from the triangulation station in azimuth 359° 01′ 54″. From the station the west gable of the house of Vandyke & Vandyke is about ⅛ mile distant in azimuth 139° 03′ 44″.

Birch (Todd County, Minn., W. H. B., 1904).—Near the middle of the south side of the SE. ¼ sec. 18, T. 127 N., R. 33 W., on land belonging to Eugene Clossen, who lives in Sauk Center, Minn., but who has a summer home about ½ mile west of the station, on the northeast edge of a lake. The station is in what is called Birchdale Township, in small timber and brush, on the highest part of a hill. It is 4½ miles north and 4 miles east of Sauk Center, on the Great Northern and Northern Pacific Railways, from which place it may be reached by following the road to Grey Eagle northeast for 2 miles, to where it crosses the Northern Pacific Railway, thence north on the Long Prairie road for about 2 miles to the road which turns east to the farm of Morse Bros.; pass this house and take the road leading north along the lake shore to the house of E. Clossen. An old road up the hill leads to the station. It is marked according to note 1, p. 267, the reference mark being 15.950 meters from the station in azimuth 177° 38′ 58″. Other azimuths and distances from the station are as follows: South side center SE. ¼ sec. 18, T. 127 N., R. 33 W., 355° 23′ 48″, 127 paces; E. Clossen's old shanty, chimney, 87° 09′ 16″, about 200 meters.

Eagle (Todd County, Minn., W. H. B., 1904).—In the SE. ¼ NW. ¼ sec. 11, T. 127 N., R. 32 W., on land belonging to the Great Northern Railway. It is in Grey Eagle Township in the timber on top of a high hill, the crest of which is made up of four small elevations, forming a crescent ⅜ mile long, the two inner elevations being farthest north. The station is on the highest point of the second knob from the eastern end, and is about ¼ mile south of the central part of Mound Lake. It is about 3 miles due south of Burtrum, on the Great Northern Railway, from which place it is reached by

going south a little over 1 mile, then west on road to Grey Eagle, taking the first left-hand road leading around the west side of Mound Lake; then following an old road to the homestead of Mrs. Carrie Whipple, on the south bank of the lake, whence an old road leads through the swamps and over the ridge to the station. The station is about ½ mile south of a sharp peak on the north side of Mound Lake, known as "The Mound," and is marked according to note 1, page 267, the reference mark being 14.850 meters from the station in azimuth 90° 45′ 11″. From the station the azimuth of a red cone spire on a white church in Burtrum is 174° 27′ 45″, and its distance about 3 miles, while the highest point of "The Mound" is distant about ½ mile in azimuth 197° 48′.

Lone (Todd County, Minn., W. H. B., 1904).—In the NE. ¼ SE. ¼ sec. 29, T. 130 N., R. 32 W., on land of disputed title, but which may eventually belong to Gust. Nelson, who lives about ⅜ mile to the west. The high, sharp hill on which it is located is quite prominent and has two lone trees on it; it is about ½ mile from the middle of the east side of Lake McClure, and is in Hartford Township. It is 5 miles north and 6 miles east from Long Prairie, on the Great Northern Railway. Three nails in a blaze 14 inches from the ground on a 1-foot pine tree are 2.2 meters northeast of the station, while 5 meters in azimuth 224° from it are 3 nails in a blaze 12 inches from the ground on an 18-inch pine tree. These two trees are 3.2 meters apart. The station is marked according to note 1, page 267, the reference mark being 4.4 meters east of the 18-inch pine tree and 9.230 meters from the station in aziumth 238° 26′. Other azimuths and distances from the station are: Gust. Nelson's house, east gable, 83° 15′ 30″, about ⅜ mile; John Steinert's house, chimney, 43° 47′ 39″, about 1 mile.

Falls (Morrison County, Minn., W. H. B., 1904).—Near the middle of the SE. ¼ sec. 12, T. 40 N., R. 32 W., in small brush and timber on the southeast edge of a ridge, nearly ½ mile north of the house of Charles Lang, and about 300 yards west of a very prominent tall pine tree. It is 4½ miles due east of Little Falls, on the Northern Pacific Railway, from which place it is reached by taking the road leading southeast from Columbia Hotel. About ¾ mile out this road bends and goes east through the centers of sections 11 and 12 toward Rich Prairie. Mr. Lang's house is north of this road and about 5 miles from town; an old road leads north from the house up a draw to the station. The station is marked according to note 1, page 267, the reference mark being 14.533 meters from the station in azimuth 54° 09′ 19″. The following azimuths and distances are from the triangulation station: Charles Lang's house, chimney, 357° 03′ 45″, about ½ mile; Charles Steinberg's barn, north gable, 349° 21′ 24″, about 1 mile.

Brockway (Stearns County, Minn., W. H. B., 1904).—In the NE. ¼ sec. 34, T. 126 N., R. 49 W., on a high wooded ridge about ¼ mile south of the Morrison-Stearns County line. It is identical with Suintaz, a triangulation station of the Mississippi River Commission. It is about 1½ miles west of the Mississippi River, 200 meters west of the house of Tom Jessok and about 3 miles west and 1½ miles north of Rice, on the Northern Pacific Railway, from which place it is reached by going west for 2 miles to a bridge over the Mississippi River, then following the west bank north for 2 miles, then west along the county line for 1 mile, when the house of Tom Jessok will be to the south ¼ mile. The station is marked at the center by the regulation mark of the Mississippi River Commission, consisting of a tile and pipe. The reference mark is similar to the one described in note 1, page 267, and is on the ridge, 11.42 meters from the station in azimuth 40°. Other azimuths from the station are as follows: Tom

Jessok's house, chimney, distant about 200 meters, 243° 09′ 02″; North Prairie Catholic Church spire, cross, 137° 03′ 50″.

Royalton North Base (Benton County, Minn., W. H. B., 1904; 1906).—Near the center of sec. 6, T. 38 N., R. 31 W., just north of the high part of a field belonging to Joseph Englert. The township in which it is located is known as Langola Township. The station is 69 paces east of the center of section 6, and 3½ feet north of the fence running east from that center; it is 1 mile south and 2 miles east of Royalton, a town on the Northern Pacific Railway. The subsurface mark is a 1-millimeter hole in a copper bolt set in a stone 6 inches square and 1 foot deep, placed 5 feet below the surface. The surface mark is a 1-millimeter hole in a bronze station mark set in a granite block 2 feet square and 14 inches high, and weighing about 900 pounds. This is set in a mass of concrete. The reference mark is similar to that described in note 1, page 267, and is 0.65 meter east of the west fence of the pasture, 7 paces south of its north fence and 57.755 meters from the station in azimuth 83° 00′ 42″. The following azimuths and distances are from the triangulation station: Joseph Englert's house, chimney, 44° 29′ 52″, about ⅛ mile; Matt Klein's barn, cupola, 282° 08′ 52″, about ¼ mile; Henry Teman's house, east gable, 70° 11′ 33″, about ⅜ mile.

Alberta (Benton County, Minn., W. H. B., 1904).—Near the middle of the west side of sec. 8, T. 38 N., R. 30 W., on the west slope of a ridge, in small timber on land belonging to Mrs. B. E. Walling, who lives in Royalton. It is in what is known as Graham Township, and is 261 paces north of the west quarter section corner of section 8, and 8 paces east of the center of the section line road on the west side of the section. It is 8½ miles east and 1¾ miles south of the town of Royalton, on the Northern Pacific Railway. The station is marked according to note 1, page 267, the reference mark being 7 paces east of the section-line road at the west side of the section, and 32.763 meters from the station in azimuth 179° 10′ 06″. The following azimuths and distances are from the triangulation station: B. Crowley's house, east gable, 79° 13′ 32″, about 1 mile; James McCullough's house, chimney, 201° 37′ 20″, about 1 mile.

Royalton South Base (Benton County, W. H. B., 1904–1905; 1906).—Just east of the middle of the south side of sec. 33, T. 38 N., R. 31 W., in a field belonging to Mrs. A. J. Fromelt, who lives in Rice, Minn. It is in what is known as Langola Township, is 22 paces north of the road at the south side of the section, about 240 paces east of the railway track, and about 1⅜ miles south of the town of Rice. The underground mark is a 1-millimeter drill hole in a copper bolt set in a stone ½ foot square and 1 foot high, placed 5 feet below the surface. The surface mark is a 1-millimeter drill hole in a bronze station mark, set in a stone block, 2 feet square and 14 inches high, and weighing about 900 pounds. This is set in a mass of concrete. The reference mark is similar to that described in note 1, page 267, and is 1½ feet inside the east right of way fence of railway, 14.215 meters east of east rail of railway track (at right angles to track), 25.50 meters south of where section-line road prolonged intersects right of way fence, and 163.78 meters from the station in azimuth 75° 41′ 42″.

Johnson (Morrison County, Minn., W. H. B., 1904).—In the northern half of SW. ¼ sec. 7, T. 131 N., R. 30 W., on the highest part of a mound on a prominent brush-covered hill. It is in what is known as Prairie Township, is about ½ mile northwest of the Randall and Alexander wagon road, and is on land belonging to Ed. Johnson, whose house is 95 paces from the station. It is 21 paces north of the fence on the north side

of Johnson's garden lot. Lake Alexander is 2 miles north of the station, while Randall, on the Northern Pacific Railway, is 6 miles due south (10 miles by wagon road). The station is marked according to note 1, page 267, the reference mark being 5 feet lower than the crest of the mound, 15 paces north of the fence on the north side of Johnson's garden lot, and 18.753 meters from the station in azimuth 51° 38′ 04″. The following azimuths and distances are from the triangulation station: John Lagerquist's house, chimney, 79° 46′ 20″, about ⅝ mile; John Vertin's house, chimney, 231° 32′ 43″, ⅜ mile; Ed. Johnson's house, chimney, 308° 34′ 53″, 95 paces.

Rail (Morrison County, Minn., W. H. B., 1904).—In the NE. ¼ sec. 21, T. 132 N., R. 30 W., on a high sharp pointed hill, known locally as "Pikes Peak." The township is known as Rail Prairie Township. The station is 12 meters west from a tall lone pine tree on the summit of the hill, about 2½ miles northeast of the eastern end of Lake Alexander, about 3 miles east and 1 mile south of Rail Prairie post office and 5 miles north and 4½ miles west of Fort Ripley, on the Northern Pacific Railway. To reach the station from Fort Ripley cross the Mississippi River at the bridge about ¾ mile above town, then go north along the west bank of the river for about 3 miles; after crossing a small stream take the first road to the left uphill and follow it for 3 miles to the house of Merritt Tubbs. Pass through his farm to the house of A. Erricsson, then take the left-hand road for about ½ mile, then a dim road on the right hand leading past old loggers camp. The station is about 2 miles from Mr. Erricsson's house. Marked according to note 1, page 267, the reference mark being about 5½ feet lower in elevation than the station and 14.911 meters from it in azimuth 6° 09′ 02″. The following azimuths and distances are from the triangulation station: G. Olson's house, chimney, 97° 11′ 36″, about 2½ miles; L. G. Johnson's house, chimney, 153° 18′ 09″, about 1 mile; Ridgely's house, west gable, 192° 26′ 05″, about ¾ mile.

Daggett (Crow Wing County, Minn., W. H. B., 1904).—At the southwest corner of sec. 30, T. 43 N., R. 30 W., on land belonging to A. J. Tomberlin, who lives 105 paces to the southeast. It is on a small knoll and is in what is known as Daggett Township. It is 86.480 meters northeast of the southwest corner of the section, 19.7 meters south of a tall prominent pine 1⅝ feet in diameter. The section corner is 8.93 meters east of and in line with the south fence line of John Vogel's pasture. The station is 13 miles due south of Brainerd, on the Northern Pacific Railway and 2 miles north and 2 miles east of Gilbert post office. It is marked according to note 1, page 267, the reference mark being on the east side of the range line, 61.02 meters east of north of the section corner, and 50.742 meters from the station in azimuth 89° 23′ 31″. The following azimuths and distances are from the triangulation station: John Vogel's house, south gable, 160° 53′ 52″, about ½ mile; A. J. Tomberlin's house, chimney, 294° 06′ 25″, 105 paces; John Campbell's barn, west gable, 348° 11′ 50″, about ⅝ mile.

Jones (Crow Wing County, Minn., W. H. B., 1904; 1906).—In the SW. ¼ of NE. ¼ sec. 12, T. 45 N., R. 30 W., about ½ mile south of Jonesville railway station ("Loerch" station in 1904) on the Northern Pacific Railway and on land owned by V. A. Loerch, who lived at the railway station. It is 290 paces east of and 185 paces north of the center of section 12, on a hill covered with small brush and timber 30 to 40 feet high. Brainerd, Minn., is south of west from the station, distant 8 miles by road. The station is marked according to note 1, page 267, the reference mark being 23.018 meters distant in azimuth 272° 47′. Other distances and azimuths from the triangulation station are

as follows: Jonesville railway station chimney, about ½ mile, 177° 27′ 08″; John Peterson's red barn, north gable, about ¾ mile, 1° 24′ 05″; Frederick Bergemann's house chimney, about ¼ mile, 91° 44′ 27″. In 1905 latitude observations were made on a wooden pier placed 7.47 meters due west of the station.

Gull (Cass County, Minn., W. H. B., 1904; 1905).—On the highest peak on the west side of Gull Lake, and near the center of the S. ½ SE. ¼ sec. 6, T. 134 N., R. 29 W., near the fence on the west edge of the 80-acre field owned by J. M. Hayes, whose house is about ⅛ mile east of the station, and between it and the lake shore. The station is 1.4 meters west of the fence, and on land constituting a State reserve. On the fence line and 4.158 meters south of the station is a pipe marking a Mississippi River Commission station. To reach the station from Brainerd, which is on the Northern Pacific Railway 6 miles south and 8 miles east (but 22 miles distant by road), take the road leading west toward Sylvan and when 1¼ miles beyond Baxter railway siding take the right-hand main traveled road and follow to the ford between Gull and Sylvan Lakes. From this ford the station is about 8 or 9 miles farther on; follow the main traveled road along the west side of Gull Lake past the house of H. B. Van Sickle, and on to the station. Marked according to note 1, page 267, the reference mark being 0.6 meter west of the fence, about 2 meters lower in elevation than the station mark, and 21.187 meters from the station in azimuth 357° 34′. Other distances and azimuths from the station are as follows: M. R. C. station mark, 4.158 meters, 331° 06′; No. 2 district schoolhouse, top of belfry, about 1 mile, 173° 14′ 28″; J. M. Hayes's house, west gable, about 250 meters, 267° 23′ 17″.

Brook (Crow Wing County, Minn., H. D. K., 1905).—In Fairfield Township, near the center of sec. 14, T. 137, R. 26, and about 1¼ miles north 20° west of the point where the wagon road between Roger Lake and Emily fords Mud Brook. It is ¼ mile east of this road, and on the highest hill which has no timber, and but a few small bushes on its top. To reach the station from Aitken, the nearest railway town (which is 20 miles to the southeast), take the Crystal Springs Ranch and Emily Road to Rogers Lake and at the forks of the road just north of Bass Lake take the right-hand road, ford Mud Brook (upper ford) about ½ mile north of the forks and follow the Emily Road about 1 mile, when the station will be on the highest hill about ¼ mile north of east. Marked according to note 1, page 267, the reference mark being 20.66 meters from the station in azimuth 227° 01′ 21″. Other distances and azimuths from the station are as follows: Frank Richter's farmhouse, north gable, about 2½ miles, 39° 52′ 58″; hotel at Emily, west gable, about 3½ miles, 161° 31′ 56″.

Rabbit (Crow Wing County, Minn., H. D. K., 1905).—In SW. ¼ sec. 32, T. 47, R. 28, on land owned by C. Ehrich, who lives in the northwest quarter of the same section. The station is on the eastern end of a range of small hills between Serpent Lake and Rabbit Lake. This hill has no timber and but few bushes on it. It is about ⅜ mile northeast of Agate Lake, ⅝ mile north of Serpent Lake, and about 1 mile south of an island in Rabbit Lake. The nearest town is Deerwood, on the Northern Pacific Railway; it is 2½ miles distant in a direct line, but 5½ miles distant by road. To reach the station from Deerwood take the wagon road north and follow it around the east and north sides of Serpent Lake; after passing D. E. Whitlen's house about 2½ miles from Deerwood, and just before passing through a gate, take the right-hand road and then all subsequent right-hand roads to the house of C. Ehrich, which is about ⅜ mile north

of the station. Marked according to note 1, page 267, the reference mark being 43.62 meters from the station in azimuth 3° 58′ 38″. Other distances and azimuths from the triangulation station are as follows: Robert Combeau's farmhouse, southwest gable, about 1½ miles, 130° 04′ 19″; C. Ehrich's old sheep house, south gable, about ⅜ mile, 162° 45′ 02″; tall tree on island in Rabbit Lake, about 1 mile, 171° 58′; Deerwood white church with black spire, 353° 53′ 29″; D. C. Whitlen's house, about ⅝ mile, 25°.

French (Aitkin County, Minn., H. D. K., 1905).—Near the center of sec. 20, T. 48, R. 25, on the east side of French Lake, and on land belonging to John Erlandson who lives in a double log house about 75 paces southeast of the station. The station is on top of a small knoll in a cleared lot between Erlandson's house and the lake and is about 5 or 6 feet from the fence on the west side of the road. Kimberly, 9 miles distant by a very poor wagon road, is the nearest railway station, and the only one accessible in time of high water. To reach the station from Kimberly take the wagon road north over long corduroy, and when ⅜ mile from the end of the long corduroy take the right-hand road; pass through Andrew Gundle's gate and keep the main road to Fleming Lake. Passing east of Fleming, take the left-hand turn and follow the ridge between Gun and Fleming Lake for about 2¾ miles to French Lake; the road passes between the station and the reference mark. The station can be reached from Aitkin, a railway town 14 miles distant, by taking the road northeast to Rice River bridge, crossing the bridge and going north ½ mile to a schoolhouse; from the schoolhouse a wagon trail starts east and up Rice River; follow it and cross to French Lake. Marked according to note 1, page 267, the reference mark being just inside the roadway, and on the west side of it close to the junction of the road fence and the fence between Erlandson's house lot and barn lot. It is 47.955 meters from the station in azimuth 343° 59′ 45″. The west gable of J. E. Erlandson's house is 80 meters from the station in azimuth 306° 01′ 14″, and the east gable of J. Hegman's house is distant about ¼ mile in azimuth 140° 42′ 31″.

Rae (Aitkin County, Minn., H. D. K., 1905).—In NE. ¼ sec. 29, T. 47, R. 24, on the Davidson & McRae stock farm, 4½ miles southeast of Kimberly railway station, on a small knoll in the pasture field on the west edge of the timber, and about 150 paces south of the wagon road which bounds the north side of section 29. The station is 142 paces from the section-line fence. To reach the station from Kimberly take the wagon road southeast to the stock farm, and after passing through Davidson & McRae's gate turn east across the pasture to the edge of the timber. Marked according to note 1, page 267, the reference mark being 32.51 meters from the station in azimuth 349° 46′ 32″. Other distances and azimuths from the station are as follows: O. Cosselin's house, east gable, about ¼ mile, 118° 02′ 38″; E. Antell's house, 160 paces, 160°; Jennison's house, south gable, about 1 mile, 168° 30′ 21″; center of island in Rice Lake, 197° 38′.

Kimberly (Aitkin County, Minn., H. D. K., 1905).—In Jevne Township, in SE. ¼ sec. 30, T. 48, R. 24, about 5 miles by wagon road northeast of Kimberly railway station and 1 mile north of the Northern Pacific Railway tracks near Portage station. It is about 22 paces west of the west wagon road from Ole Jevne's house to Portage, on a small knoll on the west edge of some timber and about ½ mile south of Jevne's house. To reach the station from Kimberly railway station follow the road on the north side of the track in an easterly direction for 3½ miles to a deep railway cut and there take the left-hand road northeast for about 1¼ miles toward Ole Jevne's house, leaving timbered hills on the south side of the road. About ⅛ mile before reaching Jevne's place

take the road to the south toward Portage and the main road to McGregor (new in 1905) for ¼ or ⅜ mile to the highest point of the timbered ridge. The station was marked according to note 1, page 267, the reference mark being 8 paces from the middle of the road and 26.47 meters from the station in azimuth 222° 33′ 19″. Other distances and azimuths from the station are as follows: Robert Bailey's house, west gable, about 1½ miles, 276° 05′ 13″; F. W. Turner's house, south gable, about ¾ mile, 162° 07′ 19″; E. D. Turner's house, south gable, about 1 mile, 196° 17′ 27″.

Grindle (Aitkin County, Minn., H. D. K., 1905).—In SW. ¼ sec. 17, T. 47, R. 23, on the east side of the wagon road on the west section line, and 250 paces north of the quarter section corner. It is on land owned by John Lewis, who lives 65 paces southeast of the station. McGregor, the nearest railway town, is 4½ miles to the north by a good wagon road. Marked according to note 1, page 267, the reference mark being just outside the fence between Mr. Lewis's house and the road, and 34.96 meters from the station in azimuth 359° 49′ 20″. Other distances and azimuths from the station are as follows: John Graydon's house, southeast gable, about 1 mile, 171° 12′ 16″; schoolhouse belfry, about 1 mile, 181° 43′ 34″; Carlson's house (on northeast shore of lake), southeast gable, about ¼ mile, 230° 52′ 51″; Johnson's barn, west gable, about ⅛ mile, 268° 56′ 14″; Lewis's house, east gable, 60 paces, 299° 42′; Hoder's house, north gable, about ¼ mile, 10° 14′ 04″; Westburger's barn, east gable, about ¾ mile, 53° 23′ 37″; center of island in Rice Lake, 56° 27′; Vernon Grindle's house, northeast corner, 200 paces, 65° 44′ 55″.

Gregor (Aitkin County, Minn., H. D. K., 1905).—In McGregor Township, in the SW. ¼ SW. ¼ sec. 18, T. 48, R. 23, about 2 miles north of McGregor railway station, on land belonging to Ole Hoven, and on a small knoll about 75 meters southwest of Hoven's house and 7 meters west of a fence between a cultivated field and a pasture. The line between the towns of McGregor and Jevne passes close by the station. The corner common to sections 18 and 19 of McGregor Township and sections 13 and 24 of Jevne Township is about 210 paces south of the station. McGregor, the nearest railway town, is 2 miles south of the station, but 5 miles from it by road. To reach the station from McGregor cross the railway just east of the railway station, take the first right-hand turn and follow the main road across Sandy River bridge, then turn east and follow the wagon trail to Hoven's place. Marked according to note 1, page 267, the reference mark being near the gateway to Hoven's place and 36.70 meters from the station in azimuth 182° 00′ 02″. Other distances and azimuths from the station are as follows: Schoolhouse belfry, about 1½ miles, 151° 17′ 08″; John Dahl's house, west gable, about ½ mile, 216° 34′ 27″.

Bethlehem (Aitkin County, Minn., H. D. K., 1905).—In Northland Township near the center of sec. 10, T. 46, R. 26, in the yard of Bethlehem Church, about 30 paces southeast of the church at a point where an old school building formerly stood. To reach the station from Aitkin, which is the nearest railway town, take East Mille Lac road, and at its forks about 4 miles from town take the left-hand fork to Bethlehem Church. Marked according to note 1, page 267, the reference mark being 26.70 meters from the station in azimuth 209° 14′ 44″. Other distances and azimuths from the station are as follows: John Larsen's new barn, north gable of cupola, about ¾ mile, 284° 29′ 51″; Christensen's house, chimney, about ½ mile, 1° 23′ 03″; John Hansen's barn, south gable, about ⅜ mile, 98° 27′ 56″; Bethlehem Church, center cross, 31.5

meters, 140° 45′ 36″; N. Lordineroff's house, center chimney, about ¼ mile, 247° 30′ 41″. Bethlehem Church spire is west by north from the reference mark and distant 33.03 meters from it.

Tamarack (Aitkin County, Minn., H. D. K., 1905).—In the NE. ¼ NE. ¼ sec. 25, T. 49, R. 23, on the north shore of Round Lake on land belonging to Edward Obernolte and about 125 meters northeast of Obernolte's house, on a knoll in a pasture field about 200 meters north of the wagon road along the lake shore. To reach the station from Tamarack, the nearest railway station, take the main road north to Round Lake. Marked according to note 1, page 267, the reference mark being at the barnyard fence, 67.51 meters from the station in azimuth 12° 40′ 58″. Other distances and azimuths from the station are as follows: John Anderson's house, northeast corner eaves, about ¾ mile, 325° 44′ 32″; Francis Jacobson's house (southeast corner of Round Lake) northwest corner eaves, 332° 53′ 23″; Edward Obernolte's house, north gable, 125 meters, 37° 25′ 23″; Dan McGary's house (on shore of Mud Lake), east gable, about 2½ miles, 139° 47′ 45″.

Douglas (Aitkin County, Minn., H. D. K., 1905).—Near the center of the NE. ¼ SW. ¼ sec. 28, T. 46 (49?), R. 23, on land belonging to E. L. Douglas, who lives at Tamarack. It is 3½ miles by road, west of south from Tamarack, from which place it is reached by following the main road south for 2 miles to where it forks, then west ¾ mile to M. O. Frisk's gate; then in a southerly direction about ¾ mile past Frisk's house. After passing through the gate on the road to John Maxwell's place (about ½ mile from the main road), follow the right-hand trail for ¼ mile. The station is on top of a hill, on which there are a few dead trees and small bushes, on the left hand or south side of the trail, which apparently ends but a little farther on. Marked according to note 1, page 267, the reference mark being on the south side of the trail and 44.86 meters from the station in azimuth 70° 52′ 58″. Other distances and azimuths from the station are as follows: Leveitchi's barn, northwest gable, about ⅜ mile, 254° 56′ 18″; Fred Burger's house, north gable, about ½ mile, 276° 20′ 57″; John Maxwell's house, west corner, ⅜ mile, 240° 41′ 07″. In 1905 latitude observations were made on a wooden pier 10.46 meters due west of the station.

Bachelor (Carlton County, Minn., H. D. K., 1905).—Near the northeast corner of the SW. ¼ sec. 10, T. 48, R. 21, on a small knoll in a cultivated field just south of Tamarack Lake, on land owned by J. D. Jones. To reach the station from Wright, the nearest railway station, go up the Tamarack River in a small boat from the wagon bridge, ¼ mile east of the town, to Tamarack Lake; from the head of the river the triangulation station bears about south by east (mag.) across the lake. To reach the station by road go through A. R. Burdick's field and follow the old trail around the west end of the lake to Jones's place. Marked according to note 1, page 267, the reference mark being 30.07 meters from the station in azimuth 191° 12′ 29″. Other distances and azimuths from the station are as follows: J. D. Jones's house, east gable, 150 meters, 94° 14′ 20″; chimney of house on north shore of Tamarack Lake, ¼ mile, 203° 59′ 45″; chimney of Grant Rice's house, 300 meters, 215° 18′ 01″.

Wright (Carlton County, Minn., H. D. K., 1905).—In the NE. ¼ NW. ¼ sec. 18, T. 49, R. 21, on State land on a small knoll on which there are a few dead trees and bushes. It is about ⅜ mile east of John T. Norten's house, and is 2 miles west and 4 miles north of Wright, the nearest railway town. To reach the station from Wright, take the road

leading northwest from the town, cross the railway track about ¼ mile west of the railway station, and continue on 8 or 9 miles to Norten's place. Just before reaching Norten's house take the wagon trail east for about ¼ mile to a burnt opening in the woods, when the station will be about 40 rods ahead (east) and about 6 paces north of the trail, midway between the timber (60 paces north) and the tamarack swamp (60 paces south). Marked according to note 1, page 267, the reference mark being close to the wagon trail and 27.91 meters from the station in azimuth 289° 30′ 08″. All near timber is dead and ready to fall. About 10 feet of the tripod legs was left standing.

Island (Carlton County, Minn., H. D. K., 1905).—In the northeast corner of sec. 16, T. 48, R. 20, about 47 meters south of the section corner, and at the east edge of the timber on the west side of the wagon road from Cromwell to Moose Lake, about 8 paces from the middle of the road. To reach the station from Cromwell, which is the nearest railway station and is 2 miles north, go east across the wagon bridge and then south to the height of land. The station is on State school land. It is marked according to note 1, page 267, the reference mark being on the same side of the road as the station and 43.56 meters distant therefrom in azimuth 179° 58′ 39″. Other distances and azimuths from the station are as follows: August Newquist's house, southwest gable, 275 meters, 155° 51′ 22″; Bellanger's barn, west gable, about 2 miles, 179° 40′ 25″; Ole Hangland's house, chimney, 300 meters, 183° 55′ 26″; reference stake for corner common to sections 9, 10, 15, and 16, about 47 meters, 193° 00′ 01″.

Cromwell (Carlton County, Minn., H. D. K., 1905).—Near the center of sec. 19, T. 49, R. 19, on a thinly wooded hill about 6 miles by wagon road northeast from Cromwell. Charles Morse, of Cromwell, can point out the exact location of the station. To reach the station from Cromwell, go east across the wagon bridge about ½ mile to the railway crossing, then north and east alternately, following the main road for about 4 miles to a point where the traveled road turns north again and a new and little traveled road continues easterly; follow this new road about 2 miles to the height of land, about 1 mile east of Wilcox's place. The station is about 7 meters south of the middle of the road, in the center of a small cleared space. Marked according to note 1, page 267, the reference mark being 29.09 meters from the station in azimuth 266° 38′ 21″. The northwest gable of a two-story farmhouse is distant about 2½ miles in azimuth 57° 09′ 20″.

Sawyer (Carlton County, Minn., H. D. K., 1905).—In the SE. ¼ SE. ¼ sec. 29, T. 49, R. 18, about 2 miles west of north from Sawyer railway station. It is in the Fond du Lac Indian Reservation, on a prominent knoll at the southwest edge of Indian village at St. Marys Lake and about 50 paces north of west from a white log house, plainly visible from the railway train in passing west of Sawyer. To reach the station from Sawyer, follow the road north by the section house to Indian village; after passing Indian Catholic Church keep left-hand road to top of knoll. Marked according to note 1, page 267, the reference mark being 29.66 meters from the station in azimuth 86° 12′ 38″. Other distances and azimuths from the station are as follows: White house, south gable, 50 meters, 260° 57′ 25″; Indian house, south gable, 125 meters, 277° 24′ 04″; Indian house, ¼ mile, 291° 50′ 59″; Sawyer, Northern Pacific Railway section house, west chimney, 341° 59′ 30″; Sawyer railway station, west chimney, 342° 27′ 21″; Indian schoolhouse, chimney, 225 meters, 200° 13′.

Mahtowa (Carlton County, Minn., H. D. K., 1905).—In Atkinson Township, in the SE. ¼ sec. 30, T. 48, R. 18, about ¼ mile west and ⅛ mile north of the southeast corner

of the section, on land belonging to August Lundberg, who lives 35 paces west of north from the station. It is in a cleared field 29.5 meters south by east from the southeast corner of Lundberg's house, and 8 meters east-southeast from the southeast corner of the dooryard fence. To reach the station from Mahtowa, the nearest railway station, take the road north toward Park Lake, and when about ½ mile south of the lake turn west and go about ¾ mile to Lundberg's house. Marked according to note 1, page 267, the reference mark being at the northeast corner of the dooryard fence and 30.22 meters from the station in azimuth 212° 42′ 18″. Other distances and azimuths from the station are as follows: Ole Eyberg's house, center chimney, about ¾ mile, 296° 21′ 48″; Mahtowa, Swedish Lutheran Church, spire, 318° 47′ 58″; Mahtowa, Northern Pacific Railway station, chimney, 325° 44′ 59″; Charles Lindberg's house, southeast of highest ridge, about ½ mile, 147° 49′ 52″; Andrew Peterson's house, chimney, about ⅜ mile, 157° 50′ 09″; August Lundberg's house, highest chimney, 50 meters, 166° 51′ 23″.

Atkinson (Carlton County, Minn., H. D. K., 1905).—In the southwest corner of sec. 36, T. 48, R. 18, about 1¾ miles direct (2¾ miles by road) south of Atkinson railway station. It is on the highest point of a prominent hill, which is covered with small brush, on land belonging to a Mr. McManus. It is 18.8 meters east of the fence between pasture land and a cleared field belonging to James French, and is just west of a small excavation in the side of the hill. To reach the station from Atkinson follow the road southwest along the Northern Pacific Railway track for 1½ miles to the first road south; then go south ½ mile and east across the cleared fields to the top of the hill. Marked according to note 1, page 267, the reference mark being at the fence corner and 27.85 meters from the station in azimuth 45° 32′ 41″. Other distances and azimuths from the station are as follows: George Hannevel's house, south gable, about ¼ mile, 111° 43′ 07″; James French's small house, southeast corner, about ⅛ mile, 136° 39′ 49″; Atkinson, G. Anderson's store, chimney, 207° 09′ 56″; Presbyterian Church spire (¼ mile east of Atkinson), 212° 18′ 44″; Thomas Ratcliffe's house, chimney, about ⅝ mile, 91° 46′ 16″.

Cloquet (Carlton County, Minn., H. D. K., 1905).—In the SE. ¼ SE. ¼ sec. 3, T. 49, R. 17, about 2 miles north and ½ mile west from the town of Cloquet and in Knife Falls Township. The station is on the line between sections 2 and 3, at the highest point of a prominent wooded hill on land belonging to Mr. Smith, of Cloquet. To reach the station, follow the road north from Cloquet, across the St. Louis River, to the forks of the road; then west and north to the height of land, about ½ mile beyond Limer's house; then pass through the gate on the left-hand (west) side of the road and follow the trail by an old camp through the timber to the top of the hill. Marked according to note 1, page 267, the reference mark being 22.23 meters from the station in azimuth 295° 50′ 09″. Other distances and azimuths from the station are as follows: Church spire in Indian village at north end of Cloquet, 66° 32′ 33″; blue dwelling house, chimney, about 1¼ miles, 291° 16′ 29″; paper mill, smokestack, 313° 27′ 33″; Limer's barn, north gable, about ¼ mile, 348° 32′ 21″.

Carlton (Carlton County, Minn., H. D. K., 1905).—Near the center of the west side of NW. ¼ sec. 18, T. 48, R. 16, about 1 mile south of Carlton, in a pasture belonging to James Dumphy, a merchant of Carlton. It is about 75 paces west of the wagon road from Carlton to Twin Lakes, on a hill covered with small bushes and scattering timber. To reach the station from Carlton, follow the main road south ½ mile to the forks of the

road, then continue south ¾ mile by the right-hand road past the farmhouse of Gus. Mosers, and on to the height of land. Marked according to note 1, page 267, the reference mark being just inside the fence on the east side of the road, and 55.61 meters from the station in azimuth 90° 08′ 17″. Other distances and azimuths from the station are as follows: Gus. Mosers's house, chimney, 300 meters, 167° 43′ 43″; Carlton County courthouse, round tower, 185° 52′ 40″; Carlton high-school belfry, 187° 47′ 00″; Thompson, brown church, south gable, 226° 23′ 50″; farmhouse, chimney, about ⅝ mile, 359° 36′ 48″; gray farmhouse, chimney, about ½ mile, 54° 40′ 00″.

Annie (St. Louis County, Minn., H. D. K., 1905).—In the SW. ¼ SE. ¼ sec. 20, T. 49, R. 15, on the highest point of a prominent wooded hill, 10 miles by wagon road northeast of Carlton, 12 miles southwest of Duluth, and 7 miles southwest of West Duluth. It is ¼ mile south of the Carlton and Duluth wagon road at Annie post office, which is about ½ mile east of the cross roads to Fond du Lac and New Duluth, and ⅛ mile west of the fork leading to Pike Lake. To reach the station from Duluth or West Duluth take the Carlton and Duluth wagon road to Annie post office, and about 200 yards east of the post office, at the corner of a cleared field, take the cut and blazed trail south through the timber to the top of the hill. The station was marked as follows: A hole 20 inches in diameter was dug 20 inches deep to a solid rock ledge; the station was marked on this rock by the intersection of two lines, each 2 inches long. Over this cross was set a piece of 4-inch terra-cotta sewer pipe, 2 feet long, and the hole was filled with concrete level with the surface of the ground. The pipe projects 4 inches above the concrete and in its top was set a 60-penny wire nail, head down, its point projecting ¼ inch, and marking the station. The letters U. S. C. & G. S. 1905 were inscribed in the concrete surrounding the pipe. The reference mark is a rude cross in a circle about 5 inches in diameter cut in outcropping ledge, and 16.78 meters from the station in azimuth 225° 18′ 52″. Other distances and azimuths from the station are as follows: Schoolhouse, center chimney, about 1¼ miles, 121° 29′ 04″; Thomas Johnson's house, chimney, about ½ mile, 129° 37′ 01″; Charles Hendrickson's house, south gable, about ⅝ mile, 130° 59′ 01″; Anderson Bros.' house, about ⅜ mile, 179° 03′ 00″; Williams's house, chimney, about ½ mile, 198° 31′ 31″.

Dedham (Douglas County, Wis., H. D. K., 1905).—In NE. ¼ sec. 30, T. 47, R. 14, about ⅛ mile south of Dedham and Black River Falls wagon road, 2½ miles south of east from Dedham railway station on the Great Northern Railway, and 2 miles southwest from Black River Falls. It is on top of a small rocky hill covered with small poplar brush. To reach the station from Superior take the road south via South Superior, Greenwood Cemetery, and Nemadji River bridge to Black River Falls and when about 2 miles southwest of the bridge over the Black River take the trail south for about ⅛ mile toward Mr. Conigan's place, when the station will be on top of a hill and about 85 paces west. The station was marked as follows: A hole was dug 20 inches in diameter and 18 inches deep to a solid ledge of rock; in this ledge a hole was drilled, 2 inches in diameter and 4 inches deep, and in it was set a 40-penny wire nail, head down, and the drill hole filled with cement. The point of the nail is 17½ inches below the surface of the ground and projects ½ inch above the rock, and marks the station. Over this underground mark was placed a piece of 4-inch terra-cotta sewer pipe 2 feet long, and the hole in the ground and the pipe both filled with concrete. A 60-penny wire nail was embedded head down in the concrete filling the pipe, and its

point projecting ¼ inch above the concrete marks the station. In the concrete surrounding the pipe were inscribed the letters U. S. C. & G. S. 1905. The reference mark is similar to that described in note 1, page —, and is 19.96 meters from the station in azimuth 47° 16′ 05″. Other distances and azimuths from the station are as follows: Farmhouse, chimney, about 2 miles, 104° 11′ 40″; Dedham, Great Northern Railway station, chimney, 113° 02′ 39″; hotel at Dedham, northeast chimney, 115° 39′ 17″; Great Northern Railway trestle, west end, about 2 miles, 181° 13′ 15″.

Superior (Douglas County, Wis., H. D. K., 1905).—In the middle of the south side of the SE. ¼ sec. 2, T. 48, R. 14, about 1¾ miles southeast of South Superior and 20 paces north of the wagon road along the south side of section 2. To reach the station from Superior, take Tower Avenue south through South Superior to Fred Billings public school; then follow the road east and southeast across Nemadji River to the point where the road turns due east again and follow it to the height of land between Nemadji River and the first small creek to the east. The station will then be about 20 paces north of the road, in a pasture field, and about halfway between the turn to the east above mentioned and a bridge over the creek. Marked according to note 1, page 267, the reference mark being just inside the fence along the north side of the road, and 41.71 meters from the station in azimuth 310° 08′ 13″. The distance and azimuth from the station of a farmhouse chimney are about ½ mile, 113° 19′ 11″.

Duluth (St. Louis County, Minn., H. D. K., 1905).—On the summit of a hill at the head of Fortieth Avenue, West Duluth, about 1½ miles back from St. Louis Bay, and ¾ mile from Grand Avenue. It is about 50 paces back from the brow of the hill and just southwest of the prolongation of Fortieth Avenue, which is opened to the foot of the hill. Marked as follows: A hole was dug 20 inches in diameter and 12 inches deep to solid rock. A cross with 2-inch arms intersecting at right angles was cut in the rock and marks the station. Over this mark was set a piece of 4-inch terra-cotta sewer pipe, 17 inches long, and the hole and pipe both filled with concrete. The pipe projects 5 inches above the concrete surrounding it. In the concrete in top of the pipe was embedded a 60-penny wire nail, head down, its point projecting ¼ inch and marking the station. The concrete surrounding the pipe was marked with the letters U. S. C. & G. S. 1905. The reference mark is similar to that described in note 1, page 267, and is 16.45 meters from the station in azimuth 65° 40′ 31″. The azimuth from the station of West Duluth, National Iron Works tower, is 342° 19′ 21″.

Minnesota Point South Base (St. Louis County, Minn., U. S. E., 1870; 1905).—About ⅜ mile north of the south end of the long sand spit which separates Lake Superior from Superior Bay, and 60 feet from the shore of Superior Bay. A substantial tripod and scaffold were built over the station and a high board fence surrounds it, forming a square 50 feet on a side. The underground mark is a red sandstone block 1 foot square and 3 feet long, set with its top 5 feet below the surface of the ground. In the top of this stone is set a triangular brass plug, 0.03 foot on a side in cross section, on the end of which two scratches starting from two corners of the plug and intersecting at its center mark the station. Above the subsurface stone was placed a block of granite 1 foot square and 4 feet 10 inches long; the top of this stone is 6 inches above the surface of the ground. A ¼-inch drill hole in the center of the top of this stone marks the station. Three red sandstone blocks 1 foot square and 3 feet long were placed as reference marks as follows: Each 15 feet from the station, one in prolongation of the base line, and two at right angles

to and on opposite sides of that line. In 1905 the surface mark was in excellent condition. The azimuth from the triangulation station of elevator M smokestack is 75° 07′.

Minnesota Point North Base (St. Louis County, Minn., U. S. E., 1870; 1905).—On the low sand spit which separates Lake Superior from Superior Bay. This spit is about 6 miles long and $^1/_5$ mile wide and is largely covered with shrubbery and pine forest. The station is about 10 meters from the west shore of the spit and is about 1½ miles south of the Duluth ship canal. It is about 100 feet west of the car track and is just north of Twenty-fifth Street. Substantial tripod and scaffold were built over the station and it was surrounded by a high board fence, forming a 50-foot square. Marked as follows: A red sandstone block 1 foot square on top and 3 feet long was set on end so that its top surface is about 1 inch below the surface of the ground. In the center of the top face of this stone is set a triangular brass plug, 0.03 foot on a side in cross section. On the end of this plug are two scratches running from two corners of the plug and intersecting near its center. The intersection of these two scratches marks the station. Over the top of the sandstone block is placed a cast-iron cap or cover. This cap is ½ inch thick and 2 feet square and is provided with a flange 6 inches wide setting down into the ground around the head of the stone, so that the top of the surface of the cap is even with the surface of the ground. In the center of the upper surface of the cover is a hub $^3/_8$-inch high and 2 inches in diameter, in the center of which is drilled a ¼-inch hole. This hole marks the center of the station. Three reference stones are placed as follows: Each 15 feet from the station, one in prolongation of the base, and two at right angles to the base line and on either side of it. These stones are similar to the stone at the center of the station, being 1 foot square and 3 feet long and of red sandstone. The north reference stone has been incased in cement to arrest decay. The ground everywhere around the station is a fine sand. Many summer cottages, but no substantial buildings, surround the station. In 1905 the stone center mark was found to be in bad condition, due to disintegration. The following azimuths are from the station: Duluth State Normal School, chimney, 181° 39′ 18″; elevator M, smokestack, 334° 10′ 22″; Alger & Smith's sawmill, smokestack, 71° 17′ 17″.

PAGE TO FERGUS FALLS.

SUPPLEMENTARY POINTS.

Niobrara, U. S. E. (Knox County, Nebr., F. D. G., 1901).—On the right bank of the Missouri River, on a very sharp round-topped knob, at the west end of a ridge which turns north 200 feet east of the station, runs 300 feet, and ends in a knob similar to the one at the west end. The station is about 2 miles from the river, opposite Running Water, S. Dak. The station is marked by a small drilled hole in the center of a block of stone 18 inches square, placed 3 feet below the surface of the ground.

Lost Creek, U. S. E. (Knox County, Nebr., F. D. G., 1901).—On the right bank of the Missouri River, 1 mile back from a point 1¼ miles below the mouth of Lost Creek. The land is the highest in the immediate vicinity. Marked according to note 7, page 267.

Arneson 2 (Bon Homme County, S. Dak., F. D. G., 1910).—On the left bank of the Missouri River, 2 miles back from the river on a high ridge, and 300 feet from the north end of the ridge. About ¾ mile south is a sharp-pointed hill, as high as, or higher than

the station. A wagon road close to the station runs northeast to a small white schoolhouse. The station is about 600 feet northeast of the southwest corner of sec. 3, T. 92 N., R. 61 W., and ¼ mile east of Arneson's house. Marked according to note 6, page 267.

Ponca, U. S. E. (Knox County, Nebr., F. D. G., 1901).—On the right bank of the Missouri River, on a very high and sharp-topped sandstone butte, 2 miles south of Ponca Creek and 5 miles from the river. The highest mass of rock on the butte is 15 feet northwest of the station. Originally marked according to note 7, page 267, but in 1901 only the underground mark was recovered.

Conger, U. S. E. (Bon Homme County, S. Dak., F. D. G., 1901).—On the left bank of the Missouri River, 4 miles from the river, 6 miles east from Yankton Indian Agency, on a very high ridge, a spur of which, running nearly west and 300 feet west of the station, is higher than the station. An Indian house on low ground is in sight from the station 1 000 feet to the north. Marked according to note 7, page 267.

High Point (Bon Homme County, S. Dak., F. D. G., 1901).—In sec. 16, T. 96 N., R. 61 W., on a prominent hill, about 4.5 miles west and 6.5 miles south of Tripp, Hutchinson County, S. Dak. A sand pit is about 10 feet south of the station. Marked according to note 6, page 267.

Layton (Hutchinson County, S. Dak., F. D. G., 1901).—In sec. 27, T. 97 N., R. 61 W., on very high ground owned by G. W. Layton, 200 meters east of his house, and about 4 miles west and 2.5 miles south of Tripp, S. Dak., northeast of station, and 6 feet therefrom is a large exposed rock. Marked according to note 6, p. 267.

Turkey Ridge (Turner County, S. Dak., F. D. G., 1901).—On high land about 25 paces south and 109 paces east of the west center of sec. 5, T. 97 N., R. 55 W. A small frame schoolhouse is at the southwest corner of the section. Marked according to note 6, page 267.

County-line monument (Hanson-Hutchinson Counties, S. Dak., O. W. F., 1903).—On the county line between Hanson and Hutchinson Counties, at the northwest corner of sec. 7, T. 100 N., R. 58 W., and the northeast corner of sec. 12, T. 100 N., R. 59 W., in about the middle of the road. Marked by an iron pipe projecting about 1 foot above the ground, and while apparently set by the United States Geological Survey, the cap bearing legend and inscription has been broken away.

Farmer reference mark (Hanson County, S. Dak., O. W. F., 1903).—See *Farmer*, page 271.

Howard astronomic station (Miner County, S. Dak., W. H. B., 1906;1907).—Situated in the grounds of the county courthouse in Howard, in a direct line between the center of the dome of the courthouse and the cross on the Catholic church. It is 12.967 meters from the center of the flagstaff on the dome, 7.295 meters from the southwest corner, and 13.414 meters from the northwest corner of the sandstone course running around the courthouse at a height of about 4 feet above the ground, and 5.388 meters in a line almost perpendicular to the face of the building, from the head of a large iron bolt used as a brace to the foundation. The station was marked by the concrete pier used in the longitude work in 1907.

SECTION CORNERS.

Sec. 17, T. 100 N., R. 57 W.—Northwest corner is marked by a large stone, 12 by 14 by 20 inches, set at the center of the crossing of the roads, with its top 1 inch below the surface of the ground. It is an old and very reliable corner.

Sec. 18, T. 100 N., R. 55 W.—Northwest corner is marked by a rough square, chiseled in relief on the highest point of a bowlder.

Sec. 21, T. 103 N., R. 55 W.—Northwest corner is marked by a mound of earth, in which was found an old oak stake, 3 by 14 inches, and quite rotten.

Sec. 14, T. 105 N., R. 57 W.—Northeast corner marked by a mound of earth, quite pronounced. There was originally a stake in the center of the mound.

Sec. 20, T. 105 N., R. 55 W.—Northeast corner marked by a mound of earth in the middle of a street. The mound is overgrown with grass.

Sec. 20, T. 105 N., R. 54 W.—Northeast corner marked by an oak stake, 3½ inches in diameter, surrounded by a pile of small bowlders. It is about in the center of cross-roads.

Sec. 21, T. 107 N., R. 54 W.—Quarter corner, center south side marked by a bowlder, about 8 by 10 inches in size.

Sec. 26, T. 110 N., R. 55 W.—Quarter corner, center east side marked by a pyramidal stone.

Sec. 28, T. 109 N., R. 53 W.—Northeast corner marked by a distinct mound of earth.

Sec. 15, T. 108 N., R. 55 W.—Northwest corner marked by a distinct mound of earth.

Sec. 13, T. 109 N., R. 56 W.—Southwest corner marked by a stone.

Sec. 29, T. 110 N., R. 52 W.—Northeast quarter section, northwest corner marked by a mound of earth and a pile of stones.

Sec. 34, T. 111 N., R. 53 W.—Southeast corner, marked by a stone in center of roads.

Sec. 33, T. 112 N., R. 51 W.—Northeast corner marked by a stone.

Sec. 26, T. 112 N., R. 54 W.—Northwest corner marked by a mound of earth and a rough pile of stones.

Sec. 36, T. 115 N., R. 53 W.—Quarter corner, center north side marked by a granite bowlder in the center of a rough mound of earth.

Sec. 34, T. 113 N., R. 51 W.—Southwest corner is on railroad land, 5.240 meters south of the south edge of the north rail. Marked by a red stone post.

Sec. 31, T. 119 N., R. 53 W.—Quarter corner, center north side marked by a mound of earth. The reference mark for station Helgen is 0.71 meter a little west of south from this mound.

Sec. 10, T. 125 N., *R. 52 W.*—Northeast corner marked by a mound of earth and a pile of stones.

Sec. 18, T. 124 N., R. 49 W.—Southeast corner marked by a mound of earth, surrounded by four depressions, on lines at right angles to each other.

Sec. 17, T. 125 N., R. 48 W.—Quarter corner, center west side marked by center of a mound of earth, surrounded by four depressions, on lines at right angles to each other.

FERGUS FALLS TO CANADA.

SUPPLEMENTARY POINTS.

C. & G. S. B. M. E_4 (Union County, S. Dak., W. B., 1906).—Three and two-tenths kilometers south of Elk Point, S. Dak., 18 meters northeast of the railway, at the northeast corner of the crossroads, 1 meter north and east of the southwest corner of a cultivated field, and 0.6 meter below the rails. Marked according to note 5, page 267.

C. & G. S. B. M. E_5 (Norman County, Minn., W. B., 1906).—At Borup, Minn., about 400 meters east of the Great Northern Railway tracks, in the northeast corner of the public school grounds; 7 meters from the eastern edge of the property and 3 meters from the north edge. Marked by a copper bolt cemented in the top of a 4-foot reenforced concrete post, 7 inches square, with edges beveled, projecting about 6 inches from the ground, with its top marked U. S. B. M.

C. & G. S. B. M. K_5 (Norman County, Minn., W. B., 1906).—One and two-tenths miles east and ½ mile north of Hadler, Minn., in Pleasant View Township, near the northeast corner of the SW. ¼ sec. 15; in the corner of a pasture fence and about 5 meters south of the quarter section road. Set in sandy clay; marked according to note 5, page 267.

C & G. S. B. M. D_6 (Polk County, Minn., W. B., 1906).—Near Angus, Minn., in the northeast corner of the NE. ¼ sec. 1, Keystone Township; 25 paces west of a road crossing; 1 foot south of a pasture fence. Set in cement; marked according to note 5, page 267.

C. & G. S. B. M. O_6 (Marshall County, Minn., W. B., 1906).—Near Argyle, Minn., in Tamarack Township, in sec. 35, T. 157, R. 48, on the west side of a road leading to a farmhouse, in a fence corner. On the property of Mr. Josc. Set in clay; marked according to note 5, page 267.

C. & G. S. B. M. T_6 (Marshall County, Minn., W. B., 1906).—Near Stephen, Minn., in the northwest corner of the NE. ¼ sec. 4, T. 157 R. 48; 11 meters south of the road and 5 meters east of the drainage ditch. Set in clay; marked according to note 5, page 267.

FERGUS FALLS TO DULUTH.

SUPPLEMENTARY POINTS.

Dalton Astronomic (Ottertail County, Minn., W. H. B., 1904, 1907).—On the south edge of the town of Dalton, near the Great Northern Railway station, on a prominent small knoll in a vacant lot belonging to M. T. McMahon who lives in Fergus Falls and owns the Dalton Lumber Co. The ground north of the station was laid out for a street, which in 1904 had not been improved. The station was marked according to note 1, page 267, the reference mark being on the north side of the street at the south end of a lot belonging to John Rorang, of Dalton, and leading back from the store building just west of the Bank of Dalton. It is 29.757 meters from the station in azimuth 179° 26′ 04″. The railway telegraph station is 120 paces west. In 1907 longitude observations were made at a point 4.15 meters west and 2.26 meters south of the triangulation station and the longitude pier left in place. It is of concrete and is 2 feet in the ground and 3 feet above ground. Various distances and azimuths from the triangulation station are as follows: Great Northern Railway section house, about

500 feet, 346° 11′ 09″; Dalton Lumber Co's. building, gable, about 300 feet, 6° 47′ 42″; Minneapolis and Northern elevator, northeast corner, 80.3 meters, 59° 00′ 11″; Bank of Dalton, chimney, about 175 feet, 187° 05′ 06″; Oliver Rustadt's house, small gable over west entrance, about 200 feet, 273° 08′ 07″.

Gregory M. R. C. (Morrison County, Minn., W. H. B., 1904).—A station of the Mississippi River Commission, located in Little Falls Township, in the NW. ¼ sec. 34, T. 40 N., R. 32 W., on a bluff on the east side of the Mississippi River, about 4 miles south and 1 mile east of Little Falls. It is 350 meters back of the end of a ridge, 9 meters south of a wire fence, and 5 meters west of a 4-foot bowlder. To reach the station from Little Falls take the road leading south past the ball grounds to the country schoolhouse where the road turns east and follows along the quarter-section line of sections 27–26. Near the top of the ridge take right-hand road to house of Mr. J. Crabtree (⅜ mile). Go through his yard and take faint road through brush to top of ridge and station. The station was marked according to note 4, page 267.

Gottwalt M. R. C. (Benton County, Minn., W. H. B., 1904).—A station of the Mississippi River Commission, located near the west side of sec. 14, T. 38 N., R. 31 W. It is near the middle of north-and-south road, 5 meters east of wagon track, midway between the houses of Joseph Culeger and Lewis E. Gottwalt, ½ mile north of road leading northeast from Rice, Minn., about 3 miles from Rice, on the first road branching to left after passing Rice Mill. Marked according to note 4, page 267.

Swan Creek M. R. C. (Morrison County, Minn., W. H. B., 1904).—A station of the Mississippi River Commission, located in SW. ¼ sec. 12, T. 128 N., R. 30 W., on high ridge on the right bank of the Mississippi River, about 3 miles below Little Falls, Minn., 1 mile below the mouth of Swan Creek and ½ mile west of the river. It is 2 meters south of an east-and-west fence and 65 meters west of junction of that fence with a north-and-south fence. It is in timber, on the property of Wiecoent Rekocoski, 300 meters northeast of group of three houses, which stand on the second east-and-west road below Swan Creek, and 150 meters nearly south of large lone pine. Blazed trees are at the following distances and azimuths from the station: 24-inch white oak, 17.4 meters, 264°; 20-inch white oak, 23.1 meters, 161° 30′; 10-inch red oak, 3.4 meters, 45°. Marked according to note 4, page 267.

Royalton M. R. C. (Benton County, Minn., W. H. B., 1903).—A station of the Mississippi River Commission, in the scrub-oak timber on a ridge 600 meters east of the Northern Pacific Railway, 1½ miles below Royalton, Minn., 350 meters north of east-and-west wagon road, 30 meters west of edge of wheat field, about 250 meters west and 40 meters south of farmhouse, on property of S. G. Hillman, in E. ½ SW. ¼ sec. 1, T. 38, R. 32. Blazed trees are at the following distances and azimuths from the station: 8-inch scrub oak, 15.7 meters, 136°; 10-inch scrub oak, 5.6 meters, 246°; 8-inch black oak, 7.2 meters, 3°. Marked according to note 4, page 267.

Back Base M. R. C. (Benton County, Minn., W. H. B., 1903).—A station of the Mississippi River Commission, being in the open prairie 300 feet west of the Northern Pacific Railway, 2 miles south of Rice's station, and about 10 meters south of section line. It is near the north side center of NW. ¼ sec. 10, T. 37 N., R. 31 W. Marked according to note 4, page 267.

Skounter Hill M. R. C. (Benton County, Minn., W. H. B., 1904).—A station of the Mississippi River Commission, on a large bare sand mound, 1½ miles northwest of Rice,

Minn., on the highest part of the mound, on the property of the Deering Manufacturing Co., of St. Paul. The mound is the only one of size in the vicinity and is known as Skounter Hill. Marked according to note 4, page 267.

Big Mound M. R. C. (Morrison County, Minn., W. H. B. 1904).—A station of the Mississippi River Commission, in NE. ¼ sec. 23, T. 132 N., R. 30 W., about 4 miles above old Fort Ripley, on the right bank of the Mississippi River, and 1½ miles from the river. It is 400 meters north of the second road above the Fort Ripley ferry (now abandoned), which branches to the left from the river road about 1½ miles east of Mrs. Brown's residence. It is on the top of the largest mound in the vicinity, which is the largest mound east of Chadwick Lake. A small log cabin stands at the junction of the above road with the river road. Marked according to note 4, page 267.

Oleson M. R. C. (Crow Wing County, Minn., W. H. B., 1904).—A station of the Mississippi River Commission, located in S. ½ sec. 27, T. 44 N., R. 31 W., about ¼ mile southeast of farmhouse of Chris Oleson, on Brainerd and St. Mathias wagon road, 3 miles northeast of Crow Wing depot and about 3 miles below point where this road crosses railroad, in jack pines, 80 meters east of north-and-south wire fence on upper end of last high ridge in the vicinity, and on property of the Northern Pacific Railway Co. The following distances and azimuths are from the station to blazed trees: 6-inch red oak, 5 meters, 346°; 14-inch jack pine, 3.3 meters, 143°; 12-inch jack pine, 13.7 meters, 236°. Marked according to note 4, page 267.

COMPUTATION, ADJUSTMENT, AND ACCURACY OF THE ELEVATIONS.

The zenith distances directly observed at each station were first computed. These zenith distances were corrected for height of the object observed and of instrument so as to refer them all to the ground at each station, or to the station marks.

The difference of elevation of each pair of stations in the main scheme was then computed from the observations over the line joining them, by the formula

$$h_2 - h_1 = s \tan \tfrac{1}{2} (\zeta_2 - \zeta_1)\left[1 + \frac{h_2 + h_1}{2\rho} + \frac{s^2}{12\rho^2}\right]$$

in which h_2 and h_1 are elevations of the stations, ζ_2 and ζ_1 are the measured zenith distances, s is the horizontal distance between the stations, and ρ is the radius of curvature.

As there are always two or more lines to each new station, many rigid conditions existed between the observed differences of elevation, even if the connections with the precise leveling were ignored, and the least square adjustment furnishes the readiest accurate means of deriving the required elevations.

The elevations from the stations of the Page base net northward to the international boundary and eastward to the Minnesota Point base at Duluth were adjusted in four sets of equations.

The first adjustment involved all stations of the primary scheme on either side of the Brown Valley base from station Mound at the south to station Foss at the north.

The second adjustment involved all stations of the primary scheme between the stations of the Page base net in northern Nebraska to the station Mound of the first adjustment.

The third adjustment fixed the elevations of all stations of the primary scheme between station Foss of the first adjustment, and the Minnesota Point base on Lake Superior.

The fourth adjustment fixed the elevations of the primary stations of the Fergus Falls to Canada section of the triangulation.

In the first adjustment the elevations of stations Mound, Oscarson, and Foss were held fixed at 634.87, 317.56, and 297.24 meters, respectively,[1] these being the elevations as fixed by precise leveling. The difference of elevation between the two ends of the Brown Valley base was held as determined by the precise leveling, namely, 7.70 meters and the difference 8.44 meters computed from the measured zenith distances was rejected.

The elevations of the two ends of the base and of the nine remaining stations connected by the observations are unknowns to be determined by least squares from the 31 observed differences of elevation indicated below.

In the following tabulation the observed differences of elevation treated in the first adjustment are shown, together with their adjusted values. The weight, p, assigned to each observed difference of elevation is inversely proportional to the square of the length, s, of the line between stations in meters and was conveniently computed by the formula $\log p = 9 - 2 \log s$. The observed difference of elevation is given the sign of the elevation of the second station named minus the elevation of the first. The quantity contained in the last column but one is the correction to be subtracted from an observed difference of elevation to obtain the adjusted difference of elevation.

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Mound	Helgen	1.7	−41.31	−41.72	+0.41	0.286
Mound	Boating	1.6	−15.65	−15.29	−0.36	0.207
Helgen	Boating	1.1	+26.71	+26.43	+0.28	0.086
Boating	Waubay	2.2	−25.09	−25.02	−0.07	0.011
Mound	Waubay	0.68	−40.39	−40.31	−0.08	0.004
Helgen	Waubay	1.3	+1.70	+1.41	+0.29	0.109
Boating	Preacher Hill	2.1	+30.85	+31.04	−0.19	0.076
Waubay	Preacher Hill	2.3	+55.98	+56.06	−0.08	0.014
Preacher Hill	Pickerel	6.8	−34.22	−34.14	−0.08	0.044
Waubay	Pickerel	3.6	+22.01	+21.92	+0.09	0.029
Preacher Hill	Drywood	3.1	−27.44	−27.37	−0.07	0.015
Pickerel	Drywood	2.6	+6.71	+6.77	−0.06	0.009
Boating	Brown Valley NW. base	0.76	−263.22	−264.21	+0.99	0.745
Preacher Hill	Brown Valley NW. base	2.1	−295.40	−295.25	−0.15	0.047
Drywood	Brown Valley NW. base	2.7	−268.23	−267.88	−0.35	0.331
Boating	Brown Valley SE. base	1.0	−272.74	−271.91	−0.83	0.689
Preacher Hill	Brown Valley SE. base	2.1	−302.98	−302.95	−0.03	0.002
Boating	Layden	0.51	−251.90	−252.56	+0.66	0.222
Brown Valley SE.base	Layden	5.4	+18.42	+19.35	−0.93	4.670
Preacher Hill	Layden	0.85	−282.98	−283.60	+0.62	0.327
Brown Valley NW. base	Layden	5.7	+12.29	+11.65	+0.64	2.335
Drywood	Layden	0.98	−255.72	−256.23	+0.51	0.255
Layden	Enwiller	2.2	−29.09	−29.32	+0.23	0.116
Drywood	Enwiller	0.65	−285.66	−285.55	−0.11	0.008
Enwiller	Hankinson	1.2	+42.41	+42.50	−0.09	0.010
Drywood	Hankinson	0.44	−242.23	−243.05	+0.82	0.296
Layden	Oscarson	0.98	−50.03	−49.46	−0.57	0.318
Drywood	Oscarson	0.32	−306.40	−305.69	−0.71	0.161
Enwiller	Oscarson	3.5	−19.98	−20.14	+0.16	0.090
Hankinson	Oscarson	0.74	−62.97	−62.64	−0.33	0.081
Hankinson	Foss	0.91	−82.42	−82.96	+0.54	0.265

[1] See Precise Leveling in the United States 1903-1907, p. 114.

The probable error of an observation of weight unity derived from this first adjustment is ±0.85 meter. In other words, the reciprocal observations over a line 31.7 kilometers (19⅔ miles) long, this being the length of the line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 0.85 meter. The probable errors for lines of other lengths were assumed to be proportional to their lengths.

The probable errors of the elevations of the three stations fixed by precise leveling are about ±0.04 meter. The probable error approaches this value for stations adjacent to those fixed by precise leveling and is greatest for the most remote stations. Of the elevations least accurately determined, those of the stations Brown Valley northwest base and Brown Valley southeast base have a probable error of ±0.24 meter from the vertical angle measures, alone or when combined with the probable error of the elevations fixed by the precise leveling, it was still ±0.24 meter.

The results of the second adjustment in which the stations concerned are those from the Page base net in northern Nebraska to stations Mound and Helgen of the first adjustment, are shown below in the form used for the first adjustment.

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Hall	Walnut	1.0	−34.11	−33.50	−0.61	0.37
Old	Walnut	4.8	+12.99	+13.11	−0.12	0.07
Page SW base	Walnut	1.8	−35.15	−35.46	+0.31	0.17
Page NE base	Walnut	4.2	+10.29	+10.19	+0.10	0.04
Prairie	Walnut	3.0	− 5.00	− 5.52	+0.52	0.81
Walnut	Sparta	1.8	−42.53	−43.16	+0.63	0.71
Hall	Sparta	0.6	−78.15	−76.66	−1.49	1.33
Sparta	Santee	1.8	−35.52	−35.54	+0.02	0.00
Walnut	Santee	0.6	−77.98	−78.70	+0.72	0.31
Walnut	Avon	0.5	−58.80	−58.37	−0.43	0.09
Sparta	Avon	0.5	−14.84	−15.21	+0.37	0.07
Santee	Avon	1.4	+20.70	+20.33	+0.37	0.19
Santee	Vod	1.0	−43.45	−43.63	+0.18	0.03
Avon	Vod	2.7	−63.78	−63.96	+0.18	0.09
Vod	Yankton	1.1	+ 3.68	+ 3.66	+0.02	0.00
Avon	Yankton	0.5	−60.27	−60.30	+0.03	0.00
Santee	Yankton	0.6	−40.33	−39.97	−0.36	0.08
Vod	Wieters	1.4	−56.53	−57.29	+0.76	0.81
Yankton	Wieters	0.9	−61.48	−60.95	−0.53	0.25
Yankton	Freeman	1.2	+32.08	+31.85	+0.23	0.06
Vod	Freeman	0.6	+34.81	+35.51	−0.70	0.29
Wieters	Freeman	1.9	+92.86	+92.80	+0.06	0.01
Wieters	Wolf Creek	2.2	+ 7.50	+ 7.28	+0.22	0.11
Freeman	Wolf Creek	2.0	−85.61	−85.52	−0.09	0.02
Freeman	Silver Lake	2.6	−63.39	−63.44	+0.05	0.01
Wolf Creek	Silver Lake	3.8	+22.39	+22.08	+0.31	0.36
Wolf Creek	Elm Springs	4.7	− 7.63	− 7.44	−0.19	0.17
Elm Springs	Farmer	1.8	+14.98	+15.48	+0.50	0.45
Farmer	Salem	2.8	+37.85	+38.26	−0.41	0.47
Wolf Creek	Salem	1.2	+46.31	+46.30	+0.01	0.00
Silver Lake	Salem	1.6	+25.05	+24.22	+0.83	1.10
Farmer	Canova	1.4	+55.28	+55.31	−0.03	0.00
Salem	Canova	2.4	+16.74	+17.05	−0.31	0.23
Salem	Owens	2.1	+52.20	+51.76	+0.44	0.41
Canova	Owens	9.9	+34.69	+34.71	−0.02	0.00

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Farmer	Reese	2.1	+ 8.52	+ 8.38	+0.14	0.04
Canova	Reese	5.3	−46.96	−46.93	−0.03	0.01
Canova	Caldwell	1.7	+10.13	+10.53	−0.40	0.27
Reese	Caldwell	1.8	+57.55	+57.46	+0.09	0.01
Caldwell	Crane	2.7	+73.26	+73.25	+0.01	0.00
Canova	Crane	2.2	+83.91	+83.78	+0.13	0.04
Owens	Crane	2.9	+49.31	+49.07	+0.24	0.17
Crane	Miner	4.2	−17.24	−16.93	−0.31	0.40
Caldwell	Miner	6.8	+56.08	+56.32	−0.24	0.39
Crane	Brock	2.2	−18.88	−18.86	−0.02	0.00
Miner	Brock	2.6	− 2.22	− 1.93	−0.29	0.22
Brock	Hansen	3.0	−17.67	−17.38	−0.29	0.25
Crane	Hansen	1.2	−36.15	−36.24*	+0.09	0.01
Miner	Hansen	4.3	−19.40	−19.32	−0.08	0.03
Miner	Drakola	10.0	−16.73	−16.55	−0.18	0.32
Caldwell	Drakola	4.0	+40.02	+39.77	+0.25	0.25
Hansen	Drakola	8.3	+ 2.85	+ 2.76	+0.09	0.07
Brock	Jeska	6.3	+14.24	+14.41	−0.17	0.18
Jeska	Larson	12.3	− 1.02	− .90	−0.12	0.17
Brock	Larson	3.6	+13.83	+13.51	+0.32	0.37
Hansen	Larson	2.5	+30.85	+30.90	−0.05	0.01
Hansen	Weiss	2.0	+32.13	+31.83	+0.30	0.18
Larson	Weiss	4.3	+ 1.04	+ 0.94	+0.10	0.04
Larson	Oakwood Lake	2.5	−25.00	−24.66	−0.34	0.29
Jeska	Oakwood Lake	2.4	−25.39	−25.56	+0.17	0.07
Weiss	Oakwood Lake	1.5	−25.52	−25.60	+0.08	0.01
Oakwood Lake	Horswill	0.9	+34.77	+35.41	−0.64	0.37
Weiss	Horswill	1.2	+10.20	+ 9.81	+0.39	0.18
Oakwood Lake	Olson	1.2	+51.92	+51.71	+0.21	0.05
Weiss	Olson	0.6	+26.76	+26.11	+0.65	0.25
Horswill	Olson	2.3	+16.54	+16.30	+0.24	0.13
Horswill	Elfring	7.2	−15.26	−15.22	−0.04	0.01
Olson	Elfring	1.4	−31.40	−31.52	+0.12	0.02
Olson	Franklin	2.3	+24.92	+24.48	+0.42	0.40
Horswill	Franklin	1.7	+40.57	+40.78	−0.21	0.07
Elfring	Franklin	2.6	+55.86	+56.00	−0.14	0.05
Franklin	Mound	2.7	+23.21	+22.87	+0.34	0.31
Franklin	Helgen	1.0	−19.52	−18.85	−0.67	0.45
Elfring	Helgen	1.3	+37.36	+37.15	+0.21	0.06

* Fixed by precise leveling.

In this second adjustment, nine stations were taken as fixed. Five stations of the Page base net—Hall, Old, Prairie, Page southwest base, and Page northeast base—had been fixed by a previous adjustment, their elevations being 624.53, 577.92, 596.55, 626.49, and 580.84 meters, respectively. These are the elevations set forth on pages 422 and 423 of Appendix 6, Report for 1901, corrected by −14 centimeters to take account of the effect of new leveling subsequently introduced into the precise level net. In addition to Mound and Helgen with elevations of 634.87 and 593.15 meters, respectively, derived from the first adjustment, stations Hansen and Crane had been fixed by precise leveling; their elevations being 529.58 and 565.82 meters, respectively. The elevations of the 28 remaining stations indicated by the observations are the 28 unknowns determined by least squares from the 74 observed difference of elevation given in the above table.

The probable error of an observation of weight unity derived from the adjustment is ±0.39 meter. Unit weight corresponds to reciprocal observations over a line 31.7 kilometers (19¾ miles) long.

The probable error of the stations fixed by precise leveling is about ±0.04 meter. Station Elm Springs was assumed to be the one least accurately determined, and its probable error was therefore computed as a limiting value and was found to be ±0.26 meter from the vertical angles alone, or, when combined with the probable error of the elevations fixed by the precise leveling, it was ±0.26 meter.

In other words, for the least accurately determined station in the main scheme between the Page base net and the station Mound, there is an even chance that the elevation is correct within 0.3 meter or 1 foot, and for most stations in the main scheme the accuracy is greater than this.

The elevations of the stations of the main scheme from Wahpeton at the south and west, to Minnesota Point north and south bases at the north and east were obtained from the third adjustment, as shown in the tabulation below. The elevations of Foss, Oscarson, Elbow, Dalton, Alexandria, and Osakis were held fixed at 297.24, 317.56, 390.09, 423.32, 451.28, and 428.43 meters, respectively, these being the elevations as fixed by precise leveling.[1] The elevations of Royalton north base and Royalton south base were held fixed at 348.23 and 324.17 meters, respectively, as determined by the leveling made at the time the base was measured and by a short trigonometric connection with P. B. M. back base having an elevation of 323.292 meters.[1] The elevation of Carlton was held fixed at 376.611 meters from a short trigonometric connection with P. B. M. 5, whose elevation from precise leveling is 332.219 meters.[1] Two additional elevations were held fixed from the precise leveling as follows: "P. B. M. Court House" at Aitkin and "B. M. Iron Bay Iron Works" at West Duluth with elevations 370.810 and 191.707 meters, respectively, and the nonreciprocal observations connecting these with the three or four stations of the main scheme were used in this adjustment with a weight 0.3 of that assigned to corresponding lines of the main scheme and over which reciprocal observations were obtained:

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Foss	Western	1.3	+ 42.49	+ 43.16	−0.67	0.584
Foss	Wahpeton	4.4	− 2.29	− 2.61	+0.32	0.451
Wahpeton	Western	1.0	+ 47.22	+ 45.77	+1.45	2.102
Oscarson	Bullis	1.1	+ 9.17	+ 9.17	0.00	0.000
Bullis	Dalton	1.2	+ 97.57	+ 96.59	+0.98	1.152
Bullis	Elbow	2.8	+ 62.95	+ 63.36	−0.41	0.471
Western	Dalton	2.8	+ 83.10	+ 82.92	+0.18	0.094
Elbow	Leaf	1.0	+136.79	+136.73	+0.06	0.004
Dalton	Leaf	1.2	+103.71	+103.50	+0.21	0.053
Elbow	Holmes	1.1	+ 94.04	+ 93.26	+0.78	0.669
Leaf	Holmes	1.0	− 43.62	− 43.47	−0.15	0.023
Holmes	Alexandria	2.2	− 31.74	− 32.07	+0.33	0.240
Alexandria	Parker	1.6	+ 43.60	+ 43.48	+0.12	0.023
Leaf	Parker	3.4	− 31.93	− 32.06	+0.13	0.057
Alexandria	Leslie	1.6	− 19.50	− 19.53	+0.03	0.001

[1] See Precise Leveling in the United States 1903–1907, pp. 98, 100, 114, 115.

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Parker	Leslie	1.6	− 62.74	− 63.01	+0.27	0.117
Parker	Osakis	0.8	− 66.08	− 66.33	+0.25	0.050
Osakis	Leslie	2.6	+ 3.34	+ 3.32	+0.02	0.001
Osakis	Maple	5.5	+ 2.93	+ 2.89	+0.04	0.009
Leslie	Maple	6.2	− 0.44	− 0.43	−0.01	0.000
Leslie	Long	4.9	+ 6.27	+ 6.16	+0.11	0.059
Maple	Long	8.0	+ 6.57	+ 6.59	−0.02	0.003
Maple	Birch	5.1	+ 6.09	+ 6.04	+0.05	0.013
Osakis	Birch	2.5	+ 8.83	+ 8.93	−0.10	0.025
Long	Birch	2.8	− 0.27	− 0.55	+0.28	0.220
Birch	Eagle	4.2	+ 9.33	+ 9.15	+0.18	0.136
Long	Lone	4.6	+ 20.03	+ 20.09	−0.06	0.017
Eagle	Lone	1.7	+ 11.52	+ 11.49	+0.03	0.002
Eagle	Falls	0.7	− 40.02	− 41.08	+1.06	0.787
Falls	Brockway	1.8	− 23.97	− 24.30	+0.33	0.196
Lone	Brockway	0.5	− 76.11	− 76.87	+0.76	0.289
Falls	Royalton N. base	3.1	− 57.15	− 57.20	+0.05	0.008
Royalton S. base	Alberta	9.6	+ 36.90	+ 37.38	−0.48	2.212
Royalton S. base	Brockway	11.8	+ 56.72	+ 56.96	−0.24	0.680
Alberta	Brockway	4.1	+ 19.39	+ 19.58	−0.19	0.148
Royalton N. base	Alberta	8.9	+ 13.75	+ 13.32	+0.43	1.646
Royalton N. base	Brockway	21.2	+ 33.02	+ 32.90	+0.12	0.305
Lone	Johnson	2.0	− 0.05	+ 0.26	−0.31	0.192
Johnson	Rail	19.0	+ 9.57	+ 9.57	0.00	0.000
Rail	Daggett	2.1	− 66.31	− 66.30	−0.01	0.000
Falls	Daggett	2.0	− 3.89	− 3.90	+0.01	0.000
Johnson	Daggett	1.6	− 57.10	− 56.73	−0.37	0.219
Daggett	Jones	1.4	− 4.70	− 3.94	−0.76	0.809
Daggett	Gull	0.9	+ 39.41	+ 38.90	+0.51	0.234
Jones	Gull	1.7	+ 42.47	+ 42.84	−0.37	0.233
Jones	Rabbit	3.2	+ 28.13	+ 28.19	−0.06	0.012
Gull	Rabbit	0.7	− 14.00	− 14.65	+0.65	0.296
Gull	Brook	0.5	− 0.94	+ 0.33	−1.27	0.806
Jones	Brook	0.9	+ 42.90	+ 43.17	−0.27	0.066
Rabbit	Brook	2.7	+ 15.00	+ 14.98	+0.02	0.001
Rabbit	Bethlehem	2.0	− 23.03	− 23.06	+0.03	0.002
Brook	Bethlehem	0.9	− 38.05	− 38.04	−0.01	0.000
Brook	French	1.1	− 55.28	− 54.70	−0.58	0.370
Bethlehem	French	3.0	− 17.10	− 16.66	−0.44	0.581
Bethlehem	Kimberly	2.3	+ 2.82	+ 2.37	+0.45	0.466
French	Kimberly	12.2	+ 18.89	+ 19.03	−0.14	0.239
Rabbit	Aitkin	1.4	.....	.....	+0.10	0.014
French	Aitkin	1.1	.....	.....	+0.07	0.005
Brook	Aitkin	0.6	.....	.....	−0.28	0.047
Kimberly	Aitkin	0.6	.....	.....	−0.42	0.106
French	Rae	4.2	+ 4.32	+ 4.41	−0.09	0.034
Bethlehem	Rae	3.1	− 12.15	− 12.25	+0.10	0.031
Kimberly	Rae	12.7	− 14.68	− 14.62	−0.06	0.046
Kimberly	Gregor	13.0	− 25.68	− 25.65	−0.03	0.012
Rae	Gregor	5.6	− 10.95	− 11.03	+0.08	0.036
Rae	Grindle	12.1	− 4.30	− 4.21	−0.09	0.098
Kimberly	Grindle	6.7	− 18.74	− 18.83	+0.09	0.054
Gregor	Grindle	11.2	+ 6.86	+ 6.82	+0.04	0.018
Gregor	Tamarack	6.7	+ 10.24	+ 10.23	+0.01	0.001
Grindle	Tamarack	3.1	+ 3.19	+ 3.41	−0.22	0.150
Grindle	Douglas	6.2	+ 12.70	+ 12.62	+0.08	0.040
Gregor	Douglas	5.1	+ 19.38	+ 19.44	−0.06	0.018
Tamarack	Douglas	7.8	+ 9.18	+ 9.21	−0.03	0.007
Tamarack	Wright	7.9	+ 5.63	+ 5.68	−0.05	0.020
Tamarack	Bachelor	3.7	+ 13.08	+ 13.11	−0.03	0.003

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Wright	Bachelor	10. 1	+ 7. 40	+ 7. 43	−0. 03	0. 009
Douglas	Bachelor	6. 6	+ 3. 90	+ 3. 90	0. 00	0. 000
Bachelor	Cromwell	3. 8	+ 32. 49	+ 32. 59	−0. 10	0. 038
Bachelor	Island	11. 8	+ 7. 60	+ 7. 61	−0. 01	0. 001
Cromwell	Island	12. 1	− 25. 10	− 24. 98	−0. 12	0. 174
Island	Mahtowa	3. 7	− 11. 06	− 10. 51	−0. 55	1. 119
Cromwell	Mahtowa	4. 2	− 35. 35	− 35. 49	+0. 14	0. 082
Island	Sawyer	3. 0	+ 5. 53	+ 5. 33	+0. 20	0. 120
Cromwell	Sawyer	6. 5	− 19. 58	− 19. 65	+0. 07	0. 032
Mahtowa	Sawyer	12. 4	+ 15. 84	+ 15. 84	0. 00	0. 000
Mahtowa	Atkinson	21. 7	− 7. 38	− 7. 35	−0. 03	0. 020
Sawyer	Atkinson	7. 6	− 23. 11	− 23. 19	+0. 08	0. 049
Atkinson	Cloquet	2. 6	+ 34. 49	+ 34. 64	−0. 15	0. 058
Mahtowa	Cloquet	2. 1	+ 26. 88	+ 27. 29	−0. 41	0. 353
Sawyer	Cloquet	4. 6	+ 11. 56	+ 11. 45	+0. 11	0. 050
Atkinson	Carlton	5. 8	− 15. 82	− 15. 92	+0. 10	0. 058
Cloquet	Carlton	6. 4	− 50. 69	− 50. 56	−0. 13	0. 108
Cloquet	Annie	3. 6	+ 10. 49	+ 10. 44	+0. 05	0. 009
Carlton	Annie	4. 9	+ 60. 82	+ 61. 00	−0. 18	0. 159
Atkinson	Annie	1. 3	+ 44. 85	+ 45. 08	−0. 23	0. 069
Carlton	Dedham	1. 7	− 82. 79	− 82. 28	−0. 51	0. 221
Annie	Dedham	2. 2	−143. 64	−143. 28	−0. 36	0. 285
Dedham	Superior	5. 0	− 91. 06	− 90. 80	−0. 26	0. 338
Annie	Superior	4. 3	−234. 17	−234. 08	−0. 09	0. 035
Annie	Duluth	11. 6	− 48. 47	− 48. 48	+0. 01	0. 001
Dedham	Duluth	1. 6	+ 94. 58	+ 94. 80	−0. 22	0. 077
Superior	Duluth	5. 2	+185. 63	+185. 60	+0. 03	0. 005
Superior	Minn. Point S. base	14. 3	− 18. 35	− 18. 25	−0. 10	0. 143
Duluth	Minn. Point S. base	7. 5	−204. 25	−203. 85	−0. 40	1. 200
Duluth	Minn. Point N. base	21. 2	−205. 24	−205. 30	+0. 06	0. 076
Minn. Pt. S. base	Minn. Point N. base	27. 3	− 1. 61	− 1. 45	−0. 16	0. 699
Superior	West Duluth	2. 6	.....	.....	−0. 195	0. 099
Duluth	West Duluth	52. 4	.....	.....	+0. 035	0. 063
Minn. Pt. N. base	West Duluth	7. 5	.....	.....	−0. 415	1. 292

In this third adjustment the elevations of the 44 remaining stations indicated by the observations are the 48 unknowns determined by least squares from the 109 observed differences of elevation given in the above table.

The probable error of an observation of weight unity derived from this adjustment is ±0.42 meter. Unit weight corresponds as in the other adjustments to reciprocal observations over a line 31.7 kilometers long.

Station Wright was selected as being most remote from the stations determined by precise leveling, and the probable error computed for its elevation is ±0.19 meter from the vertical angle measures alone. This probable error, combined with the probable error of stations fixed by precise leveling, becomes ±0.2 meter.

The results of the fourth adjustment, in which the stations concerned are those from the line Wahpeton-Western to the Canadian border, are shown below in the form used for the first adjustment.

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Indian	Western	0.87	− 86.81	− 85.51	−1.30	1.47
Indian	Fox	2.72	−114.01	−113.82	−0.19	0.10
Indian	Wahpeton	0.88	−131.95	−131.28	−0.67	0.40
Indian	Meadows	2.06	−126.96	−127.59	+0.63	0.82
Indian	Barnesville	0.91	−127.00	−129.10	+2.10	4.01
Indian	Tansem	1.18	+ 44.29	+ 43.60	+0.69	0.56
Western	Fox	2.44	− 28.05	− 28.31	+0.26	0.17
Wahpeton	Fox	3.18	+ 17.32	+ 17.46	−0.14	0.06
Meadows	Fox	2.13	+ 13.94	+ 13.77	+0.17	0.06
Western	Wahpeton	1.04	− 46.06	− 45.77	−0.29	0.09
Wahpeton	Meadows (rejected)	2.08	+ 7.53			
Meadows	Barnesville	1.26	− 0.76	− 1.51	+0.75	0.71
Meadows	Tansem	0.72	+171.18	+171.19	−0.01	0.00
Tansem	Barnesville	2.74	−172.75	−172.70	−0.05	0.01
Tansem	Eglon	4.06	− 40.55	− 40.74	+0.19	0.15
Barnesville	Eglon	1.80	+132.12	+131.96	+0.16	0.05
Tansem	Riverton	1.82	−142.08	−142.19	+0.11	0.02
Barnesville	Riverton	3.57	+ 31.18	+ 30.51	+0.67	1.60
Eglon	Riverton	4.30	−101.40	−101.45	+0.05	0.13
Eglon	Keene	1.86	− 87.44	− 87.93	+0.49	0.45
Eglon	Syre	0.61	− 14.52	− 14.42	−0.10	0.01
Riverton	Morken	1.58	− 50.62	− 50.79	+0.17	0.05
Riverton	Keene	2.48	+ 14.56	+ 13.52	+1.04	2.68
Keene	Morken	4.94	− 64.11	− 64.31	+0.20	0.20
Keene	Borup	2.55	− 62.85	− 63.70	+0.85	1.84
Keene	Syre	1.32	+ 73.79	+ 73.51	+0.28	0.10
Morken	Borup	2.96	+ 1.02	+ 0.61	+0.41	0.50
Syre	Borup	1.71	−136.97	−137.21	+0.24	0.10
Syre	Gary	1.91	− 75.40	− 75.19	−0.21	0.09
Syre	Wicklow	1.00	−136.96	−137.25	+0.29	0.08
Borup	Gary	1.18	+ 61.90	+ 62.02	−0.12	0.02
Borup	Wicklow	2.13	− 0.82	− 0.04	−0.78	1.30
Gary	Wicklow	3.21	− 61.97	− 62.06	+0.09	0.03
Fertile	Tilden	2.55	− 28.40	− 28.57	+0.17	0.07
Fertile	Andover	1.04	− 93.51	− 93.33	−0.18	0.03
Wicklow	Fertile	2.04	+ 85.63	+ 85.39	+0.24	0.12
Wicklow	Beltrami	3.17	− 3.20	− 3.43	+0.23	0.17
Gary	Beltrami	1.28	− 64.96	− 65.49	+0.53	0.36
Gary	Fertile	4.56	+ 23.01	+ 23.33	−0.32	0.47
Fertile	Beltrami	2.25	− 89.36	− 88.82	−0.54	0.66
Beltrami	Andover	2.24	− 4.67	− 4.51	−0.16	0.06
Tilden	Andover	2.25	− 64.59	− 64.76	+0.17	0.07
Beltrami	Tilden	1.32	+ 60.66	+ 60.25	+0.41	0.22
Tilden	Shirley	1.00	− 66.05	− 66.11	+0.06	0.00
Andover	Shirley	3.51	− 1.55	− 1.35	−0.20	0.14
Tilden	Ives	1.32	− 27.21	− 27.60	+0.39	0.20
Andover	Ives	1.36	+ 37.56	+ 37.16	+0.40	0.22
Shirley	Ives	2.72	+ 38.82	+ 38.51	+0.31	0.26
Ives	Sherack	1.85	− 43.08	− 43.68	+0.60	0.67
Shirley	Sherack	2.98	− 5.68	− 5.17	−0.51	0.77
Sherack	Bray	2.47	+46.27	+46.29	−0.02	0.00
Sherack	Viking	0.94	+55.25	+55.54	−0.29	0.08
Bray	Shirley (rejected)	1.31	−45.36			
Bray	Ives	4.66	− 2.79	− 2.61	−0.18	0.15
Sherack	Warren	1.96	+ 5.12	+ 5.48	−0.36	0.25
Bray	Warren	1.51	−40.75	−40.81	+0.06	0.01
Viking	Warren	2.86	−50.25	−50.06	−0.19	0.10
Bray	Viking	2.14	+ 9.58	+ 9.25	+0.33	0.23
Warren	Argyle	3.32	− 8.07	− 8.23	+0.16	0.09
Viking	Argyle	1.35	−58.67	−58.25	−0.38	0.19

Station 1	Station 2	Weight p	Observed difference of elevations h_2-h_1	Adjusted difference of elevations h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Viking	Wright	4.00	+ 2.06	+ 1.68	+0.38	0.58
Warren	Wright	1.68	+50.72	+51.74	−1.02	1.75
Argyle	Stephen E. base	5.36	+ 8.43	+ 8.73	−0.30	0.48
Wright	Stephen E. base	3.40	−52.24	+51.24	−1.00	3.40
Argyle	Stephen W. base	10.00	− 6.16	− 6.29	+0.13	0.17
Wright	Stephen W. base	1.69	−65.65	−66.26	+0.61	0.63
Wright	Argyle	2.25	−60.42	−59.97	−0.45	0.46
Argyle	Donaldson	2.49	− 8.46	− 7.94	−0.52	0.67
Stephen W. base	Donaldson	9.91	− 1.77	− 1.65	−0.12	0.14
Stephen E. base	Donaldson	5.41	−16.71	−16.67	−0.04	0.01
Wright	Donaldson	1.06	−66.35	−67.91	+1.56	2.58
Donaldson	Deer	2.70	+45.27	+45.47	−0.20	0.11
Stephen W. base	Deer	2.28	+43.30	+43.82	−0.52	0.62
Stephen E. base	Deer	5.89	+29.06	+28.80	+0.26	0.40
Argyle	Deer	1.41	+36.97	+37.53	−0.56	0.44
Wright	Deer	2.26	−21.77	−22.44	+0.67	1.01
Donaldson	Skane	2.48	− 4.83	− 4.92	+0.09	0.02
Deer	Skane	1.02	−48.71	−50.39	+1.68	2.88
Deer	Jupiter	3.28	−21.90	−21.53	−0.37	0.45
Donaldson	Jupiter	2.18	+23.60	+23.94	−0.34	0.25
Skane	Jupiter	2.70	+28.54	+28.86	−0.32	0.28
Jupiter	Hallock	4.08	−24.18	−23.72	−0.46	0.86
Skane	Hallock	6.75	+ 5.51	+ 5.14	+0.37	0.92
Jupiter	Granville	2.82	+ 2.93	+ 3.24	−0.31	0.27
Skane	Granville	1.75	+31.96	+32.10	−0.14	0.04
Hallock	Granville	7.19	+26.85	+26.96	−0.11	0.09
Skane	Hill	3.25	− 3.04	− 3.19	+0.15	0.07
Hallock	Hill	4.55	− 8.01	− 8.33	+0.32	0.46
Granville	Hill	2.14	−35.26	−35.29	+0.03	0.00
Hill	States	3.45	+ 1.35	+ 1.24	+0.11	0.04
Granville	States	1.47	−33.73	−34.05	+0.32	0.15
Granville	Canada	4.76	+ 1.29	+ 1.80	−0.51	1.24
Hill	Canada	1.75	+37.98	+37.09	+0.89	1.39
States	Canada	3.23	+36.12	+35.85	+0.27	0.24

In this fourth and last adjustment the elevation of nine stations were taken as fixed. The stations Wahpeton and Western had been fixed by the third adjustment, their elevations being 294.63 and 340.40 meters, respectively. Stations Indian, Borup, Wicklow, Sherack, Argyle, and Stephen west base were held fixed from the results of precise leveling, their elevations being 425.91, 277.14, 277.10, 262.64, 259.89, and 253.60 meters, respectively. These elevations were obtained from the elevations of the following bench marks of the precise level net, viz, E_4, E_5, K_5, D_6, O_6, and T_6, their elevations being 422.000, 277.500, 276.442, 262.523, 260.331, and 253.713 meters, respectively. These bench marks are located near the triangulation stations in each case and the small difference in the height between the bench mark and the station determined with a vertical angle was adopted without correction. The difference of elevation between the two ends of the Stephen base line, as determined by the leveling over the line, and the elevation of Stephen east base, 268.62 meters, were adopted.

The elevations of the remaining 29 stations indicated by the observations are the 29 unknowns determined by least squares from the 86 observed differences of elevation in the above table.

The probable error of an observation of weight unity derived from this adjustment is ±0.58 meter. Unit weight corresponds as in the other adjustments to reciprocal observations over a line 31.7 kilometers long.

Station States may be assumed to be the one least accurately determined and its probable error, if computed, would probably not exceed ±0.4 meter when combined with the probable error of the elevations fixed by precise leveling.

ELEVATIONS.

The datum for all the elevations is mean sea level.

The stations are in three classes: First those fixed directly by the spirit leveling, and of which the elevations are subject to a probable error of ±0.04 meter; second, the stations in the main scheme fixed by reciprocal measures of vertical angles and which are subject to probable errors varying from ±0.1 to ±0.4 meter, and the third, the intersection stations, of which the elevations are fixed by measurements of vertical angles which are not reciprocal, the intersection stations not being occupied, and whose elevations are subject to probable errors which may be as great as ±2 meters in some cases.

The accuracy with which each elevation in the main scheme is determined depends mainly upon the remoteness of that station from the nearest one of which the elevation is fixed by spirit leveling, as indicated in class 1 of the following table. Station States is probably least accurately determined of all the stations in the main scheme.

For a table to be used in converting feet to meters, or vice versa, see page 236.

Table of elevations.

Station	Point to which elevation refers	Elevation
Class 1		*Meters*
Mound	Station mark	634.87
Oscarson	Station mark	317.56
Foss	Station mark	297.24
Class 2		
Helgen	Station mark	593.2
Boating	Station mark	619.6
Waubay	Station mark	594.6
Preacher Hill	Station mark	650.6
Pickerel	Station mark	616.5
Drywood	Station mark	623.3
Brown Valley NW. base	Station mark	355.4
Brown Valley SE. base	Station mark	347.7
Layden	Station mark	367.0
Enwiller	Station mark	337.7
Hankinson	Station mark	380.2
Class 1		
Hansen	Station mark	529.58
Crane	Station mark	565.82
Page SW. base	Station mark	626.49
Page NE. base	Station mark	580.84
Class 2		
Hall	Station mark	624.5
Old	Station mark	577.9
Prairie	Station mark	596.5
Walnut	Station mark	591.5
Sparta	Station mark	547.9
Santee	Station mark	512.3
Avon	Station mark	532.7
Vod	Station mark	486.7
Yankton	Station mark	472.4
Wieters	Station mark	411.4
Freeman	Station mark	504.2
Wolf Creek	Station mark	418.7
Silver Lake	Station mark	440.8
Elm Springs	Station mark	411.2
Farmer	Station mark	426.7
Salem	Station mark	465.0

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
		Meters
Class 2—Continued.		
Canova	Station mark	482.0
Owens	Station mark	516.7
Reese	Station mark	435.1
Caldwell	Station mark	492.6
Brock	Station mark	547.0
Miner	Station mark	548.9
Drakola	Station mark	532.3
Jeska	Station mark	561.4
Larson	Station mark	560.5
Weiss	Station mark	561.4
Oakwood Lake	Station mark	535.8
Horswill	Station mark	571.2
Olson	Station mark	587.5
Elfring	Station mark	556.0
Franklin	Station mark	612.0
Class 3		
Council Hill	Ground at station	566.7
Conger U. S. E.	Ground at station	514.4
Ponca U. S. E.	Ground at station	511.2
Lost Creek U. S. E.[1]	Ground at station	490.3
Arneson [2]	Ground at station	507.4
Layton	Ground at station	579.5
Niobrara U. S. E.	Ground at station	495.6
High Point [1]	Ground at station	574.8
Scotland water tower	Base of tank	432.4
Tripp water tower [1]	Top	511.1
Lesterville water tower	Top	442.4
U. S. Geological Survey B. M., SE. corner S. 36, T. 96, R. 60		465.5
Turkey Ridge [1]		530.2
Alexandria courthouse	Top of dome	432.5
Alexandria Baptist Church spire	Top of cone	442.1
Church on ridge, spire east end	Top of cone	445.9
County-line monument [1]	Top of monument	401.7
German Baptist Church	Ridge of roof	415.6
Alexandria elevator	Top	430.1
Alexandria small open belfry	Top of belfry	430.5
Emery elevator	Top	442.9
Dolton elevator		457.6
Bridgewater church No. 1, spire	Top	454.3
Bridgewater church No. 2, spire	Top	453.8
Bridgewater elevator	Top	450.5
Freeman elevator	Ridge of roof	482.9
Freeman highest spire	Top	487.1
Freeman schoolhouse, squatty spire	Top	478.5
Canastota red elevator	Top of cupola	494.5
Canastota highest spire	Top	491.8
Canastota high spire near elevator	Top	490.1
Epiphany church spire	Top	442.1
Vilas windmill	Center of wheel	464.6
Epiphany waterworks tank tower	Top of tank	440.4
Church 7 miles N. by W. of Salem	Top	480.4
Salem Catholic Church spire	Top	501.7
Dover church, toadstool spire		447.5
Farmer Catholic Church	Ball on spire	447.4
Swedish Lutheran Church, wh. pyr. spire	Ball	509.4
Canova lead-colored elevator	Top	483.0
Roswell church, high slender spire	Top	449.4
Canova open belfry	Top	480.8
Vilas elevator	Top	462.5
Howard courthouse dome	Top	499.1
Howard Congregational Church spire	Top	507.5
Howard Catholic Church spire	Top of pyramid	503.8
Howard Methodist Church spire	Top	499.2
Howard elevator	Top	498.1
Winfred church spire	Top of cone	535.6
Winfred elevator	Top	535.2
Orland lone church spire	Top	572.0
Swedish Baptist Church, square pink spire	Top	488.3
Ramona white spire	Top of cone	578.4
Freedom church spire	Top of pyramid	536.6
Ramona low dome	Top	570.0
Ramona elevator	Top	570.9
Breton Baptist Church spire	Top of cone	530.5
German Lutheran Church square base, octagonal top	Top of cone	577.2
Church, high spire (SE. of Hansen)	Top of ball	547.4
Lake Preston schoolhouse cupola	Top of cupola	544.9
Lake Preston Congregational Church, needle spire	Top of ball	547.6
Fedora elevator	Top	437.1

[1] No check on this elevation.

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
Class 3—Continued.		
		Meters
Carthage middle height spire	Top	454.7
Carthage highest spire	Weather vane	457.9
Lake Preston flour mill stack	Top	542.0
Desmet highest spire		552.9
Desmet dome		544.9
Oldham schoolhouse golden dome	Top of dome	541.1
Oldham small sharp spire, square base	Top	542.9
Oldham highest spire	Top	547.5
Round church spire	Top of ball	557.0
Erwin church spire (blunt cone)	Top of cone	588.2
Large church (15 miles from Brock), spire	Top of cone	570.0
Arlington Methodist Church spire with corner minarets	Top of solid part	577.3
Arlington Baptist Church spire	Top of pyramid	579.8
Arlington Christian Church spire	Top of octagonal part	581.7
Kranzburg church spire	Top of cone	639.3
Lutheran Church (3½ miles from Olson) spire	Top of cone	631.8
Waverly dull heavy spire	Top of pyramid	625.7
Watertown courthouse clock spire	Top of pyramid	567.2
Watertown Methodist Episcopal Church spire	Top of cone	561.0
Watertown water tower	Top	576.2
High sharp spire	Top	594.2
Summit high-school belfry	Top of pyramid	631.4
Webster waterworks tank	Top of point	610.4
Webster courthouse tower	Top of tower	596.4
Webster high sharp spire	Extreme top	596.0
Wist, church near, spire	Top of cone	631.3
Wist, high chimney on large building	Top	625.3
Waubay gothic church spire [1]	Top of cone	574.6
Beardsley water tank	Top of cone	367.1
Beardsley square slender spire	Top of pyramid	356.3
Brown Valley, high spire on large building	Top of slender cone	333.4
Brown Valley water tower	Top of dull cone	341.0
Brown Valley white spire	Top of cone	326.6
Indian church spire	Top of pyramid	354.6
Wilmot western white spire	Top of cone	387.9
Wilmot eastern white spire	Top	384.8
Peaver open belfry	Top of cone	378.3
Sec. 18, T. 100 N., R. 55 W., NW. corner	Top of stone	440.7
Sec. 21, T. 103 N., R. 55 W., NW. corner	Ground	460.5
Sec. 14, T. 105 N., R. 57 W., NE. corner	Top of mound	434.9
Sec. 20, T. 105 N., R. 54 W., NE. corner	Ground	514.0
Sec. 21, T. 107 N., R. 54 W., S. quarter corner	Ground	547.7
Sec. 26, T. 110 N., R. 55 W., E. quarter corner	Top of mound	525.4
Sec. 28, T. 109 N., R. 53 W., NE. corner	Top of mound	541.5
Sec. 15, T. 108 N., R. 55 W., NW. corner	Mark	540.8
Sec. 13, T. 109 N., R. 56 W., SW. corner	Top of mound	523.3
Sec. 29, T. 110 N., R. 52 W., NW. corner	Mark	549.8
Sec. 34, T. 111 N., R. 53 W., SE. corner	Top of stone in center of road	540.7
Sec. 33, T. 112 N., R. 51 W., NE. corner	Ground	529.4
Sec. 26, T. 112 N., R. 54 W., NW. corner	Ground	546.4
Sec. 36, T. 115 N., R. 53 W., N. quarter corner	Top of stone	563.7
Sec. 34, T. 113 N., R. 51 W., SW. corner	Top of stone	607.0
Sec. 31, T. 119 N., R. 53 W., N. quarter corner	Top of mound	575.0
Sec. 18, T. 124 N., R. 49 W., SE. corner		345.4
Sec. 17, T. 125 N., R. 48 W., W. quarter corner	Top of mound	359.6
Auxiliary station near Farmer		424.6
Class 1		
Elbow	Station mark	390.09
Dalton	Station mark	423.32
Dalton astronomic station	Station mark	420.05
Alexandria	Station mark	451.28
Osakis	Station mark	428.43
Royalton north base	Station mark	348.23
Royalton south base	Station mark	324.17
P. B. M. back base	Station mark	323.29
Carlton	Station mark	376.61
Carlton P. B. M. 5	Station mark	332.22
Aitkin courthouse, U. S. P. B. M.		370.81
Iron Bay B. M.		191.71
Aitkin water tower	Top	402.39
Aitkin high school	Top of cone	405.19
Aitkin jail	Top of cone	390.89
Union Match Co., water tower	Top.	219.00
Union Match Co., factory cupola	Top of cupola	213.71

[1] No check on this elevation.

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
Class 2		*Meters*
Wahpeton	Station mark	294.6
Western	Station mark	340.4
Bullis	Station mark	326.7
Leaf	Station mark	526.8
Holmes	Station mark	483.4
Parker	Station mark	494.8
Leslie	Station mark	431.8
Maple	Station mark	431.3
Birch	Station mark	437.9
Eagle	Station mark	446.5
Lone	Station mark	458.0
Falls	Station mark	405.4
Brockway	Station mark	381.1
Alberta	Station mark	361.6
Johnson	Station mark	458.3
Rail	Station mark	467.8
Daggett	Station mark	401.5
Jones	Station mark	397.6
Gull	Station mark	440.4
Rabbit	Station mark	425.8
Brook	Station mark	440.8
Bethlehem	Station mark	402.7
French	Station mark	386.1
Kimberly	Station mark	405.1
Rae	Station mark	390.5
Gregor	Station mark	379.4
Tamarack	Station mark	389.7
Douglas	Station mark	398.9
Wright	Station mark	395.4
Bachelor	Station mark	402.8
Cromwell	Station mark	435.4
Island	Station mark	420.4
Mahtowa	Station mark	399.9
Sawyer	Station mark	415.7
Atkinson	Station mark	392.5
Cloquet	Station mark	427.2
Annie	Station mark	437.6
Dedham	Station mark	294.3
Superior	Station mark	203.5
Duluth	Station mark	389.1
Minnesota Point north base	Station mark	183.8
Minnesota Point south base	Station mark	185.3
Class 3		
Graceville water tower	Top	371.8
Graceville Catholic Church spire	Top	376.1
Wheaton water tower	Top	339.7
Church, very tall, black spire	Top	395.5
Swedish Lutheran Church spire	Top	354.4
Large church, spire on west end	Top	375.6
Hankinson high school spire [1]	Top	352.6
Hankinson Catholic church spire [1]	Top	346.7
Fairmount tall east elevator [1]		318.3
Campbell open belfry spire	Top of cone	318.8
Childs tallest elevator		317.0
Childs, church near, black spire [1]		323.9
Church (5 miles S. by W. of Dalton) spire	Top of spire	407.3
Alexandria water tower	Top	463.5
Western P. O. church [1]	Ball on spire	353.6
Herman water tower		368.2
Elbow Lake water tower	Top	409.5
Hereford tallest elevator	Top	348.4
Osakis water tower	Top	446.4
Long Prairie water tank	Top	442.0
Long Bridge church [1]	Top of spire	435.8
Sauk Center Catholic Church	Top of cone	417.1
Rice Catholic Church spire	Cross	339.1
Rich Prairie Catholic Church spire	Top	408.5
Gregory M. R. C.	Top of cap on pipe	375.3
Royalton M. R. C.	Top of pipe station mark	347.9
Gottwalt M. R. C.	Top of cap on pipe	331.3
Swan Creek M. R. C.	Top of cap on pipe	376.2
Skounter Hill M. R. C.[1]	Top of cap on pipe	336.7
Buckman Catholic Church dome	Cross on dome	409.6
Little Falls Catholic Church [1]	Cross	373.3
Little Falls courthouse tower [1]	Top	367.2
Little Falls high-school belfry [1]	Top	369.2
Little Falls Pine Tree Lumber Co.'s stack [1]	Top	380.0

[1] No check on this elevation.

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
Class 3—Continued		*Meters*
Nashua white church [1]	Top of spire	323.3
Blackmer south elevator [1]	Top	316.6
Wahpeton Catholic Church spire	Cross	326.6
Royalton Old Catholic Church	Cross	349.6
Wendell tallest elevator	Top	367.8
Evansville water tower	Top	450.8
Brainerd railroad shops stack	Top of stack	406.5
Brainerd Lumber Co.'s stack	Top of stack	410.2
Brainerd Catholic Church spire	Top of cone	405.0
Brainerd other church spire	Top of spire	402.0
Bethlehem church spire	Top of cone	433.2
McGregor schoolhouse belfry	Top of belfry	392.3
McGregor Vanderwaters's sawmill	Top of stack	394.8
Cloquet Catholic Church spire	Center of cross	424.7
Scanlon Johnson's sawmill	Top of stack	399.8
Cloquet paper mill	Top of stack	405.8
Scanlon schoolhouse belfry	Top of belfry	384.2
Scanlon (SE. edge of) sawmill	Top of stack	382.1
Proctorknott railroad shops water tank	Top of tank	418.4
Itasca elevator (C., St. P., M. & O. R. R.)	Top of stack	240.1
South Superior Webster Chair Mfg. Co.	Top of stack	236.2
South Superior Bryant School building	Top of NW. chimney	228.2
South Superior Fred Billings School building	Top of belfry	222.2
Superior Ore Docks, Weather Bureau signal tower	Top of cone	220.6
Saunders G. N. water tank	Top	218.2
Superior G. N. elevator S	Top of south gable	255.9
Duluth and Superior Interstate Bridge	Top of operator's tower in center of draw span	202.9
Superior State Normal School	Top of smaller higher tower	222.4
Superior Pierhead Rear Range L. H. [1]	Top of cone	203.5
Superior elevator K	Top of stack	233.2
Superior elevator T	Top of south gable	232.8
East Superior Lincoln schoolhouse [1]	Top of tower	216.7
Duluth, house at head of W. 5th Ave.	Top of center chimney	368.1
Boylston G. N. signal tower [1]	Top	224.1
East Superior, Presbyterian Church spire	Top	227.6
Superior, St. Mary's Hospital spire [1]	Top of cone	225.0
Duluth high school	Top of spire	281.0
Duluth Incline Pavilion, Weather Bureau signal tower [1]	Top of flagstaff	166.4
Duluth elevator H	Top of stack	228.5
Duluth aerial bridge [1]	SW. column of north pier at lower chord of truss	226.2
West Duluth Irving School [1]	Top of chimney	227.3
Duluth Brewing & Malting Co.	Top of dome	221.0
Duluth elevator B	Top of stack	226.0
Duluth Methodist Episcopal or Catholic Church spire	Top	281.3
Class 1		
Indian	Station mark	425.91
Borup	Station mark	277.14
Wicklow	Station mark	277.10
Sherack	Station mark	262.64
Argyle	Station mark	259.89
Stephen west base	Station mark	253.60
Stephen east base	Station mark	268.62
Class 2		
Fox	Station mark	312.1
Meadows	Station mark	298.3
Barnesville	Station mark	296.8
Tansem	Station mark	469.5
Riverton	Station mark	327.3
Eglon	Station mark	428.8
Keene	Station mark	340.8
Morken	Station mark	276.5
Syre	Station mark	414.4
Gary	Station mark	339.2
Beltrami	Station mark	273.7
Fertile	Station mark	362.5
Tilden	Station mark	333.9
Andover	Station mark	269.2
Shirley	Station mark	267.8
Ives	Station mark	306.3
Bray	Station mark	308.9
Warren	Station mark	268.1
Viking	Station mark	318.2

[1] No check on this elevation.

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
		Meters
Class 2—Continued		
Wright	Station mark	319.9
Donaldson	Station mark	252.0
Deer	Station mark	297.4
Jupiter	Station mark	275.9
Skane	Station mark	247.0
Hallock	Station mark	252.2
Granville	Station mark	279.1
Hill	Station mark	243.8
States	Station mark	245.1
Canada	Station mark	280.9
Class 3		
Fergus Falls Asylum	Top of stack	426.7
Fergus Falls Northwestern College	Top of dome	403.6
Oscar church spire	Ball on spire	415.2
Church (5 miles N. of Indian) spire	Bottom of cone	433.3
Wahpeton schoolhouse	Top of roof	316.5
Church (N. of Fox)	Top of roof	330.4
Church (NW. of Foxhome)	Top of roof	327.1
Foxhome white elevator	Top	334.3
Foxhome red elevator	Top	335.3
Lawndale elevator	Top	344.9
Breckenridge Hospital cupola	Bottom of cupola	312.1
Barnesville tall elevator	Top	338.9
Doran, church east of, spire [1]	Top of roof	312.0
Carlisle elevator	Top	397.0
Everdell slender elevator	Top	321.2
Everdell broad elevator	Top	322.5
Wataseo lone elevator	Top	320.0
Breckenridge courthouse	Top of cupola	321.6
Wahpeton standpipe	Top	336.9
Barnesville church	Top of roof	328.6
Brushvale low elevator	Top	312.7
Barnesville standpipe	Top	346.8
Brushvale tall elevator	Top	315.0
Barnesville stack	Top	331.9
Foxhome schoolhouse	Top of roof	328.3
Downer NW. elevator	Top	317.7
Downer SE. elevator	Top	317.3
Fargo Catholic Church spire	Top of cone	323.1
Glyndon elevator	Top	303.2
Glyndon church spire	Top of cone	303.4
Rollag church	Top of roof	430.9
Muscada elevator	Top	348.8
Church (3 miles E. of Eglon)	Top of roof	444.8
Borup church	Top of roof	287.8
Borup elevator, tall	Top	298.2
Borup elevator, slender top	Top	294.9
Wheatville elevator, red, slender top	Top	295.1
Church (NE. of Fargo)	Top of cone	300.0
Hitterdal elevator	Top	399.8
Hitterdal tall church spire	Middle of cone	400.7
Hitterdal low church	Bottom of cone	394.4
Twin Valley standpipe	Top	370.4
Twin Valley tall elevator, slender top	Top	353.5
Twin Valley white church spire	Top of cone	356.3
Church spire (3 miles NE. of Keene)	Top of roof	363.0
Hadler south elevator	Top	297.4
Hadler north elevator	Top	297.2
Gary south elevator (long top)	Top	354.6
Gary north elevator (short top)	Top	353.5
Felton tall elevator	Top	297.6
Felton church spire	Top of roof	288.0
Felton schoolhouse	Top of roof	291.9
Wheatville elevator, yellow	Top	295.8
Ada standpipe	Top	307.7
Church (5 miles NE. of Borup)	Top of roof	292.6
Ada courthouse tower	Top	302.2
Ada schoolhouse	Top of cupola	303.3
Gary church spire	Bottom of cone	350.6
Fleming elevator	Top	368.5
Beltrami south elevator	Top	298.8
Beltrami north elevator	Top	298.7
Fertile large elevator	Top	368.4
Fertile small elevator	Top	363.7
Fertile standpipe	Top	385.0
Rindal church spire	Top of roof	369.9
Crookston high school	Top of cupola	292.2
Crookston Catholic Church spire	Top of cone	295.4

[1] No check on this elevation.

Table of elevations—Continued.

Station	Point to which elevation refers	Elevation
Class 3—Continued		*Meters*
Crookston courthouse dome	Top	299.7
Crookston brickyard chimney	Top of chimney	293.0
Crookston standpipe	Top	300.9
Melvin elevator	Top	330.9
Sherack low elevator	Top	279.2
Russia elevator	Top	291.7
Sherack tall elevator	Top	282.5
Lockhart church spire	Top of cone	286.8
Lockhart elevator	Top	294.1
Eldred SW. low elevator	Top	283.4
Eldred NE. tall elevator	Top	288.1
Climax tall elevator	Top	287.9
Kittson elevator	Top	287.8
Euclid school belfry	Top of roof	283.1
Euclid tall elevator, brown	Top	293.9
Euclid low elevator, red	Top	291.7
Roon elevator	Top	284.0
Angus tall elevator (tall top)	Top	287.0
Angus tall elevator (low top)	Top	287.1
Viking west elevator (slender top)	Top	348.5
Viking east elevator (large top)	Top	348.5
Viking low elevator	Top	347.0
Warren standpipe	Top	298.7
Warren courthouse tower	Top of solid portion	284.0
Warren school cupola	Top of cupola	284.8
Radium west elevator (large top)	Top	303.8
Radium east elevator (low)	Top	302.4
Radium tall elevator	Top	304.7
Brush Farm elevator	Top	283.4
Lone elevator, between Warren and Radium	Top	282.3
Luna elevator	Top	280.4
Argyle E. L. P. smokestack	Top	277.6
Argyle tallest elevator	Top	281.0
Argyle tall church spire	Bottom of cone	274.3
Church 8 miles NW. of Wright	Top of roof	293.9
Stephen low church spire	Top of cone	269.8
Stephen tall church spire	Bottom of cone	265.0
Stephen school cupola	Top	272.2
Woodward Farm elevator	Top	275.8
Tabor west church	Bottom of cone	266.9
Tabor east church	Top of roof	269.0
Donaldson church	Top of roof	262.7
Church 7 miles NW. by W. of Deer	Top of spire	289.4
Church 5 miles NE. of Stephen W. base	Top of roof	272.2
Donaldson tall elevator	Top	274.7
Kennedy church	Top of spire	277.2
Kennedy school	Top of cupola	273.8
Church (9 miles NW. of Deer) spire	Top of spire	297.0
Hallock tall church spire	Top	274.2
Hallock standpipe	Top	291.4
Hallock courthouse	Top of tower	275.4
Church 5 miles S. of Skane	Top of spire	269.7
Halma elevator	Top	325.0
Chatham elevator	Top	271.4
Lancaster tall elevator	Top	298.8
Lancaster school	Top of cupola	293.3
Church (8 miles E. of Hallock)	Top of spire	285.9
Church (8 miles SE. by E. of Hallock)	Top of spire	286.5
Northcote tall elevator	Top	267.8
Northcote church	Top of spire	263.6
Joliette tall church spire	Top	265.0
Joliette tall elevator	Top	263.9
Humboldt church	Top of spire	259.5
Humboldt school	Top of cupola	261.8
Northern Pacific R. R. tall elevator	Top	263.8
St. Vincent Junction tall elevator	Top	266.8
Emerson tall church	Top of spire	266.7
Emerson tower, flat top	Flat top	262.7
Orleans school	Top of cupola	272.5
Grampian lone elevator	Top	261.9
Pembina square open tower	Top of tower	267.8
St. Vincent tower, round top	Top	264.7
St. Vincent bell tower	Top	261.8

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Index to positions, descriptions, sketches, and elevations—Continued.

[1] For elevations of these points see "Precise Leveling in the United States, 1903-1907," p. 116.

Index to positions, descriptions, sketches, and elevations—Continued.

Station	Position	Description	Sketch	Elevation
	Page	*Page*	*Number*	*Page*
Brush Farm elevator	258	.....	10	324
Brushvale:				
Low elevator	254	.....	9	323
Tall elevator	254	.....	9	323
Bryant School, South Superior	265	.....	8	322
Buckman Catholic Church	263	.....	6	321
Bullis	239	280	5	321
C. & G. S. bench marks:				
E_4	261	307	9	[1]
E_5	261	307	9	[1]
K_5	261	307	9	[1]
D_6	261	307	10	[1]
O_6	261	307	10	[1]
T_6	261	307	10	[1]
Caldwell	238	273	2, 3	319
Campbell:				
Church, open belfry	251	.....	5	321
Church spire	251	.....	5	.....
Elevator No. 1	251	.....	5	.....
Elevator No. 2	251	.....	5	.....
Canada	241	288	11	323
Canastota:				
Elevator	245	.....	2	319
High church spire	245	.....	2	319
Highest white spire	245	.....	2	319
Canova	237	272	2	319
Canova:				
Lead-colored elevator	247	.....	2	319
Open belfry	247	.....	2	319
Carlisle elevator, north gable	254	.....	9	323
Carlton	243	301	8	320
Carlton, P. B. M. 5	.....	.....	.....	320
Carthage:				
Highest spire	248	.....	3	320
Spire	248	.....	3	320
Catholic Church:				
Alexandria	262	.....	5, 6	.....
Brainerd	263	.....	6, 7	322
Buckman	263	.....	6	321
Cloquet	264	.....	8	322
Crookston	257	.....	10	323
Duluth	265	.....	8	322
Evansville	262	.....	5	.....
Fairmount	251	.....	5	.....
Fargo	255	.....	9	323
Farmer	246	.....	2	319
Graceville	250	.....	5	321
Hankinson	250	.....	5	321
Howard	247	.....	2	319
Kranzburg	249	.....	3, 4	320
Little Falls	263	.....	6	321
Long Prairie	262	.....	6	.....
On Ridge	262	.....	6	.....
Rice	263	.....	6	321
Rich Prairie	263	.....	6	321
Royalton	263	.....	6	322
Salem	246	.....	2	319
Sauk Center	262	.....	6	321
Tyandall	244	.....	1	.....
Wahpeton	251	.....	9	322
Catholic Church spire	245	.....	1, 2	.....
Chatham elevator	259	.....	11	324

[1] For elevations of these points see "Precise Leveling in the United States, 1903-1907," p. 116.

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Station	Position	Description	Sketch	Elevation
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Hallock, 8 miles southeast by east of	259	.....	11	324
Hankinson, Catholic	250	.....	5	321
Hansen, high spire southeast of	248	.....	3	319
Hitterdal, low spire	255	.....	9	323
Hitterdal, tall spire	255	.....	9	323
Howard, Catholic	247	.....	2	319
Howard, Congregational	247	.....	2	319
Howard, Methodist	247	.....	2	319
Humboldt	260	.....	11	324
Indian	250	.....	4	320
Indian, 5 miles north of	254	.....	9	323
Joliette	260	.....	11	324
Keene, 3 miles northeast of	255	.....	9	323
Kennedy	259	.....	11	324
Kranzburg, Catholic	249	.....	3, 4	320
Lake Preston, Congregational	248	.....	3	319
Large, 15 miles from Brock	249	.....	3	320
Large, spire on west end	250	.....	5	321
Little Falls, Catholic	263	.....	6	321
Lockhart	256	.....	10	324
Long Bridge	262	.....	6	321
Long Prairie, Catholic	262	.....	6	.....
Nashua	251	.....	5	322
Northcote	260	.....	11	324
Olson, Lutheran, 3¼ miles from	249	.....	3	320
On ridge, Catholic	262	.....	6	.....
On ridge, east end, spire	245	.....	2	319
Orland	246	.....	2	319
Osakis, low spire	262	.....	6	.....
Osakis, tall spire	262	.....	6	.....
Oscar	254	.....	9	323
Parkston	245	.....	2	.....
Rice, Catholic	263	.....	6	321
Rice, Protestant	263	.....	6	.....
Rich Prairie, Catholic	263	.....	6	321
Rindal	256	.....	10	323
Rollag	254	.....	9	323
Roswell	247	.....	2	319
Round spire	248	.....	3	320
Royalton, Catholic	263	.....	6	322
Salem, Catholic	246	.....	2	319
Salem, 7 miles north by west of	246	.....	2	.....
Sauk Center, Catholic	262	.....	6	321
Scotland, Episcopal	244	.....	1	.....
Skane, 5 miles south of	259	.....	11	324
Stephen, low spire	259	.....	10	324
Stephen, tall spire	259	.....	10	324
Stephen, west base, 5 miles northeast of	259	.....	10	324
Swedish Baptist	246	.....	2	319
Swedish Lutheran	246	.....	2	319
Swedish Lutheran, 2 miles from Enwiller	250	.....	5	321
Tabor	244	.....	1	.....
Tabor, east	258	.....	10	324
Tabor, west	258	.....	10	324
Twin Valley	256	.....	9	323
Tyndall, Catholic	244	.....	1	.....
Very tall	250	.....	5	321
Vodnany	244	.....	1	.....
Wahpeton, Catholic	251	.....	9	322
Watertown, Methodist Episcopal	249	.....	3, 4	320
Waubay	249	.....	4	320
Wendell	252	.....	5	.....
Western Postoffice	251	.....	5	321

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Station	Position	Description	Sketch	Elevation
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Oleson, M. R. C.	263	309	6	.....
Olson	238	275	3	319
Olson, Lutheran Church, 3½ miles from	249	.....	3	.....
Orland lone church spire	246	.....	2	319
Orleans school cupola	260	.....	11	324
Osakis	241	291	6	320
Osakis:				
Low church spire	262	.....	6	.....
Tall church spire	262	.....	6	.....
Water tower	262	.....	6	321
Oscar church spire	254	.....	9	323
Oscarson	239	279	5	318
Owens	237	272	2	319
Page northeast base	237	268	1	318
Page southwest base	237	268	1	318
PAGE TO FERGUS FALLS	237, 243	268, 304	.....	.....
P. B. M. back base	.....	.....	.....	320
Paper mill, Cloquet	264	.....	8	322
Parker	241	291	5, 6	321
Parkston:				
Church spire	245	.....	2	.....
Iron smokestack	245	.....	2	.....
Peaver open belfry	250	.....	4	320
Pembina square open tower	260	.....	11	324
Peterson's (Wm.) house chimney	264	.....	8	.....
Pickerel	238	277	4	318
Pierhead, front range L. H., Superior	265	.....	8	.....
Pierhead, rear range L. H., Superior	265	.....	8	.....
Pine Tree Lumber Co.'s stack, Little Falls	263	.....	6	321
Ponca, U. S. E	244	305	1	319
Prairie	237	268	1	318
Preacher Hill	238	277	4	318
Presbyterian Church, East Superior	265	.....	8	322
Presbyterian schoolhouse, Scotland	244	.....	1	.....
Proctorknott Ry. shops water tank	264	.....	8	322
Protestant Church, Rice	263	.....	6	.....
Rabbit	242	296	7	321
Radium:				
East elevator	258	.....	10	324
Tall elevator	258	.....	10	324
West elevator	258	.....	10	324
Rae	242	297	7	321
Rail	242	295	6	321
Railroad shops, Brainerd	263	.....	6, 7	322
Railway shops water tank, Proctorknott	264	.....	8	322
Railway water tank, Wendell	252	.....	5	.....
Ramona:				
Elevator	248	.....	3	319
Low dome	248	.....	3	319
White spire	247	.....	3	319
Reese	237	272	2	319
Reference mark, Farmer	246	305	2	.....
Rice:				
Catholic Church	263	.....	6	321
Protestant Church	263	.....	6	.....
Rich Prairie Catholic Church	263	.....	6	321
Rindal church spire	256	.....	10	323
Riverton	239	282	9	322
Rollag church spire	254	.....	9	323
Roon elevator	258	.....	10	324
Roswell church spire	247	.....	2	319
Round church spire	248	.....	3	320
Royalton M. R. C.	263	308	6	321

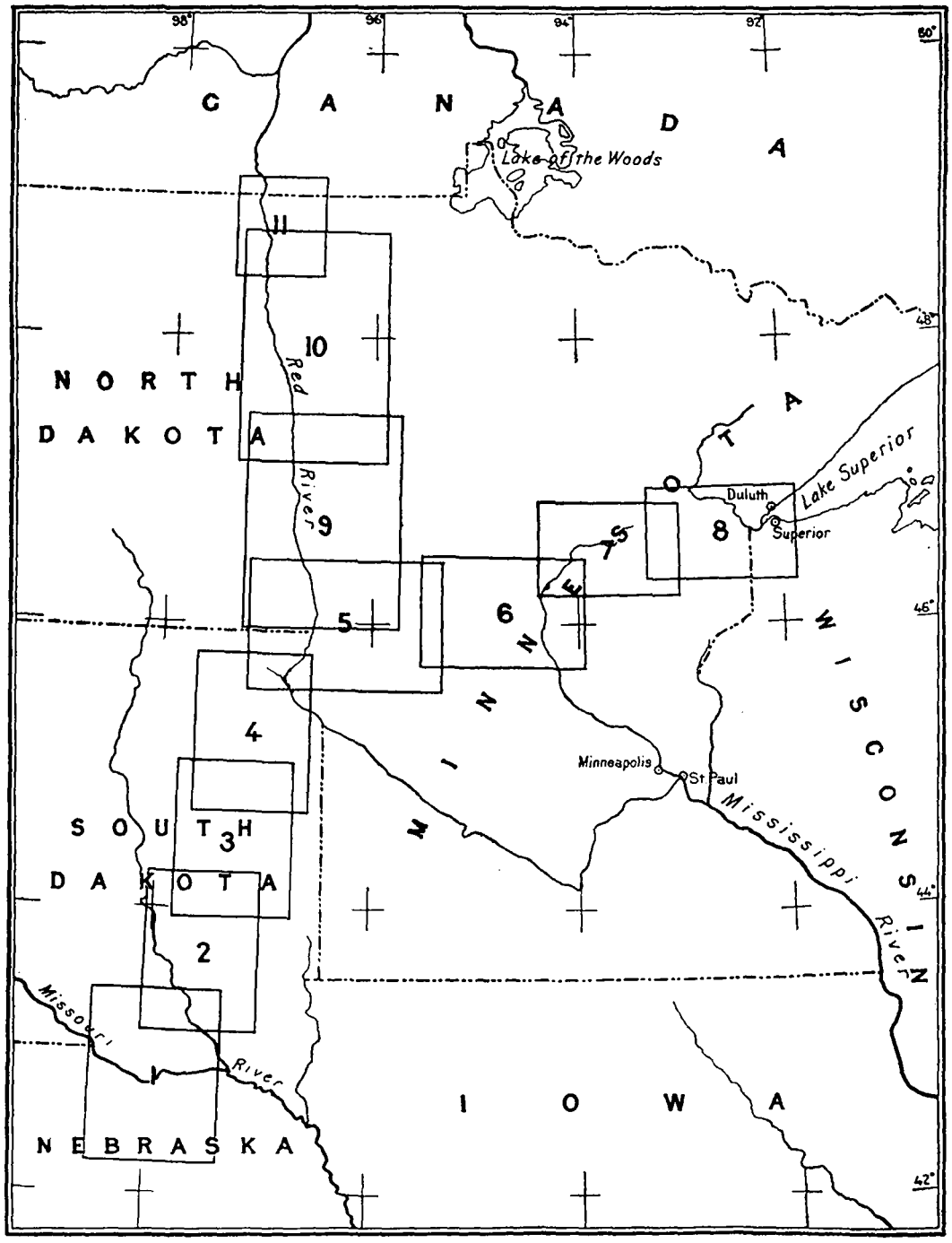
Index to positions, descriptions, sketches, and elevations—Continued.

Index to positions, descriptions, sketches, and elevations—Continued.

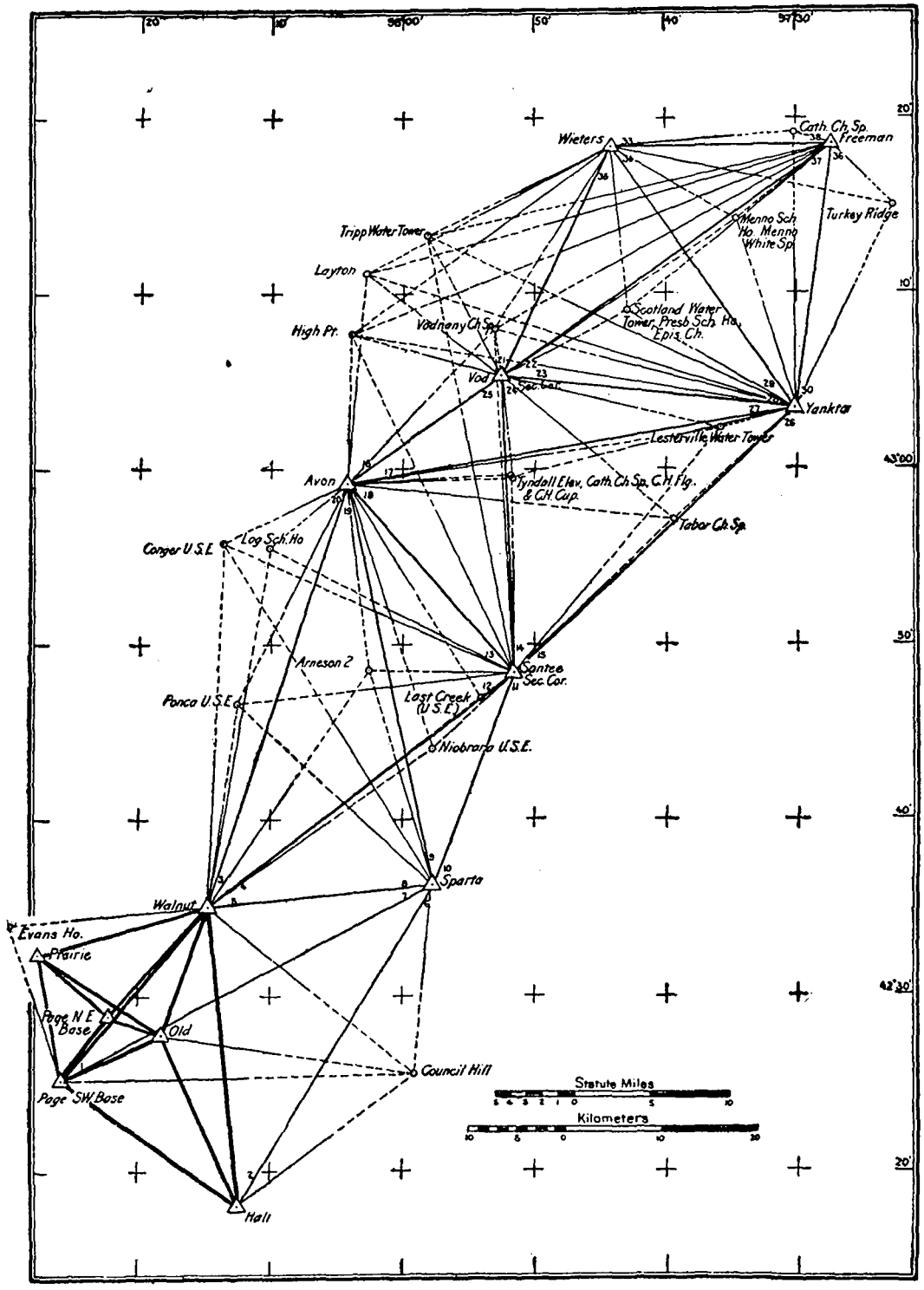
Index to positions, descriptions, sketches, and elevations—Continued.

Index to positions, descriptions, sketches, and elevations—Continued.

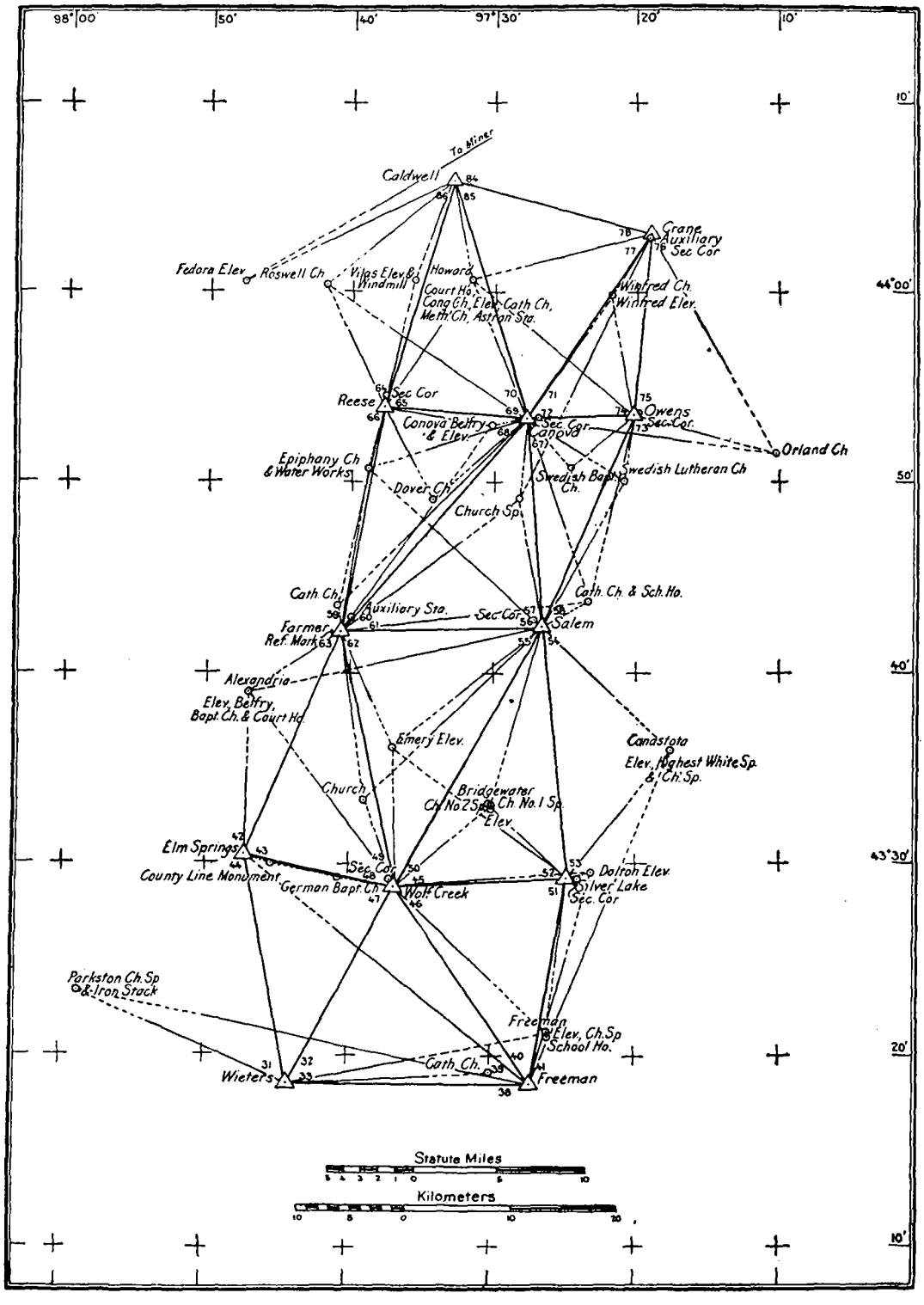
Index to positions, descriptions, sketches, and elevations—Continued.



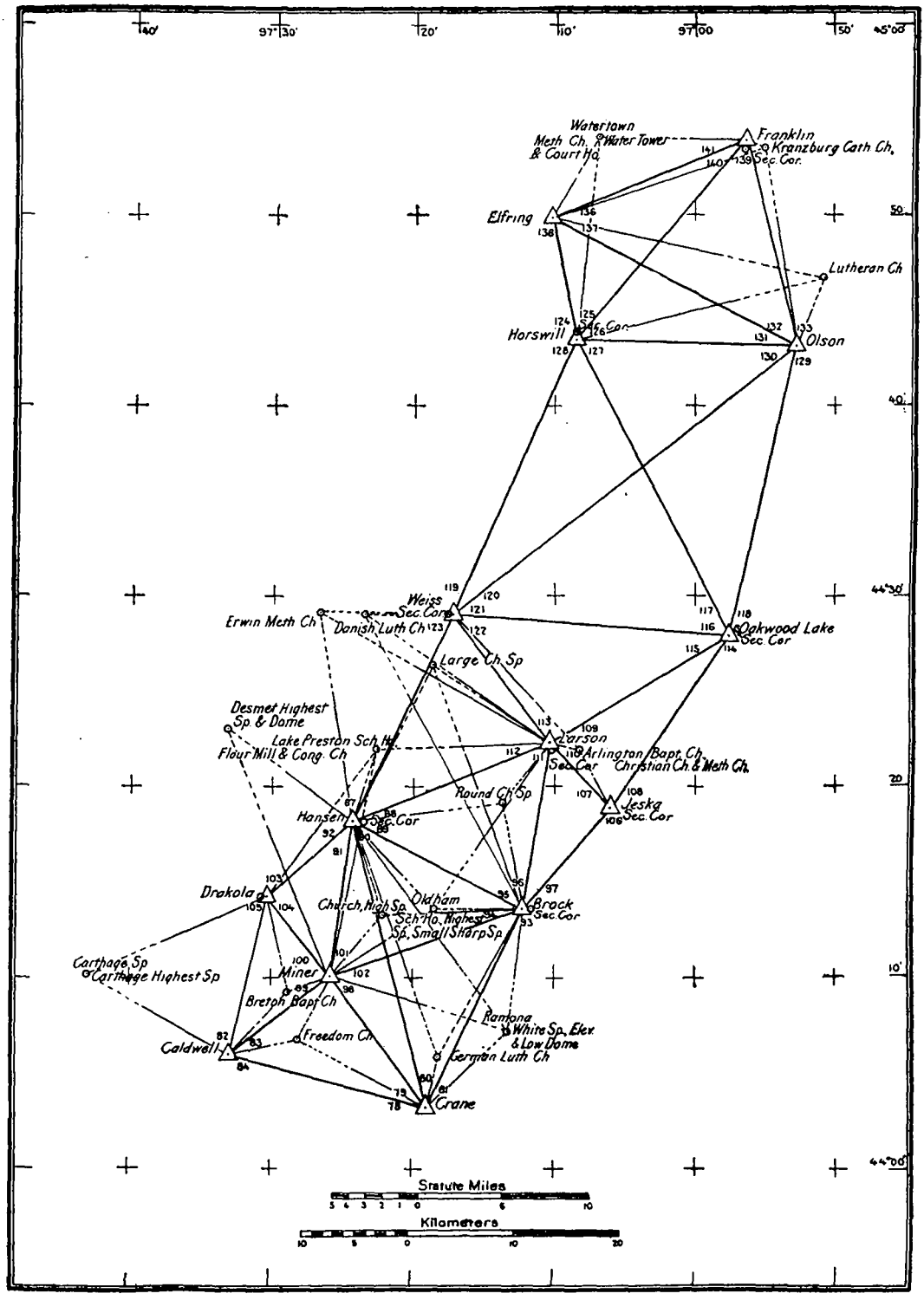
INDEX MAP TO TRIANGULATION SKETCHES.



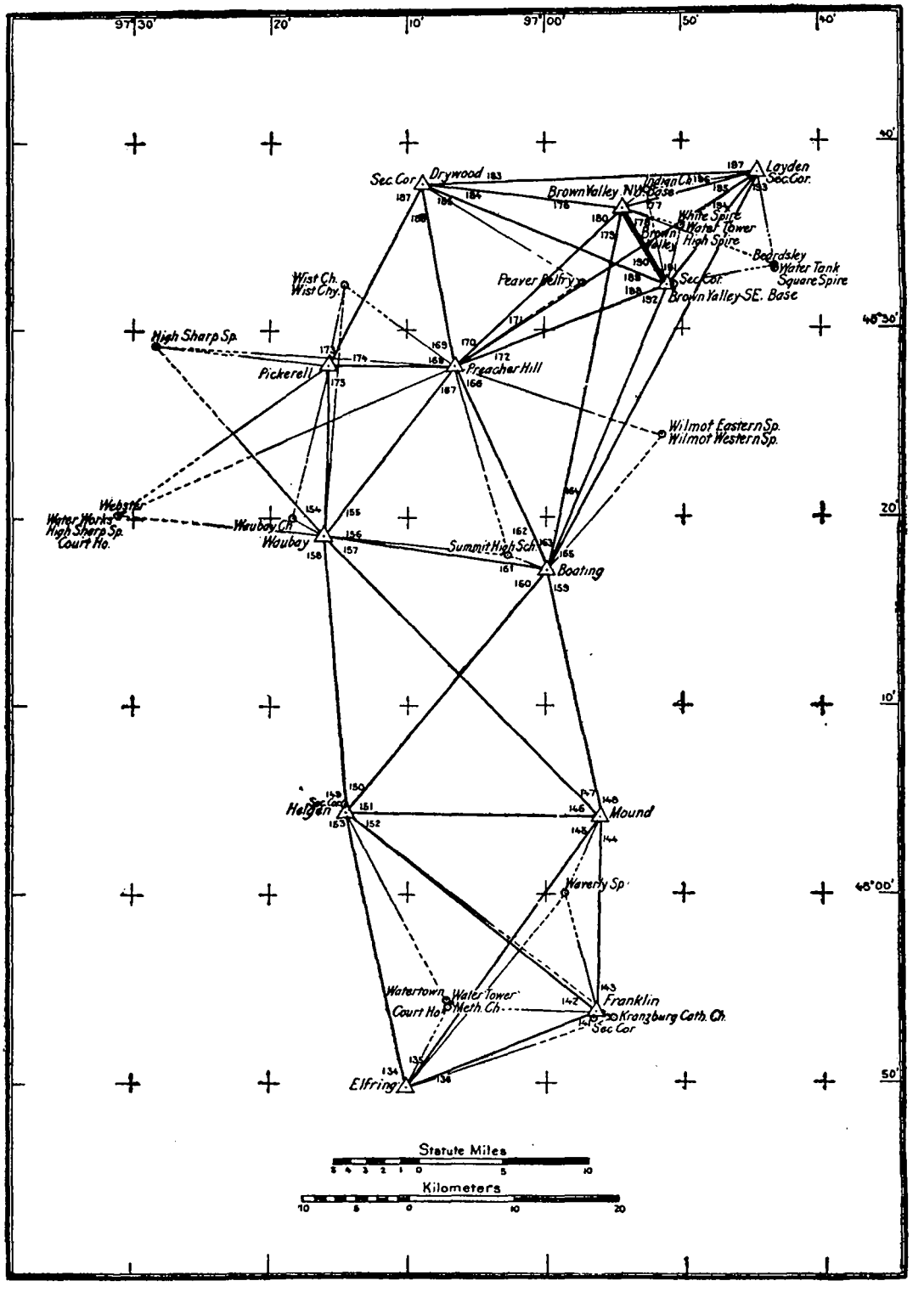
PAGE BASE TO FREEMAN-WIETERS.



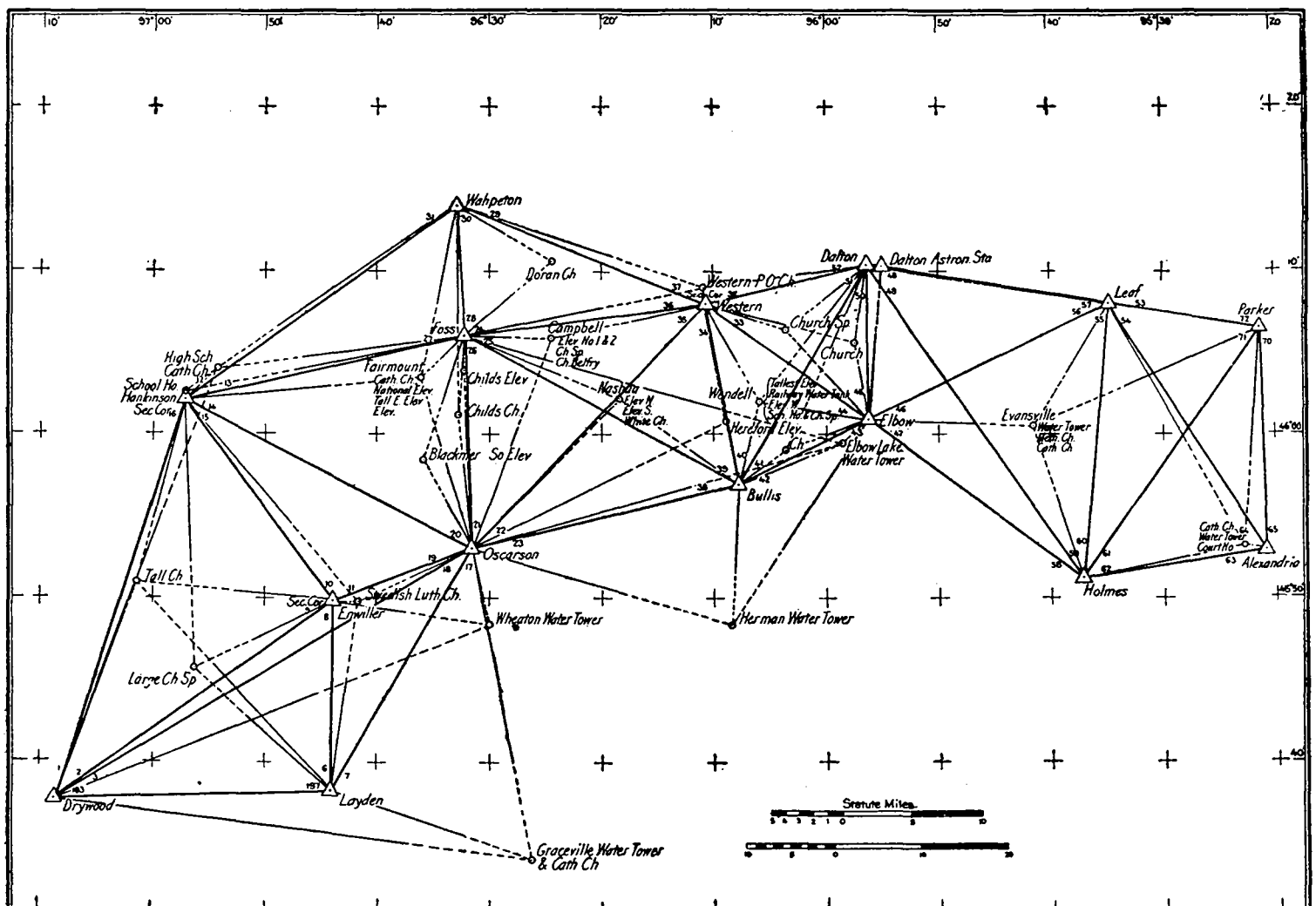
WIETERS-FREEMAN TO CRANE-CALDWELL.



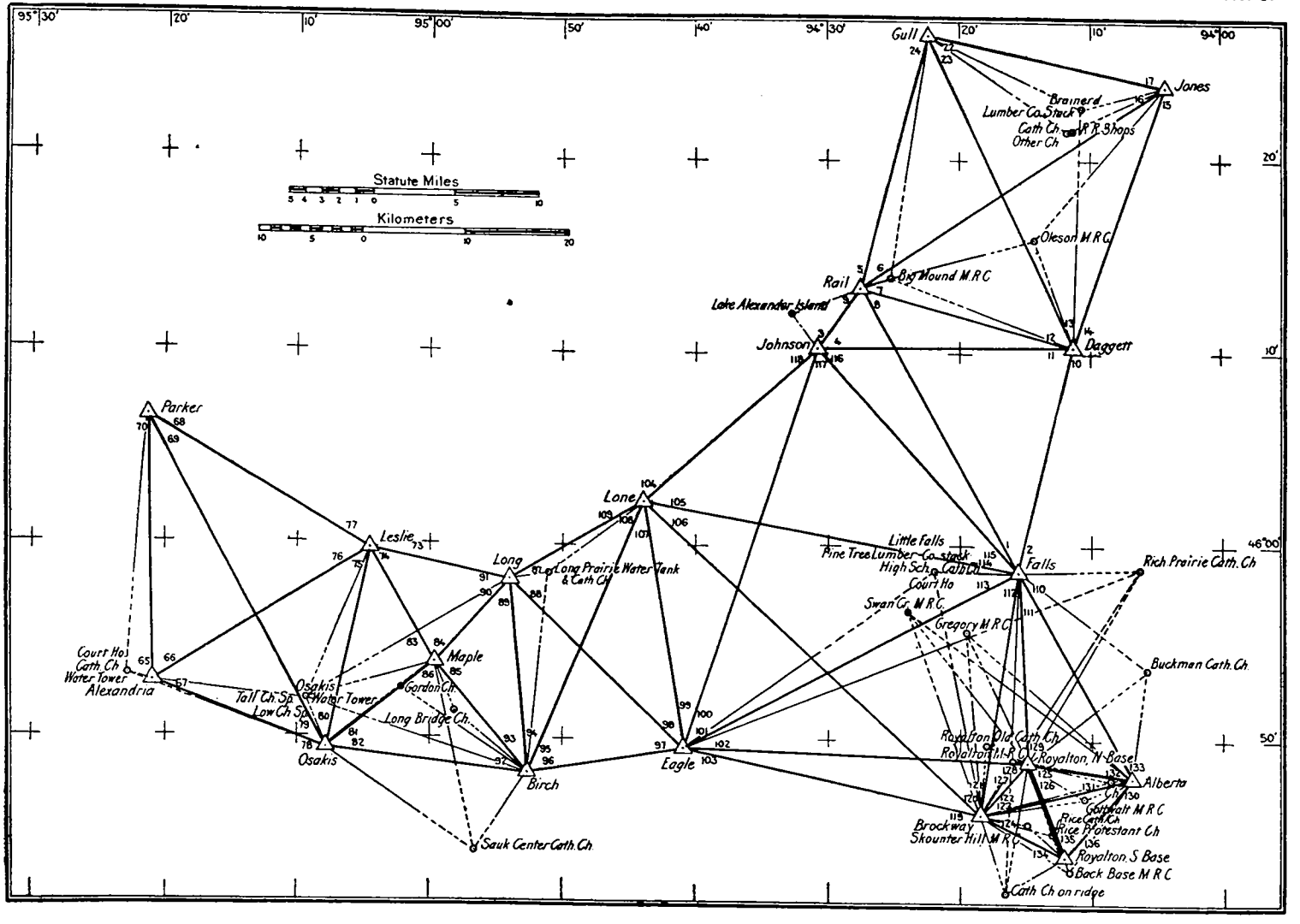
CRANE-CALDWELL TO FRANKLIN-ELFRING.



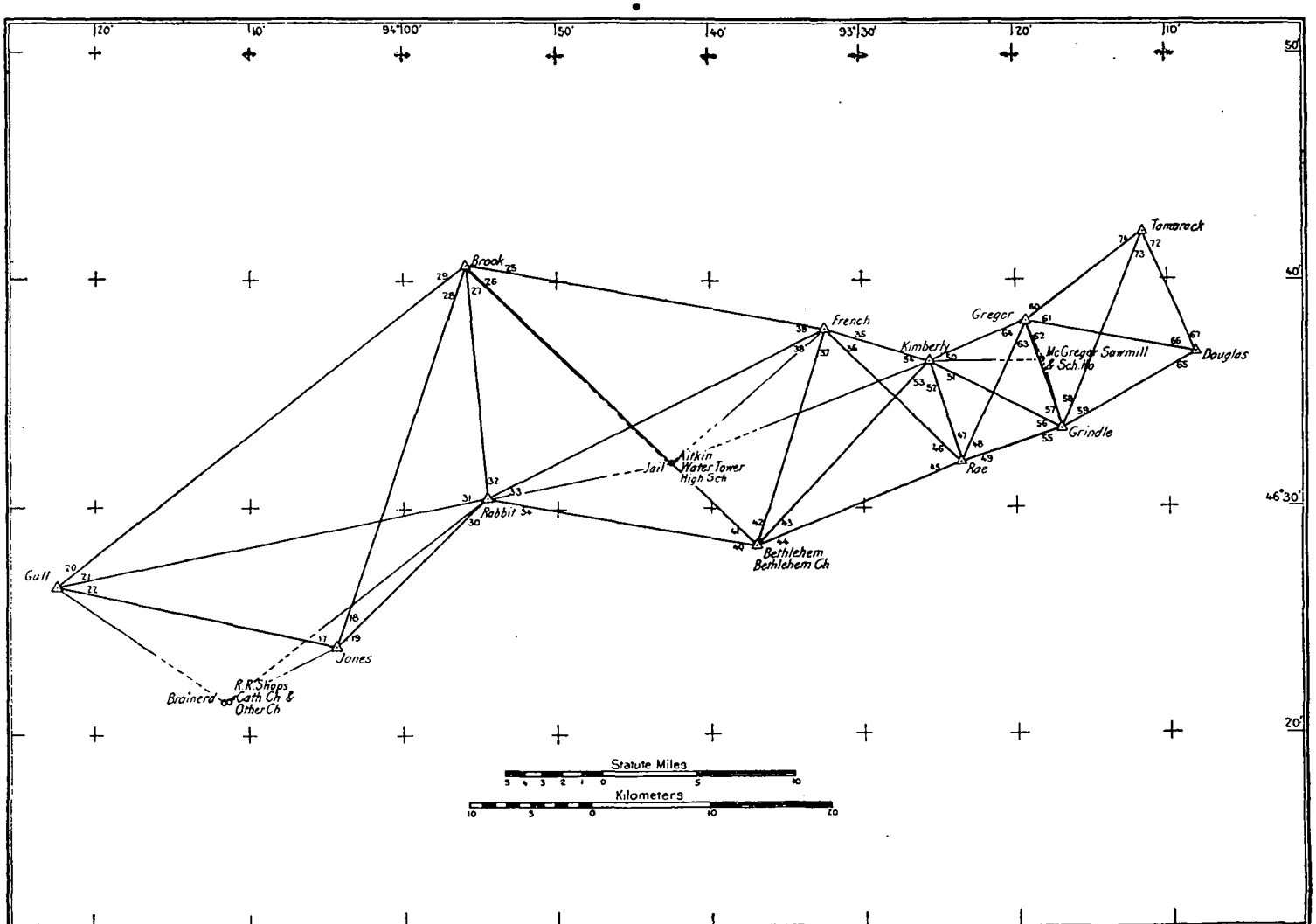
FRANKLIN-ELFRING TO BROWN VALLEY.



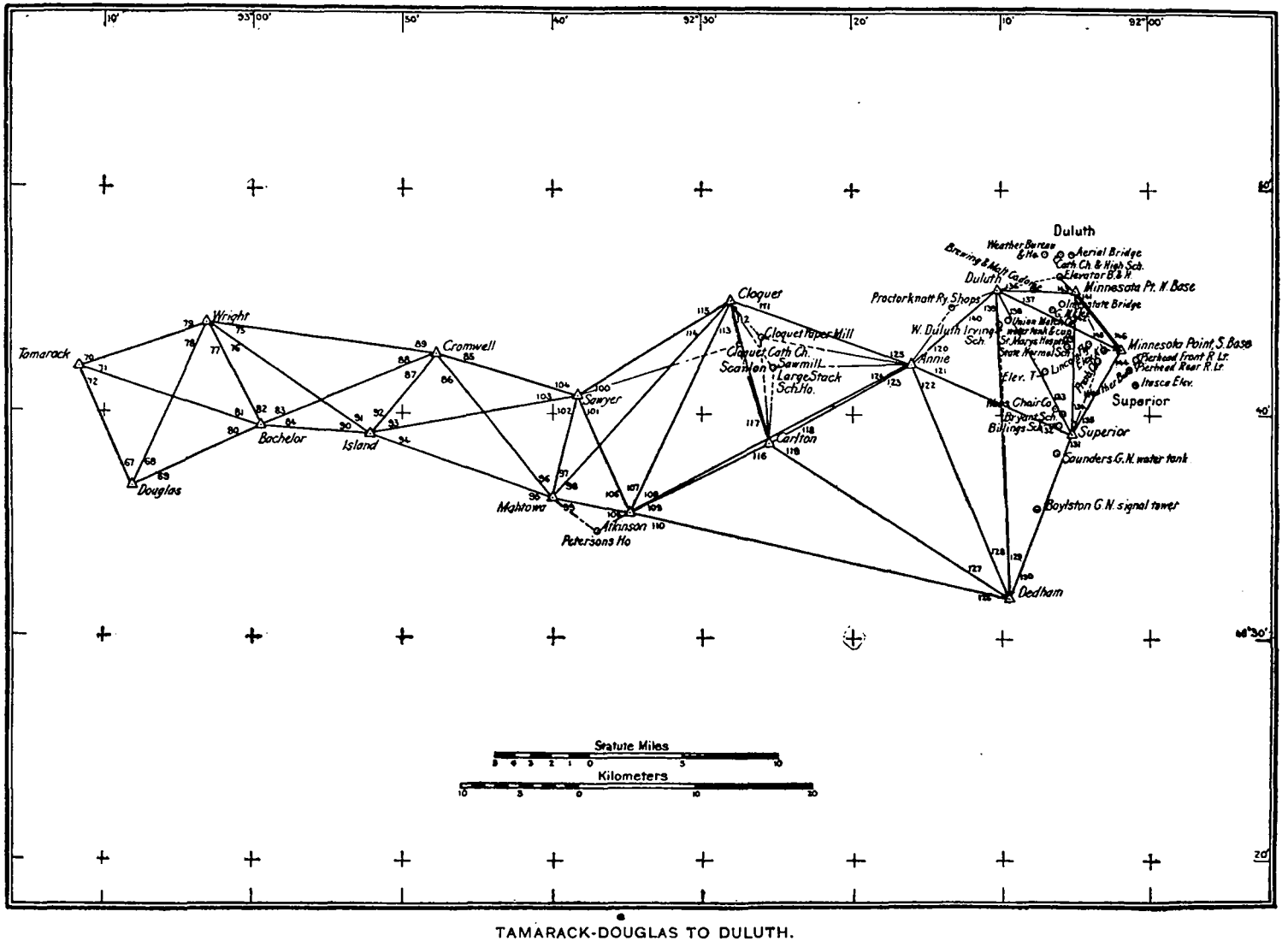
BROWN VALLEY TO ALEXANDRIA-PARKER.



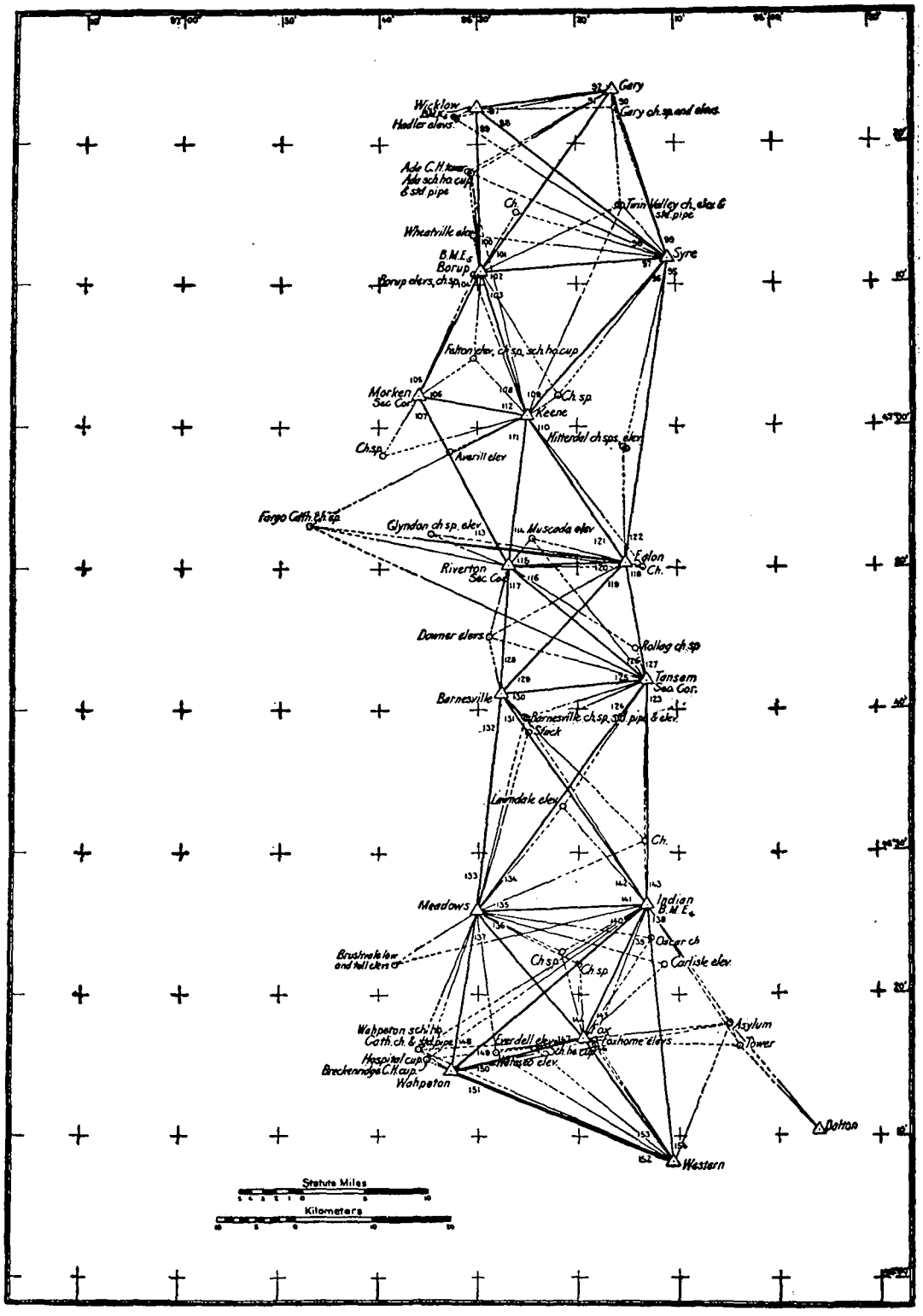
ALEXANDRIA-PARKER TO GULL- ONES.



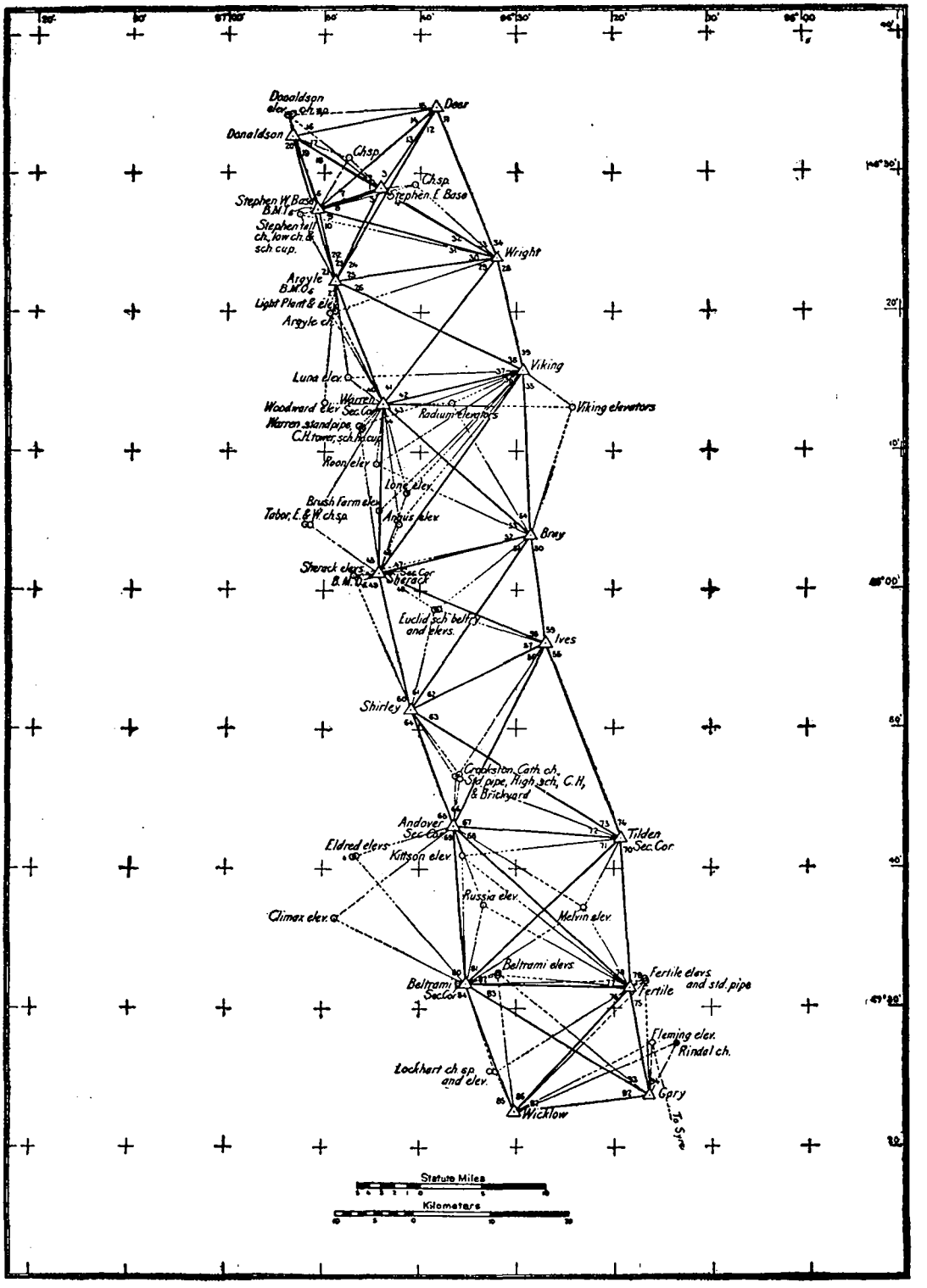
GULL-JONES TO TAMARACK-DOUGLAS.



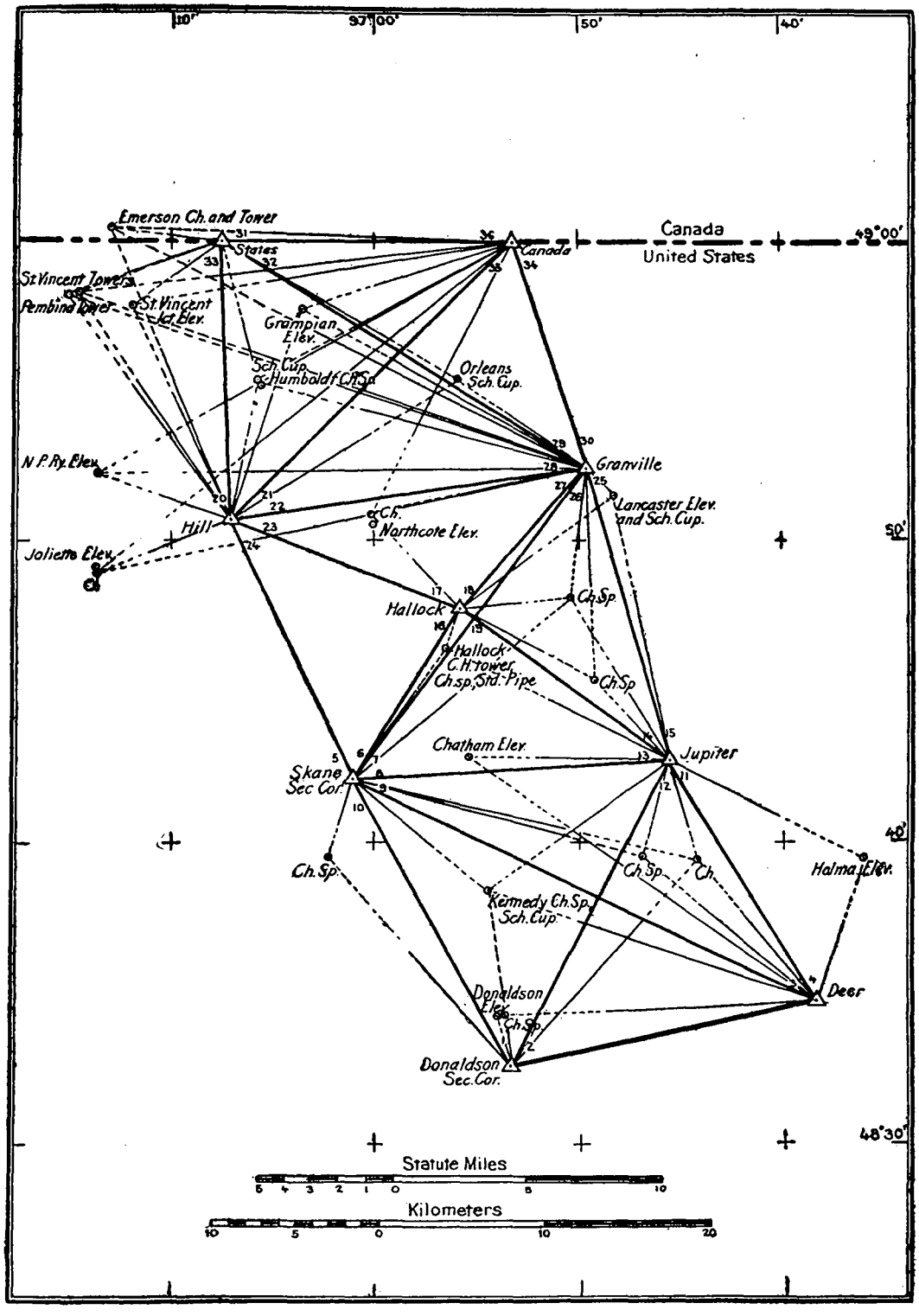
TAMARACK-DOUGLAS TO DULUTH.



FERGUS FALLS TO WICKLOW-GARY.



WICKLOW-GARY TO STEPHEN.



STEPHEN TO UNITED STATES-CANADA BOUNDARY.

APPENDIX 5

REPORT 1911

TRIANGULATION ALONG THE NINETY-EIGHTH MERIDIAN, SEGUIN TO POINT ISABEL, TEX.

By

A. L. BALDWIN

Computer, Coast and Geodetic Survey

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ILLUSTRATIONS.

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TRIANGULATION ALONG THE NINETY-EIGHTH MERIDIAN, SEGUIN TO POINT ISABEL, TEX.

By A. L. BALDWIN,
Computer, Coast and Geodetic Survey.

GENERAL STATEMENT.

During November and December, 1904, and January, 1905, a triangulation party under the direction of Mr. W. H. Burger, assistant, extended the primary triangulation along the ninety-eighth meridian from the line Serita–Stockdale, on which the triangulation of the preceding winter had closed, to the Alice base line. The line Serita–Stockdale is the southern limit of the first figure to the southward of the Seguin base net.

During October and November, 1905, a similar party under the direction of Mr. Harold D. King, assistant, connected the line Elliff–Nolan of the triangulation of 1904–5 with the Laguna Madre base line on the Gulf of Mexico. The line Elliff–Nolan comprises one side of the third figure north of the Alice base line. This section of the triangulation is almost at right angles to the ninety-eighth meridian, and was determined upon after an examination had been made of the coast triangulation, which is less than half a degree to the eastward and parallel to the triangulation proposed along the meridian. This coast triangulation extends nearly south from the Laguna Madre base line to Point Isabel, a distance of about 180 kilometers (112 miles). It consists of 15 quadrilaterals, and all the observations were made by Mr. R. E. Halter, assistant, in the years 1877 to 1880. Although scarcely more than tertiary in the character of the observations, it is supplemented by an accurate base line at each end, and has a Laplace station at its southern extremity to control the azimuth. It was adjusted and the results are set forth in this appendix.

The Point Isabel base figure, comprising six stations, connects the Point Isabel base line with the line Fronton–Cameron of the coast triangulation. The observations were made by Mr. O. B. French, assistant, in March and April, 1906.

The length of the triangulation here discussed, measured along the ninety-eighth meridian, is 235 statute miles, and the number of primary stations occupied is 38.

The primary triangulation along this meridian was complete at the south end when the Point Isabel base net was finished, in April, 1906.

The results of the ninety-eighth meridian triangulation from the vicinity of the Page base in the northern part of Nebraska to the junction with the portion published

in this appendix, have already been published,[1] and Appendix 4 of this report contains the results of the triangulation between the Page base and the Canada boundary.

The engineer who wants only the necessary information to enable him to extend this triangulation, or to base other surveys upon it, will find the information he desires in the latter part of this appendix, commencing with the explanation of the tables of positions, lengths, and azimuths. The index printed at the end of the appendix, used in connection with the sketches, will enable him to find quickly the data he desires for any given locality.

The progress made in the primary triangulation in the season of 1903–4 in Texas, which was commented upon [2] as being up to that time probably the most rapidly and economically executed triangulation of that grade of accuracy, appears to be exceeded in economy and closely approached in speed of execution by the primary triangulation reported upon in this appendix. This redounds to the credit of the three officers who executed the triangulation.

The reconnoissance for the primary scheme, beginning with the line Serita–Stockdale and extending to the Alice base, with the connection to the Laguna Madre base, was executed in two short seasons, September 20 to November 4, 1904, and December 26, 1904, to January 12, 1905, by Signalman Jasper S. Bilby. On this reconnoissance he traveled alone by means of a light one-horse buggy, and carried a small outfit.

The field organization for the season 1904–5 consisted, in addition to the reconnoissance party, of a building party, one observing party, and four light keepers. The building party, consisting of a foreman and three hands under the direction of Mr. Bilby, erected the observing towers in advance of the observing party and marked the stations in a permanent manner. The observing party consisted of an observer, who was also the chief of party, a foreman, hand, and cook.

The signals used in all the primary triangulation on this southern portion of the ninety-eighth meridian were identical with those used in 1902 and described in Appendix 4 of the Report for 1903.

The instrument used by both Mr. Burger and Mr. King was theodolite No. 145, a direction instrument with a horizontal circle 12 inches in diameter.[3] All pointings for horizontal angles were made by using two parallel vertical lines about 20″ apart in the diaphragm of the telescope. The arrangement of the pointing lines in the micrometer microscopes and the method of making the pointings are the same as described on pages 248–249 of Appendix 5, Report for 1905.

The four light keepers were directed by letter and by code signals sent in a modified Morse alphabet, using the lamps and heliotropes in signaling.

The general instructions issued to the chiefs of the observing parties are published in Appendix 4 of this report. All the primary observations were made in accordance with these general instructions.

The field organization for the season 1905 was similar to that for the season 1904–5, except that the building party completed the erection of signals before the observing

[1] See Appendix 3, Report for 1901, On the measurement of nine bases along the ninety-eighth meridian; Appendix 6, Report for 1901, Triangulation northward along the ninety-eighth meridian in Kansas and Nebraska; Appendix 3, Report for 1902, Triangulation in Kansas; Appendix 4, Report for 1903, Triangulation southward along the ninety-eighth meridian in 1902; Appendix 5, Report for 1905, Triangulation along the ninety-eighth meridian, Lampasas to Seguin, Tex.; and Appendix 4, Report for 1907, The measurement of six primary base lines with steel and invar tapes.

[2] See p. 248, Appendix 5, Report for 1905.

[3] See Appendix 8, Report for 1904.

was begun, and the observing party with Mr. Bilby as foreman had only a recorder, and its entire outfit was moved in one large farm wagon. The number of light keepers was five.

The notable feature of this season's work was the extent to which acetylene lamps were used. During the entire season heliotropes were used for two positions only and on only one primary horizontal direction.

The field organization for the season of 1906 was unique. Mr. O. B. French, assistant, was able, because of the length of the lines, to interrupt the base-line campaign on which he was entering and to occupy three of the six stations of the Point Isabel base figure from one camp. The observations were made on lights almost entirely. At only one station were any daylight observations made. Six nights of observing completed the observations at the six stations.

PROGRAM OF OCCUPATION OF STATIONS.

In the following three tables the primary stations occupied during the several seasons are arranged in the order of their occupation. The second column of each table indicates the days on which horizontal observations on primary stations were taken, the third column the number of such days, and the fourth column the approximate height of the instrument above the ground.

Stations occupied.

Assistant W. H. BURGER, Chief of Party and Observer.

Station	Days on which observations of primary horizontal directions were made	Number of days	Height of instrument above ground
	1904.		*Meters*
Serita	Nov. 11	1	4.92
Stockdale	Nov. 12	1	14.08
Ruckman	Nov. 16–17	2	15.21
Karnes	Nov. 18, 23	2	9.37
Bryde	Nov. 28–30	3	9.37
Choate	Dec. 1–2, 5	3	3.46
Pettus	Dec. 6	1	9.34
Borroum	Dec. 8–9	2	9.48
Weiss	Dec. 12–13, 20	3	9.32
Beeville	Dec. 14, 16	2	15.47
Fleming	Dec. 17, 19	2	18.54
Miller	Dec. 22–23	2	15.32
O'Neill	Dec. 29, 31	2	15.76
	1905.		
Welder	Jan. 2–3	2	18.64
Skelly	Jan. 4–5	2	15.34
Mathis	Jan. 7, 9	2	15.44
Nolan	Jan. 10–11	2	18.58
Elliff	Jan. 13–14	2	18.74
Reynolds	Jan. 16, 17	2	15.27
Alice	Jan. 19–20	2	15.39
Wood	Jan. 21, 23	2	15.32
Alice east base	Jan. 24	1	9.37
Alice west base	Jan. 25	1	9.32

Stations occupied—Continued.

Assistant H. D. KING, Chief of Party and Observer, 1905.

Station	Days on which observations of primary horizontal directions were made	Number of days	Height of instrument above ground
			Meters
Elliff	Oct. 21	1	18.72
Nolan	Oct. 23	1	18.59
Kaleta	Oct. 24–25	2	18.43
Rogers	Oct. 26–27	2	18.46
Corpus	Oct. 28, 30	2	15.46
Portland	Nov. 1–4, 6	5	15.57
McGloins Bluff	Nov. 7–8	2	3.10
Mustang	Nov. 9–10, 13–14	4	5.15
Padre	Nov. 15	1	3.15
Laguna Madre north base	Nov. 17–18	2	15.31
Laguna Madre south base	Nov. 20, 22	2	15.38

Assistant O. B. FRENCH, Chief of Party and Observer, 1906.

Point Isabel west base	Mar. 29, Apr. 3	2	9.14
Point Isabel east base	Apr. 4	1	5.49
Point Isabel south base	Apr. 5	1	5.49
Cameron	Apr. 9	1	9.14
Fronton	Apr. 10	1	9.14
Arista	Apr. 11	1	5.49

STATEMENT OF ADJUSTMENTS.

No local adjustments were made, these having become unnecessary since the adoption of the present method of supplying missing observations in broken series.

The quadrilateral formed by the stations Lavernia–Thomas–Stockdale–Serita, the observations for which were made at the close of the season of 1903–4, forms a part of the first adjustment. The length and direction of the line Lavernia–Thomas had been fixed by the adjustment of the section of triangulation between the Lampasas base net and the Seguin base.[1]

The figure adjustments were made in three sections. The first section comprised the quadrilateral mentioned in the preceding paragraph together with all the triangulation of the seasons of 1904–5 and 1905 and served to connect the line Lavernia-Thomas of the Seguin base net with the Alice and the Laguna Madre base lines (see illustrations Nos. 1, 2, and 3); the second section comprised only the Point Isabel base net (see illustration No. 7); and the third section served to connect this base net with three points of the first section, including the ends of the Laguna Madre base line, and comprises the coast triangulation of the seasons 1877 to 1880. (See illustrations Nos. 4, 5, and 6.)

The lengths of the Alice and Laguna Madre base lines had been fixed by base measurement. The length published for the Alice base, as reduced to sea level on the supposition that the elevation of Alice east base above mean sea level was 60 meters, is 6 971.688 meters.[2] The assumed elevation, 60 meters, was the best that was available

[1] See Appendix 5, Report for 1905, p. 252.

[2] See Appendix 3, Report for 1901, pp. 282–283.

for Alice east base at the time the report upon the base measurements was published. When the triangulation was completed to the Gulf in 1905, the adjustment of the vertical observations determined the elevation of this point to be 42.31 meters. This decreased the computed reduction to sea level by 0.0196 meter, and made the reduced length of the base line 6 971.7076 meters.

The length of the Laguna Madre base was determined by measurements made by a party under the direction of Mr. R. E. Halter, assistant, in April, 1882, using the 4-meter secondary contact-slide steel bars, designated as bars Nos. 5 and 6. A measure in each direction was made with this apparatus; the first measure gave 5 486.869 meters and the second measure 5 486.841 meters. A mean of the two measures, 5 486.855 meters, was adopted as the length of the base. No sea-level correction was applied, as the mean elevation of the line was approximately only 2 meters above mean sea level.

In this first adjustment the direction and length of the line Lavernia–Thomas, the length of the Alice base, the length of the Laguna Madre base, and the direction of the line Alice–Wood were held fixed. Station Alice is a Laplace point, the geodetic station having been occupied as an astronomical longitude and azimuth station. The Laplace azimuth [1] of the line Alice–Wood was computed and held fixed at 276° 47′ 23″.79.

A Laplace azimuth [1] (also called a true geodetic azimuth) as used in this publication is one computed at a station of the triangulation from coincident longitude and azimuth observations, using the Laplace equation: (Astronomic azimuth − Laplace azimuth) + sine of latitude (astronomic longitude − geodetic longitude) = zero.

In the following condition equations the numbers assigned to the directions correspond to those shown in illustrations Nos. 1 to 7. The number of a direction inclosed in parentheses, thus (1), means the required correction to that direction. In each set of condition equations, those which refer to closures of triangles are given first, the azimuth equation next, then the equations which refer to ratios of sides, and the length equations last. In the solution of the normal equations, however, the azimuth equation was assigned a place immediately preceding the length equation. (See p. 371.) In the side and length equations the absolute term is expressed in units of the sixth decimal place of logarithms.

The work of making the difficult least square adjustments was done by Mr. M. H. Doolittle and Mr. E. H. Bowen.

CONDITION EQUATIONS.

SEGUIN BASE NET TO ALICE BASE AND LAGUNA MADRE BASE.

1. $0 = +1.03 - (1) + (3) - (13) + (14)$
2. $0 = +1.50 - (2) + (4) - (5) + (6)$
3. $0 = +0.05 - (1) + (2) - (6) + (7) - (12) + (14)$
4. $0 = +0.28 - (7) + (9) - (11) + (12) - (20) + (21)$
5. $0 = -0.51 - (7) + (8) - (10) + (12) - (18) + (19)$
6. $0 = -0.80 - (8) + (9) - (17) + (18) - (20) + (22)$
7. $0 = -2.80 - (15) + (17) - (22) + (23) - (33) + (34)$
8. $0 = +0.53 - (16) + (17) - (22) + (24) - (25) + (26)$
9. $0 = -0.08 - (15) + (16) - (26) + (27) - (32) + (34)$
10. $0 = +0.27 - (27) + (28) - (31) + (32) - (37) + (38)$

[1] See pp. 17–18 of the Investigation in 1909 of the Figure of the Earth and Isostasy.

11. $o = -0.47 - (28) + (29) - (36) + (37) - (39) + (40)$
12. $o = -2.07 - (30) + (31) + (35) - (38) - (47) + (48)$
13. $o = +0.86 - (35) + (36) - (40) + (41) - (46) + (47)$
14. $o = -1.14 - (41) + (43) - (45) + (46) - (54) + (55)$
15. $o = +1.99 - (41) + (42) - (44) + (46) - (52) + (53)$
16. $o = +0.11 - (42) + (43) - (51) + (52) - (54) + (56)$
17. $o = +1.17 - (50) + (51) - (56) + (58) - (59) + (60)$
18. $o = +0.17 - (49) + (51) - (56) + (57) - (67) + (68)$
19. $o = +1.76 - (49) + (50) - (60) + (61) - (66) + (68)$
20. $o = -0.86 - (61) + (62) - (64) + (66) - (72) + (73)$
21. $o = -0.52 - (64) + (65) - (71) + (73) - (75) + (76)$
22. $o = -1.37 - (62) + (63) - (71) + (72) - (74) + (76)$
23. $o = +0.31 - (70) + (71) - (76) + (78) - (79) + (80)$
24. $o = +2.27 - (69) + (70) - (80) + (81) - (86) + (88)$
25. $o = +1.03 - (77) + (78) - (79) + (81) - (86) + (87)$
26. $o = 0.00 - (81) + (82) - (84) + (86) - (92) + (93)$
27. $o = +0.74 - (84) + (85) - (91) + (93) - (95) + (96)$
28. $o = -0.36 - (82) + (83) - (91) + (92) - (94) + (96)$
29. $o = +0.21 - (89) + (91) - (96) + (97) - (107) + (108)$
30. $o = +0.46 - (97) + (98) - (99) + (101) - (106) + (107)$
31. $o = +1.04 - (89) + (90) - (100) + (101) - (106) + (108)$
32. $o = -1.23 - (101) + (103) - (105) + (106) - (112) + (113)$
33. $o = -0.14 - (102) + (103) - (109) + (110) - (112) + (114)$
34. $o = -0.20 - (104) + (105) - (109) + (111) - (113) + (114)$
35. $o = +0.59 + (84) - (93) - (115) + (117) - (127) + (128)$
36. $o = -0.84 - (115) + (116) - (120) + (121) - (126) + (128)$
37. $o = +0.78 - (117) + (118) - (119) + (121) - (126) + (127)$
38. $o = -0.01 - (121) + (122) - (124) + (126) - (133) + (134)$
39. $o = -0.50 - (122) + (123) - (132) + (133) - (135) + (137)$
40. $o = -0.62 - (124) + (125) - (132) + (134) - (136) + (137)$
41. $o = -2.11 - (138) + (139) - (142) + (145) - (150) + (152)$
42. $o = +1.86 - (129) + (132) - (137) + (138) - (145) + (146)$
43. $o = +0.57 - (130) + (132) - (137) + (139) - (150) + (151)$
44. $o = -0.94 - (138) + (140) - (144) + (145) - (153) + (155)$
45. $o = -0.18 - (142) + (144) - (149) + (152) - (155) + (156)$
46. $o = +2.23 - (130) + (131) - (149) + (151) - (154) + (156)$
47. $o = +0.58 - (140) + (141) + (153) - (158) - (159) + (160)$
48. $o = +0.97 - (139) + (141) - (148) + (150) - (159) + (161)$
49. $o = 0.00 - (157) + (158) - (160) + (162) - (163) + (164)$
50. $o = -0.65 - (147) + (149) - (156) + (157) - (164) + (166)$
51. $o = +0.44 - (142) + (143) - (147) + (152) - (165) + (166)$
52(α). $o = +1.66 + (4) - (5) + (9) - (20) + (24) - (25) + (29) - (39) + (43) - (54) + (58) - (59) + (63) - (74) + (78) - (79) + (83) - (94) + (98) - (99) + (101)$
53. $o = +2.5 - 1.30(1) + 4.52(2) - 1.92(5) + 2.32(6) - 0.40(7) - 2.33(12) + 3.20(13) - 0.87(14)$
54. $o = +8.8 - 1.67(7) + 1.99(8) - 0.32(9) + 0.21(17) + 4.35(18) - 4.56(19) - 4.20(20) + 6.05(21) - 1.85(22)$
55. $o = +11.7 - 1.87(15) + 5.67(16) - 3.80(17) - 3.84(25) + 3.00(26) + 0.84(27) - 3.44(32) + 5.63(33) - 2.19(34)$
56. $o = -6.7 - 3.01(27) + 5.02(28) - 2.01(29) - 2.62(30) + 3.86(31) - 1.24(32) - 0.84(39) + 3.27(40) - 2.43(41) - 2.54(46) + 5.99(47) - 3.45(48)$
57. $o = -1.8 - 3.17(41) + 5.86(42) - 2.69(43) - 2.79(44) + 2.61(45) + 0.18(46) - 0.12(54) + 3.09(55) + 2.97(56)$
58. $o = -3.8 - 3.90(49) + 2.78(50) + 1.12(51) - 3.23(56) + 7.81(57) - 4.58(58) + 0.46(59) + 1.17(60) - 1.63(62)$
59. $o = -0.1 - 0.11(64) + 2.88(65) - 2.77(66) - 3.81(71) + 7.27(72) - 3.46(73) - 3.36(74) + 2.74(75) + 0.62(76)$
60. $o = -0.8 - 0.21(69) - 2.29(70) - 2.08(71) - 3.08(79) + 1.72(80) + 1.36(81) - 4.05(86) + 6.68(87) - 2.63(88)$
61. $o = +7.9 + 0.85(84) + 1.00(85) - 1.85(86) - 1.83(91) + 6.00(92) - 4.17(93) - 3.04(94) + 2.96(95) + 0.08(96)$
62. $o = +2.5 - 5.26(89) + 5.76(90) - 0.50(91) - 1.65(96) + 4.87(97) - 3.22(98) - 0.94(99) + 4.02(100) - 3.08(101)$

63. o=−4.1−2.29(101)−6.16(102)−3.87(103)−3.64(104)+4.27(105)−0.63(106)+0.45(112)+2.52(113)
−2.95(114)

64. o=+3.9+2.16(84)+0.12(93)+2.89(115)−5.05(116)−3.10(117)+2.98(118)+2.31(126)−2.35(127)
+0.04(128)

65. o=−2.1+2.97(121)−8.76(122)+5.79(123)+2.52(124)−3.02(125)+0.50(126)+3.15(132)−7.09(133)
+3.94(134)+1.89(135)−2.33(136)+0.44(137)

66. o=−5.6+4.89(129)−4.72(130)−0.17(132)+2.27(137)−5.04(138)+2.77(139)+1.77(150)−5.59(151)
+3.82(152)

67. o=+6.1+2.66(137)−2.27(138)−0.39(140)−0.51(144)−2.30(145)+2.81(146)+3.53(153)−7.08(154)
+3.55(155)

68. o=−2.7+5.28(130)−7.12(131)+1.84(132)−0.39(137)−5.70(139)+6.09(140)+1.58(149)−2.25(150)
+0.67(151)

69. o=−3.7+6.65(142)−14.99(143)+8.34(144)+4.44(147)−2.23(149)−2.21(152)−1.68(155)−0.63(156)
+2.31(157)

70. o=+2.8+5.70(139)−14.32(140)+8.62(141)+6.74(148)−8.99(149)+2.25(150)+1.51(159)−4.98(160)
+3.47(161)

71. o=−2.4+4.32(147)−11.06(148)+6.74(149)−1.86(156)−1.32(157)+3.18(158)+2.75(163)−2.00(164)
−0.75(166)

72. o=+1.1−1.93(84)+1.93(85)−0.50(89)+0.50(91)+0.12(93)+1.38(95)−1.38(96)−3.22(97)+3.22(98)
+0.94(99)−0.94(101)−3.87(102)+3.87(103)−0.63(104)+0.63(106)+1.67(107)−1.67(108)
+1.02(110)−1.02(111)−0.43(112)+0.43(114)+2.89(115)−2.89(116)−0.12(118)−1.83(119)
+1.83(120)+1.46(121)−1.46(123)+2.52(124)−2.52(125)−0.04(126)+0.04(128)−0.17(129)
−0.95(132)+1.12(134)−1.89(135)+1.89(136)+1.34(138)−1.34(140)+3.40(142)−3.40(144)
−2.30(145)+2.30(146)+2.23(147)−2.12(149)−0.11(152)−1.15(153)+1.15(155)−0.54(160)
+0.54(162)+2.00(163)−3.06(164)+1.06(166)

73. o=−3.9−1.30(1)−1.28(3)+1.28(4)+0.40(5)−0.72(7)+0.32(9)−2.94(10)+2.94(11)+0.87(13)
−0.87(14)−1.87(15)+1.66(17)+0.21(19)+4.20(20)−4.20(21)−2.81(23)+2.81(24)−0.84(25)
+0.84(27)−2.01(28)+2.01(29)−1.24(31)+1.24(32)+2.19(33)−2.19(34)+0.35(35)−0.35(36)
+0.17(37)−0.17(38)+0.84(39)−0.84(40)−0.70(41)+0.70(43)−2.61(44)+2.61(45)+2.54(46)
−2.54(47)−2.78(49)+2.78(50)−0.64(51)+0.64(53)+1.62(54)−1.62(55)−1.33(56)+1.33(58)
+2.39(59)−2.39(60)+0.61(61)−0.61(63)−1.72(64)+1.72(65)+0.30(66)−0.30(68)−2.36(69)
+2.36(70)+1.20(71)−1.20(73)+2.74(74)−2.74(75)−0.12(76)+0.12(78)+1.72(79)−1.72(80)
−0.37(81)+0.37(83)−1.93(84)+1.93(85)+0.93(86)−0.93(88)−0.50(89)+1.03(91)−0.53(93)
+2.96(94)−2.96(95)−3.22(97)+3.22(98)+0.94(99)−0.94(100)−3.87(101)+3.87(102)−0.63(104)
+0.63(106)+1.67(107)−1.67(108)+1.02(110)−1.02(111)−0.43(112)+0.43(113).

POINT ISABEL BASE NET.

1. o=+0.13−(12)+(15)−(16)+(18)−(28)+(29)
2. o=+0.03−(18)+(19)−(22)+(24)−(26)+(28)
3. o=+0.21−(13)+(15)−(16)+(19)−(22)+(23)
4. o=+0.41−(7)+(10)−(11)+(13)−(23)+(25)
5. o=+1.11−(7)+(9)−(17)+(19)−(22)+(25)
6. o=+0.13−(8)+(10)−(11)+(12)−(29)+(30)
7. o=+0.23−(1)+(5)−(6)+(9)−(17)+(20)
8. o=−1.27−(3)+(4)−(21)+(24)−(26)+(27)
9. o=−0.21−(3)+(5)−(6)+(8)+(27)−(30)
10. o=−1.46−(2)+(4)−(13)+(14)−(21)+(23)
11. o=+4.1+9.64(12)−12.26(13)+2.62(15)−0.71(16)−5.84(18)+6.55(19)+1.55(26)−0.62(28)−0.93(29)
12. o=+19.5+6.66(7)−15.26(8)+8.60(9)+13.96(17)−19.80(18)+5.84(19)+0.13(22)−3.28(24)+3.15(25)
13. o=+10.5+6.66(7)−8.91(8)+2.25(10)+5.96(11)−15.60(12)+9.64(13)+1.54(23)−4.69(24)+3.15(25)
14. o=+3.2+3.21(1)−15.35(3)+12.14(5)+3.69(6)−12.29(8)+8.60(9)+13.96(17)+14.15(18)+0.19(20)
15. o=+2.93+4.49(3)−6.17(4)+1.68(5)+0.98(6)−1.65(7)+0.67(8)−0.84(26)+1.01(27)−0.17(30)
16. o=+4.68−5.31(1)+5.54(2)−0.23(5)−0.22(6)+0.60(9)−0.38(10)−0.07(11)+2.85(14)−2.78(15)

LAGUNA MADRE BASE TO POINT ISABEL BASE NET.

1. $o = -6.71 + (1) - (3) - (4) + (6) - (21) + (22)$
2. $o = -1.41 - (5) + (6) - (8) + (10) - (21) + (23)$
3. $o = -3.38 - (2) + (3) - (8) + (11) - (22) + (23)$
4. $o = +3.80 - (5) + (7) - (9) + (10) - (13) + (14)$
5. $o = +5.18 - (6) + (7) - (13) + (15) - (20) + (21)$
6. $o = +1.88 - (15) + (17) - (19) + (20) - (24) + (25)$
7. $o = -1.27 - (16) + (17) - (24) + (26) - (31) + (32)$
8. $o = -3.61 - (15) + (16) - (18) + (20) - (32) + (33)$
9. $o = +1.87 - (26) + (27) - (29) + (31) - (42) + (43)$
10. $o = -2.29 - (26) + (28) - (30) + (31) - (34) + (35)$
11. $o = -0.54 - (27) + (28) - (34) + (36) - (41) + (42)$
12. $o = +5.80 - (36) + (38) - (40) + (41) - (44) + (45)$
13. $o = +0.06 - (37) + (38) - (44) + (46) - (51) + (52)$
14. $o = +9.98 - (36) + (37) - (39) + (41) - (52) + (53)$
15. $o = +3.35 - (46) + (48) - (50) + (51) - (54) + (55)$
16. $o = -2.69 - (47) + (48) - (54) + (56) - (61) + (62)$
17. $o = +2.17 - (46) + (47) - (49) + (51) - (62) + (63)$
18. $o = -1.46 - (56) + (58) - (60) + (61) - (64) + (65)$
19. $o = +3.69 - (57) + (58) - (64) + (66) - (71) + (72)$
20. $o = +1.01 - (56) + (57) - (59) + (61) - (72) + (73)$
21. $o = +0.33 - (66) + (67) - (69) + (71) - (82) + (83)$
22. $o = +2.01 - (66) + (68) - (70) + (71) - (74) + (75)$
23. $o = +0.26 - (69) + (70) - (75) + (76) - (81) + (83)$
24. $o = +3.39 - (76) + (77) - (79) + (81) - (92) + (93)$
25. $o = +2.06 - (76) + (78) - (80) + (81) - (84) + (85)$
26. $o = +0.60 - (77) + (78) - (91) + (92) - (84) + (86)$
27. $o = -7.74 - (86) + (88) - (90) + (91) - (94) + (95)$
28. $o = -0.76 - (89) + (90) - (95) + (96) - (101) + (103)$
29. $o = +4.69 - (86) + (87) - (89) + (91) - (102) + (103)$
30. $o = +5.83 - (96) + (97) - (99) + (101) - (112) + (113)$
31. $o = -1.16 - (96) + (98) - (100) + (101) - (104) + (105)$
32. $o = +1.35 - (99) + (100) - (105) + (106) - (111) + (113)$
33. $o = -11.43 - (106) + (108) - (110) + (111) - (114) + (115)$
34. $o = -4.69 - (107) + (108) - (114) + (116) - (121) + (122)$
35. $o = -14.41 - (106) + (107) - (109) + (111) - (122) + (123)$
36. $o = -4.36 - (116) + (118) - (120) + (121) - (124) + (125)$
37. $o = -1.07 - (119) + (120) - (125) + (126) - (131) + (133)$
38. $o = -1.60 - (116) + (117) - (119) + (121) - (132) + (133)$
39. $o = +2.37 - (126) + (128) - (130) + (131) - (134) + (135)$
40. $o = -3.61 - (129) + (130) - (135) + (136) - (142) + (144)$
41. $o = -9.68 - (126) + (127) - (129) + (131) - (143) + (144)$
42. $o = -6.12 - (136) + (139) - (141) + (142) - (145) + (146)$
43. $o = -0.70 - (140) + (141) - (146) + (147) - (150) + (152)$
44. $o = -5.85 - (136) + (137) - (140) + (142) - (151) + (152)$
45. $o = -0.54 - (138) + (139) - (145) + (148) - (153) + (154)$
46. $o = -0.09 - (147) + (148) - (149) + (150) - (153) + (155)$

(α) $o = -25.72 - (4) + (7) - (13) + (17) - (24) + (28) - (34) + (38) - (44) + (48) - (54) + (58) - (64) + (68) - (74) + (78) - (84) + (88) - (94) + (98) - (104) + (108) - (114) + (118) - (124) + (128) - (134) + (139) - (145) + (148)$

47. $o = -22.1 + 4.48(1) - 4.48(2) + 1.37(4) - 1.37(5) - 3.48(10) + 9.17(11) - 5.69(12)$
48. $o = +22.2 - 2.84(1) + 0.07(2) + 2.77(3) - 1.53(8) + 5.01(10) - 3.48(11) - 4.70(21) + 5.92(22) - 1.22(23)$
49. $o = -0.4 - 1.53(8) + 6.27(9) - 4.74(10) - 2.60(13) + 2.45(14) + 0.15(15) - 3.45(20) + 4.67(21) - 1.22(23)$
50. $o = +6.9 + 0.01(18) + 1.30(19) - 1.31(20) - 3.51(24) + 3.41(25) + 0.10(26) - 1.41(31) + 4.92(32) - 3.51(33)$

51. o=+13.9−1.91(26)+5.55(27)−3.64(28)−3.64(29)+3.33(30)+0.31(31)−0.03(34)+1.58(35)−1.55(36)
52. o=−8.9+1.51(40)−1.51(41)−3.75(44)+3.59(45)+0.16(46)−1.69(51)+5.46(52)−3.77(53)
53. o=+7.6−2.31(46)+6.23(47)−3.92(48)−3.47(49)+2.89(50)+0.58(51)+0.34(54)+1.26(55)−1.60(56)
54. o=+6.8−1.28(56)+1.58(57)−0.30(58)−3.72(64)+4.68(65)−0.96(66)−0.29(71)+4.37(72)−4.08(73)
55. o=+15.7−1.90(66)+2.00(67)−0.10(68)−3.86(74)+6.01(75)+2.15(76)+0.21(81)+3.70(82)−3.91(83)
56. o=−2.6−1.79(76)+1.51(77)+0.28(78)−3.34(84)+5.10(85)−1.76(86)−0.03(91)+3.03(92)−3.00(93)
57. o=−25.2−1.68(86)+1.75(87)−0.07(88)−3.01(94)+4.65(95)−1.64(96)−0.03(101)+3.11(102)−3.08(103)
58. o=−26.1+0.13(99)+2.76(100)−2.89(101)−1.86(104)+1.66(105)+0.20(106)−3.14(111)+5.15(112)−2.01(113)
59. o=−2.2−2.89(106)+5.69(107)−2.80(108)−2.72(109)+2.61(110)+0.11(111)+0.03(114)+2.69(115)−2.72(116)
60. o=+27.1−0.30(116)+5.09(117)−4.79(118)−3.11(119)+5.02(120)−1.91(121)−3.07(131)+3.99(132)−0.92(133)
61. o=+42.9−3.92(126)+3.86(127)+0.06(128)−2.23(134)+6.27(135)−4.04(136)+0.06(142)+2.07(143)−2.13(144)
62. o=+12.3−0.01(140)+6.09(141)−6.08(142)−1.58(145)+1.13(146)+0.45(147)−7.06(150)+8.70(151)−1.64(152)
63. o=−6.4−1.15(137)+3.17(138)−2.02(139)−0.97(149)+8.03(150)−7.06(151)−10.21(153)+10.52(154)−0.31(155)

S. o=+12.7−2.77(1)+2.77(3)+1.50(6)−1.50(7)+0.15(13)−0.15(15)+3.36(18)−3.36(19)−5.92(21)
+5.92(22)−3.41(24)+3.41(25)+0.45(26)−0.45(28)+3.33(29)−3.33(30)−0.11(31)+0.11(33)
−2.89(34)+2.89(35)+3.07(37)−3.07(38)+0.17(41)−0.17(43)+0.16(44)+0.58(46)−0.74(48)
+2.89(49)−2.89(50)−3.77(52)+3.77(53)−2.50(54)+2.50(55)−0.30(56)+0.30(58)+3.32(59)
−3.32(60)−0.19(61)+0.19(63)−3.72(64)+3.72(65)+2.44(67)−2.44(68)−0.52(69)+0.23(71)
+0.29(73)−0.64(74)+0.64(76)+2.23(77)−2.23(78)−0.03(79)+0.03(80)−3.70(82)+3.70(83)
−0.28(84)+0.28(86)+2.70(87)−2.70(88)−0.21(89)+0.21(91)−3.03(92)+3.03(93)−0.11(94)
+0.11(96)+1.72(97)−1.72(98)−0.13(99)+0.13(101)−3.11(102)+3.11(103)+0.20(104)+0.44(106)
−0.64(108)+2.61(109)−2.61(110)−2.01(112)+2.01(113)−1.59(114)+1.59(115)+0.30(116)
−0.30(118)+3.11(119)−3.11(120)+0.49(121)−0.49(123)−1.75(124)+1.75(125)+1.07(127)
−1.07(128)−0.60(129)−0.32(131)+0.52(133)−0.73(134)+0.39(136)+0.34(139)+0.72(140)
−0.72(141)−2.07(143)+2.07(144)−1.13(145)+1.13(146)+0.97(149)−1.79(150)+0.82(152)
−0.31(153)+0.31(155)

ACCURACY AS INDICATED BY CORRECTIONS TO OBSERVED DIRECTIONS.

The corrections to observed directions resulting from the figure adjustments indicated by the preceding observation equations are as follows:

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS.

Seguin base net to Alice base and to Laguna Madre base.

Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction
	"		"		"		"
1	+0.295	43	+0.038	85	−0.587	127	+0.137
2	+0.125	44	+0.683	86	+0.467	128	−0.096
3	−0.363	45	−0.283	87	+0.082	129	+0.179
4	−0.202	46	−0.211	88	−0.805	130	+0.359
5	+0.497	47	−0.110	89	+0.090	131	−0.300
6	−0.676	48	−0.078	90	+0.069	132	−0.314
7	+0.019	49	+0.364	91	+0.550	133	−0.123
8	−0.470	50	+0.243	92	−0.372	134	+0.199
9	+0.630	51	+0.079	93	+0.310	135	−0.035
10	−0.280	52	+0.350	94	+0.383	136	−0.035
11	+0.237	53	−1.037	95	−0.298	137	+0.210
12	+0.274	54	−0.034	96	−0.058	138	−0.452
13	+0.071	55	+0.752	97	−0.334	139	+0.375
14	−0.301	56	−0.406	98	+0.307	140	+0.097
15	−0.524	57	+0.057	99	+0.295	141	−0.160
16	−0.151	58	−0.370	100	−0.180	142	−0.171
17	+0.294	59	+0.758	101	−0.447	143	−0.252
18	−0.033	60	−0.284	102	+0.063	144	+0.068
19	+0.413	61	−0.605	103	+0.268	145	+0.530
20	+0.106	62	−0.255	104	−0.453	146	−0.175
21	−0.822	63	+0.386	105	+0.270	147	+0.151
22	+0.132	64	−0.010	106	+0.431	148	+0.085
23	+0.739	65	−0.006	107	+0.072	149	+0.247
24	−0.155	66	+0.768	108	−0.320	150	−0.335
25	+0.479	67	−0.202	109	+0.009	151	−0.397
26	−0.208	68	−0.550	110	+0.047	152	+0.249
27	−0.462	69	+0.401	111	−0.057	153	−0.194
28	+0.116	70	−0.135	112	−0.084	154	+0.603
29	+0.075	71	−0.211	113	+0.270	155	−0.265
30	−0.421	72	+0.107	114	−0.187	156	−0.325
31	+0.698	73	−0.161	115	+0.180	157	+0.112
32	+0.394	74	−0.139	116	+0.509	158	+0.069
33	−1.024	75	−0.194	117	−0.022	159	−0.017
34	+0.353	76	+0.272	118	−0.625	160	−0.075
35	+0.420	77	+0.221	119	+0.465	161	−0.032
36	−0.064	78	−0.159	120	−0.455	162	+0.124
37	+0.143	79	+0.173	121	+0.110	163	−0.055
38	−0.499	80	+0.371	122	−0.092	164	−0.212
39	−0.071	81	−0.092	123	−0.028	165	+0.361
40	+0.233	82	−1.087	124	+0.069	166	−0.094
41	−0.246	83	+0.635	125	−0.069		
42	+0.046	84	+0.154	126	−0.041		

TABLES OF CORRECTIONS TO OBSERVED DIRECTIONS—Continued.

Point Isabel base net.

Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction	Number of direction	Correction to direction
	"		"		"		"
1	+0.162	9	−0.252	17	+0.058	25	−0.370
2	−0.522	10	−0.123	18	+0.242	26	−0.154
3	−0.228	11	−0.133	19	−0.598	27	−0.247
4	+0.460	12	+0.125	20	+0.327	28	+0.369
5	+0.128	13	−0.005	21	−0.323	29	−0.048
6	+0.213	14	−0,128	22	+0.064	30	+0.080
7	−0.231	15	+0.141	23	+0.277		
8	+0.393	16	−0.029	24	+0.351		

Laguna Madre base to Point Isabel base net.

1	+1.273	40	+0.406	79	+1.262	118	+2.662
2	−0.689	41	−1.005	80	+0.740	119	−0.522
3	−0.584	42	−1.799	81	−0.211	120	−0.775
4	−2.346	43	−0.897	82	−1.315	121	−0.107
5	+0.612	44	+1.054	83	−0.477	122	−2.693
6	+2.158	45	−0.731	84	−0.205	123	+4.097
7	−0.434	46	+0.385	85	−0.381	124	−2.313
8	+0.139	47	−0.829	86	−0.631	125	−0.050
9	+0.168	48	+0.121	87	−1.213	126	+1.502
10	−2.065	49	+0.537	88	+2.430	127	+0.273
11	+1.695	50	+1.486	89	+0.540	128	+0.587
12	+0.064	51	−0.097	90	+0.233	129	−1.225
13	+0.274	52	+0.635	91	+0.078	130	−1.136
14	−0.256	53	−2.560	92	+0.229	131	+1.800
15	−0.501	54	−0.309	93	−1.080	132	−1.008
16	+0.462	55	−1.811	94	−3.701	133	+1.569
17	+0.020	56	+0.662	95	+1.129	134	+0.810
18	−0.688	57	+1.078	96	+0.823	135	−3.580
19	+1.752	58	+0.382	97	−0.644	136	−0.611
20	+0.493	59	+1.352	98	+2.392	137	+0.888
21	−1.326	60	−1.514	99	−0.619	138	+1.853
22	−0.976	61	−0.352	100	+1.533	139	+0.641
23	+0.743	62	+0.418	101	−2.435	140	−0.822
24	−0.527	63	+0.096	102	+2.584	141	+0.208
25	−1.666	64	+0.010	103	−1.063	142	+2.461
26	+0.942	65	+0.588	104	−3.333	143	−4.866
27	+0.778	66	+0.021	105	+0.230	144	+3.019
28	+0.472	67	−0.087	106	−1.875	145	−1.346
29	+1.981	68	−0.532	107	+1.151	146	+1.265
30	−2.058	69	+1.742	108	+3.827	147	−0.068
31	−0.625	70	−0.077	109	−3.082	148	+0.149
32	−0.380	71	+0.683	110	−1.207	149	−0.031
33	+1.082	72	−2.321	111	+1.513	150	−0.305
34	−0.234	73	−0.026	112	+2.661	151	−0.363
35	+1.097	74	+0.988	113	+0.115	152	+0.699
36	+1.408	75	−1.227	114	−3.368	153	−0.137
37	−1.075	76	+0.594	115	−0.363	154	+0.123
38	−1.196	77	−0.015	116	+1.232	155	+0.014
39	+3.295	78	−0.339	117	−0.162		

The maximum correction to a direction in the first section adjusted was 1''.09 to the direction from Mathis to Elliff. The maximum in the second section was 0''.60 to the direction from Point Isabel west base to Point Isabel south base. The maximum in the third section, consisting of the tertiary triangulation along the coast, was 4''.87 to the direction from Singer to Armadillo.

The probable error of an observed direction is

$$d = \pm 0.674\sqrt{\frac{\overline{v^2}}{c}}$$

in which v^2 is the sum of the squares of the corrections to the directions and c is the number of conditions.

The probable error for an observed direction for the first section is ±0''.36. Or, separating the triangulation according to seasons, the probable error of a direction for the season 1904–5 is ±0''.41, and for the season 1905, ±0''.25.

The probable error for an observed direction for the second section is ±0''.25.

The probable error of a direction being the best test of the accuracy of triangulation, these probable errors place the triangulation of the season 1905 and that of the Point Isabel base net among the best sections of triangulation yet reported in the United States. This is shown in the table printed on page 231 of Appendix 4 of this report.

ACCURACY AS INDICATED BY CORRECTIONS TO ANGLES AND CLOSURES OF TRIANGLES.

The correction to each angle is the algebraic sum of the corrections to two directions. In order to make it possible to study the corrections to the separate angles, they are shown in the following table for every triangle in the main scheme from Seguin base net to Laguna Madre base, from Laguna Madre base to Point Isabel base net, and in the Point Isabel base net. There are also shown the error of closure of the triangles, the corrected spherical angles, and the spherical excess. The plus sign prefixed to the error of closure of a triangle indicates that the sum of the angles is less than 180° plus the spherical excess. The spherical excess is a convenient indication of the size of the triangle since it is proportional to the area.

TABLES OF TRIANGLES.

Seguin base net to Laguna Madre base.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Stockdale	−0.37		67 31 34.74	
Lavernia	−0.36	−1.03	54 09 08.77	1.01
Thomas	−0.30		58 19 17.51	
Serita	−1.17		42 15 12.08	
Lavernia	−0.20	−1.50	112 47 22.59	0.79
Thomas	−0.13		24 57 26.12	

TABLES OF TRIANGLES—Continued.

Seguin base net to Laguna Madre base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Serita	−0.48		79 19 41.02	
Lavernia	+0.16	−0.53	58 38 13.82	0.67
Stockdale	−0.21		42 02 05.83	
Stockdale	−0.57		109 33 40.58	
Serita	+0.69	−0.05	37 04 28.94	0.90
Thomas	−0.17		33 21 51.38	
Karnes	−0.93		26 37 43.83	
Serita	+0.61	−0.28	81 28 40.89	1.83
Stockdale	+0.04		71 53 37.11	
Ruckman	+0.45		25 51 27.91	
Serita	−0.49	+0.51	46 38 09.35	1.38
Stockdale	+0.55		107 30 24.12	
Ruckman	+0.12		95 38 24.19	
Karnes	+0.95	+1.59	48 44 50.65	1.86
Stockdale	+0.52		35 36 47.02	
Karnes	+0.02		75 22 34.48	
Serita	+1.10	+0.80	34 50 31.54	2.31
Ruckman	−0.33		69 46 56.28	
Choate	+1.37		43 54 05.46	
Karnes	+0.61	+2.80	87 38 28.45	1.56
Ruckman	+0.82		48 27 27.65	
Bryde	−0.69		35 04 41.17	
Karnes	−0.29	−0.53	124 31 55.83	0.72
Ruckman	+0.45		20 23 23.72	
Bryde	−0.94		111 38 12.27	
Karnes	−0.89	−3.25	36 53 27.39	0.57
Choate	−1.42		31 28 20.91	
Choate	−0.04		75 22 26.38	
Bryde	−0.25	+0.08	76 33 31.10	1.41
Ruckman	+0.37		28 04 03.93	
Pettus	−0.64		85 28 06.05	
Bryde	+0.58	−0.37	34 59 28.38	0.35
Choate	−0.31		59 32 25.92	
Barroum	+0.30		68 19 23.48	
Bryde	−0.04	+0.47	46 23 27.61	0.37
Pettus	+0.21		65 17 09.28	
Wiess	+0.03		31 22 38.46	
Pettus	+0.92	+2.07	109 50 17.23	0.26
Choate	+1.12		38 47 04.57	
Wiess	+0.10		39 38 40.94	
Barroum	−0.48	−0.86	40 56 51.93	0.32
Pettus	−0.48		99 24 27.45	

TABLES OF TRIANGLES—Continued.

Seguin base net to Laguna Madre base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	″	″	° ′ ″	″
Fleming	+0.79		52 30 18.10	
Barroum	+0.28	+1.14	71 37 22.28	0.76
Wiess	+0.07		55 52 20.38	
Beeville	−1.39		51 41 17.58	
Barroum	+0.29	−1.99	33 33 15.08	0.54
Wiess	−0.89		94 45 27.88	
Beeville	−1.12		106 47 42.63	
Fleming	−1.16	−3.25	34 19 10.28	0.40
Wiess	−0.97		38 53 07.49	
Fleming	−0.37		86 49 28.38	
Barroum	−0.01	−0.11	38 04 07.20	0.63
Beeville	+0.27		55 06 25.05	
Miller	−1.04		41 23 52.98	
Fleming	+0.03	−1.17	57 49 04.36	0.60
Beeville	−0.16		80 47 03.26	
O'Neill	−0.35		28 55 14.19	
Fleming	+0.46	−0.17	33 07 39.29	0.47
Beeville	−0.28		117 57 06.99	
O'Neill	−1.32		81 53 21.96	
Miller	−0.32	−1.76	60 56 34.72	0.41
Beeville	−0.12		37 10 03.73	
Miller	−1.36		102 20 27.70	
Fleming	−0.43	−2.76	24 41 25.07	0.54
O'Neill	−0.97		52 58 07.77	
Skelly	−0.05		37 34 34.95	
Miller	+0.99	+1.71	106 12 43.02	0.27
O'Neill	+0.77		36 12 42.30	
Welder	−0.27		31 21 27.79	
Miller	+0.35	+0.86	61 38 58.20	0.49
O'Neill	+0.78		86 59 34.50	
Welder	+0.05		60 18 32.58	
Skelly	+0.47	+0.52	68 54 35.82	0.59
O'Neill	0.00		50 46 52.19	
Skelly	+0.41		106 29 10.76	
Miller	+0.64	+1.37	44 33 44.82	0.37
Welder	+0.32		28 57 04.79	
Mathis	+0.20		50 46 09.94	
Skelly	−0.43	−0.31	86 35 23.89	0.49
Welder	−0.08		42 38 26.66	
Nolan	−0.88		38 42 19.11	
Skelly	−0.05	−1.54	56 59 00.32	0.25
Welder	−0.61		84 18 41.33	

TABLES OF TRIANGLES—Continued.

Seguin base net to Laguna Madre base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Nolan	−1. 27		66 10 32. 77	
Mathis	−0. 46	−2. 27	72 09 13. 22	0. 65
Welder	−0. 54		41 40 14. 66	
Reynolds	−0. 68		35 28 03. 22	
Mathis	+0. 73	+1. 10	79 59 42. 54	0. 76
Nolan	+1. 05		64 32 15. 00	
Elliff	+0. 68		26 46 12. 15	
Mathis	−0. 99	0. 00	41 13 02. 85	0. 67
Nolan	+0. 31		112 00 45. 67	
Elliff	−0. 24		75 49 55. 09	
Reynolds	+0. 24	−0. 74	56 41 35. 15	0. 91
Nolan	−0. 74		47 28 30. 67	
Reynolds	−0. 44		92 09 38. 37	
Mathis	+1. 72	+0. 36	38 46 39. 69	1. 00
Elliff	−0. 92		49 03 42. 94	
Wood	−0. 39		51 29 21. 01	
Reynolds	−0. 28	−0. 21	51 49 52. 13	0. 81
Elliff	+0. 46		76 40 47. 67	
Alice	−0. 47		38 25 04. 21	
Reynolds	+0. 37	+0. 38	84 59 54. 38	1. 11
Elliff	+0. 48		56 35 02. 52	
Alice	−0. 74		66 02 38. 81	
Reynolds	+0. 64	−0. 46	33 10 02. 24	0. 75
Wood	−0. 36		80 47 19. 70	
Wood	−0. 75		132 16 40. 71	
Alice	−0. 27	−1. 04	27 37 34. 60	0. 46
Elliff	−0. 02		20 05 45. 15	
Alice east base	−0. 10		64 03 56. 89	
Alice	+0. 51	+1. 29	42 38 58. 72	0. 33
Wood	+0. 88		73 17 04. 72	
Alice west base	+0. 35		61 46 50. 62	
Alice	+0. 72	+1. 23	71 11 25. 09	0. 36
Wood	+0. 16		47 01 44. 65	
Alice west base	−0. 10		101 40 43. 40	
Alice	+0. 20	+0. 14	28 32 26. 36	0. 19
Alice east base	+0. 04		49 46 50. 43	
Alice east base	−0. 06		113 50 47. 32	
Alice west base	−0. 46	+0. 20	39 53 52. 77	0. 16
Wood	+0. 72		26 15 20. 07	
Rogers	−0. 92		49 02 44. 94	
Elliff	−0. 93	−2. 21	86 40 58. 81	0. 98
Nolan	−0. 36		44 16 17. 23	

TABLES OF TRIANGLES—Continued.

Seguin base net to Laguna Madre base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Kaleta	+0.18		41 52 03.42	
Rogers	−0.36	−0.78	103 55 51.04	0.74
Elliff	−0.60		34 12 06.28	
Kaleta	−0.05		89 02 29.80	
Rogers	+0.56	+0.84	54 53 06.10	0.89
Nolan	+0.33		36 04 24.99	
Kaleta	−0.23		47 10 26.38	
Elliff	−0.33	−0.59	52 28 52.53	1.13
Nolan	−0.03		80 20 42.22	
Corpus	0.00		48 04 30.92	
Rogers	−0.14	−0.11	55 18 01.44	0.69
Kaleta	+0.03		76 37 28.33	
Portland	+0.19		33 46 29.98	
Corpus	+0.25	+0.50	126 15 02.13	0.54
Rogers	+0.06		19 58 28.43	
Portland	+0.51		61 55 08.71	
Corpus	+0.25	+0.62	78 10 31.21	0.56
Kaleta	−0.14		39 54 20.64	
Portland	+0.32		28 08 38.73	
Rogers	−0.20	+0.01	35 19 33.01	0.71
Kaleta	−0.11		116 31 48.97	
McGloins Bluff	−0.71		42 30 50.69	
Corpus	−0.66	−1.86	42 53 33.51	0.42
Portland	−0.49		94 35 36.22	
Mustang	−0.06		29 20 33.71	
Corpus	+0.16	−0.57	80 06 33.93	0.79
Portland	−0.67		70 32 53.15	
Mustang	+0.58		49 57 51.15	
Corpus	+0.83	+2.11	37 13 00.43	0.71
McGloins Bluff	+0.70		92 49 09.13	
Mustang	+0.64		20 37 17.44	
Portland	+0.18	+0.82	24 02 43.07	0.34
McGloins Bluff	0.00		135 19 59.83	
Laguna Madre north base	+0.80		30 47 33.50	
Corpus	−0.11	+0.67	100 23 42.16	0.60
Portland	−0.02		48 48 44.94	
Laguna Madre north base	−0.07		61 25 34.69	
Corpus	+0.55	+0.94	57 30 08.65	0.76
McGloins Bluff	+0.46		61 04 17.42	
Laguna Madre north base	−0.13		116 39 06.64	
Corpus	−0.28	−0.99	20 17 08.22	0.41
Mustang	−0.58		43 03 45.55	

TABLES OF TRIANGLES—Continued.

Seguin base net to Laguna Madre base—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Laguna Madre north base	−0. 87		30 38 01. 19	
Portland	−0. 48	−1. 59	45 46 51. 27	0. 58
McGloins Bluff	−0. 24		103 35 08. 12	
Laguna Madre north base	−0. 93		85 51 33. 14	
Portland	−0. 66	−2. 23	21 44 08. 20	0. 60
Mustang	−0. 64		72 24 19. 26	
Laguna Madre north base	−0. 06		55 13 31. 95	
McGloins Bluff	+0. 24	+0. 18	31 44 51. 71	0. 36
Mustang	0. 00		93 01 36. 70	
Laguna Madre south base	−0. 06		54 18 51. 64	
Corpus	−0. 26	−0. 58	13 43 07. 19	0. 24
Laguna Madre north base	−0. 26		111 58 01. 41	
Laguna Madre south base	−0. 02		85 34 22. 00	
Corpus	−0. 53	−0. 97	34 00 15. 42	0. 75
Mustang	−0. 42		60 25 23. 33	
Laguna Madre south base	+0. 04		31 15 30. 36	
Laguna Madre north base	+0. 40	+0. 60	131 22 51. 96	0. 10
Mustang	+0. 16		17 21 37. 78	
Padre	−0. 16		46 25 07. 68	
Laguna Madre south base	+0. 20	0. 00	75 35 50. 13	0. 09
Laguna Madre north base	−0. 04		57 59 02. 28	
Padre	+0. 57		37 11 58. 20	
Laguna Madre north base	+0. 38	+1. 27	128 37 21. 63	0. 26
McGloins Bluff	+0. 32		14 10 40. 43	
Padre	−0. 04		109 39 51. 93	
Laguna Madre south base	+0. 16	+0. 05	44 20 19. 77	0. 16
Mustang	−0. 07		25 59 48. 46	
Padre	+0. 12		63 14 44. 25	
Laguna Madre north base	+0. 44	+0. 65	73 23 49. 68	0. 17
Mustang	+0. 09		43 21 26. 24	
Padre	−0. 46		26 02 46. 04	
McGloins Bluff	−0. 08	−0. 44	17 34 11. 28	0. 27
Mustang	+0. 10		136 23 02. 95	

Point Isabel base net.

Point Isabel south base	+0. 29		86 30 37. 11	
Point Isabel west base	−0. 84	−0. 03	19 49 31. 61	0. 05
Point Isabel east base	+0. 52		73 39 51. 33	
Cameron	+0. 02		51 05 44. 98	
Point Isabel east base	−0. 42	−0. 13	40 09 21. 81	0. 11
Point Isabel west base	+0. 27		88 44 53. 32	

TABLES OF TRIANGLES—Continued.

Point Isabel base net—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ' "	"
Cameron	−0.13		12 19 51.85	
Point Isabel east base	+0.11	+0.05	113 49 13.15	0.06
Point Isabel south base	+0.07		53 50 55.06	
Cameron	+0.15		38 45 53.13	
Point Isabel south base	+0.21	−0.21	32 39 42.04	0.10
Point Isabel west base	−0.57		108 34 24.93	
Fronton	+0.62		17 32 59.03	
Point Isabel south base	−0.72	−0.33	33 46 39.19	0.02
Point Isabel east base	−0.23		128 40 21.80	
Fronton	−0.02		31 18 50.77	
Point Isabel south base	−0.43	−1.11	120 17 16.30	0.10
Point Isabel west base	−0.66		28 23 53.03	
Fronton	+0.11		60 35 55.51	
Point Isabel south base	−0.65	−0.41	87 37 34.25	0.18
Cameron	+0.13		31 46 30.42	
Fronton	−0.64		13 45 51.74	
Point Isabel east base	−0.29	−0.75	157 39 46.87	0.03
Point Isabel west base	+0.18		8 34 21.42	
Fronton	−0.52		43 02 56.47	
Point Isabel east base	+0.13	−0.13	117 30 25.06	0.10
Cameron	+0.26		19 26 38.57	
Fronton	+0.13		29 17 04.74	
Point Isabel west base	+0.09	+0.49	80 10 31.90	0.18
Cameron	+0.27		70 32 23.54	
Arista	−0.68		2 10 46.34	
Point Isabel west base	+0.35	−0.06	173 35 31.92	0.01
Cameron	+0.27		4 13 41.75	
Arista	−0.39		33 17 30.13	
Point Isabel west base	+0.08	+0.31	84 50 38.60	0.22
Point Isabel east base	+0.62		61 51 51.49	
Arista	+0.30		35 58 34.94	
Point Isabel west base	+0.92	+1.61	65 01 06.99	0.19
Point Isabel south base	+0.39		79 00 18.26	
Arista	−0.04		43 08 11.82	
Point Isabel west base	+0.27	−0.23	93 25 00.03	0.35
Fronton	−0.46		43 26 48.50	
Arista	+0.29		31 06 43.79	
Cameron	−0.25	+0.24	46 52 03.23	0.32
Point Isabel east base	+0.20		102 01 13.30	
Arista	+0.98		33 47 48.60	
Cameron	−0.12	+1.46	34 32 11.38	0.28
Point Isabel south base	+0.60		111 40 00.30	

TABLES OF TRIANGLES—Continued.

Point Isabel base net—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Arista	+0.65		40 57 25.49	
Cameron	+0.01	+0.32	66 18 41.80	0.52
Fronton	−0.34		72 43 53.23	
Arista	+0.69		2 41 04.81	
Point Isabel east base	−0.09	+1.27	11 47 59.85	0.02
Point Isabel south base	+0.67		165 30 55.36	
Arista	+0.36		9 50 41.70	
Point Isabel east base	−0.33	+0.21	140 28 21.64	0.10
Fronton	+0.18		29 40 56.76	
Arista	−0.33		7 09 36.89	
Point Isabel south base	+0.04	−0.73	160 42 25.44	0.06
Fronton	−0.44		12 07 57.73	

Laguna Madre base to Point Isabel base net.

Grants	+3.76		31 10 46.52	
Lagnna Madre south base	+2.96	+8.68	56 58 31.13	0.13
Laguna Madre north base	+1.96		91 50 42.48	
Grants	−1.63		60 04 18.67	
Laguna Madre north base	−1.96		94 45 41.42	0.41
McGloins Bluff			25 10 00.32	
Chappa	+0.35		19 34 02.97	
Laguna Madre south base	+4.50	+6.71	123 13 15.98	0.12
Laguna Madre north base	+1.86		37 12 41.17	
Chappa	+2.07		59 48 31.65	
Laguna Madre south base	+1.54	+1.41	66 14 44.85	0.24
Grants	−2.20		53 56 43.74	
Chappa	+1.72		40 14 28.68	
Laguna Madre north base	+0.10	+3.38	54 38 01.31	0.25
Grants	+1.56		85 07 30.26	
Peat Island	−0.53		40 39 24.45	
Laguna Madre south base	−1.04	−3.80	120 46 30.40	0.12
Grants	−2.25		18 34 05.27	
Peat Island	−0.77		94 03 21.40	
Laguna Madre south base	−2.59	−5.18	54 31 45.54	0.11
Chappa	−1.82		31 24 53.17	
Peat Island	−0.25		53 23 56.94	
Grants	+0.03	+0.03	35 22 38.47	0.23
Chappa	+0.25		91 13 24.82	
Mott	−1.14		31 42 31.65	
Peat Island	+0.52	−1.88	90 05 24.15	0.27
Chappa	−1.26		58 12 04.47	

TABLES OF TRIANGLES—Continued.

Laguna Madre base to Point Isabel base net—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Richards	+0.24		56 08 19.34	
Mott	+1.47	+1.27	92 34 45.65	0.27
Peat Island	−0.44		31 16 55.28	
Richards	+1.71		87 04 21.50	
Mott	+2.61	+6.76	60 52 14.00	0.28
Chappa	+2.44		32 03 24.78	
Richards	+1.46		30 56 02.15	
Peat Island	+0.97	+3.61	58 48 28.88	0.28
Chappa	+1.18		90 15 29.25	
Wheelbarrow	+0.90		33 50 34.25	
Mott	−0.16	−1.87	47 49 37.75	0.22
Richards	−2.61		98 19 48.22	
Point of Rocks	+1.33		36 06 13.92	
Mott	−0.47	+2.29	77 52 09.87	0.26
Richards	+1.43		66 01 36.47	
Point of Rocks	+1.64		89 10 55.43	
Mott	−0.31	+0.54	30 02 32.12	0.24
Wheelbarrow	−0.79		60 46 32.69	
Point of Rocks	+0.31		53 04 41.51	
Richards	−4.04	−3.62	32 18 11.75	0.20
Wheelbarrow	+0.11		94 37 06.94	
Griffins Point	−1.79		30 24 46.13	
Point of Rocks	−2.60	−5.80	95 12 58.94	0.21
Wheelbarrow	−1.41		54 22 15.14	
Shells	+0.73		51 18 12.33	
Griffins Point	−0.67	−0.06	94 16 31.67	0.25
Point of Rocks	−0.12		34 25 16.25	
Shells	−2.47		80 28 33.91	
Griffins Point	+1.12	−4.24	63 51 45.54	0.28
Wheelbarrow	−2.89		35 39 40.83	
Shells	−3.20		29 10 21.58	
Point of Rocks	−2.48	−9.98	60 47 42.69	0.24
Wheelbarrow	−4.30		90 01 55.97	
Coyote	−1.50		40 03 44.37	
Griffins Point	−0.27	−3.35	70 33 04.31	0.25
Shells	−1.58		69 23 11.57	
Venado	+0.77		52 39 01.12	
Coyote	+0.97	+2.69	99 06 41.17	0.23
Griffins Point	+0.95		28 14 17.94	
Venado	+0.45		84 54 12.96	
Coyote	+2.47	+3.87	59 02 56.80	0.20
Shells	+0.95		36 02 50.44	

TABLES OF TRIANGLES—Continued.

Laguna Madre base to Point Isabel base net—Continued.

Stations	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles	Spherical excess
	"	"	° ' "	"
Venado	−0.32		32 15 11.84	
Griffins Point	−1.22	−2.17	42 18 46.37	0.22
Shells	−0.63		105 26 02.01	
Indian	+0.58		29 30 22.20	
Coyote	−0.28	+1.46	81 46 49.92	0.26
Venado	+1.16		68 42 48.14	
Station Hill	−3.01		56 26 19.56	
Indian	+0.01	−3.69	94 58 25.54	0.28
Coyote	−0.69		28 35 15.18	
Station Hill	−0.71		82 09 06.74	
Indian	−0.56	−4.14	65 28 03.35	0.27
Venado	−2.87		32 22 50.18	
Station Hill	+2.29		25 42 47.17	
Coyote	+0.42	+1.01	53 11 34.75	0.25
Venado	−1.70		101 05 38.33	
Stoley	+0.84		29 39 37.03	
Indian	−0.11	−0.33	46 26 16.84	0.23
Station Hill	−1.06		103 54 06.36	
Avoca	−2.22		28 38 38.28	
Indian	−0.55	−2.01	87 16 46.75	0.30
Station Hill	+0.76		64 04 35.27	
Avoca	−0.39		73 00 00.61	
Indian	−0.45	−1.94	40 50 29.90	0.39
Stoley	−1.10		66 09 29.88	
Avoca	+1.82		44 21 22.32	
Station Hill	−1.82	−0.26	39 49 31.09	0.32
Stoley	−0.26		95 49 06.91	
Tank	−1.31		34 47 01.32	
Avoca	−0.61	−3.39	54 18 43.09	0.41
Stoley	−1.47		90 54 16.00	
Topa	−0.18		32 15 15.41	
Avoca	−0.93	−2.06	97 41 19.37	0.41
Stoley	−0.95		50 03 25.63	
Topa	−0.43		82 18 16.25	
Avoca	−0.32	−0.60	43 22 36.28	0.50
Tank	−0.15		54 19 07.97	
Topa	−0.25		50 03 00.84	
Stoley	−0.52	−1.93	40 50 50.37	0.50
Tank	−1.16		89 06 09.29	
Lomalto	+4.83		35 00 58.37	
Topa	+3.06	+7.74	88 11 29.01	0.62
Tank	−0.15		56 47 33.24	

TABLES OF TRIANGLES—Continued.

Laguna Madre base to Point Isabel base net—Continued.

Stations	Corrections to angles.	Error of closure of triangle.	Corrected spherical angles	Spherical excess
	"	"	° ′ ″	"
Gladiator	+5.02		55 04 06.72	
Lomalto	+4.53	+13.19	87 02 12.30	0.68
Topa	+3.64		37 53 41.66	
Gladiator	+1.37		89 08 39.13	
Lomalto	−0.30	+ 0.76	52 01 13.93	0.64
Tank	+0.31		38 50 07.58	
Gladiator	−3.65		34 04 32.41	
Topa	−0.58	− 4.69	50 17 47.35	0.58
Tank	−0.46		95 37 40.82	
Waterhole	−2.54		46 22 34.81	
Lomalto	−1.47	− 5.83	40 06 20.83	0.45
Gladiator	−1.82		93 31 04.81	
Rifle	+3.56		51 45 57.82	
Lomalto	+1.57	+ 1.16	90 56 06.39	0.39
Gladiator	−3.97		37 17 56.18	
Rifle	+1.46		95 18 55.77	
Lomalto	+3.03	+ 5.64	50 49 45.55	0.42
Waterhole	+1.15		33 51 19.10	
Rifle	−2.10		43 32 57.95	
Gladiator	+2.15	− 1.35	56 13 08.63	0.48
Waterhole	−1.40		80 13 53.90	
Colorado	+3.01		52 53 25.95	
Rifle	+5.70	+11.43	73 03 55.72	0.57
Waterhole	+2.72		54 02 38.90	
Santa Cruz	−2.59		52 07 42.64	
Colorado	+4.60	+ 4.69	90 53 48.78	0.46
Rifle	+2.68		36 58 29.04	
Santa Cruz	+4.21		103 05 39.76	
Colorado	+1.59	+ 7.67	38 00 22.83	0.34
Waterhole	+1.87		38 53 57.75	
Santa Cruz	+6.79		50 57 57.11	
Rifle	+3.03	+14.41	36 05 26.69	0.45
Waterhole	+4.59		92 56 36.65	
Armadillo	+2.26		50 19 10.24	
Colorado	+1.43	+ 4.36	81 56 31.23	0.33
Santa Cruz	+0.67		47 44 18.86	
Black Hill	−2.81		27 49 47.70	
Armadillo	+3.81	+ 3.83	129 42 32.26	0.20
Colorado	+2.83		22 27 40.24	
Black Hill	−0.23		66 29 25.59	
Armadillo	+1.55	+ 1.07	79 23 22.02	0.35
Santa Cruz	−0.25		34 07 12.74	

TABLES OF TRIANGLES—Continued.

Laguna Madre base to Point Isabel base net—Continued.

Stations	Corrections to angles	Error of closure of triangle	Corrected spherical angles	Spherical excess
	"	"	° " "	"
Black Hill	+2. 58		38 39 37. 89	
Colorado	−1. 39	+ 1. 60	59 28 51. 00	0. 48
Santa Cruz	+0. 41		81 51 31. 59	
Fox	−4. 39		43 20 57. 21	
Armadillo	−0. 92	− 2. 37	91 41 54. 10	0. 22
Black Hill	+2. 94		44 57 08. 91	
Singer	−7. 33		46 05 06. 97	
Fox	−1. 42	− 8. 44	70 51 04. 18	0. 27
Armadillo	+0. 31		63 03 49. 12	
Singer	+0. 55		91 31 08. 25	
Fox	+2. 97	+ 3. 61	27 30 06. 97	0. 19
Black Hill	+0. 09		60 58 44. 97	
Singer	+7. 88		45 26 01. 28	
Armadillo	−1. 23	+ 9. 68	28 38 04. 98	0. 14
Black Hill	+3. 03		105 55 53. 88	
Cameron	+2. 61		61 46 33. 83	
Fox	+1. 26	+ 6. 12	99 09 03. 90	0. 13
Singer	+2. 25		19 04 22. 40	
Pool	−0. 06		16 36 36. 58	
Cameron	+1. 28	+ 0. 97	102 03 36. 36	0. 15
Fox	−0. 25		61 19 47. 21	
Pool	+1. 00		68 37 34. 21	
Cameron	−1. 33	+ 0. 70	40 17 02. 53	0. 29
Singer	+1. 03		71 05 23. 55	
Pool	+1. 06		52 00 57. 63	
Fox	+1. 50	+ 5. 85	37 49 16. 68	0. 27
Singer	+3. 29		90 09 45. 96	
Fronton	+0. 26		11 18 44. 01	
Cameron	+1. 49	+ 0. 54	135 06 06. 65	0. 09
Fox	−1. 24		33 35 09. 43	
Fronton	+0. 15		81 35 51. 20	
Cameron	+0. 22	+ 0. 09	33 02 30. 30	0. 23
Pool	−0. 28		65 21 38. 73	
Fronton	−0. 11		70 17 07. 19	
Fox	+0. 96	+ 0. 52	27 44 37. 78	0. 29
Pool	−0. 33		81 58 15. 32	

The maximum correction of any angle of the primary triangulation is 1".42 to the angle at Choate between Bryde and Karnes.

The mean error of an angle, $a = \sqrt{\frac{\Sigma \Delta^2}{3n}}$ (in which $\Sigma \Delta^2$ is the sum of the squares of the closing errors of the triangles and n is the number of triangles) was computed for

each section of the primary triangulation. For the first section the mean error of an angle is ±0″.72, and for the second section ±0″.40.

Separating the first section adjusted, into the two seasons, we have the following facts of interest: For the season of 1904–5 the mean error of an angle is ±0″.78, the maximum closing error of a triangle 3″.25, and the average closing error 1″.04. For the season of 1905 the mean error is ±0″.62, the maximum closing error of a triangle 2″.23, and the average closing error 0″.85.

Similar statistics for the second section, the season of 1906, show a maximum closing error of a triangle of 1″.61 and an average closing error of 0″.50.

THE ACCORD OF BASES.

There are four bases which serve to fix the lengths in the triangulation under discussion, viz, the Seguin, Alice, Laguna Madre, and Point Isabel. The accord in length between each of these bases as measured and its value as computed from the triangulation through the adjacent triangles furnish valuable tests of the accuracy of the triangulation.

In solving the normal equations in each section of the figure adjustment the length equation (where one exists) was, as usual, assigned to the last place, so that the discrepancy in length after all the conditions relating to closures of triangles and ratios of sides had been satisfied, became known. In the following table the discrepancies developed between bases are given in terms of the seventh decimal place of logarithms, and are also expressed as ratios. A plus sign before a discrepancy expressed in terms of logarithms means that the first base mentioned is longer as measured than as computed through the intervening triangulation from the second base mentioned. There is also given for comparison in the table the discrepancies between bases of seven sections of the ninety-eighth meridian triangulation for which the results have already been published.

Bases	Discrepancy in seventh place of logarithms	Discrepancy expressed as a ratio
Seguin–Alice, 1904–5	−144	1/30200
Alice–Laguna Madre, 1905	+ 73	1/59500
Laguna Madre–Point Isabel, 1877–1880 [1]	+260	1/16700
Salina–Shelton, 1897–1899	+ 75	1/58000
Shelton–Page, 1899–1901	− 16	1/270000
Anthony–Elreno, 1902	+ 7	1/620000
Elreno–Bowie, 1902	− 64	1/68000
Bowie–Stephenville, 1902	− 77	1/56000
Stephenville–Lampasas, 1902	− 47	1/92000
Lampasas–Seguin, 1903–4	− 7	1/620000

[1] Tertiary triangulation.

The greatest discrepancy in the transcontinental triangulation was 169 in the seventh place of logarithms. The discrepancy developed in the tertiary triangulation, while it exceeds this, is considered satisfactory of its kind.

ACCORD IN AZIMUTH.

The introduction of Laplace azimuths is novel in adjustments of primary triangulation in the United States. Such azimuths are usually of a much higher degree of accuracy than the geodetic azimuth directly computed through the triangulation. The geographic positions along the ninety-eighth meridian as far south as Lavernia–Thomas had already been computed on the United States Standard Datum (see below) and are not subject to change. At the three Laplace stations—Salina west base, Bowie northwest base, and Austin—the United States standard azimuth was greater than the Laplace azimuth by 4″.9, 6″.8, and 9″.3, respectively. It is not certain, however, that the Laplace azimuth at Austin is more accurate than the geodetic azimuth computed through the triangulation. The station was not occupied in the triangulation, and the observations from the main scheme were secondary in character.

Although it was not known what amount of twist might still be in the triangulation at Lavernia–Thomas, it was determined to distribute it by means of an azimuth equation, and in this manner to make the United States standard azimuth at Alice equal to the Laplace azimuth. This azimuth equation in the solution of the normal equations was assigned a position next preceding the length equation, so that the discrepancy in azimuth, after all the conditions relating to closures of triangles and ratios of sides had been satisfied, became known. At Alice the discrepancy in azimuth amounted to 1″.22, the Laplace azimuth being greater than the United States standard azimuth by that amount. This means that the assumed twist in azimuth underwent a change in sign and became almost insignificant in size.

In a similar manner, a Laplace azimuth was held fixed at Fronton, a station of the Point Isabel base net. The azimuth discrepancy, after all the conditions of triangle closure and ratios of sides through the tertiary triangulation of the third section had been satisfied, was 11″.07. The azimuth computed through the triangulation was smaller than the adopted Laplace azimuth for the line Fronton-Cameron, which was held fixed at 134° 10′ 33″.51.

ERRORS AND COST.

A study of the errors developed in the primary triangulation has been made by Mr. William Bowie, assistant, inspector of geodetic work, in Appendix 4 of this report. In the same appendix (p. 181) Mr. Bowie has also computed the cost for the various seasons of the ninety-eighth meridian triangulation, and has included therein the cost data for these sections.

EXPLANATION OF POSITIONS, LENGTHS, AND AZIMUTHS, AND OF THE UNITED STATES STANDARD DATUM.

The lengths, as already fully explained in connection with adjustments, all depend upon the Seguin, Alice, Laguna Madre, and Point Isabel bases. The lengths as given are all reduced to sea level. If the actual length of a line simply reduced to the horizontal is desired it may be obtained with all accuracy ordinarily needed by adding to the sea level length as given a correction = (length of line as given)

$$\left[\frac{\text{mean elevation of the two ends of the line in meters}}{6370000}\right].$$

The maximum value of this correction does not exceed $\frac{1}{2700}$ for the length of any

portion of the triangulation here published. The maximum error made in the use of the above approximate formula for the correction does not exceed $\frac{1}{10000000}$ for the length of any portion of this triangulation.

The positions—that is, the latitudes, longitudes, and azimuths—need special explanation.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, as expressed in meters, which has been in use in the Coast and Geodetic Survey for many years.

After a spheroid has been adopted and all the angles and lengths in the triangulation have been fully fixed, it is still necessary, before the computation of latitudes, longitudes, and azimuths can be made, to adopt a standard latitude and longitude for a specified station and a standard azimuth for a line from that station. For convenience, the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The primary triangulation in the United States was commenced at various points and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation in California, in the latitude of San Francisco, in the vicinity of Santa Barbara Channel, and in the vicinity of San Diego. With the lapse of time these separate pieces have expanded until they have touched or overlapped.

The transcontinental triangulation, of which the office computation was completed in 1899, joins all of the detached portions mentioned and makes them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one for the whole country, or at least for as much of the country as is covered by continuous triangulation. To do this is a very heavy piece of work, and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the Superintendent adopted what is now known as the United States Standard Datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in The Transcontinental Triangulation and in The Eastern Oblique Arc of the United States, publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum.

As the adoption of such a standard datum is a matter of considerable importance, it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the Coast and Geodetic Survey are: First, the control of the charts published by the Survey; second, the furnishing of geographic positions (latitudes and longitudes), of accurately determined

elevations, and of distances and azimuths to officers connected with the Coast and Geodetic Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now or may hereafter become available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function it is also highly desirable that when a certain spheroid and geodetic datum have been adopted for a country they be rigidly adhered to without change for all time, unless shown to be largely in error.

In striving to attain the third object, the determination of the figure of the earth, the conditions are decidedly different. This problem concerns itself primarily with astronomic observations of latitude, longitude, and azimuth, and with the geodetic positions of the points at which the astronomic observations were made, but it is not concerned with the geodetic positions of other points fixed by the triangulations. The geodetic positions (latitudes and longitudes) of comparatively few points are therefore concerned in this problem. However, in marked contrast to the statements made in the preceding paragraph, it is desirable in dealing with this problem that, with each new important accession of data, a new spheroid fitting the geoid with the greatest possible accuracy, and new values for the geodetic latitudes, longitudes, and azimuths of the highest degree of accuracy, should be derived.

The United States Standard Datum was adopted with reference to positions furnished for geographic purposes, but has no reference to the problem of the determination of the figure of the earth. It is adopted with reference to the engineer's problem of furnishing standard positions, and does not affect the scientist's problem of the determination of the figure of the earth.

The principles which guided in the selection of the datum to be adopted were: First, that the adopted datum should not differ widely from the ideal datum, for which the sum of the station errors in latitude, longitude, and azimuth should each be zero; second, it is desirable that the adopted datum should produce minimum changes in the publications of the Survey, including its charts; and, third, it is desirable, other things being equal, to adopt that datum which allowed a maximum number of positions already in the office registers to remain unchanged, and therefore necessitated a minimum amount of new computation. These considerations led to the adoption as the United States Standard of the datum which had been in use for many years in the northeastern group of States and along the Atlantic coast as far as North Carolina.

An examination of the station errors available in 1903, on the United States Standard Datum, at 246 latitude stations, 76 longitude stations, and 152 azimuth stations scattered widely over the United States from Maine to Louisiana and to California,

indicated that this datum approaches closely to the ideal in which the algebraic sum of the station errors of each class would be zero.[1]

The adopted United States Standard Datum, upon which the positions and azimuths given in this publication depend, may be defined in terms of the position of the station Meades Ranch as follows:

	°	′	″
ϕ	=39	13	26.686
λ	=98	32	30.506
α to Waldo	=75	28	14.52

Points are then said to be upon the United States Standard Datum when they are connected with the station Meades Ranch by continuous triangulation, through which the corresponding latitudes, longitudes, and azimuths have been computed on the Clarke spheroid of 1866, as expressed in meters, starting from the above data.

The principal lists of geographic positions heretofore published on the United States Standard Datum throughout the whole United States are contained in the following publications of the Coast and Geodetic Survey and of other organizations: Appendix 8 of the Report for 1885, positions in Massachusetts and Rhode Island; Appendix 8 of the Report for 1888, positions in Connecticut; Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland; Appendix 10 of the Report for 1894, positions in Massachusetts; Appendix 6 of the Report for 1901, positions in Kansas and Nebraska; Appendix 3 of the Report for 1902, positions in Kansas, Missouri, Nebraska, and Colorado; Appendix 4 of the Report for 1903, positions in Kansas, Oklahoma, and Texas; Appendix 9 of the Report for 1904, positions in California; Appendix 5 of the Report for 1905, positions in Texas; Appendix 3 of the Report for 1907, positions in California; Appendix 5 of the Report for 1910, positions in California; in Appendix EEE, pages 2905–3031, Annual Report of the Chief of Engineers, 1902, positions of points on and near the Great Lakes; in the publications of the Massachusetts Harbor and Land Commission; and in various bulletins of the United States Geological Survey. In the present report, in addition to this appendix, there are two other appendixes giving positions on the standard datum—Appendix 4, positions in Nebraska, North and South Dakota, and Minnesota, and Appendix 6, positions in Florida.

TABLES OF POSITIONS, AZIMUTHS, AND LENGTHS.

In the tables of positions the latitude and longitude of each point are given on the United States Standard Datum (see p. 371), also the length and azimuth of each line observed over, whether in one or both ways. Along with the latitude and longitude of each point the lengths and azimuths are given of lines from that point to other points of the triangulation. No lengths or azimuths are repeated, and for a given line the length and azimuth will generally be found opposite the position of the last mentioned of the two stations involved.

For the convenience of the draftsman a column of "seconds in meters" is given, in which is placed the length (in meters) of each small arc of a meridian or parallel corre-

[1] This is further borne out in the reduction of 765 astronomic stations in connection with the "Supplementary investigation in 1909 of the figure of the earth and isostasy," by J. F. Hayford, published by the Coast and Geodetic Survey.

sponding to the seconds of the given latitude or longitude. To facilitate further the use of the tables, a column is given of the logarithms of the lengths. It must be remembered that it is the logarithm which is first derived in the computation, the lengths given in this table being then derived from the corresponding logarithms.

The rule followed in recent publications of this Office has been to give latitudes and longitudes to thousandths of seconds for all points the positions of which are fixed by fully adjusted triangulation. Points, the positions of which are given to hundredths of seconds only, are marked by footnotes as being without check (observed from only two stations) or checked by verticals only.

In the columns giving azimuths, distances, and logarithms of distances the accuracy is indicated to a certain extent by the number of decimal places given, it being understood that in each case two doubtful figures are given. In some cases there is very little doubt of the correctness of the second figure from the right, while in a few cases some doubt may be cast on the third figure from the right.

These tables may be conveniently consulted by using as finders the seven sketches at the end of this appendix and the index on pages 411 to 414. In the third column of the index will be found for each point a reference to the page on which its description is given, in the fourth column the number of the sketch on which it appears, and in the fifth column the page on which its elevation above sea level will be found.

For the convenience of those who wish to convert the distances given in this table or the elevations given later on from meters into feet the following conversion table is here inserted:

Meters	Feet	Feet	Meters
1	3. 280833	1	0. 3048006
2	6. 561667	2	0. 6096012
3	9. 842500	3	0. 9144018
4	13. 123333	4	1. 2192024
5	16. 404167	5	1. 5240030
6	19. 685000	6	1. 8288037
7	22. 965833	7	2. 1336043
8	26. 246667	8	2. 4384049
9	29. 527500	9	2. 7432055
10	32. 808333	10	3. 0480061

Seguin base net to Laguna Madre base.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Thomas	29 25 40.885	1258.8					
1904	97 56 16.612	447.8					
Lavernia	29 18 52.004	1601.1	236 56 45.68	57 02 38.14	Thomas	23110.74	4.3638139
1904	98 08 15.243	411.3					
Stockdale	29 14 42.591	1311.3	111 11 54.10	291 05 54.45	Lavernia	21283.82	4.3280497
1904	97 55 59.873	1616.8	178 43 28.84	358 43 20.64	Thomas	20272.65	4.3069106
Serita	29 11 08.497	261.6	169 44 55.00	349 44 08.27	Lavernia	14502.13	4.1614317
1904	98 06 39.600	1070.0	212 00 07.08	32 05 12.02	Thomas	31686.92	4.5008800
			249 04 36.02	69 09 48.27	Stockdale	18493.89	4.2670283

Seguin base net to Laguna Madre base—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Karnes	28 52 38.640	1189.6	150 39 02.17	330 33 16.91	Serita	39218.72	4.5934934
1904	97 54 48.145	1304.7	177 16 46.00	357 16 11.16	Stockdale	40806.41	4.6107284
Ruckman	29 01 36.729	1130.8	46 06 44.05	226 01 36.65	Karnes	23877.40	4.3779870
1904	97 44 13.119	355.0	115 53 40.33	295 42 45.37	Serita	40439.88	4.6068008
			141 45 08.24	321 39 24.13	Stockdale	30827.81	4.4889427
Choate	28 43 00.104	3.2	133 45 35.99	313 40 05.10	Karnes	25772.85	4.4111624
1904	97 43 21.241	576.5	177 39 41.45	357 39 16.40	Ruckman	34405.11	4.5366230
Bryde	28 44 54.794	1686.8	170 34 14.67	350 33 32.49	Karnes	14475.64	4.1606379
1904	97 53 20.631	559.8	205 38 55.84	25 43 20.33	Ruckman	34227.77	4.5343786
			282 12 26.94	102 17 15.08	Choate	16643.99	4.2212575
Pettus	28 39 11.653	358.7	137 14 48.24	317 11 55.32	Bryde	14391.91	4.1581184
1904	97 47 20.547	558.1	222 42 54.29	42 44 49.16	Choate	9574.44	3.9811132
Borroum	28 37 18.696	575.5	183 35 07.36	3 35 22.93	Bryde	14068.59	4.1482506
1904	97 53 53.057	1441.3	251 54 30.84	71 57 38.96	Pettus	11213.66	4.0497475
Wiess	28 33 39.566	1218.0	112 56 04.09	292 51 22.77	Borroum	17339.22	4.2390296
1904	97 44 05.216	141.8	152 34 45.03	332 33 11.51	Pettus	11518.52	4.0613968
			183 57 23.49	3 57 44.59	Choate	17297.35	4.2379797
Fleming	28 27 32.833	1010.7	184 28 20.24	4 28 45.05	Borroum	18090.63	4.2574537
1904	97 54 44.986	1223.8	236 58 38.34	57 03 43.71	Wiess	20739.63	4.3168010
Beeville	28 27 22.579	695.1	91 21 46.75	271 17 48.62	Fleming	13599.71	4.1335297
1904	97 46 25.259	687.2	146 28 11.80	326 24 37.85	Borroum	22021.92	4.3428552
			198 09 29.38	18 10 36.22	Wiess	12214.15	4.0868634
Miller	28 18 06.751	207.8	149 09 54.77	329 06 52.98	Fleming	20300.11	4.3074984
1904	97 48 22.538	614.2	190 33 47.75	10 34 43.49	Beeville	17405.85	4.2406952
O'Neill	28 19 56.064	1725.9	71 33 17.89	251 30 22.47	Miller	10621.98	4.0262056
1905	97 42 12.721	346.5	124 31 25.66	304 25 27.91	Fleming	24841.34	4.3951751
			153 26 39.85	333 24 39.76	Beeville	15368.81	4.1866403
Skelly	28 12 32.735	1007.7	177 43 12.60	357 43 05.49	Miller	10290.21	4.0124243
1904	97 48 07.514	204.9	215 17 47.55	35 20 35.59	O'Neill	16725.65	4.2233831
Welder	28 10 33.529	1032.1	104 16 33.80	284 12 23.37	Skelly	14916.35	4.1736625
1904	97 39 17.425	475.3	133 13 38.59	313 09 20.67	Miller	20383.91	4.3092875
			164 35 06.38	344 33 43.40	O'Neill	17963.78	4.2543976
Mathis	28 05 36.469	1122.6	190 47 05.03	10 47 47.26	Skelly	13044.44	4.1154255
1904	97 49 37.021	1010.7	241 33 14.97	61 38 07.14	Welder	19222.58	4.2838117
Nolan	28 00 22.728	699.6	133 45 22.01	313 42 28.19	Mathis	13970.55	4.1452136
1904	97 43 27.390	748.4	161 13 35.68	341 11 23.69	Skelly	23736.70	4.3754203
			199 55 54.78	19 57 52.48	Welder	20002.02	4.3010739
Elliff	27 50 05.924	182.4	174 56 14.63	354 55 31.04	Mathis	28756.30	4.4587330
1904	97 48 04.068	111.3	201 42 26.78	21 44 36.34	Nolan	20437.94	4.3104371
Reynolds	27 55 48.761	1500.9	213 38 43.52	33 42 10.73	Mathis	21738.46	4.3372287
1904	97 56 58.206	1591.4	249 06 46.74	69 13 07.01	Nolan	23711.01	4.3749501
			305 48 21.89	125 52 31.69	Elliff	18022.86	4.2558238
Alice	27 44 33.012	1016.1	210 44 44.89	30 48 16.27	Reynolds	24209.53	4.3839863
1904	98 04 30.885	845.9	249 09 49.10	69 17 29.17	Elliff	28893.65	4.4608024
Wood	27 43 41.237	1269.3	96 51 10.07	276 47 23.70	Alice	13417.68	4.1276774
1904	97 56 24.473	670.4	177 38 29.77	357 38 14.02	Reynolds	22413.09	4.3505017
			229 07 50.78	49 11 44.02	Elliff	18108.14	4.2578739
Alice, east base	27 38 40.200	1237.4	139 23 59.95	319 26 22.42	Alice	14289.74	4.1550244
1900	97 58 51.918	1423.1	203 32 56.84	23 34 05.35	Wood	10108.63	4.0046921
Alice, west base	27 38 38.960	1199.2	167 59 28.12	347 58 48.78	Alice	11141.99	4.0469630
1900	98 03 06.241	171.1	229 46 18.74	49 49 25.42	Wood	14414.33	4.1587944
			269 40 11.52	89 42 09.52	Alice, east base	6971.7076	3.8433392
Rogers	27 46 51.873	1596.7	108 28 31.04	288 23 25.59	Elliff	18890.67	4.2762474
1905	97 37 09.319	255.1	157 31 15.98	337 28 19.11	Nolan	27016.43	4.4316279
Kaleta	27 54 08.160	251.2	32 26 47.69	212 24 22.08	Rogers	15910.12	4.2016735
1905	97 31 57.540	1573.7	74 18 51.11	254 11 19.31	Elliff	27471.90	4.4388887
			121 29 17.49	301 23 54.11	Nolan	22102.49	4.3444413

Seguin base net to Laguna Madre base—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Corpus	27 47 18.341	564.6	87 48 17.47	267 42 23.52	Rogers	20803.89	4.3181445
1905	97 24 30.008	821.5	135 52 48.39	315 49 19.36	Kaleta	17580.74	4.2450372
Portland	27 53 02.343	72.1	34 05 21.81	214 03 19.60	Corpus	12783.31	4.1066432
1905	97 20 08.292	226.8	67 51 51.79	247 43 55.09	Rogers	30178.27	4.4796943
			96 00 30.52	275 54 58.72	Kaleta	19503.56	4.2901138
McGloins Bluff	27 49 36.229	1115.1	77 02 06.23	256 56 53.11	Corpus	18855.87	4.2754466
1860	97 13 18.803	514.6	119 32 56.92	299 29 45.59	Portland	12875.15	4.1097524
Mustang	27 41 50.533	1555.4	114 16 14.83	294 09 53.54	Corpus	24597.73	4.3908950
1905	97 10 50.923	1395.2	143 36 48.54	323 32 28.66	Portland	25699.01	4.4099164
			164 14 05.98	344 12 57.10	McGloins Bluff	14895.51	4.1730554
Laguna Madre north base	27 40 10.565	325.2	134 30 49.51	314 27 01.76	Corpus	18791.92	4.2739712
1882	97 16 20.529	562.6	165 18 23.01	345 16 36.86	Portland	24560.89	4.3902441
			195 56 24.20	15 57 48.81	McGloins Bluff	18108.92	4.2578927
			251 09 56.15	71 12 29.28	Mustang	9541.85	3.9796327
Laguna Madre south base	27 37 25.926	798.0	148 13 20.86	328 10 08.96	Corpus	21456.51	4.3315592
1882	97 17 37.263	1021.6	202 32 12.50	22 32 48.11	Laguna Madre N. base	5486.855	3.7393234
			233 47 42.86	53 50 51.50	Mustang	13797.55	4.1398019
Padre	27 36 56.350	1734.4	98 09 50.11	278 08 02.64	Laguna Madre S. base	6422.30	3.8076907
1905	97 13 45.396	1244.8					
			144 34 57.79	324 33 45.82	Laguna Madre N. base	7336.31	3.8654778
			181 46 56.00	1 47 08.38	McGloins Bluff	23400.96	4.3692337
			207 49 42.04	27 51 03.04	Mustang	10240.32	4.0103136
Supplementary points.							
Karnes City courthouse steeple	28 53 05.934	182.7	54 06 05.7	234 05 45.1	Karnes	1433.0	3.156239
1904	97 54 05.309	143.8	148 34 07.6	328 28 01.6	Serita	39081.1	4.591967
			175 34 07.6	355 33 12.0	Stockdale	40040.1	4.602495
			225 31 10.0	45 35 56.7	Ruckman	22459.5	4.351400
			355 24 58.2	175 25 19.8	Bryde	15168.6	4.180945
Beeville white church red cone, spire	28 24 17.319	533.1	110 38 41.2	290 34 01.1	Fleming	17101.5	4.233035
1904	97 44 56.770	1545.4	157 06 49.7	337 06 07.6	Beeville	6190.6	3.791734
			330 56 23.6	150 57 41.6	O'Neill	9199.7	3.963772
Beeville Catholic Church spire	28 24 24.325	748.8	27 31 07.8	207 29 22.4	Miller	13104.1	4.117407
1904	97 44 40.324	1097.8	109 27 57.1	289 23 09.2	Fleming	17448.1	4.241749
			152 30 51.0	332 30 01.0	Beeville	6186.0	3.791408
			334 02 18.1	154 03 28.3	O'Neill	9184.2	3.963039
Beeville water tower	28 24 22.273	685.7	28 07 29.7	208 05 42.1	Miller	13105.8	4.117464
1904	97 44 35.796	974.4	109 31 35.7	289 26 45.6	Fleming	17585.4	4.245152
			151 47 07.5	331 46 15.4	Beeville	6299.4	3.799298
			334 33 50.7	154 34 58.7	O'Neill	9073.8	3.957789
Beeville Catholic Convent[1]	28 24 27.74	854.0	109 17 19	289 12 33	Fleming	17283.7	4.237637
1904	97 44 45.37	1235.0	153 12 38	333 11 51	Beeville	6029.8	3.780306
Jones (Capt.) house, tallest cone	28 26 02.773	85.4	335 15 09.1	155 16 40.0	O'Neill	12429.0	4.094435
1904	97 45 23.734	654.9	18 23 28.7	198 22 03.9	Miller	15441.4	4.188686
			100 19 35.6	280 15 08.3	Fleming	15521.2	4.190924
			145 43 57.6	325 43 28.3	Beeville	2972.9	3.473185
Skidmore Methodist Church spire	28 15 18.206	560.4	345 27 30.1	165 28 09.5	Welder	9053.0	3.956792
1904–5	97 40 40.752	1110.8	67 20 08.9	247 16 37.6	Skelly	13202.9	4.120669
			112 26 06.5	292 22 27.8	Miller	13612.5	4.133937
			157 12 15.6	337 09 32.1	Beeville	24192.1	4.383673
			163 40 33.8	343 39 50.2	O'Neill	8912.9	3.950021
Skidmore Catholic Church spire	28 15 28.875	888.8	345 31 20.9	165 32 01.6	Welder	9389.5	3.972644
1904–5	97 40 43.477	1185.1	111 15 35.5	291 11 58.0	Miller	13421.3	4.127794
			157 03 46.4	337 01 04.1	Beeville	23860.6	4.377682
			163 32 06.9	343 31 24.6	O'Neill	8576.9	3.933332
Skidmore Baptist Church spire	28 15 12.239	376.8	345 16 55.7	165 17 34.8	Welder	8870.5	3.947948
1904–5	97 40 40.040	1091.4	68 06 25.3	248 02 53.6	Skelly	13151.2	4.118966
			157 19 46.7	337 17 02.8	Beeville	24369.0	4.386837
			163 53 01.9	343 52 18.0	O'Neill	9094.7	3.958790
Clareville gin stack[1]	28 19 16.09	495.3	290 50 04	110 51 42	Miller	5997.8	3.777903
1905	97 51 48.27	1315.0	334 07 51	154 09 35	Skelly	13797.7	4.139807

[1] No check on this position.

Seguin base net to Laguna Madre base—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Runge schoolhouse steeple	28 53 17.670	544.0	3 13 23.7	183 13 04.8	Choate	19042.2	4.279717
1904	97 42 41.791	1132.4	86 33 19.1	266 27 28.3	Karnes	19718.9	4.294883
			170 51 44.6	350 51 00.4	Ruckman	15562.0	4.192065
Runge church, tallest spire	28 53 10.300	317.1	3 03 02.4	183 02 43.4	Choate	18812.0	4.274434
1904	97 42 44.157	1201.9	87 12 12.5	267 06 22.9	Karnes	19637.1	4.293078
			171 14 32.1	351 13 49.1	Ruckman	15775.3	4.197977
Mathis gin stack	28 05 41.943	1291.2	314 22 10.4	134 25 03.2	Nolan	14045.7	4.147544
1904	97 49 34.882	952.3	19 06 47.3	199 06 46.3	Mathis	178.3	2.251212
			33 35 08.9	213 31 40.7	Reynolds	21911.1	4.340664
Mathis Methodist Church spire	28 05 39.785	1224.7	192 05 49.6	12 06 36.7	Skelly	13000.7	4.113967
1905	97 49 47.424	1294.7	289 46 08.2	109 46 13.1	Mathis	301.8	2.479684
			313 12 50.4	133 15 49.3	Nolan	14246.9	4.153720
Wood's ranch house cupola	27 45 56.745	1746.8	77 27 45.9	257 24 29.3	Alice	11847.9	4.073641
1905	97 57 28.605	783.2	182 36 40.8	2 36 55.0	Reynolds	18241.9	4.261071
			337 09 38.6	157 10 08.5	Wood	4525.8	3.655691
Alice, Walters & Co. gin stack	27 44 47.012	1447.0	278 08 28.2	98 12 27.6	Wood	14239.3	4.153488
1905	98 04 59.076	1617.8	318 16 31.1	138 19 21.7	Alice east base	15122.3	4.179618
			299 10 04.7	119 10 17.8	Alice	8842.2	3.946560
Alice spire	27 45 02.648	81.5	280 49 01.8	100 52 44.0	Wood	13314.7	4.124332
1905	98 04 21.925	600.4	322 27 04.7	142 29 38.1	Alice east base	14843.7	4.171542
			15 03 27.8	195 03 23.7	Alice	944.6	2.975273
McNeill's (P. E.) house windmill	27 59 37.598	1157.3	217 03 30.1	37 05 53.7	Mathis	13846.4	4.141338
1905	97 54 42.674	1166.1	265 39 01.1	85 44 18.1	Nolan	18503.2	4.267247
			328 11 58.1	148 15 04.7	Elliff	20699.3	4.315956
			27 44 56.3	207 43 52.7	Reynolds	7958.7	3.900843
Banquete, Elliff's (Cyrus), house chimney[2]	27 47 40.76	1254.7	60 31 02	240 27 20	Wood	14966.1	4.175110
1905	97 48 28.85	789.7	188 37 46	8 37 58	Elliff	4519.4	3.655082
King's ranch house, tallest chimney[1]	27 50 53.75	1654.4	5 27 24	185 27 02	Wood	13373.7	4.126252
1905	97 55 38.04	1040.8	166 25 53	346 25 15	Reynolds	9341.8	3.970432
Bay View College recitation hall, belfry	27 52 11.976	368.6	99 52 40.0	279 46 47.0	Kaleta	20950.4	4.321192
1905	97 19 22.824	624.4	141 15 59.7	321 15 38.4	Portland	1987.6	3.298325
			295 40 44.5	115 43 34.5	McGloins Bluff	11053.8	4.043513
			323 44 18.0	143 48 16.6	Mustang	23713.1	4.374989
Bay View College dormitory, chimney	27 52 10.736	330.5	99 59 01.6	279 53 08.2	Kaleta	20950.5	4.321194
1905	97 19 23.068	631.0	142 05 34.1	322 05 13.0	Portland	2013.4	3.303931
			295 29 08.7	115 31 58.9	McGloins Bluff	11043.4	4.043102
			347 16 55.9	167 18 21.0	Laguna Madre N. base	22724.1	4.356486
Corpus Christi L. H.	27 47 21.187	652.2	88 18 53.8	268 18 03.3	Corpus	2966.2	3.472202
1905	97 22 41.706	1141.7	201 46 48.5	21 48 00.1	Portland	11309.3	4.053434
			254 51 54.9	74 56 17.5	McGloins Bluff	15958.3	4.202988
Aransas L. H.	27 51 49.792	1532.7	31 50 05.3	211 45 15.6	Padre	32356.1	4.509956
1860	97 03 22.962	628.1	33 38 55.2	213 35 26.4	Mustang	22176.4	4.345891
			44 44 25.5	224 38 23.3	Laguna Madre N. base	30274.6	4.481078
			75 53 07.9	255 48 29.6	McGloins Bluff	16813.9	4.225668
Corpus Christi standpipe	27 47 41.837	1298.0	23 51 04.9	203 50 59.5	Corpus	790.8	2.898041
1905	97 24 18.328	501.8	85 52 57.2	265 46 57.8	Rogers	21163.0	4.325578
			133 27 11.4	313 23 37.0	Kaleta	17299.7	4.238038
			214 43 32.1	34 45 28.9	Portland	12005.9	4.079394
			258 55 11.5	79 00 19.2	McGloins Bluff	18391.9	4.264627
			296 00 26.1	116 06 42.1	Mustang	24614.7	4.391195
			316 40 29.1	136 44 11.5	Laguna Madre N. base	19084.5	4.280681
Robstown railway water tank	27 47 09.929[4]	305.6	111 43 50.9	291 39 58.8	Elliff	14652.3	4.165906
1905	97 39 46.676	1277.9	224 53 14.4	44 56 53.5	Kaleta	18180.0	4.259594
			277 20 28.4	97 21 41.8	Rogers	4343.8	3.637868

[1] No check on this position.

[2] Checked by vertical angles only.

Seguin base net to Laguna Madre base—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Corpus Christi colored church spire 1905	27 47 54.005 97 23 47.404	1662.4 1297.6	85 04 23.9 130 41 15.9 259 35 42.2 297 41 57.3 319 20 24.7	264 58 10.0 310 37 26.9 79 40 35.5 117 47 58.9 139 23 52.7	Rogers Kaleta McGloins Bluff Mustang Laguna Madre N. base	22036.5 17677.3 17490.4 24028.6 18796.5	4.343143 4.247415 4.242800 4.380729 4.274076
Corpus Christi Catholic Church spire 1905	27 47 48.511 97 23 51.330	1493.1 1405.2	85 29 20.7 131 19 43.9 212 16 09.5 259 07 01.2 297 13 23.0 318 45 13.1	265 23 08.6 311 15 56.7 32 17 53.7 79 11 56.4 117 19 26.4 138 48 42.9	Rogers Kaleta Portland McGloins Bluff Mustang Laguna Madre N. base	21915.5 17707.1 11426.5 17627.2 24046.0 18739.2	4.340751 4.248148 4.057915 4.246184 4.381042 4.272750
Corpus Christi King Mem. Epis. Church spire 1905	27 47 47.277 97 23 47.386	1455.2 1297.2	52 38 47.6 211 42 33.4 318 55 35.9	232 38 27.7 31 44 15.6 138 59 03.8	Corpus Portland Laguna Madre N. base	1467.9 11401.6 18639.5	3.166693 4.056965 4.270434
Windmill No. 1 1905	27 40 34.401 97 17 16.302	1058.9 446.8	257 27 48.0 295 38 16.4 5 39 26.9	77 30 47.1 115 38 42.3 185 39 17.2	Mustang Laguna Madre N. base Laguna Madre S. base	10817.0 1695.4 5829.7	4.034106 3.229284 3.765648
Alta Vista Hotel, south spire 1905	27 45 34.048 97 22 41.344	1048.0 1132.2	95 48 43.2 137 10 58.8 196 52 33.4 289 25 30.9	275 41 58.8 317 10 08.1 16 53 44.8 109 31 01.4	Rogers Corpus Portland Mustang	23886.4 4376.9 14420.8 20639.8	4.378151 3.641171 4.158989 4.314706
Corpus Christi, Dr. Spohn's house, cupola 1905	27 47 37.027 97 23 47.822	1139.7 1309.1	63 31 41.4 86 25 39.2 210 56 43.0 257 55 42.9 318 15 12.5	243 31 21.7 266 19 25.5 30 58 25.5 78 00 36.3 138 18 40.6	Corpus Rogers Portland McGloins Bluff Laguna Madre N. base	1290.2 21986.3 11677.3 17603.5 18410.8	3.110652 4.342152 4.067342 4.245599 4.265072
Water tank near north base 1905	27 40 12.629 97 16 21.226	388.8 581.7	134 24 57.9 196 03 13.1 251 33 49.1 324 43 38.5 343 15 42.3 22 06 43.5	314 21 10.4 16 04 38.0 71 36 22.6 144 44 50.7 163 15 42.6 202 06 08.2	Corpus McGloins Bluff Mustang Padre Laguna Madre N. base Laguna Madre S. base	18733.8 18053.1 9539.7 7399.2 66.3 5538.4	4.272627 4.256552 3.979533 3.869183 1.821734 3.743381
Epworth League pavilion, center 1905	27 49 33.235 97 23 06.560	1023.0 179.5	28 49 14.0 120 15 29.6 217 08 30.0 269 38 00.9	208 48 35.1 300 11 21.4 37 09 53.3 89 42 35.3	Corpus Kaleta Portland McGloins Bluff	4739.0 16811.5 8075.8 16085.3	3.675685 4.225607 3.907186 4.206430
Ritter's windmill 1905	27 39 13.336 97 16 57.888	410.5 1586.7	210 09 57.3 308 36 45.8 18 05 02.4	30 10 14.6 128 38 15.2 198 04 44.2	Laguna Madre N. base Padre Laguna Madre S. base	2037.5 6754.8 3477.9	3.309101 3.829610 3.541314
Windmill No. 2 1905	27 41 33.146 97 15 35.022	1020.2 959.7	266 02 54.4 340 33 57.0 23 46 18.4 26 08 06.5	86 05 06.5 160 34 47.9 203 45 21.7 206 07 45.4	Mustang Padre Laguna Madre S. base Laguna Madre N. base	7802.7 9034.2 8314.5 2831.3	3.892243 3.955892 3.919837 3.451984
Shamrock Island barn, SW. gable 1905	27 45 47.685 97 10 08.511	1467.8 233.1	9 02 42.9 19 59 02.0 44 30 25.9	189 02 23.2 199 57 21.2 224 27 32.9	Mustang Padre Laguna Madre N. base	7391.6 17401.1 14544.4	3.868736 4.240576 4.162695
Cestohowa church spire [1] 1905	29 00 38.36 97 56 01.84	1181.0 49.8	264 35 59 352 17 59	84 41 43 172 18 35	Ruckman Karnes	19263.3 14903.1	4.284730 4.173276
Panna Maria church spire [1] 1905	28 57 24.89 97 53 52.94	766.3 1433.5	243 40 19 9 38 05	63 45 00 189 37 38	Ruckman Karnes	17505.8 8938.5	4.243181 3.951264

[1] Checked by vertical angles only.

Seguin base net to Laguna Madre base—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Parkman's gin stack [1]	27 45 10.42	320.7	281 25 14	101 29 05	Wood	13824.7	4.140655
1905	98 04 39.19	1073.3	348 49 40	168 49 44	Alice	1173.6	3.069508
Rosita ranch house, south chimney [1]	27 52 27.57	848.6	326 40 31	146 42 17	Corpus	11389.7	4.056513
1905	97 28 18.57	508.0	117 21 09	297 19 26	Kaleta	6742.0	3.828789
McHarry's barn, cupola [1]	27 54 18.54	570.7	347 49 29	167 49 38	Portland	2399.3	3.380077
1905	97 20 26.79	732.6	89 04 35	268 59 12	Kaleta	18893.0	4.276300
Brighton post office, north gable [2]	27 36 41.82	1287.2	204 40 19	24 40 30	Laguna Madre S. base	1493.8	3.174307
	97 18 00.01	0.3					
1905			266 19 09	86 21 07	Padre	6995.7	3.844834

Laguna Madre base to Point Isabel.

Principal points.							
Grants	27 38 28.423	874.8	79 33 39.85	259 30 43.63	Laguna Madre S. base	10592.57	4.0250015
1877	97 11 17.315	474.7					
			110 44 26.37	290 42 05.63	Laguna Madre N. base	8885.80	3.9486965
			170 48 45.04	350 47 48.49	McGloin's Bluff	20823.17	4.3185469
Chappa	27 32 59.795	1840.4	145 47 02.58	325 45 28.48	Laguna Madre S. base	9907.59	3.9959680
1877	97 14 14.066	386.0					
			165 21 05.55	345 20 06.94	Laguna Madre N. base	13705.19	4.1368849
			205 35 34.23	25 36 56.11	Grants	11216.70	4.0498657
Peat Island	27 34 48.160	1482.4	200 16 43.69	20 17 14.01	Laguna Madre S. base	5177.09	3.7140861
1877	97 18 42.708	1171.4					
			240 56 08.14	60 59 34.58	Grants	13968.66	4.1451548
			294 20 05.09	114 22 09.41	Chappa	8089.12	3.9079014
Mott	27 28 21.193	652.3	204 23 58.20	24 25 29.24	Peat Island	13080.20	4.1166142
1877	97 21 59.707	1639.7	236 06 29.85	56 10 04.94	Chappa	15390.19	4.1872439
Richards	27 26 20.569	633.1	117 00 46.22	296 58 43.85	Mott	8179.18	3.9127097
1877	97 17 34.297	941.9	173 09 05.56	353 08 33.96	Peat Island	15735.94	4.1968926
			204 05 07.72	24 06 40.16	Chappa	13461.23	4.1290848
Wheelbarrow	27 20 45.556	1402.2	164 49 25.39	344 48 21.60	Mott	14531.60	4.1623133
1877	97 19 41.146	1131.0	198 39 59.64	18 40 58.00	Richards	10884.53	4.0368095
Point of Rocks	27 21 42.870	1319.5	194 49 59.26	14 50 53.72	Mott	12683.24	4.1032302
1877	97 23 57.972	1593.3	230 56 13.18	50 59 09.75	Richards	13570.71	4.1326025
			284 00 54.69	104 02 52.70	Wheelbarrow	7275.81	3.8618816
Griffins Point	27 15 44.480	1369.1	199 12 49.45	19 13 53.63	Point of Rocks	11682.15	4.0675229
1877	97 26 17.861	491.3	229 37 35.58	49 40 37.56	Wheelbarrow	14313.12	4.1557344
Shells	27 13 54.832	1687.7	113 31 30.24	293 29 21.12	Griffins Point	8461.07	3.9274253
1877	97 21 35.830	984.8	164 49 42.57	344 48 37.38	Point of Rocks	14926.49	4.1739578
			194 00 04.15	14 00 56.73	Wheelbarrow	13029.05	4.1149129
Coyote	27 09 05.698	175.4	184 02 11.03	4 02 25.43	Griffins Point	12304.41	4.0900607
1877	97 26 49.348	1358.8	224 05 55.40	44 08 18.67	Shells	12395.93	4.0932793
Venado	27 08 11.509	354.2	103 10 50.35	283 08 52.20	Coyote	7323.38	3.8647116
1877	97 22 30.381	836.6	155 49 51.47	335 48 07.49	Griffins Point	15282.97	4.1842077
			188 05 03.31	8 05 28.23	Shells	10673.05	4.0282885
Indian	27 01 37.205	1145.1	184 55 22.46	4 55 42.12	Coyote	13854.85	4.1416019
1878	97 27 32.529	896.6	214 25 44.66	34 28 02.21	Venado	14716.56	4.1678062
Station Hill	27 00 52.697	1621.9	99 55 57.17	279 53 48.01	Indian	7955.83	3.9006855
1878	97 22 48.231	1329.7	156 22 16.73	336 20 26.94	Coyote	16563.98	4.2191646
			182 05 03.91	2 05 12.03	Venado	13514.62	4.1308040

[1] Checked by vertical angles only.

[2] No check on this position.

Laguna Madre base to Point Isabel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Stoley	26 54 35.082	1079.7	146 22 27.03	326 20 04 85	Indian	15606.14	4.1932956
1878	97 22 19.006	524.4	176 02 04.06	356 01 50.81	Station Hill	11649.90	4.0663221
Avoca	26 53 36.012	1108.2	187 10 04.12	7 10 34.75	Indian	14926.62	4.1739613
1878	97 28 40.096	1106.6	215 48 42.40	35 51 21.90	Station Hill	16577.90	4.2195293
			260 10 04.72	80 12 57.15	Stoley	10672.27	4.0282567
Tank	26 46 29.942	921.5	134 32 25.89	314 28 47.81	Avoca	18705.21	4.2719626
1878	97 20 36.997	1022.6	169 19 27.21	349 18 41.15	Stoley	15194.36	4.1816823
Topo	26 45 18.196	560.0	177 51 33.46	357 51 24.09	Avoca	15331.86	4.1855948
1878	97 28 19.344	534.5	210 06 48.87	30 09 31.52	Stoley	19817.83	4.2970560
			260 09 49.71	80 13 17.92	Tank	12963.34	4.1127170
Lomalto	26 35 16.627	511.7	168 22 20.61	348 21 18.72	Topo	18902.39	4.2765168
1879	97 26 01.463	40.5	203 23 18.98	23 25 44.68	Tank	22580.54	4.3537344
Gladiator	26 37 12.307	378.8	75 28 14.77	255 24 32.91	Lomalto	14161.50	4.1511092
1878	97 17 46.050	1273.9	130 32 21.49	310 27 37.06	Topo	23025.46	4.3622082
			164 36 53.90	344 35 37.10	Tank	17800.67	4.2504363
Waterhole	26 30 42.935	1321.3	115 35 38.21	295 30 53.74	Lomalto	19526.28	4.2906195
1879	97 15 25.047	693.6	161 58 13.02	341 57 09.96	Gladiator	12602.58	4.1004595
Rifle	26 29 31.663	974.4	166 21 20.91	346 20 39.29	Lomalto	10925.01	4.0384219
1879	97 24 28.329	784.5	261 40 16.68	81 44 19.11	Waterhole	15203.46	4.1819425
			218 07 18.73	38 10 18.59	Gladiator	18026.46	4.2559106
Colorado	26 21 58.123	1787.5	154 45 58.13	334 44 12.40	Rifle	15431.95	4.1884209
1879	97 20 30.775	853.2	207 39 24.09	27 41 40.21	Waterhole	18237.63	4.2609683
Santa Cruz	26 24 35.430	1090.4	65 42 38.73	245 39 46.92	Colorado	11758.12	4.0703380
1879	97 14 04.207	116.6	117 50 21.37	297 45 43.37	Rifle	19546.84	4.2910766
			168 48 18.49	348 47 42.47	Waterhole	11529.58	4.0618133
Armadillo	26 16 47.844	1472.4	147 37 54.97	327 36 18.15	Colorado	11306.92	4.0533443
1879	97 16 52.438	1454.9	197 57 05.21	17 58 19.87	Santa Cruz	15127.05	4.1797542
Black Hill	26 16 09.319	286.8	97 22 53.64	277 20 27.23	Armadillo	9253.31	3.9662970
1879	97 11 21.686	601.7	125 12 41.34	305 08 37.91	Colorado	18632.21	4.2702644
			163 52 19.24	343 51 07.13	Santa Cruz	16214.29	4.2098981
Fox	26 11 42.206	1298.8	189 01 57.50	9 02 21.33	Armadillo	9523.95	3.9788169
1867	97 17 46.330	1286.4	232 22 54.71	52 25 44.73	Black Hill	13474.16	4.1295017
Singer	26 12 49.310	1517.5	79 56 06.25	259 53 01.68	Fox	11786.53	4.0713858
1867	97 10 48.351	1342.3	126 01 13.22	305 58 32.21	Armadillo	12489.34	4.0965395
			171 27 14.50	351 26 59.76	Black Hill	6224.26	3.7940878
Cameron	26 09 20.184	621.2	179 02 06.75	359 02 05.58	Fox	4371.20	3.6406005
1867	97 17 43.679	1213.2	240 48 40.58	60 51 43.85	Singer	13206.71	4.1207947
Pool	26 07 56.067	1725.4	101 09 11.94	281 05 43.11	Cameron	13416.69	4.1276454
1867	97 09 49.740	1381.8	117 45 48.52	297 42 18.36	Fox	14953.97	4.1747573
			169 46 46.15	349 46 20.30	Singer	9169.83	3.9623614
Fronton	26 04 41.129	1265.7	134 10 33.53	314 08 13.41	Cameron	12327.43	4.0908726
1867	97 12 25.353	704.5	145 29 17.54	325 26 56.14	Fox	15729.40	4.1967122
			215 46 24.73	35 47 33.20	Pool	7394.82	3.8689276
Point Isabel south base	26 03 41.391	1273.7	165 55 25.25	345 54 43.83	Cameron	10748.92	4.0313648
1886	97 16 09.553	266.4	253 32 59.50	73 34 38.03	Fronton	6497.03	3.8127151
Point Isabel west base	26 06 19.476	599.3	204 39 56.46	24 40 36.96	Cameron	6119.69	3.7867294
1906	97 19 15.631	434.3	284 50 28.36	104 53 28.79	Fronton	11796.20	4.0717421
			313 14 21.39	133 15 43.21	Point Isabel S. base	7099.96	3.8512557
Point Isabel east base	26 04 44.059	1355.8	39 46 45.70	219 46 20.32	Point Isabel S. base	2509.29	3.3995509
1906	97 15 11.793	327.7	113 26 37.03	293 24 49.78	Point Isabel W. base	7384.922	3.8683459
			153 35 58.84	333 34 51.98	Cameron	9487.52	3.9771525
			271 06 23.90	91 07 37.05	Fronton	4626.65	3.6652667
Arista	26 00 13.334	410.3	198 14 29.68	18 15 28.38	Point Isabel W. base	11864.19	4.0742379
1885	97 21 29.287	814.4	200 25 16.02	20 26 55.21	Cameron	17958.63	4.2542732
			231 31 59.81	51 34 45.54	Point Isabel E. base	13399.56	4.1270907
			234 13 04.62	54 15 24.95	Point Isabel S. base	10955.33	4.0396254
			241 22 41.51	61 26 40.29	Fronton	17221.80	4.2360786

Laguna Madre base to Point Isabel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Flour Bluff	27 42 00.463	14.2	198 45 18.39	18 46 39.48	McGloins Bluff	14816.56	4.1707474
1860	97 16 12.878	352.8	308 50 27.71	128 52 44.97	Grants	10402.41	4.0171338
			348 55 02.40	168 55 57.48	Chappa	16957.74	4.2293680
			17 09 49.80	197 08 40.29	Peat Island	13925.95	4.1438247
Thompsons	27 43 11.501	354.0	26 37 51.93	206 36 37.90	Grants	9746.51	3.9888490
1876	97 08 37.946	1039.4	80 04 42.62	260 01 11.08	Flour Bluff	12653.69	4.1022170
			147 01 12.03	326 59 01.16	McGloins Bluff	14120.01	4.1498349
			208 22 14.88	28 24 41.74	Aransas L. H.	18134.74	4.2585113
Kenedy	27 18 53.532	1647.6	253 14 58.6	73 18 10.3	Wheelbarrow	11982.2	4.078536
1877	97 26 38.581	1060.7	317 48 45.2	137 51 03.9	Shells	12404.0	4.093563
			354 24 21.4	174 24 30.9	Griffins Point	5846.6	3.766904
Penescal	27 14 54.908	1690.0	210 59 16.3	31 00 29.8	Kenedy	8568.2	3.932890
1877	97 29 19.029	523.5	252 57 59.1	72 59 22.1	Griffins Point	5212.0	3.717007
Rabbit	27 17 49.187	1513.9	253 49 54.4	73 51 48.5	Kenedy	7119.1	3.852424
1877	97 30 47.271	1299.8	297 22 05.0	117 24 08.4	Griffins Point	8344.6	3.921408
			335 38 58.1	155 39 38.5	Penescal	5887.6	3.769938
Crawford	27 14 28.678	882.7	231 37 22.1	51 39 32.1	Rabbit	9944.4	3.997580
1877	97 35 30.771	846.6	265 27 46.0	85 30 36.2	Penescal	10258.9	4.011102
Tree	27 17 54.279	1670.6	271 02 06.1	91 04 28.1	Rabbit	8513.4	3.930102
1877	97 35 56.814	1562.3	296 45 01.4	116 48 03.7	Penescal	12254.8	4.088306
			353 32 24.3	173 32 36.2	Crawford	6368.5	3.804039
Bovido[1]	27 17 27.18	836.6	262 05 44	82 07 24	Tree	6074.4	3.783506
1877	97 39 35.62	979.6	309 11 30	129 13 22	Crawford	8691.6	3.939100
Camp	27 37 35.868	1104.0	58 46 40.6	238 44 16.9	Peat Island	9952.9	3.997950
1876	97 13 32.397	888.3	151 38 19.6	331 37 05.1	Flour Bluff	9256.2	3.966431
			246 23 40.8	66 24 43.5	Grants	4041.2	3.606507
Jack	27 39 22.059	679.0	23 08 17.3	203 07 16.5	Peat Island	9167.6	3.962257
1877	97 16 31.370	859.8	185 55 56.8	5 56 05.4	Flour Bluff	4902.0	3.690376
			280 50 09.1	100 52 34.8	Grants	8765.5	3.942779
Peg	27 31 47.084	1449.1	24 35 40.2	204 34 51.4	Mott	6969.2	3.843182
1877	97 20 14.061	385.9	204 12 22.1	24 13 04.3	Peat Island	6111.1	3.786118
			257 12 38.0	77 15 24.4	Chappa	10128.1	4.005526
			336 24 46.9	156 26 00.5	Richards	10965.1	4.040011
Gum Pen	27 05 05.035	155.0	48 39 08.9	228 37 09.0	Indian	9679.4	3.985847
1878	97 23 08.914	245.6	190 28 30.1	10 28 47.6	Venado	5836.6	3.766160
			355 48 03.4	175 48 12.8	Station Hill	7787.3	3.891386
New	26 59 44.306	1363.6	167 27 54.5	347 27 41.8	Indian	3559.6	3.551407
1878	97 27 04.502	124.1	213 19 16.2	33 21 03.3	Gum Pen	11815.4	4.072448
			320 22 34.8	140 24 44.2	Stoley	12352.6	4.091758
Rock Pen	27 12 57.675	1775.1	11 49 24.7	191 48 59.9	Coyote	7294.5	3.862997
1877	97 25 55.065	1515.3	173 02 11.8	353 02 01.4	Griffins Point	5172.2	3.713674
			327 22 42.9	147 24 16.4	Venado	10455.8	4.019358
Bird	27 31 00.904	27.8	63 01 13.8	242 58 31.5	Mott	10827.4	4.034523
1877	97 16 08.260	226.7	148 48 10.1	328 46 58.6	Peat Island	8178.3	3.912664
Frank	27 22 45.895	1412.6	343 40 27.8	163 41 31.1	Griffins Point	1375.7	3.138530
1877	97 28 35.974	988.5	21 34 21.2	201 33 20.9	Rabbit	9819.7	3.992098
			53 30 03.6	233 26 41.1	Tree	15080.0	4.178401
Cow	27 25 20.350	626.4	184 01 28.5	4 01 35.1	Mott	5580.0	3.746637
1877	97 22 13.972	383.8	256 24 56.9	76 27 05.8	Richards	7901.9	3.897730
			333 35 12.3	153 36 22.6	Wheelbarrow	9443.0	3.975108
			23 07 22.0	203 06 34.2	Point of Rocks	7278.2	3.862025
Willow	27 19 11.741	361.4	51 23 49.3	231 21 36.2	Griffins Point	10220.3	4.009464
1877	97 21 27.497	756.0	138 21 57.9	318 20 48.8	Point of Rocks	6224.6	3.794111
			225 20 54.7	45 21 43.5	Wheelbarrow	4109.1	3.613751
Camp No. 2	27 23 15.362	472.8	64 22 33.8	244 20 54.5	Point of Rocks	6579.5	3.818194
1877	97 20 22.110	607.6	164 06 40.4	344 05 55.4	Mott	9787.6	3.990674
			218 57 00.0	38 58 17.2	Richards	7331.2	3.865177
			346 16 37.6	166 16 56.4	Wheelbarrow	4746.3	3.676358

[1] No check on this position.

Laguna Madre base to Point Isabel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Murdocks Landing 1877	27 11 16.685 97 22 51.438	513.6 1405.8	58 24 04.7 145 26 29.4 203 08 25.3 354 11 26.3	238 22 16.1 325 24 55.0 23 08 59.9 174 11 35.9	Coyote Griffins Point Shells Venado	7691.0 10009.9 5293.6 5728.8	3.885980 4.000431 3.723751 3.758062
Penescal house, north gable 1877	27 14 26.370 97 30 04.205	811.6 115.7	90 28 25.2 123 26 21.0 169 15 29.4 214 30 19.4 234 44 49.9 248 52 26.2	270 25 55.7 303 23 39.4 349 15 09.7 34 31 53.6 54 45 10.6 68 54 09.8	Crawford Tree Rabbit Kenedy Penescal Griffins Point	8984.9 11619.5 6353.8 9979.9 1521.9 6674.7	3.953512 4.065186 3.803035 3.999127 3.182384 3.824429
Ford [1] 1877	27 36 16.33 97 13 46.10	502.6 1264.2	7 13 48 71 34 12	187 13 35 251 31 55	Chappa Peat Island	6097.7 8575.4	3.785169 3.933256
Kenedy's warehouse, south gable 1877	27 16 39.416 97 30 54.485	1213.2 1498.5	62 07 04.5 185 16 42.1 239 35 15.9 282 30 41.1 320 46 09.4	242 04 57.9 5 16 45.4 59 37 13.2 102 32 47.8 140 46 53.1	Crawford Rabbit Kenedy Griffins Point Penescal	8599.6 2156.6 8158.4 7794.2 4152.2	3.934476 3.333773 3.911606 3.891772 3.618278
Sand 1878	26 57 25.461 97 23 18.370	783.6 506.7	342 39 07.6 51 30 54.8 137 53 13.5	162 39 34.5 231 28 29.1 317 51 18.2	Stoley Avoca Indian	5493.6 11342.7 10447.2	3.739855 4.054717 4.019000
Mosquito 1878	26 48 16.098 97 28 47.860	495.4 1321.9	181 14 48.1 222 36 00.2 283 31 00.9 351 48 39.1	1 14 51.6 42 38 55.9 103 34 42.1 171 48 51.9	Avoca Stoley Tank Topo	9848.3 15851.9 13946.9 5531.6	3.993360 4.200080 4.144477 3.742851
Crossing 1878	26 50 57.095 97 22 30.521	1757.2 842.6	339 07 12.7 42 45 01.3 115 38 19.0 182 42 41.1	159 08 04.0 222 42 24.1 295 35 32.0 2 42 46.3	Tank Topo Avoca Stoley	8799.5 14198.8 11313.1 6716.5	3.944458 4.152253 4.053582 3.827144
Portalis 1878	26 38 34.651 97 26 53.715	1066.4 1485.6	169 12 51.1 215 25 22.7 279 27 46.6 346 39 11.4	349 12 12.8 35 28 12.1 99 31 52.1 166 39 35.0	Topo Tank Gladiator Lomalto	12643.1 17955.6 15359.3 6263.4	4.101854 4.254199 4.186370 3.796813
Rainy 1878	26 41 57.797 97 20 00.775	1778.8 21.4	337 00 47.1 38 57 37.3 114 08 39.0 173 11 13.1	157 01 47.6 218 54 55.6 294 04 54.8 353 10 56.8	Gladiator Lomalto Topo Tank	9543.6 15872.9 15096.5 8435.2	3.979711 4.200657 4.178877 3.926096
Bonnet 1878	26 30 27.965 97 24 42.405	860.6 1174.2	166 09 59.3 222 46 29.3 268 15 20.2 347 19 13.3	346 09 24.0 42 49 35.7 88 19 29.1 167 19 19.6	Lomalto Gladiator Waterhole Rifle	9149.3 16959.9 15440.0 1776.0	3.961387 4.229423 4.188648 3.249448
Brant 1879	26 34 17.195 97 17 21.681	529.2 600.0	53 22 43.2 172 52 10.9 333 54 16.3	233 19 32.6 352 52 00.0 153 55 08.4	Rifle Gladiator Waterhole	14721.8 5431.2 7342.0	4.167961 3.734897 3.865813
Duck 1879	26 27 47.488 97 14 48.691	1461.5 1348.8	348 13 04.9 41 25 28.8 101 19 44.3 169 26 20.1	168 13 24.7 221 22 56.6 281 15 26.0 349 26 04.0	Santa Cruz Colorado Rifle Waterhole	6037.7 14334.2 16371.6 5492.5	3.780874 4.156374 4.214090 3.739770
Pelican 1879	26 24 33.602 97 22 45.643	1034.1 1265.0	162 46 32.3 269 44 40.9 321 59 28.4	342 45 46.6 89 48 32.8 142 00 28.3	Rifle Santa Cruz Colorado	9603.9 14451.1 6072.1	3.982447 4.159901 3.783337
Crane, lone palmetto tree 1879	26 22 19.271 97 14 59.509	593.1 1649.7	17 04 37.2 85 58 00.8 200 05 24.0 332 02 04.6	197 03 47.2 265 55 33.7 20 05 48.6 152 03 41.2	Armadillo Colorado Santa Cruz Black Hill	10669.5 9206.9 4461.8 12888.7	4.028146 3.964113 3.649514 4.110209
Oil 1879	26 20 27.623 97 12 17.392	850.1 482.3	348 59 46.7 48 27 29.5 101 32 16.1 158 47 10.0	169 00 11.4 228 25 27.7 281 28 37.1 338 46 22.6	Black Hill Armadillo Colorado Santa Cruz	8098.0 10195.6 13960.8 8180.9	3.908376 4.008411 4.144909 3.912801
Cat 1879	26 19 42.998 97 19 33.331	1323.3 894.4	159 02 39.8 295 42 40.3 320 21 58.6	339 02 14.3 115 46 18.1 140 23 09.9	Colorado Black Hill Armadillo	4453.1 15140.8 6998.1	3.648661 4.180150 3.844979

[1] No check on this position.

Laguna Madre base to Point Isabel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Snipe	26 14 30.845	949.2	210 47 45.7	30 48 25.8	Armadillo	4908.4	3.690936
1879	97 18 23.013	638.7	255 26 36.5	75 29 42.9	Black Hill	12078.4	4.082010
			348 53 47.7	168 54 03.9	Fox	5288.7	3.723349
Mesena	26 05 07.511	231.1	171 30 23.6	351 30 05.2	Cameron	7862.0	3.895531
1867	97 17 01.871	52.0	246 36 31.9	66 39 42.0	Pool	13079.4	4.116588
			276 00 49.7	96 02 51.2	Fronton	7727.7	3.888050
Brazos Beacon	26 03 40.176	1236.4	101 43 26.0	281 40 00.7	Mesena	13258.5	4.122493
1867	97 09 14.745	409.8	109 30 29.5	289 29 05.7	Fronton	5620.1	3.749746
			172 57 44.7	352 57 29.3	Pool	7934.5	3.899518
Wolf Trap	26 00 29.331	902.6	141 08 12.3	321 06 23.4	Mesena	10996.5	4.041253
1854	97 12 53.592	1470.2	185 47 01.1	5 47 13.5	Fronton	7788.3	3.891443
			226 00 01.9	46 01 38.0	Brazos Beacon	8456.5	3.927193
Boca Chica 2	26 00 19.361	595.8	92 49 22.2	272 47 43.6	Wolf Trap	6260.5	3.796607
1867	97 09 08.742	243.1	124 00 55.0	303 57 27.3	Mesena	15863.1	4.200387
			145 51 11.8	325 49 45.5	Fronton	9734.9	3.988330
			178 27 11.2	358 27 08.6	Brazos Beacon	6182.0	3.791131
Rio Grande Observatory	25 57 17.197	529.2	131 01 27.1	310 59 40.0	Wolf Trap	9010.5	3.954750
1853	97 08 49.146	1367.3	174 26 50.6	354 26 42.0	Boca Chica 2	5632.2	3.750675
Mesena 2	26 05 07.480	230.2	171 31 52.97	351 31 34.62	Cameron	7862.4	3.895555
1885	97 17 01.990	55.3	276 00 15.41	96 02 17.03	Fronton	7730.9	3.888228
			283 14 11.68	103 15 00.14	Point Isabel E. base	3146.2	3.497792
			331 10 50.05	151 11 13.10	Point Isabel S. base	3023.7	3.480540
			39 23 59.70	219 22 02.34	Arista	11711.4	4.068607
Point Isabel L. H.	26 04 38.589	1187.5	61 36 15.87	241 32 17.77	Arista	17146.41	4.2341731
1867	97 12 26.914	748.0	96 39 01.48	276 37 00.54	Mesena 2	7696.39	3.8862871
			134 34 33.77	314 32 14.33	Cameron	12351.08	4.0917050
			145 46 43.62	325 44 22.89	Fox	15769.42	4.1978158
			184 52 00.32	4 52 29.08	Black Hill	21333.50	4.3290620
			190 16 10.51	10 16 53.94	Singer	15347.49	4.1860373
			209 02 16.07	29 02 16.75	Fronton	89.38	1.95126
McManus	26 00 22.427	690.1	295 08 38.4	115 08 47.8	Arista	658.4635	2.818532
1885	97 21 50.721	1410.5					
Kingsbury	25 59 32.283	993.4	229 32 18.2	49 32 46.7	McManus	2378.050	3.376221
1885	97 22 55.782	1551.5					
Tank	25 57 23.601	726.3	225 03 35.0	45 04 37.5	Kingsbury	5606.895	3.7487224
1885	97 25 18.479	514.1					
Egan	25 56 21.981	676.4	225 03 29.7	45 03 59.6	Tank	2684.611	3.428881
1885	97 26 26.781	745.2					
Valls	25 56 12.795	393.7	229 35 53.0	49 35 58.2	Egan	436.154	2.639640
1885	97 26 38.718	1077.3					
Gomilla	25 56 06.437	198.1	235 09 49.1	55 09 53.5	Valls	342.530	2.534699
1885	97 26 48.822	1358.6					
Sherwood	25 55 34.612	1065.1	236 36 34.4	56 36 57.8	Gomilla	1779.676	3.250341
1885	97 27 42.222	1175.0					
Forto	25 54 33.330	1025.6	237 02 30.0	57 03 15.7	Sherwood	3466.975	3.5399507
1885	97 29 26.757	744.7					
Garrison	25 53 45.027	1385.6	165 10 56.4	345 10 50.2	Forto	1537.567	3.186834
1885	97 29 12.629	351.5					
Brownsville	25 53 52.910	1628.2	295 08 09.0	115 08 17.1	Garrison	571.075	2.756693
1885	97 29 31.202	868.5					

DESCRIPTION OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this publication or to the index on page 411.

All directions in the descriptions given in the form of azimuths are reckoned continuously from the south around by the west to 360°, west being 90°, north 180°, and east 270°. The azimuths are true; where magnetic bearings are given they are indicated as such.

Usually the surface and underground marks are not in contact, so that a disturbance of the surface mark will not, in general, affect the underground mark. The underground mark should be resorted to only when there is evidence that the surface mark has been disturbed.

Any person who finds that one of the stations here described has been disturbed or that the description no longer fits the facts is requested to send such information to the Superintendent, Coast and Geodetic Survey, Washington, D. C.

GENERAL NOTES IN REGARD TO STATION MARKS.

NOTE 1.—A hole was dug 18 inches in diameter to a depth of 2 feet, then 1 foot in diameter to a depth of 4½ feet. In this was set the lower or underground mark, a 2-inch iron pipe, 2 feet long; the hole was then filled level with the top of the pipe with a concrete made of Portland cement, sand, and broken rock. The pipe was filled with concrete and a 60-penny steel wire nail was set in the center of the top, with its point projecting one-fourth inch, to mark the center of the station. Over this was placed 6 inches of sand. Then the surface mark, a similar piece of pipe, was plumbed directly over the lower mark, and the hole and pipe filled with concrete level with the surface. A 60-penny steel wire nail set in the center of the top of this pipe with its point projecting marked the center of the station. The top of the concrete was then covered with one-half inch of cement, on which were inscribed the letters U. S. C. & G. S. and the year. The reference mark was an iron pipe, 2 feet long, set in a hole 1 foot in diameter, surrounded and filled with concrete, with a 60-penny wire nail projecting one-fourth inch above the top of the pipe, which was level with the surface of the ground.

NOTE 2.—The station was marked by a subsurface mark and a surface mark. The subsurface mark consisted of a piece of terra-cotta sewer pipe, 4 inches in diameter and 2 feet long, filled with concrete and encased in a cylinder of concrete 1 foot in diameter and 2 feet long. In the center of its top is embedded a 60-penny steel spike, head down, the point of the spike projecting about one-fourth inch above the surface and marking the center. It is 2½ feet below the surface of the ground, the bottom of the pipe being 4½ feet below the surface. Above the whole is placed a layer of sand 6 inches deep. Resting on this layer of sand is placed the surface mark, consisting of another piece of terra-cotta sewer pipe, 4 inches in diameter and 2 feet long, filled with concrete and embedded in a cylinder of concrete 18 inches in diameter and 2 feet long. In the center of its top is placed a 60-penny steel spike, head down, its point projecting about one-fourth inch above the surface of the concrete, which was finished with one-half inch of neat cement mortar and marked with the letters U. S. C. & G. S. 1905. The point of the spike marks the center of the station and is very little above the surface of the ground. The reference mark is a cylinder of pipe and concrete similar to the subsurface

mark, placed with its top even with the surface of the ground. The point of a steel spike, in the cement, is the reference mark, and it is nowhere less than 10 meters from the station.

NOTE 3.—The station was marked by a concrete pyramid or coral rock buried 3 to 4 feet below the surface of the ground and having in its top a drill hole filled with lead. Above the underground mark was placed a cedar stub with a copper tack in its top, the stub projecting from 6 to 18 inches above the surface of the ground. Four reference stubs were placed around the station at the distances given, on lines intersecting at the center in approximate right angles; these stubs were usually of cedar.

NOTE 4.—The station was marked the same as in note 3, except that there was no center stub at the surface, its place being taken by the signal, which was a scantling set in the ground and well braced.

SEGUIN BASE NET TO LAGUNA MADRE BASE.

PRINCIPAL POINTS.

Thomas (Guadalupe County, Tex., W. H. B., 1903–4).—Eleven miles by road S. 15° E. from Seguin, the nearest railroad town; 270 paces N. 62° E. (magnetic) from Thomas Springs (only a water hole), well known for miles around; just inside the pasture of William Brodt, of Seguin, near the gate giving entrance to the pasture and the road leading to the house of William Oliver, who lives about ¼ mile east; 74 paces S. 65° E. (magnetic) from the northwest corner post of the pasture. The hill is cleared, except for large trees, to the north and west pasture fences in the neighborhood of the station. Fine white sand is in abundance. The station was marked according to note 1, page 385. The reference mark (which has no nail) is about 1½ feet north of the north fence line of the pasture, 82 paces east along fence line from the northwest corner near the gate, 50.873 meters N. 10° E. (magnetic) from the station, and about ½ foot higher (in elevation) than the station. The azimuth from the station of the west gable of James Pruitt's house is 82° 18′ 20″, and of the west gable of William Oliver's house 273° 27′ 14″.

Lavernia (Wilson County, Tex., O. W. F., 1904).—About 3¾ miles by road southwest from Lavernia, in the Howard pasture on the southern end of a sand ridge covered with oak and hickory trees and brush. Marked according to note 1, page 385, the reference mark being 30.071 meters from the station in azimuth 158° 50′ 13″. Other distances and azimuths from the station are as follows: Three post-oak trees deeply marked with 6-inch triangles on the sides facing the station—one 11 inches in diameter, 16.33 meters, 292°, one 7 inches in diameter, 15.63 meters, 336°, and one 16 inches in diameter, 5.02 meters, 92°; large stone chimney of a dwelling house beyond Lavernia, about 4 miles, 222° 38′ 39″; stone chimney of dwelling house, about 3 miles, 73° 37′ 22″.

Stockdale (Wilson County, Tex., W. H. B., 1904).—Two miles northeast of the town of Stockdale, about 200 meters south of the Stockdale and Union Valley Road and almost in the center of a large cotton field belonging to Mr. Richard Strand, who lives in the edge of the field about 250 meters northeast of the station. The station was marked according to note 1, page 385, the reference mark, which is practically at the same elevation as the station, being 20.542 meters from it in azimuth 345° 18′ 12″. The following azimuths are from the triangulation station: Northeast gable of Mrs. M. S. West's house, distant $\frac{1}{10}$ mile, 18° 21′ 55″; spire of Stockdale public school, 59°

29′ 52″; south gable of Richard Strand's house, distant ⅛ mile, 231° 29′ 54″; south gable of Nat Luker's house, distant ¼ mile, 329° 09′ 47″. From the reference mark the azimuths of these objects are as follows: Northeast gable of Mrs. M. S. West's house, 19° 52′ 50″; spire of Stockdale public school, 59° 48′ 55″; south gable of Richard Strand's house, 228° 25′ 00″; south gable of Nat Luker's house, 328° 43′ 43″.

Serita (Wilson County, Tex., O. W. F., 1904).—About 1½ miles S. 72° W. from the Marcelena post office, 4½ miles N. 40° E. from Floresville, and about 125 meters northwest from the Floresville and Marcelena wagon road, upon what is known as Serita Hill, on land owned by Mr. James, of Floresville, and rented in 1903 by G. W, Holder. The station was marked according to note 1, page 385, the reference mark being 13.010 meters from the station in azimuth 349° 45′ 53″. An oak tree 17 inches in diameter and bearing a 7-inch triangle cut in its side is 8.862 meters N. 33° W. from the station. A post oak tree 1 foot in diameter is 4.308 meters N. 80° W. from the station. The following azimuths are from the triangulation station: Large stone chimney on the house of G. W. Holder, distant about ¼ mile, 61° 04′ 28″; stone chimney on house of Clarence Noble, distant about 700 meters, 85° 33′ 21″; brick chimney on house of Sam Newman, distant about 1 mile, 123° 09′ 31″.

Karnes (Karnes County, Tex., W. H. B., 1904, 1905).—About ¾ mile southwest of Karnes City, 125 paces south of the Karnes City and Campbellton wagon road, on land belonging to Robert Salge, 26.91 meters from the southwestern gable of his house and 16.93 meters southwest of the southwest corner of his yard. The azimuth of the southwest gable of Mr. Salge's house from the station is 253° 18′ 20″. The reference mark is near the southeast corner of Mr. Salge's yard, 0.08 meter from the east fence, 0.46 meter from the south fence, and 30.024 meters from the station in azimuth 283° 08′ 51″. The latitude station established in 1905 was 4.84 meters due east of the triangulation station and was marked by a pier built of wooden posts.

Ruckman (Karnes County, Tex., W. H. B., 1904).—About 14 miles by road northeast of Karnes City; 7 miles northeast of Helena post office; 3 miles east by south of Radford post office, in a 7 000-acre pasture owned by John Ruckman, postmaster and merchant in Helena. The station is 402 paces east of the corner at a gate on the Riddleville–Runge road, 2 miles south of the house of W. H. Patten, and 95 paces from the Helena and Gonzales wagon road leading through the pasture; these two roads meet about 300 feet south of the station. The station was marked as in note 1, page 385, the reference mark being 37.478 meters from the station in azimuth 177° 10′ 33″. The following azimuths are from the station: Southwest gable of August Wagonshein's house, distant 2½ miles, 195° 07′ 19″; chimney on Albert Gerhart's house, distant 2 miles, 265° 03′ 11″; tall gatepost 2 miles south of W. H. Patten's, distant 95 paces, 93° 10′ 17″; smokestack on cotton gin at Radford post office, distant 3 miles, 114° 25′ 48″.

Choate (Karnes County, Tex., W. H. B., 1904).—About 12 miles by road southeast of Kenedy; 3½ miles by road south of Choate post office; ⅓ mile southwest of Mr. W. R. Scogin's house, in a pasture owned by Mrs. McKenney or her daughter, Mrs. W. R. Scogin. The station is on the highest part of a small hill covered with brush and about 415 paces west by south from the gate leading from Mrs. Scogin's house lot into the pasture. The station was marked according to note 1, page 385, the reference mark being about 2 feet lower than the station and 17.830 meters from it in azimuth 269° 15′.

The following azimuths are from the triangulation station: Chimney of W. R. Scogin's house, distant 500 yards, 200° 04′ 45″; chimney of J. L. Teas's house, distant ¾ mile, 227° 48′ 42″; chimney of Oscar Davenport's house, distant 1 mile, 309° 27′ 46″; smoke-stack on gin at Choate post office, distant 3 miles, 162° 47′ 57″.

Bryde (Karnes County, Tex., W. H. B., 1904).—About 6½ miles by road southwest of Kenedy, in and near the south side of a pasture belonging to D. McBryde and about ¾ mile south of his house. The station is on a ridge which is 5 minutes walk almost due east from a large tank on a draw ½ mile southeast of McBryde's house. The station was marked according to note 1, page 385, the reference mark being 36.235 meters from the triangulation station in azimuth 275° 13′ 04″, and 24.006 meters west of the fence separating McBryde's pasture from the cotton field of T. D. Packett, at a point 90 meters south from the gate in the fence. The following azimuths are from the triangulation station: T. D. Packett's windmill, distant ¾ mile, 280° 34′ 23″; Mrs. Andy William's windmill, distant ¾ mile, 343° 48′ 10″; largest chimney on the house of D. McBryde, distant ¾ mile, 158° 57′ 41″.

Pettus (Bee County, Tex., W. H. B., 1904).—About 2½ miles northeast of Pettus on a brush and timber covered ridge in a pasture owned by George A. Ray, who lives 1 mile southwest of Pettus. It is 1½ miles by road southwest of Sam Porter's house, 17 paces north of the wagon road from his place to Pettus and 18 meters north of a fence. The station was marked according to note 1, page 385, the reference mark being just inside the fence line at the same elevation as the station and 38.740 meters from it in azimuth 4° 29′ 20″. The azimuth from the station to the west chimney of Bob McKenney's house, distant ¾ mile, is 202° 46′ 06″, and to the chimney over the west gable of Sam Porter's house is 225° 48′ 18″.

Borroum (Bee County, Tex., W. H. B., 1904).—About 2 miles south of Caesar post-office, ½ mile east of the road from Caesar post office to Mineral post office, about 7 miles by road west of Pettus, on a brush-covered ridge in a large pasture owned by Mr. P. Borroum, and 1 mile south of his house. The station is on the highest part of a semi-bare spot on the crest of the ridge, which is surrounded by large live-oak trees. It is marked according to note 1, page 385, the reference mark being at practically the same elevation as the station and 35.340 meters from it in azimuth 181° 29′ 51″. The following azimuths are from the triangulation station: Rutherford's windmill, distant 1¾ miles, 63° 04′ 58″; Caesar post-office chimney, distant 2 miles, 181° 13′ 36″; windmill of P. Borroum, in pasture near tank, 192° 24′ 33″; chimney on Will Fox's house, distant ¾ mile, 314° 43′ 03″.

Wiess (Bee County, Tex., W. H. B., 1904).—About 11 miles by road north of Beeville, 5½ miles by road northeast of Normana, 1 mile west of H. Philip's house, in a large pasture owned by V. Wiess, who lives in Beaumont. The Beeville and Charco road passes through the eastern part of this pasture. The station is on a ridge covered with live-oak trees and brush and forming the divide between Blanco and Medea Creeks. It was marked according to note 1, page 385, the reference mark being at the same elevation as the station, and 24.150 meters from it in azimuth 220° 32′ 35″. The following azimuths are from the triangulation station: Cupola on ranch house (V. Wiess's Blanco farm), distant 1¼ miles, 251° 08′ 00″; west gable of H. Philip's house, distant 1 mile, 287° 29′ 53″; J. J. Berkland's house, distant 1¼ miles, 358° 21′ 01″.

Fleming (Bee County, Tex., W. H. B., 1904).—Eleven miles by road N. 62° W. of Beeville, 3 miles N. 38° E. of Cadiz post office, on a ridge covered with small brush in a pasture belonging to the Flemings. To reach the station from Beeville follow the Beeville and Mineral City wagon road for 7 miles to Carter's windmill, which stands close to and on the right-hand side of the road; pass through a gate on the left and opposite the windmill and follow the main road for 2 miles to a cross lane; turn to the right 200 yards and pass in a gate on the left at the house of William Chandler; follow the main road passing about 150 yards to the right of the house and go southwest about 1 mile, passing through two gates into the Fleming pasture. After passing through the second gate turn to the right and the station is 1 mile distant on top of a ridge. Marked as in note 1, page 385, the reference mark being at the same elevation as the station and 27.385 meters from it in azimuth 166° 56′ 40″. The following azimuths are from the triangulation station: Gin stack at Cadiz post office, distant 2 miles, 35° 44′ 43″; east chimney of Howard West's house, distant 1¾ miles, 184° 46′ 40″; Williams's gin stack, distant 1 mile, 244° 02′ 14″; Beeville water tower, distant 8 miles, 289° 26′ 46″; chimney of William Chandler's house, distant 2 miles, 289° 57′ 46″.

Beeville (Bee County, Tex., W. H. B., 1904).—About 4¼ miles N. 25° W. from Beeville, east of the Beeville and Normana road, in a large pasture owned by Mrs. Little, who lives in Beeville. On account of the heavy sand this road separates near the station into two parallel roads, and the station is 94 paces east of the nearer and 132 paces east of the other of these two branches. To reach the station from Beeville take the Beeville and Normana road, which, about 3½ miles out, passes into Mrs. Little's pasture; go 1 mile farther along the road and the station will be on a ridge to the right, about ¼ mile from the point where the road crosses the railway track after passing the station. The station was marked as in note 1, page 385, the reference mark being 3 feet lower than the station, and 47.098 meters from it in azimuth 7° 02′ 09″. The following azimuths are from the triangulation station: Southeast gable of Sid. Dugat's barn, distant ½ mile, 148° 39′ 12″; tallest chimney on Mrs. Little's house, distant ⅝ mile, 280° 19′ 08″.

Miller (Bee County, Tex., W. H. B., 1904–1906).—Nine miles by road S. 25° W. of Beeville, on the east fence line of the Beeville, Almos schoolhouse, and Mathis wagon road, on the west side of a large pasture owned by I. J. Miller, cashier of the Commercial Bank of Beeville. This pasture is known as the Berry pasture, having been owned until recently by P. H. Berry, proprietor of a livery and feed stable in Beeville. The station is 1.55 meters west of the east fence of the lane, 35.440 meters north of the south boundary of the Berry pasture, and 191 paces south of the gate opening into the pasture. To reach the pasture from Beeville follow the road to Clareville for 4½ miles to the second lane on the left, then go due south 4½ miles to the station. The station was marked according to note 1, page 385, the reference mark being at the same elevation as the station, and 48.403 meters from it in azimuth 180° 21′ 40″. The following azimuths are from the triangulation station: Southeast chimney of J. G. Roundtree's house, distant 1¼ miles, 56° 32′ 31″; largest chimney on Bud Clare's house, distant 1¼ miles, 243° 56′ 21″. In 1906 latitude observations were made on a wooden pier placed 4.50 meters due west of the triangulation station, and very nearly in the center of the north and south lane.

O'Neill (Bee County, Tex., W. H. B., 1904).—Seven miles by road southeast of Beeville, on a ridge covered with brush and mesquite trees, 700 paces east of the San

Antonio & Aransas Pass Railway, in a large pasture owned by George B. O'Neill, and 1¼ miles southwest of his house. The station was marked according to note 1, page 385, the reference mark being at the same elevation as the station and 31.037 meters from it in azimuth 122° 26′ 16″. The following azimuths are from triangulation station: Windmill on William O'Neill's ranch, distant ¾ mile, 36° 39′ 00″; chimney on Vego Kohler's ranch house, distant 1½ miles, 149° 45′ 45″; George B. O'Neill's windmill, distant 1¼ miles, 216° 06′ 15″.

Skelly (Bee County, Tex., W. H. B., 1904).—Nine miles by road S. 67° W. of Skidmore, ½ mile south of J. M. Skelly's ranch house, and in a pasture recently purchased from Mr. Skelly by Fritz Bremer. The station is located in a small inclosure in which stands a windmill; it is 52 meters northeast of the windmill, 126 paces north-northwest of Mr. Bremer's house, and 120 paces east of the gate on the west side of the lot leading to Mr. Skelly's house. The station was marked according to note 1, page 385, the reference mark, which is 0.50 meter west of the east fence of the inclosure, being at the same elevation as the station, and 21.242 meters from it in azimuth 165° 51′ 26″. The following azimuths are from the triangulation station: Windmill of Mrs. Brown (who lives in Mr. Skelly's house), distant ¼ mile, 170° 23′ 31″; chimney on Fritz Bremer's house, distant 126 paces, 338° 16′ 20″.

Welder (Bee County, Tex., W. H. B., 1904).—About 5 miles (7 miles by road) S. 25° E. of Skidmore, 2½ miles south of the Corpus Christi branch of the San Antonio & Aransas Pass Railway, 2 miles south of Pete Boale's house in a large pasture owned by J. J. Welder, who lives in Victoria, and whose foreman in charge of the ranch is J. E. Sullivan, living 7 miles south of Skidmore. The station is about 300 paces east of the road leading south through the Welder pasture, which abounds in mesquite and live oak. To reach the station from Skidmore follow the road along the south side of the Corpus Christi branch of the San Antonio & Aransas Pass Railway, almost to mile post 4 from Skidmore, go through the wire gate to the south, then south about ¾ mile, and just before reaching the creek near Pete Boale's house turn to the right and pass through a wire gate, thence 2 miles south to the station, which is 63.50 meters from the large gate leading into a lot where a windmill and tank are located; this gate is 124 paces from the windmill. The station was marked according to note 1, page 385, the reference mark being at the same elevation as the station and 28.997 meters south of it.

Mathis (San Patricio County, Tex., W. H. B., 1904).—In the east corner of lot 10, block 15 of the village of Mathis, on land belonging to S. G. Borden, who lives in Sharpsburg, Tex., and whose agent in Mathis is A. B. Watts, jr. The station is 5.14 meters northwest of the southeast fence line of the lot and 30.01 meters northeast from the southwest fence line; Bee Street runs along the southeast side of the lot and San Patricio Avenue along the southwest side. The station is 130 paces east of the railway track, and 144.46 meters east of the railway station. The station was marked according to note 1, page 385, the reference mark being in the south corner of lot 10, 0.36 meter from the fence line of Bee Street, 0.79 meter from the fence line of San Patricio Avenue, and 29.542 meters from the station in azimuth 219° 29′ 47″. From the triangulation station Mathis railway station (ornament over gable facing railway track) is distant 144.46 meters in azimuth 291° 07′ 29″.

Nolan (San Patricio County, Tex., W. H. B., 1904).—Nine miles S. 65° E. from Mathis, ¼ mile north of the Mathis and Sinton wagon road, in a pasture owned by Christopher Nolan, who now lives in San Patricio. The station is 41.70 meters northwest of Mr. Nolan's ranch house, near his stock pens, 85 paces northwest of his windmill, and 6.75 meters north of the fence on the south side of the pasture. To reach the station from Mathis follow the Mathis and San Patricio road for about 4 miles to a large bridge, crossing which, take the middle of three roads, which in half a mile, just before reaching a farm house, branches, one branch going east and the other south along a lane; follow the south road, passing through a gate at its southern end, then take the left-hand road, which is the Sinton road, and follow it for 4 miles to Mr. Nolan's house, where the station will be ¼ mile to the left. The station was marked as in note 1, page 385, the reference mark being 10.52 meters north of the gate leading from the stock pens to the pasture, 0.47 meter west of the east fence of the pasture in which the station is located, and 44.573 meters from the station in azimuth 238° 49′ 56″. The following azimuths are from the station: Windmill in Harry Timon's pasture, distant ½ mile, 29° 08′ 02″; windmill in Welder pasture, distant 2 miles, 259° 54′ 57″; Christopher Nolan's windmill, distant 85 paces, 309° 29′ 01″.

Elliff (Nueces County, Tex., W. H. B., 1904–1906).—Three miles north of Banquete, ¼ mile west of the Banquete and San Patricio wagon road, in a pasture near the stock pens of Mr. J. A. Elliff, and 50 paces west-southwest of his house. The station is between the stock pens and the house on the north, a cotton field on the south, and the large pasture of J. A. Elliff, leased to C. C. Wright, on the west. It is 5.85 meters north of the fence on the north side of the cotton field, 33.17 meters east of the gate leading into the large pasture of Mr. Elliff on the west, 25.15 meters south of the stock pens, and 44.94 meters southwest of the southwest corner of Mr. Elliff's house. The station was marked according to note 1, page 385, the reference mark being at the same elevation as the station and 30.362 meters from it in azimuth 235° 13′ 11″. The reference mark is located in the angle formed by the stock pens and house lot, and is 0.40 meter west of the house lot, 0.25 meter south of the stock-pen fence, and 15.17 meters southwest of the southwest corner of the house. The following azimuths are from the triangulation station: Southwest corner of J. A. Elliff's house, distant 44.94 meters, 242° 10′ 06″; chimney of C. C. Wright's house, distant ¾ mile, 307° 49′ 37″; chimney on Banquete railway station, distant 3 miles, 358° 02′ 37″.

Reynolds (Nueces County, Tex., W. H. B., 1904).—Three and one-half miles northeast of Alfred railway station, ½ mile northeast of Reynolds switch, 339 paces east of the San Antonio & Aransas Pass Railway, in a pasture belonging to George J. Reynolds, and ⅜ mile north of his house. The station is 27.52 meters west of the west fence of a cotton field and 352 paces north of its southwest corner. The station was marked according to note 1, page 385, the reference mark being at the same elevation as the station, 0.30 meter west of the cotton-field fence and 27.221 meters from the station in azimuth 116° 36′ 41″. The following azimuths are from the triangulation station: Chimney on Alfred railway station, distant 3½ miles, 213° 14′ 06″; chimney on E. E. Miller's house, distant ½ mile, 101° 51′ 57″; chimney on George J. Reynolds's house, distant ⅜ mile, 192° 47′ 56″.

Alice (Nueces County, Tex., W. H. B., 1904; 1906).—In the South Heights addition to the town of Alice, ⅓ mile south of the Mexican National Railway track, about ⅛ mile

east of the San Antonio & Aransas Pass Railway track, on a vacant lot belonging to the Alice Land Co., of which F. B. Nayer is manager and a member. The station stands close to the edge of Cactus Avenue, which runs east and west, but has not been fenced, and between King Street on the west and Wright Street on the east. The station was marked according to note 1, page 385, the reference mark being at the southwest corner of the house lot of Mrs. E. McKenzie, 0.23 meter south of the south fence of the lot, 0.70 meter east from its southwest corner, at the same elevation as the station, and 53.820 meters from it in azimuth 165° 18′ 14″. The following azimuths are from the triangulation station: Chimney on F. W. Ellis's house, on opposite side of King Street, 56° 23′ 57″; northeast fence corner of F. W. Ellis's house lot, distant 36.93 meters, 59° 58′ 54″; southeast corner post of vacant lot across King Street from Mrs. McKenzie's house, distant 61.88 meters, 147° 59′ 14″; south gable of Mrs. E. McKenzie's house 176° 10′ 51″; Methodist Church spire 192° 01′ 36″. In 1905 latitude observations were made on a pier built of wooden posts, boxed in, situated 9.03 meters due east of the triangulation station. The longitude station established in 1906 was 2.75 feet due north of the triangulation station, and was marked by a concrete pier 16 by 26 inches, 2½ feet in the ground and 2⅔ feet above the ground.

Wood (Nueces County, Tex., W. H. B., 1904).—Nine miles S. 87° E. of Alice, 3½ miles south of the Mexican National Railway, in a large pasture owned by John H. Wood, who lives in Beeville, and leased to a Frank A. Welder, of Victoria. The station is near a windmill and circular tank in the pasture, being 35.73 meters from the windmill, in azimuth 25° 27.9′, and 22.50 meters from the nearest edge of the tank. The tank and windmill are on a small ridge and are inclosed in a fence. The station was marked according to note 1, page 385, the reference mark being in the south corner of the inclosure in which the windmill stands, 2.87 meters from the windmill, and 33.738 meters from the station in azimuth 209° 15′. The following azimuths are from the triangulation station: Alice Methodist Church spire 101° 20′ 46″; chimney on large ranch house, distant 4 miles, 9° 33′ 45″.

Alice east base (Nueces County, Tex., S. F., 1899; 1904).—About 10½ miles by road southeast of Alice, 2 miles east of the Alice and Brownsville road in one of the King pastures, on a slight elevation. To reach the station from Alice follow the Brownsville road for 8¼ miles to a point ¼ mile beyond the gate leading west to Joe Garcia's, and about ½ mile nearer than the gate beyond the bridge at the end of the lane; go through the fence and proceed almost due east through to the east side of the pasture owned by the Garcia Bros.; pass through a gate, and the station is ½ mile distant on a slight elevation. The underground stone is 6 inches square and 12 inches long, embedded in concrete with its top 24 inches below the top of the surface stone. This surface stone is of limestone, 24 inches square and 14 inches deep, and is embedded in a mass of concrete 48 inches square and 22 inches deep. In each stone the exact center of the station is marked by a station mark composed of copper and brass, and having a shank 7.6 meters long with a slit in its lower end into which a brass wedge is inserted, so that when the bolt is driven home it bulges at the bottom of the hole, which is made larger there than at the top, and in this manner the mark is securely fastened in place. The top of the station mark is 80 millimeters in diameter, with an inner circle (countersunk) 37 millimeters in diameter. The letters U. S. C. & G. S. are cast on the space between the inner and outer circles. The station mark in the underground stone is protected by

a wooden box. The reference mark is of the style described in note 1, page 385, is at the same elevation as the station, and 20.765 meters from it in azimuth 351° 41′ 20″. The following azimuths are from the triangulation station: Joe Garcia's windmill, distant 4½ miles, 91° 15′ 27″; Alice Methodist Church spire 142° 29′ 27″; chimney on large ranch house, distant 1½ miles, 256° 54′ 26″.

Alice west base (Nueces County, Tex., S. F., 1899; 1904).—Eleven miles by road from Alice, 3½ miles west of the Brownsville and Alice wagon road, on that part of the Coloraras ranch belonging to Luciano Garcia, and about 300 yards northeast of his house. To reach the station from Alice follow the Brownsville road, which runs S. 30° E., for 8 miles to a gate leading west to Joe Garcia's house; this gate is 438 meters north of the base line where it crosses the Brownsville road. Passing through the gate go westward about 3½ miles, past the house of Joe Garcia, to the top of a small ridge on which is the triangulation station. The station is marked in a manner similar to Alice east base. The reference mark is similar to the one described in note 1, page 385, is at the same elevation as the station, and 36.335 meters from it in azimuth 197° 54′ 54″; it is 18 paces south of the wagon road leading south to several Mexican shacks. The following azimuths are from the triangulation station: North gable Mexican shack, distant ⅛ mile, 70° 24′ 07″; north gable of ranch house, distant 3 miles, 155° 53′ 44″; north chimney of Mexican shack, distant ⅛ mile, 201° 14′ 48″; Joe Garcia's windmill, distant ⅜ mile, 262° 49′ 33″.

Rogers (Nueces County, Tex., H. D. K., 1905).—Located ¼ mile south of Rogers railway station on the Texas Mexican Railway; 15.79 meters east of the board fence which is on the east line of the Driscoll ranch; 8.3 meters east of the center of the road leading south from Rogers; 3 miles by wagon road or railroad east of Robstown, the junction point of the Mexican National and the St. Louis, Brownsville & Mexico Railways. The station was marked according to note 2, page 385, the reference mark being 8.3 meters east of the center of the road, 15.67 meters east of the Driscoll ranch line fence, and 25.76 meters from the station in azimuth 179° 21′ 21″. The following azimuths are from the triangulation station: Southwest corner of section house, distant ¼ mile, 130° 40′ 32″; Rogers stock pens, north post of chute, 175° 33′ 25″; windmill at railway crossing, distant 2½ miles, 264° 21′ 21″; windmill, distant 1½ miles, 275° 34′ 20″; windmill, distant ¼ mile, 329° 59′ 20″.

Kaleta (San Patricio County, Tex., H. D. K., 1905).—About 2 miles east of Kaleta post office, about 5 miles east of Sharpsburg, and 4 miles east of Angelita, a station on the St. Louis, Brownsville & Mexico Railway; in the middle of a small cleared space on a prominent brush-covered ridge in a pasture owned by Turner Bros. It is ½ mile northeast of the Kaleta and Portland wagon road, ½ mile east of Turner Bros.' windmill, and 200 yards northeast of an old road leading from windmill to eastward along the top of the ridge. C. V. Turner can direct one to the station, which was marked according to note 2, page 385, the reference mark being 27.34 meters from the station in azimuth 175° 11′ 09″. The following azimuths are from the triangulation station: Sharpsburg schoolhouse belfry, distant 5 miles, 99° 51′ 10″; Angelita railway station, east gable, distant 4 miles, 103° 02′ 10″; chimney of Turner Bros.' house, distant ¾ mile, 144° 48′ 03″; chimney of R. E. Turner's house, distant ½ mile, 169° 27′ 46″; "Ratana" windmill, distant 3 miles, 225° 51′ 45″.

Corpus (Nueces County, Tex., H. D. K., 1905).—In the southwest edge of Corpus Christi, about ⅛ mile southwest of the post office, ½ mile west of the Mexican National Railway station, ¼ mile southwest of the old railroad shops, 8.85 meters north of the northwest corner fence post of the Hebrew burying ground, and 44.3 meters south of the south rail of the Texas Mexican Railway track at the first road crossing west of the old shops. The station is on vacant ground, partly covered with brush, owner of the land not known. The station was marked according to note 2, page 385, the reference mark being 20.32 meters from the station in azimuth 2° 31′ 37″. The following azimuths are from the triangulation station: Chimney of Mexican house, distant 100 meters, 5° 36′ 18″; west chimney on red farmhouse, distant 400 meters, 21° 34′ 11″.

Portland (San Patricio County, Tex., H. D. K., 1905).—About 1 mile northwest of Portland in a cultivated field belonging to Robert Arnold, who lives in Portland. The station is 100 paces east-northeast from the edge of the bluff above Nueces Bay, 7.11 meters west of fence on west side of Portland and Kaleta wagon road, and 49.83 meters southeast from the southwest corner of a small blue house with a red roof, owned by Mr. Arnold and occupied by a Mexican tenant. The station was marked according to note 2, page 385, the reference mark being just inside the fence corner, where the fence between the house lot and cultivated field joins the road fence and 39.97 meters from the station in azimuth 190° 32′ 23″. The following azimuths are from the triangulation station: East gable of farmhouse, distant ¼ mile, 127° 43′ 06″; southwest corner of R. Arnold's tenant house, distant 49.83 meters, 157° 36′ 01″; chimney of San Antonio & Aransas Pass Railway station at Portland, 299° 39′ 51″.

McGloins Bluff (San Patricio County, Tex., S. A. G., 1860; 1905).—On McGloins Bluff, on the northeast shore of Corpus Christi Bay, on a small sand hill near the extreme western end of the bluff, overlooking Ingleside Cove, on land owned by J. G. Hatch estate. The land is leased to James Stern, who lives in the old Hatch residence, about ½ mile north of the station. The station is well protected by a dense growth of live-oak brush. The center of the station was marked by a bottle buried about 2 feet below the surface of the ground, over which is a wooden post 4 inches square with a nail to mark the station. The reference marks are four iron posts, triangular in shape, their tops marked U. S. C. S., set about 6 feet from the station, so that the lines joining them diagonally will intersect at the station. The following azimuths are from the triangulation station: Water tower at Gregory, 147° 45′ 14″; southwest gable of farmhouse, distant 1 mile, 171° 11′; chimney on ell of a large 2½-story house near Ingleside Hotel, 178° 02′ 06″; chimney on James Stern's house, distant ½ mile, 179° 46′ 21″.

Mustang (Nueces County, Tex., H. D. K., 1905).—On the inside shore of Mustang Island, about 6 miles north of the south end of the island, and 2 miles northwest of Grant's ranch house; 1¼ miles north of anchorage behind the "bulkhead," and about 2 miles from the south end of a long narrow tongue separated from the main body of Mustang Island by a shallow slough about 3 miles long. The station is 15 meters from the high-water mark of the bay shore, 40 meters from the high-water mark of the shore of the slough, and 330 meters north of an old fence. The station was marked according to note 2, page 385, the reference mark being 12 meters from the high-water mark of the bay shore, 18 meters from the high-water mark of the shore of the slough, and 29.213 meters from the station, in azimuth 196° 07′ 05″. The following azimuths are from the triangulation station: Northeast gable of sheep barn at Grant's ranch, distant 2

miles, 11° 47′ 43″; north gable of Grant's ranch house, 12° 09′ 27″; middle ground stake, Bulkhead Anchorage, 49° 30′ 55″; chimney of farmhouse ¾ mile south of north base, 65° 57′ 31″.

Laguna Madre north base (Nueces County, Tex., R. E. H., 1883; 1905).—About 2½ miles south of Flour Bluff and about 250 meters back from the west shore of the Laguna Madre in a cleared field, formerly in cultivation but now in pasture, belonging to William Hoffman (or to William Turcotte), living in Corpus Christi. The station is 67 paces S. 17′ E. from Hoffman's windmill and 162 paces S. 54° W. from his house. The station was marked in 1883 as follows: A pit 7 feet square was excavated to a depth of 2 feet; in the center of the pit an irregular stone about 14 inches square and 10 inches thick was set. A hole was drilled in the top of this stone and filled with lead, and the point marked thereon with crosslines. Resting on this stone stands a piece of white marble 2½ feet long and 6 inches square with the letters U. S. on its south face, C. & G. on its east face, and SUR and VEY on its north and west faces, respectively, the letters being near the top and deeply cut. In the top of the marble post was drilled a hole 1 inch in diameter and 3 inches deep; this hole was filled with lead and the center marked thereon by crosslines, which in 1905 had become erased. The post stands 1 inch above the surface of the ground. Around this post were laid symmetrically, first two layers of brick each 5 feet square, then two layers each 3 feet square, then one layer 2 feet square, and finally one layer 1½ feet square. Sand and loose rock was then filled in, the whole forming a compact mass. The bricks used were a concrete of lime and shells and were 12 by 6 by 4 inches in size. The stone used for the underground mark and for filling in around the station was a conglomerate of small shells found in the vicinity of Baffins Bay. A reference mark similar to that described in note 2, page 385, was set 13.99 meters from the station in azimuth 135° 21′. It bears the letters U. S. R. M., 1905. The following azimuths are from the triangulation station: North gable of Grant's ranch house on Mustang Island, 272° 14′ 40″; east end of ridge of two-story farmhouse, distant 2 miles, 35° 32′ 09″; windmill, distant 1½ miles, 206° 07′ 38″. Observations for latitude were made on a pier constructed of wooden posts, situated 10.03 meters due east of the triangulation station.

Laguna Madre south base (Nueces County Tex., R. E. H., 1882; 1905).—About 5½ miles south-southwest from Flour Bluff and ½ mile north-northeast from Brighton post office; about 100 meters back from the shore line in an opening in a live-oak motte; about 100 meters north-northeast from the old Thompson house, and 5.2 meters north of a fence which is the north line of the Thompson property. The land on which the station stands is owned by the Texas Land & Cattle Co., and is now leased to William Code for pasture; it is called in the Nueces County records "Flour Bluff and Encinal Farm and Garden Tracts," and has public roads 40 feet wide projected every mile from north to south; the station is located on the road (projected) along the north side of the Thompson place. In 1882 the station was marked as follows: A pit 7 feet square was excavated to a depth of 2 feet; in the center of this, with its upper surface flush with the bottom of the pit, an irregular stone about 14 inches square and 10 inches thick was set; a hole was drilled in the top of this stone and filled with lead, and the center of the station marked thereon by crosslines. Resting on this stone stands a piece of white marble 2½ feet in length and 6 inches square with the letters U. S.–C. &. G.–SUR–VEY deeply cut thereon near the top, one group on each face. Around this

post were laid symmetrically, first two layers of brick each 5 feet square, then one layer 4 feet square, then one layer 2½ feet square, and finally two layers each 1½ feet square. Over this were placed sand and layers of loose rock, making a compact mass of the whole. The marble block has a hole about 1 inch in diameter and 3 inches deep drilled in its top; this hole was filled with lead and the center of the station marked thereon by crosslines. The bricks used were concrete of lime and shells, and were 12 by 6 by 4 inches in size. The stone used for the subsurface mark and for filling in around the station was a conglomerate of small shells found in the vicinity of Baffins Bay. In 1905 the marble post was surrounded by well-sodded pasture land, above which it projected about 4 inches. A reference mark such as is described in note 2, page 385, was set 31.80 meters from the station in azimuth 309° 06′ 25″. The reference mark bears the letters U. S. R. M., 1905, and an arrow pointing to the station. The following azimuths are from the triangulation station: Chimney of old Thompson house, distant 100 meters, 29° 33′ 42″; south gable of William Code's house, distant ¾ mile, 185° 09′ 33″.

Padre (Nueces County, Tex., H. D. K., 1905).—On Padre Island, about 1 mile south of Corpus Christi Pass and about 250 meters from the western or inside shore of the island, on the top of the highest sand hill in the vicinity. This part of the island is covered with shifting sand, and the station site being but little protected by brush the station will not be long recoverable. One month after the station mark had been set it was found covered with 8 inches of sand. The station was marked according to note 2, page 385, the reference mark being 8 inches in diameter (instead of 12) and 97.19 meters from the station in azimuth 141° 06′ 05″. The reference mark is fairly well protected by brush. The following azimuths are from the triangulation station: Chimney of old Thompson house near south base, 97° 18′ 08″; windmill, 2 miles north of north base, 160° 34′ 44″; north gable of Grant's ranch house, on Mustang Island, 216° 39′ 36″.

LAGUNA MADRE BASE TO POINT ISABEL.

PRINCIPAL POINTS.

Grants (Nueces County, Tex., R. E. H., 1877; 1905).—On a prominent sand hill about 2 miles from the south end of Mustang Island, about 150 yards from the outside beach of the island and about 1½ miles northwest from Mr. Grant's house. In 1877 the station was reported as being marked according to note 3, page 386, the reference stubs being 5 feet from the station. In 1905 the station was apparently recovered, but the subsurface mark was a bottle and the stubs were gone. The station was not reoccupied and the recovery is uncertain.

Chappa (Nueces County, Tex., R. E. H., 1877; 1905).—Near the outside beach of Padre Island, about 2½ miles east-southeast from Chappa's house, on the shore of Laguna Madre. The station was marked according to note 3, page 386, the reference stubs being 4 feet from the center. In 1905 no trace of this station could be found, and it can be recovered, if at all, only by triangulation.

Peat Island (Nueces County, Tex., R. E. H., 1877; 1882).—On the main land, about 150 yards from the shore of the Laguna Madre and about 1½ miles below Peat Island. The station was marked according to note 3, page 386, the reference stubs being 6 feet from the center.

Mott (Nueces County, Tex., R. E. H., 1877).—On the mainland about 1 mile from the shore of the Laguna Madre and near a clump of trees known as "The Mott." The station was marked according to note 3, page 386, the reference stubs being 5 feet from the center.

Richards (Nueces County, Tex., R. E. H., 1877).—On the second range of sand hills near the outside shore of Padre Island, about 10 miles from Peat Island, and nearly abreast of Richards' house. The station was marked according to note 3, page 386, the reference stubs being 6 feet from the center.

Wheelbarrow (Nueces County, Tex., R. E. H., 1877).—Near the outside shore of Padre Island, on the second range of sand hills, on the highest hill in the vicinity. Marked according to note 3, page 386, the reference stubs being 6 feet from the center.

Point of Rocks (Nueces County, Tex., R. E. H., 1877).—On quite a high hill on the mainland, about ¾ mile from the shore of the Laguna Madre and about 2 miles from the entrance to Baffins Bay. The station was marked according to note 3, page 386, the reference stubs being 6 feet from the center.

Griffins Point (Cameron County, Tex., R. E. H., 1877).—On the south side of Baffins Bay, about 50 yards from the shore line. The station was marked according to note 3, page 386, except that the center stub was palmetto and the reference stubs were 5 feet from the center.

Shells (Cameron County, Tex., R. E. H., 1877).—Near the outside beach of Padre Island, on the second range of sand hills and about 100 yards from the high-water line. The station was marked according to note 3, page 386, except that the center stub projects 2 feet above the surface. The reference stubs were 2 oak and 2 cedar.

Coyote (Cameron County, Tex., R. E. H., 1877).—On the mainland, about ¼ mile from the shore of the Laguna Madre, abreast of the first to the northward of the openings into the numerous salt lagoons of this vicinity, and on a ridge of hard ground between two of these lagoons. The station was marked according to note 3, page 386, the apex of the subsurface mark being 2½ feet below the surface, and the reference stubs being 4 feet from the center.

Venado (Cameron County, Tex., R. E. H., 1877; 1881).—On the second range of sand hills near the outside beach of Padre Island, on the highest hill in the vicinity. The station was marked according to note 3, page 386, the reference stubs being 8 feet from the center.

Indian (Cameron County, Tex., R. E. H., 1878).—On the mainland, on the second range of high ground, and about 70 meters from the shore of the Laguna Madre; out in the Laguna, about 1 mile from the shore were placed two posts in line with the station. The station was marked according to note 3, page 386, the center stub projecting 18 inches above the ground and the reference stubs being 12 feet from the center.

Station Hill (Cameron County, Tex., R. E. H., 1878).—Near the outside beach of Padre Island, on the most prominent sand hill in the vicinity, and about 2 miles north of a well-known hill called "Big Hill." The station was marked according to note 3, page 386, the reference stubs being 5 feet from the center.

Stoley (Cameron County, Tex., R. E. H., 1878).—On Padre Island, about 100 yards from the outside beach, on the highest hill in the vicinity. The station was marked according to note 3, p. 386, the reference stubs being 5 feet from the center.

Avoca (Cameron County, R. E. H., 1878).—On the western side of the Laguna Madre, on an island which has the highest ground in the vicinity and by that means is easily distinguishable. The station was marked according to note 3, page 386, the center stub extending 18 inches above the ground and the reference stubs being 5 feet from the center.

Tank (Cameron County, Tex., R. E. H., 1878).—Near the outside beach of Padre Island, on the inner range of hills. In line with the station and Avoca triangulation station were placed two cedar posts, one 66 feet and the other 132 feet from the center; at right angles to this line (to the southwest) were placed two similar posts, at distances from the center of 66 and 132 feet. The station was marked according to note 3, page 386, the center stub projecting 18 inches above the surface, and the reference stubs being 5 feet from the center.

Topo (Cameron County, Tex., R. E. H., 1878; 1905).—About 30 miles, S. 60° E. from Katherine (on the St. Louis, Brownsville & Mexico Railway) in the King pasture, on the old Topo ranch near the old Topo landing on the mainland side of Laguna Madre, on a small island connected at low tide with the mainland to the south by a narrow strip of sand. The station is 7 meters north of the south shore, and 57 paces east of the west shore of the island which at this point is about 10 feet above tidewater. The island is the most southerly of the group in this vicinity. The station was originally marked according to note 3, page 386, the reference stubs being 8 feet from the center. In 1905 two of the reference stubs were still standing, the station being midway between them; the subsurface mark was also intact and was left in place. Over it was placed a new surface mark consisting of a tile 26 inches long, filled with concrete, and having a bottle also filled with concrete placed in its upper end; a copper nail in the bottle marks the center of the station; there was placed 6 inches of sand between the surface and underground marks. The tile projects about 8 inches above the ground. The latitude station was 3.90 meters west of and 0.3 meter south of the triangulation station and was marked by a wooden observing pier. The wooden floor of the observatory was also left standing.

Lomalto (Cameron County, Tex., R. E. H., 1879).—On the mainland side of the Laguna Madre. The station was marked according to note 3, page 386. The reference stubs were 6 feet from the center and the center stub projected 1 foot above the ground.

Gladiator (Cameron County, Tex., R. E. H., 1878).—About 150 yards from the outside beach of Padre Island, on the highest hill in the vicinity. The station was marked according to note 3, page 386, the reference stubs being 9 feet from the center. One of the reference stubs is in line to the triangulation station Lomalto. In line with these 4 stubs and the center and 80 yards from the center were placed 4 cedar posts, 10 feet long, 5 feet in the ground.

Waterhole (Cameron County, Tex., R. E. H., 1879).—About 200 yards from the outside beach of Padre Island. The station was marked according to note 3, page 386, the reference stubs being 4 feet 2 inches from the center. On line with these stubs and the center and 91 feet 3 inches from the center were placed 4 cedar posts, 10 feet long, 5 feet in the ground; they were marked with copper tacks.

Rifle (Cameron County, Tex., R. E. H., 1879).—On the western shore of the Laguna Madre. The station was marked according to note 3, page 386, the reference stubs being 6 feet from the center.

Colorado (Cameron County, Tex., R. E. H., 1879).—On the western side of the Laguna Madre, on a small island with a high prominent bluff, on the highest part of and about 15 meters from the edge of the bluff. The station was marked according to note 3, page 386, the reference stubs being 3 feet from the center.

Santa Cruz (Cameron County, Tex., R. E. H., 1879).—On Padre Island, about 200 yards from the Laguna Madre, and about 1 mile from the Gulf beach, on the most prominent sand hill in the immediate vicinity; about halfway between the station and the outer beach stands a house known as the Santa Cruz ranch. The station was marked according to note 3, page 386, except that the surface mark had in its top a central copper tack surrounded by three others. The reference stubs were 6 feet from the center; in line with these stubs and 50 feet from the center were placed four cedar posts.

Armadillo (Cameron County, Tex., R. E. H., 1879).—On the northeastern end of an island on the mainland side of the Laguna Madre, in a clump of mesquite bushes by which the island may be easily recognized. The station was marked according to note 3, page 386. The reference stubs were placed 4 feet from its center.

Black Hill (Cameron County, Tex., R. E. H., 1879).—On Padre Island on the highest hill in the vicinity, about 40 yards north of the highest part of the hill. The station was marked according to note 3, page 386, except that the stub had four copper tacks in its top, three of them forming a triangle around a central one. The reference stubs were 4 feet from the center. In line with these stubs and 35 feet from the station were placed four cedar posts.

Fox (Cameron County, Tex., C. H. B., 1867; 1879).—On the western shore of the Laguna Madre, on a hill about 25 feet high, semicircular in shape, and having a prominent knob on its southern end. The station was marked according to note 3, page 386, the reference stubs being 1 meter from the center.

Singer (Cameron County, Tex., C. H. B., 1867; 1879).—On Padre Island, about 10 miles north of Brazos Santiago, on a sand hill about 12 feet high; this hill is covered with grass and is about one-third of the distance from the Gulf to the Laguna Madre. The station was marked underground by a glass bottle with a copper nail in its cork, while the surface mark was a mesquite post cut to the form of a triangle with a copper tack in its top. Four mesquite posts, with copper tacks in their tops, were placed 1 meter from the station, lines joining them diagonally intersecting at the center. In 1879 four additional stubs (of cedar) were placed around the station and 6 feet from it.

Cameron (Cameron County, Tex., C. H. B., 1867; 1905).—On the second point of any prominence projecting into the Laguna Madre above Point Isabel. Just south of the station is a bay with a high island at its entrance. The hill on which the station stands is about 25 feet high, and the station is about 35 feet from the edge of the bank. The lighthouse at Point Isabel bears S. 54° W. and the next point up the Laguna Madre bears N. 10° W. The station was re-marked in 1905 as follows: The subsurface mark was a beer bottle 8 inches long filled with concrete and encased in a cylinder of concrete 8 inches in diameter and 8 inches long; in the mouth of the bottle was inserted a 12-penny nail, head down, the point of the nail projecting ¼ inch above the cement. The point of the nail is 2½ feet below the surface of the ground. Over the subsurface mark was placed a layer of sand and earth 6 inches thick, and upon this was set the surface mark, consisting of a piece of terra-cotta sewer pipe 6 inches in diameter and 26 inches

long, filled with concrete and encased in a cylinder of concrete 18 inches in diameter and 26 inches long; in the center of the top of the pipe was embedded a beer bottle, mouth up, filled with concrete, its top level with the concrete in the pipe, and a 12-penny nail inserted in its mouth, head down, with its point projecting ¼ inch above the concrete. The top of the cylinder of concrete bears the letters U. S. C. & G. S., 1905, around the top. The reference mark was as follows: A hole was dug 12 inches in diameter and 24 inches deep, and in it was set a piece of sewer pipe 6 inches in diameter and 26 inches long; the pipe and the hole around the pipe were then filled with concrete made with shell in it and a 12-penny nail set head down in the center of the top of the pipe, its point projecting ¼ inch above the concrete. The reference mark is 26.145 meters, N. 62° W. from the station.

Pool (Cameron County, Tex., C. H. B., 1867).—On Padre Island, on a high sand hill near the outer beach and about 5 miles north of Brazos Santiago entrance. Point Isabel Lighthouse bears S. 25° W. The station was marked with a mesquite post and a small framework of boards filled with sand; in the top of the post was a copper tack.

Fronton (Cameron County, Tex., C. H. B., 1867; 1906).—Located in the town of Point Isabel on the same ridge as and about 90 meters north of the lighthouse and in the yard of Mrs. Wren. From the station the northwest corner of Mrs. Wren's house bears N. 37° E., 12.210 meters; the southwest corner of the porch bears N. 78° E., 3.310 meters; the southwest corner of the yard fence bears S. 56° E., 6.570 meters; and the southwest yard fence in the direction S. 37° W. is distant 1.010 meters. The station was re-marked the same as station Cameron (p. 399). Azimuth observations were made in 1905 at a point 5.51 meters from the triangulation station in line to Point Isabel south base station. The longitude station of 1906 was 21.21 meters north of and 10.60 meters east of the triangulation station and was marked by a concrete pier 16 by 26 inches in plan, 18 inches below and 34 inches above the ground.

Point Isabel south base (Cameron County, Tex., R. E. H., 1886; 1906).—About 4 miles from Point Isabel, on a hill between two salt lagoons. The station was re-marked in 1906 in the same manner as Cameron (p. 399), the reference mark being 11.630 meters N. 71° W. from the station.

Point Isabel west base (Cameron County, Tex., O. B. F., 1906).—About 2 miles west of a small ranch house and windmill, which are about 5 miles west of Point Isabel. It is just south of the old road (now closed) from Point Isabel to Brownsville and is best reached by taking the left-hand road at the ranch above mentioned, and after following it for about 1 mile turning to the southwest into a branch road and going about ⅓ mile to the station, which is 10 meters south of the old road. The station was marked in a manner similar to Point Isabel south base (see above), except that for the surface mark a 4-inch sewer pipe instead of a 6-inch one was used, and in its top was placed a bronze station mark with a cross cut on it. The reference mark was set near line to Point Isabel east base and 24.25 meters from the station.

Point Isabel east base (Cameron County, Tex., R. E. H., 1886; 1906).—About 2.8 miles from Point Isabel, about 250 meters from the shore of the Laguna Madre, on hard land near a motte. The station was re-marked in 1905 in the same manner as Cameron (p. 399), the reference mark being 11.685 meters, N. 52° 30′ W. from the station.

Arista (Cameron County, Tex., R. E. H., 1885; 1905).—On the highest part of a hill about half way between Point Isabel and Brownsville and 650 meters from the railway. The station was marked in a similar manner to Cameron (p. 399), the reference mark being 11.330 meters, S. 63° 30′ E. from the station.

LAGUNA MADRE BASE TO POINT ISABEL.

SUPPLEMENTARY POINTS.

Flour Bluff (Nueces County, Tex., S. A. G., 1860; 1876).—On Flour Bluff on the southern side of Corpus Christi Bay. The recovery of this station in 1876 was certain, but in 1905 the station was searched for and no trace of it could be found.

Thompsons (Nueces County, Tex., R. E. H., 1876).—On Mustang Island. In 1905 this station was searched for and it was determined that the sand hill on which it was located had been blown away.

Kenedy (Nueces County, Tex., R. E. H., 1877).—In Kenedy's pasture, on the north shore of Baffins Bay, about ¼ mile from high-water mark and 25 yards north of the highest point of the hill on which it is situated. The station was marked according to note 3, page 386, the reference stubs being 4 feet from the center.

Penescal (Cameron County, Tex., R. E. H., 1877).—On the south side of Baffins Bay, near the shore, and about 1 mile to the eastward of the Penescal house. It is between a salt lagoon and the bay. The station was marked according to note 3, page 386, the center stub being of palmetto and the reference stubs being 5 feet from the center.

Rabbit (Nueces County, Tex., R. E. H., 1877).—Near the mouth of the Agua Dulce Creek, about ¼ mile from the shore, and about 1½ miles north of Kenedy's warehouse, on a small hill covered with a growth of scrub oak. The station was marked according to note 3, page 386, the reference stubs being 4 feet from the center.

Crawford (Cameron County, Tex., R. E. H., 1877).—On the south side of Baffins Bay, near the shore. The station was marked according to note 3, page 386, the reference stubs being 5 feet from the center.

Tree (Nueces County, R. E. H., 1877).—About 400 yards from the shore of the Aqua Dulce Creek, and 25 yards from the south end of a salt lagoon. Two lone trees are about 1 mile distant in a westerly direction. The station was marked according to note 3, page 386. The reference stubs were 6 feet from the center.

Bovido (Nueces County, Tex., R. E. H., 1877).—At the head of Baffins Bay, about 20 yards from the shore. The station was marked according to note 4, page 386. The reference stubs were 4 feet from the center.

Camp (Nueces County, Tex., R. E. H., 1876).—On Padre Island, about 300 yards in a southerly direction from what is known as Lynes house, on a rise of ground covered with a growth of small scrub oak. The station was marked with a concrete pyramid with lead in its apex, buried 3 feet below the surface of the ground; above this was placed a pine pole 30 feet long, braced with four braces.

Jack (Nueces County, Tex., R. E. H., 1877).—On a narrow island close to the western shore of the Laguna Madre. The station was marked according to note 4, page 386. The distance of the reference stubs from the station was not recorded.

Peg (Nueces County, Tex., R. E. H., 1877).—On the mainland side of the Laguna Madre, a short distance from the shore, and about 3½ miles from Peat Island. The station was marked according to note 4, page 386. The reference stubs were placed 4 feet from the center.

Gum Pen (Cameron County, Tex., R. E. H., 1878).—On Padre Island about midway between the two shores, on the highest hill in the vicinity, and abreast of a cattle pen

called Gum Pen, located on the Laguna shore. The station was marked according to note 4, page 386. The reference stubs were 5 feet from the center.

New (Cameron County, Tex., R. E. H., 1878).—On a point on the mainland side of the Laguna Madre, about 20 meters from the shore. The station was marked according to note 4, page 386. The reference stubs were 5 feet from the center.

Rock Pen (Cameron County, Tex., R. E. H., 1877).—On the mainland side of the Laguna Madre, 25 yards from the shore. Marked according to note 4, page 386. The reference stubs were placed 5 feet from the center.

Bird (Nueces County, Tex., R. E. H., 1877).—On Padre Island, near the Laguna shore, nearly abreast of the north end of the northernmost Bird Island, about 200 yards south of an old cattle pen, on the most prominent sand hill in the vicinity. The station was marked according to note 4, page 386. The reference stubs were 4 feet from the station.

Frank (Nueces County, Tex., R. E. H., 1877).—In Kenedy's pasture, 1 mile from the shore of the Agua Dulce Creek. The station was marked according to note 4, page 386, the reference stubs being 5 feet from the station.

Cow (Nueces County, Tex., R. E. H., 1877).—On the mainland, near the shore of the Laguna Madre, on the highest ground in the vicinity. Marked according to note 4, page 386, the distance of the reference stubs from the center not being recorded.

Willow (Nueces County, Tex., R. E. H., 1877).—On Padre Island, on the only grassy hill in the vicinity, about 100 yards from the shore of the Laguna Madre, and just west of some willow trees. The station was marked according to note 4, page 386, the distance of the reference stubs from the center not being recorded.

Camp No. 2 (Nueces County, Tex., R. E. H., 1877).—Near what was known as "The Settlement" on Padre Island, and about 200 yards east of Lyne's house, and northeast of Chappa's house. Marked by a concrete pyramid buried 3 feet below the surface of the ground; above this was placed a 30-foot braced pole.

Murdock Landing (Cameron County, Tex., R. E. H., 1877).—On Padre Island, about 100 yards from the shore of the Laguna Madre, on a grass-covered sand hill. The station was marked according to note 4, page 386, there ference stubs being 4 feet from the center.

Ford (Nueces County, Tex., R. E. H., 1877).—On Padre Island near the Laguna shore, on the highest hill in the vicinity. The station was marked with a concrete pyramid, with lead in its apex, buried 4 feet below the surface of the ground; over this stands a scantling, running up through the limbs of a willow tree to which it is lashed; the trunk of the tree is marked with a triangle cut into its side.

Sand (Cameron County, Tex., R. E. H., 1878).—On Padre Island about 20 yards from the Laguna shore, on a grassy hill, the highest hill in the immediate vicinity. The station was marked according to note 4, page 386, the reference stubs being 5 feet from the center.

Mosquito (Cameron County, Tex., R. E. H., 1878).—On the mainland side of the Laguna Madre, about 3½ miles above station Topo (p. 398); the station is about 50 yards from the shore, on a peninsula, and is on the highest ground in the vicinity. The station is marked according to note 4, page 386, the reference stubs being but three in number, and each 6½ feet from the center.

Crossing (Cameron County, Tex., R. E. H., 1878).—On Padre Island, about 75 yards from the shore of the Laguna Madre, on a grassy hill, the highest in the vicinity; in very dry weather the Laguna is sometimes crossed at this point. The station was marked according to note 4, page 386, the reference stubs being 5 feet from the center.

Portalis (Cameron County, Tex., R. E. H., 1878).—On the west shore of the Laguna Madre, on the north side of a small hook-shaped bight having a prominent tree on its western shore. The station was marked according to note 4, page 386, except that bottles were used for reference points, and were placed with their tops flush with the surface and 4 feet from the center.

Rainy (Cameron County, Tex., R. E. H., 1878).—On Padre Island about 150 yards from the shore of the Laguna Madre, on a grassy hill, the highest in the vicinity. The station was marked according to note 4, page 386, the reference stubs being 4 feet from the center.

Bonnet (Cameron County, Tex., R. E. H., 1878).—On the western shore of the Laguna Madre, on the south side of the mouth of a lagoon. The station was marked according to note 4, page 386, the reference stubs being 6 feet from the center.

Brant (Cameron County, Tex., R. E. H., 1879).—On Padre Island near the Laguna beach, on the most grassy hill in the vicinity. It is on the north side of a small indentation in the shore line. The station was marked according to note 3, page 386, the reference stubs being 4 feet 2½ inches from the center.

Duck (Cameron County, Tex., R. E. H., 1879).—On Padre Island near the Laguna beach, on a high grassy hill, the most prominent one for some miles around. The station was marked by a lead plug in a coral rock, and by four bottles buried with their tops level with the surface of the ground, 3 feet from the center and on lines intersecting at right angles at the center.

Crane, lone palmetto tree (Cameron County, Tex., R. E. H., 1879).—A lone palmetto tree on an island in the Laguna Madre.

Oil (Cameron County, Tex., R. E. H., 1879).—On Padre Island, about midway between the Gulf and the Laguna beaches. The station was marked according to note 4, page 386, the reference stubs being 3 feet from the center.

Cat (Cameron County, Tex., R. E. H., 1879).—On the eastern end of an island on the western side of the Laguna Madre. The station was marked according to note 4, page 386, the reference stubs being 4 feet from the center.

Snipe (Cameron County, Tex., R. E. H., 1879).—On the eastern end of an island on the western side of the Laguna Madre. The station was marked according to note 4, page 386.

Mesena (Cameron County, Tex., C. H. B., 1867).—Reported lost in 1885. See Mesena 2 (p. 404).

Wolf Trap (Cameron County, Tex., W. E. G., 1854; 1867).—On one of the islands known as Los Montes, about 5 miles southwest from Brazos Santiago. It is on a smooth level spot near the southern point of the hill, and is not accessible by water, the Laguna being obstructed by shoals and flats, but can be reached from the White ranch on the mainland by going to the end of the long marsh point southeast of the island, and thence across the Laguna, which is here very shoal and can be crossed with horse and wagon. In 1854 the center mark was an iron cone, but in 1867 this cone was found reduced to rust; the station was further marked by four range posts with copper tacks.

Boca Chica 2 (Cameron County, Tex., C. H. B., 1867).—On the first and highest hill going north from the Boca Chica Bridge; about 70 meters from the Gulf shore, and opposite the seventh telegraph pole, counting from the bridge; this telegraph pole has a copper nail driven into it. The hill is covered with grass, and is on the western side of the railway track. The station was marked with a mesquite post, 3 feet long, its top projecting 6 inches above the surface of the ground; a copper nail was driven in its top.

Rio Grande Observatory (Cameron County, Tex., W. E. G., 1854; 1867).—On a barren sand hill about 15 feet above tide water, on the American side of the mouth of the Rio Grande. The station was marked by a monument of masonry, cross lines marking the center. In 1867 the cross lines were gone, what was probably only the base of the monument remaining; its center was considered the center of the station. The hill on which the station was standing being in danger of washing away, was protected with planking.

Mesena 2 (Cameron County, Tex., R. E. H., 1885).—About 4¾ miles west from Point Isabel Lighthouse; near the shore of the Laguna Larga. The station is reached from Point Isabel by following the road to Brownsville for 4 miles, to where it forks, one branch following the Laguna Madre, and the other or left-hand branch approaching the shore of the Laguna Larga, and traversing the long hill on which the station is situated; this hill is nearly abreast of the point where the right-hand road recedes from the shore of the Laguna Madre, and viewed from the forks of the road is the most prominent hill in sight. The center mark was the bottom of a beer bottle buried 2½ feet below the surface of the ground, while 10 inches below the surface four beer bottles were placed 1 foot from the center on lines intersecting at right angles; a mesquite stub was placed for a surface mark. In 1905 the apparent location of the station was recovered, as indicated by three signal stakes and three instrument stakes, but no other marks were recovered.

McManus (Cameron County, Tex., R. E. H., 1885).—About 8 meters from the railroad on the north side of the road. The station was marked by a mesquite stub projecting 8 inches above the surface of the ground, and by 4 brickbats placed around and against it, 2½ feet below the surface.

Kingsbury (Cameron County, Tex., R. E. H., 1885).—About 2½ meters from and on the north side of the railroad. The station was marked with a piece of brick with a triangle on its side buried 2½ feet below the surface of the ground, over which was placed a mesquite stub, with its top 1 foot above the ground.

Tank (Cameron County, Tex., R. E. H., 1885).—At the Resaca, near the water tank, and about 2 inches from the south side of the track. Marked by a stub.

Egan (Cameron County, Tex., R. E. H., 1885).—On the south side of and 2½ meters from the railroad. It was marked by a triangle cut in a brick and buried 2½ feet below the surface of the ground; above the brick was placed a mesquite stub. The three theodolite stubs were left standing.

Valls (Cameron County, Tex., R. E. H., 1885).—On the south side of the railroad and about 2½ meters from it. It was marked by a triangle cut in a brick buried 2½ feet below the surface of the ground; above it was placed a mesquite stub.

Gomilla (Cameron County, Tex., R. E. H., 1885).—On the south side of and about 2½ meters from the railroad. The underground mark was a triangle cut in the side of a brick; the surface mark was a mesquite stub.

Sherwood (Cameron County, Tex., R. E. H., 1885).—About 3 meters from the south side of the railroad; marked with a mesquite stub.

Forto (Cameron County, Tex., R. E. H., 1885).—On the north side of and about 20 meters from the railroad, in a cultivated field owned by Emile Forto, and rented to a Mexican. The station was marked by a beer bottle buried 2½ feet below the surface of the ground; above this was placed a mesquite stub, projecting 1 foot above the ground, and having a copper tack in its top.

Garrison (Cameron County, Tex., R. E. H., 1885).—On the Fort Brown reservation adjoining the city of Brownsville; in the vicinity of the Artillery quarters, being 200 feet from the northeast corner of the Artillery barracks, and 536 feet from the southeast corner of the magazine. The station was marked by a beer bottle buried upright 2½ feet below the surface of the ground. One foot below the ground were placed four other beer bottles, in a horizontal position, their heads close to the station and pointing to it. The station was marked with a mesquite stub projecting 1 inch above the ground.

Brownsville (Cameron County, Tex., E. D. P., 1885).—In the military post southeast of the town of Brownsville. The northeast corner of the post hospital was distant 160.4 feet in azimuth 82° 20′; the southeast corner 154.4 feet in azimuth 64° 03′; the azimuth of the garrison flagpole was 104° 45′, and of the northernmost tower of the cathedral at Matamoras, 30° 32′. The station was marked by a large iron cap buried 2 feet underground. Astronomical observations were made on a pier built of wooden posts.

COMPUTATION, ADJUSTMENT, AND ACCURACY OF ELEVATIONS.

The zenith distances directly observed at each station were first computed and were corrected for height of object observed and of instrument, so as to refer them all to the station marks.

The difference of elevation of each pair of stations in the main scheme where zenith distances had been observed was then computed from the observations over the line joining them by the formula

$$h_2 - h_1 = s \tan \tfrac{1}{2}(\zeta_2 - \zeta_1)\left[1 + \frac{h_2 + h_1}{2\rho} + \frac{s^2}{12\rho^2}\right]$$

in which h_2 and h_1 are the elevations of the stations, ζ_2 and ζ_1 are the measured zenith distances, s is the horizontal distance between the stations, and ρ is the radius of curvature.

As there were always two or more lines to each new station, many rigid conditions existed between the observed differences of elevation, even if the connections with the precise leveling were ignored, and the least square adjustment furnishes the readiest accurate means of deriving the required elevations.

The elevations of the stations in the main scheme from Lavernia and Thomas at the north to Elliff at the south, and from these stations eastward to Mustang, Padre, and Aransas Lighthouse on the Gulf coast, were obtained from a single adjustment, as shown in the tabulation below.

The elevations of Lavernia and Thomas were held fixed at 237.79 and 227.38 meters, respectively, these being the elevations as fixed by the adjustment of the vertical angles

in the adjoining section of triangulation.[1] The elevations of Laguna Madre south base and of Aransas life-saving station were held fixed at 1.779 and zero meters, respectively.

In the following tabulation the observed differences of elevation treated in the adjustment are shown, together with their adjusted values. The weight, p, assigned to each observed difference of elevation is inversely proportional to the square of the length, s, of the line between stations in meters and was conveniently computed by the formula $\log p = 9 - 2 \log s$. The observed difference of elevation is given the sign of the elevation of the second station named minus the elevation of the first. The quantity contained in the last column but one is the correction to be subtracted from an observed difference of elevation to obtain the adjusted difference of elevation.

Station 1	Station 2	Weight p	Observed difference of elevation h_2-h_1	Adjusted difference of elevation h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Lavernia	Serita	4.8	−57.47	−57.11	−0.36	0.62
Thomas	Serita	1.0	−45.73	−46.70	+0.97	0.94
Serita	Stockdale	2.9	−10.56	−10.23	−0.33	0.32
Serita	Ruckman	0.61	−33.14	−33.54	+0.40	0.10
Stockdale	Ruckman	1.05	−23.62	−23.31	−0.31	0.10
Stockdale	Karnes	0.60	−30.89	−29.82	−1.07	0.70
Ruckman	Karnes	1.8	− 6.42	− 6.51	+0.09	0.01
Ruckman	Bryde	0.85	+11.83	+12.25	−0.42	0.15
Karnes	Bryde	4.8	+18.66	+18.76	−0.10	0.05
Ruckman	Choate	0.85	−20.17	−20.32	+0.15	0.02
Bryde	Choate	3.6	−32.65	−32.57	−0.08	0.02
Bryde	Pettus	4.8	−23.34	−23.29	−0.05	0.01
Choate	Pettus	10.9	+ 9.36	+ 9.28	+0.08	0.06
Bryde	Barroum	5.1	−11.51	−11.47	−0.04	0.01
Pettus	Barroum	7.9	+11.71	+11.82	−0.11	0.09
Pettus	Wiess	7.5	−26.19	−26.37	+0.18	0.24
Choate	Wiess	3.3	−17.40	−17.09	−0.31	0.32
Borroum	Wiess	3.3	−38.46	−38.19	−0.27	0.23
Borroum	Beeville	2.1	−46.81	−47.14	+0.33	0.22
Wiess	Beeville	6.7	− 9.04	− 8.95	−0.09	0.05
Barroum	Fleming	3.1	−15.08	−14.80	−0.28	0.24
Beeville	Fleming	5.4	+32.32	+32.34	−0.02	0.00
Beeville	Miller	3.3	−28.48	−28.47	−0.01	0.00
Fleming	Miller	2.4	−61.22	−60.81	−0.41	0.40
Beeville	O'Neill	4.2	−42.62	−42.68	+0.06	0.02
Miller	O'Neill	8.9	−14.16	−14.21	+0.05	0.02
Miller	Skelly	9.4	− 7.86	− 7.71	−0.15	0.22
O'Neill	Skelly	3.6	+ 6.43	+ 6.50	−0.07	0.02
O'Neill	Welder	3.1	−24.30	−24.62	+0.32	0.32
Skelly	Welder	4.5	−31.16	−31.12	−0.04	0.01
Skelly	Mathis	5.9	−15.62	−15.86	+0.24	0.34
Welder	Mathis	2.7	+15.57	+15.26	+0.31	0.26
Skelly	Nolan	1.8	−34.07	−32.39	−1.68	5.08
Mathis	Nolan	5.1	−16.36	−16.53	+0.17	0.15
Mathis	Elliff	1.2	−16.49	−17.67	+1.18	1.66
Nolan	Elliff	2.4	− 1.64	− 1.14	−0.50	0.60
Elliff	Rogers	2.8	−11.70	−11.79	+0.09	0.02
Rogers	Kaleta	4.0	+ 1.78	+ 2.63	−0.85	2.89
Nolan	Kaleta	2.0	−10.78	−10.30	−0.48	0.46
Kaleta	Corpus	3.2	−11.61	−10.91	−0.70	1.57
Rogers	Corpus	2.3	− 6.70	− 8.28	+1.58	5.74
Corpus	Portland	6.1	+ 0.25	− 0.05	+0.30	0.55
Kaleta	Portland	2.6	−11.76	−10.96	−0.80	1.66

[1] See Appendix 5, Report for 1905, p. 280.

Station 1	Station 2	Weight p	Observed difference of elevation h_2-h_1	Adjusted difference of elevation h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Portland	McGloins Bluff	6.0	+ 3.18	+ 3.23	−0.05	0.02
Corpus	McGloins Bluff	2.8	+ 3.20	+ 3.18	+0.02	0.00
Corpus	Laguna Madre N. base	2.8	− 8.65	− 8.47	−0.18	0.09
McGloins Bluff	Mustang	4.5	−12.72	−13.08	+0.36	0.58
Laguna Madre N. base	Mustang	11.0	− 1.86	− 1.43	−0.43	2.04
Laguna Madre N. base	Laguna Madre S. base	33.2	− 0.60	− 0.75	+0.15	0.76
Mustang	Laguna Madre S. base	5.2	+ 0.60	+ 0.68	−0.08	0.03
Laguna Madre N. base	Padre	18.6	+ 5.33	+ 5.36	−0.03	0.02
Mustang	Padre	9.5	+ 7.12	+ 6.79	+0.33	1.04
Laguna Madre S. base	Padre	24.3	+ 6.01	+ 6.11	−0.10	0.24
Mustang	Aransas Lighthouse	2.0	+15.61	+18.47	−2.86	16.36
McGloins Bluff	Aransas Lighthouse	3.5	+ 4.48	+ 5.39	−0.91	2.90
Aransas Lighthouse	Aransas L. S. S.	119.0	−19.64	−19.57	−0.07	0.60
McGloins Bluff	Aransas L. S. S.	3.9	−13.86	−14.18	+0.32	0.40

The probable error of an observation of weight unity derived from the adjustment is ±0.88 meter. In other words, the reciprocal observations over a line 31.7 kilometers (19⅔ miles) long, this being the length of the line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 0.88 meter. The probable errors for lines of other lengths were assumed to be proportional to their lengths.

The probable errors of the elevations of the two stations fixed by direct connection with sea level are about ±0.05 meter. The probable error approaches this value for stations adjacent to those so fixed and for the stations adjacent to Lavernia and Thomas which are adjacent to the Seguin base, where there is a connection with the precise leveling. Station O'Neill was assumed to be the least accurately determined and its probable error was therefore computed as a limiting value and was found to be ±0.39 meter from the vertical angle measures alone, and when combined with the probable error of the elevations fixed by spirit leveling, it was not changed.

In other words, for the least accurately determined station in this portion of the main scheme, there is an even chance that the elevation is correct within 0.39 meter or 1.3 feet, and for most of the stations in the main scheme the accuracy is greater than this.

The elevations of the four stations—Reynolds, Alice, Wood, and Alice east base—were then obtained from a single adjustment as shown in the tabulation below.

The elevation of station Elliff was held as fixed by the preceding adjustment at 31.07 meters. The line of precise levels run in connection with the measurement of the Alice base in 1900 served to furnish the difference in elevation between east base and west base at 9.44 meters, which was adopted in preference to the difference 9.74 meters from the observed vertical angles.

Station 1	Station 2	Weight p	Observed difference of elevation h_2-h_1	Adjusted difference of elevation h_2-h_1	Observed minus adjusted v	pv^2
			Meters	*Meters*	*Meters*	
Elliff	Reynolds	3.08	+26.28	+26.24	+0.04	0.0045
Elliff	Wood	3.05	+ 9.34	+ 9.39	−0.05	0.0076
Reynolds	Wood	1.99	−16.93	−16.85	−0.08	0.0127
Reynolds	Alice	1.71	+ 5.76	+ 5.59	+0.17	0.0494
Wood	Alice	5.56	+22.38	+22.44	−0.06	0.0200
Wood	Alice east base	9.80	+ 1.86	+ 1.85	+0.01	0.0010
Alice	Alice east base	4.90	−20.60	−20.59	−0.01	0.0005
Alice east base	Alice west base	20.61	+ 9.74	+ 9.44		

The probable error of an observation of weight unity derived from the above adjustment is ±0.12 meter. In other words, the reciprocal observations over a line 31.7 kilometers (19⅔ miles) long, this being the length of line corresponding to unit weight, determined the difference of elevation of two points with such a degree of accuracy that it is an even chance whether the error is greater or less than 0.12 meter. The probable errors for lines of other lengths were assumed to be proportional to their lengths.

The probable error of Alice, the station most remote from Elliff, may be stated to be less than ±0.39 meter, the limiting value computed for station O'Neill. The distance from the stations fixed by connection with sea level is almost the same and the probable error of the connecting lines less than for O'Neill. In other words, for the least accurately determined station in this portion of the main scheme there is an even chance that the elevation is correct within 0.39 meter or 1.3 feet, and for the four other stations in the main scheme the accuracy is greater than this.

ELEVATIONS.

The datum for all elevations is mean sea level.

The stations are in three classes: First, those fixed by direct connection with sea level. The elevations in this class are subject to a probable error of ±0.05 meter. Second, the stations in the main scheme fixed by reciprocal measures of vertical angles and which are subject to probable errors varying from ±0.1 to ±0.4 meter. Third, the intersection stations, of which the elevations are fixed by measurements of vertical angles which are nonreciprocal, the intersection stations not being occupied. These elevations are subject to probable errors which may be as great as ±2 meters.

The accuracy with which each elevation in the main scheme is determined depends mainly upon the remoteness of that station from the nearest one of the stations whose elevation is fixed by direct connection with sea level, as indicated in Class I of the following table, or on its remoteness from the nearest of the two stations, Lavernia and Thomas, which stations are adjacent to the Seguin base where there is a connection with precise leveling. Station O'Neill was assumed to be the least accurately determined of the stations in the main scheme.

For a table to be used in converting feet to meters and vice versa, see page 375.

Table of elevations.

Station	Point to which elevation refers	Elevation	Station	Point to which elevation refers	Elevation
Class 1			*Class 3*—Continued		
		Meters			*Meters*
Laguna Madre south base	Station mark	1.779	Skidmore Methodist Church spire	Top of cone	61.8
Aransas life-saving station.	Tide staff	0.000	Skidmore Baptist Church spire	Top of tallest building	[3] 62.9
Class 2					
Thomas	Station mark	[1] 227.38	Clareville gin stack (tall)	Top	96.1
Lavernia	Station mark	[1] 237.79	Capt. Jones's house	Tallest cone	[3] 99.9
Serita	Station mark	180.68	Mathis Methodist Church spire	Top of cone	62.4
Stockdale	Station mark	170.45	Mathis gin stack	Top	62.9
Ruckman	Station mark	147.14	P. E. McNeill's windmill	Center of wheel	71.0
Karnes	Station mark	140.63	Banquete, Cyrus Elliff's house	Top of chimney	40.0
Bryde	Station mark	159.39	Wood's ranch house	Top of cupola	54.8
Choate	Station mark	126.82	King's ranch house	Tallest chimney	49.4
Pettus	Station mark	136.10	King's ranch house	Top	46.0
Borroum	Station mark	147.92	Alice, Walter's & Co.'s gin stack	Top	78.1
Wiess	Station mark	109.73	Alice spire	Top	76.9
Beeville	Station mark	100.78	Cestohowa church spire	Top of cone	119.6
Fleming	Station mark	133.12	Panna Maria church spire	Top	123.9
Miller	Station mark	72.31	Parkman's gin stack	Top	76.2
O'Neill	Station mark	58.10	Robstown, railway water tank	Top	32.9
Skelly	Station mark	64.60	Corpus Christi, King Memorial Episcopal Church	Top of spire	30.0
Welder	Station mark	33.48	Corpus Christi standpipe		42.1
Mathis	Station mark	48.74	Corpus Christi, Dr. Spohn's residence	Top of cupola	27.5
Nolan	Station mark	32.21	Corpus Christi, Epworth League pavilion	Top of roof	10.6
Elliff	Station mark	31.07	Corpus Christi, colored church	Top of spire	30.4
Rogers	Station mark	19.28	Corpus Christi, Catholic Church	Top of black on spire	38.7
Kaleta	Station mark	21.91	Bay View College dormitory	Top of chimney	22.8
Corpus	Station mark	11.00	Bay View College dormitory	Ridge	[3] 20.5
Portland	Station mark	10.95	Bay View College recitation hall	Top of belfry	21.6
McGloins Bluff	Station mark	14.18	Alta Vista Hotel	Top of S. spire	30.3
Laguna Madre north base	Station mark	2.53	McHarry's barn	Top of cupola	20.1
Mustang	Station mark	1.10	Rosita ranch house	Top of S. chimney	23.3
Aransas L. H.		19.57	Shamrock Island, large barn	Top of SW. gable	7.0
Padre	Station mark	7.89	Ritter's windmill	Center of wheel	17.7
Reynolds	Station mark	57.31			
Wood	Station mark	40.46			
Alice	Station mark	62.90			
Alice east base	Station mark	42.31			
Alice west base	Station mark	51.75			
Class 3					
Karnes City Court House	Top of steeple	158.4			
Runge church	Tallest spire	122.2			
Beeville water-tower	Top	92.5			
Beeville Catholic Church spire.	Top of cone	91.7			
Skidmore Catholic Church spire.	Top of cone	62.0			

[1] See Appendix 5, Report for 1905, p. 280.

[3] No check on this elevation.

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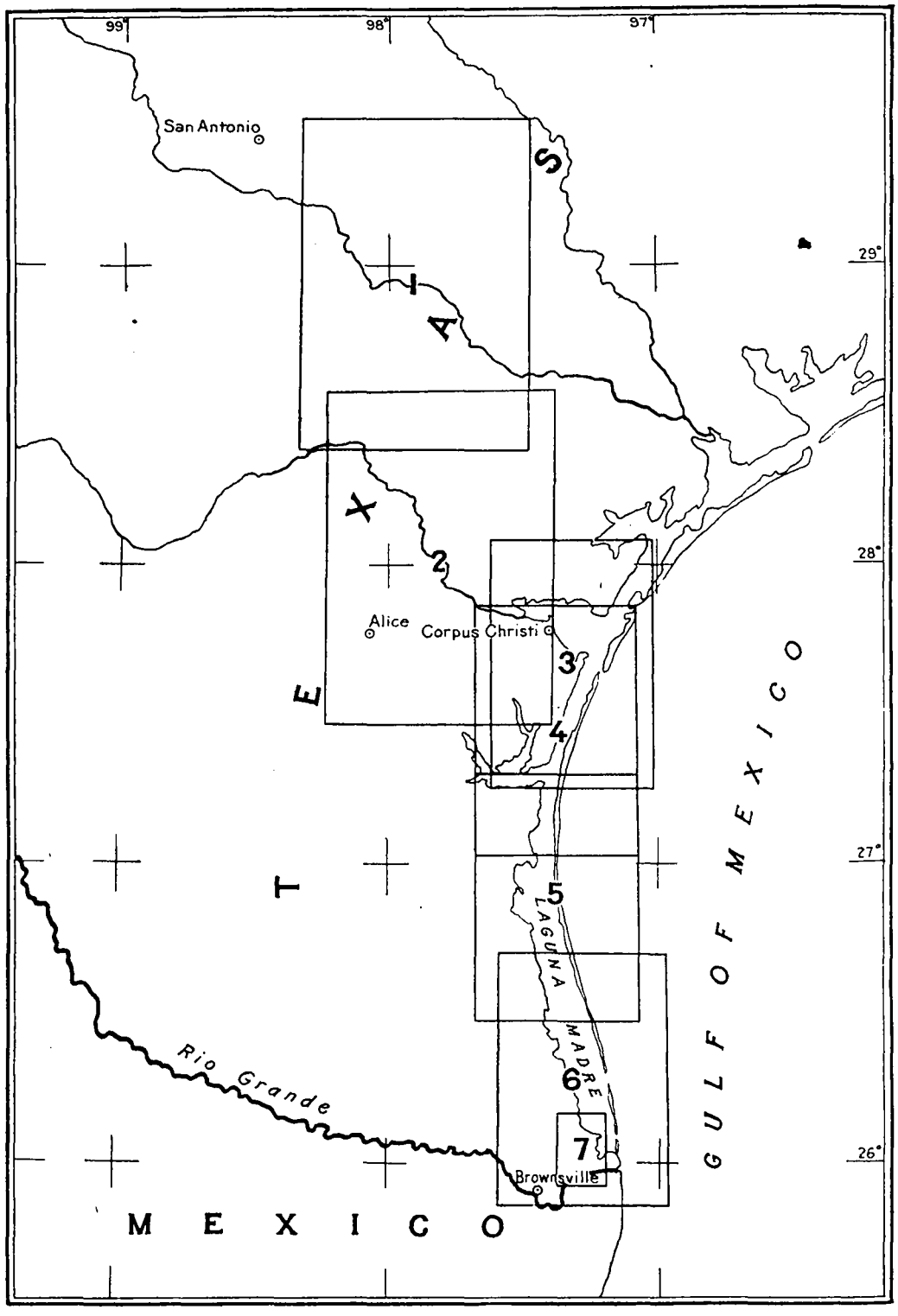
Index to positions, descriptions, sketches, and elevations.

Index to positions, descriptions, sketches, and elevations—Continued.

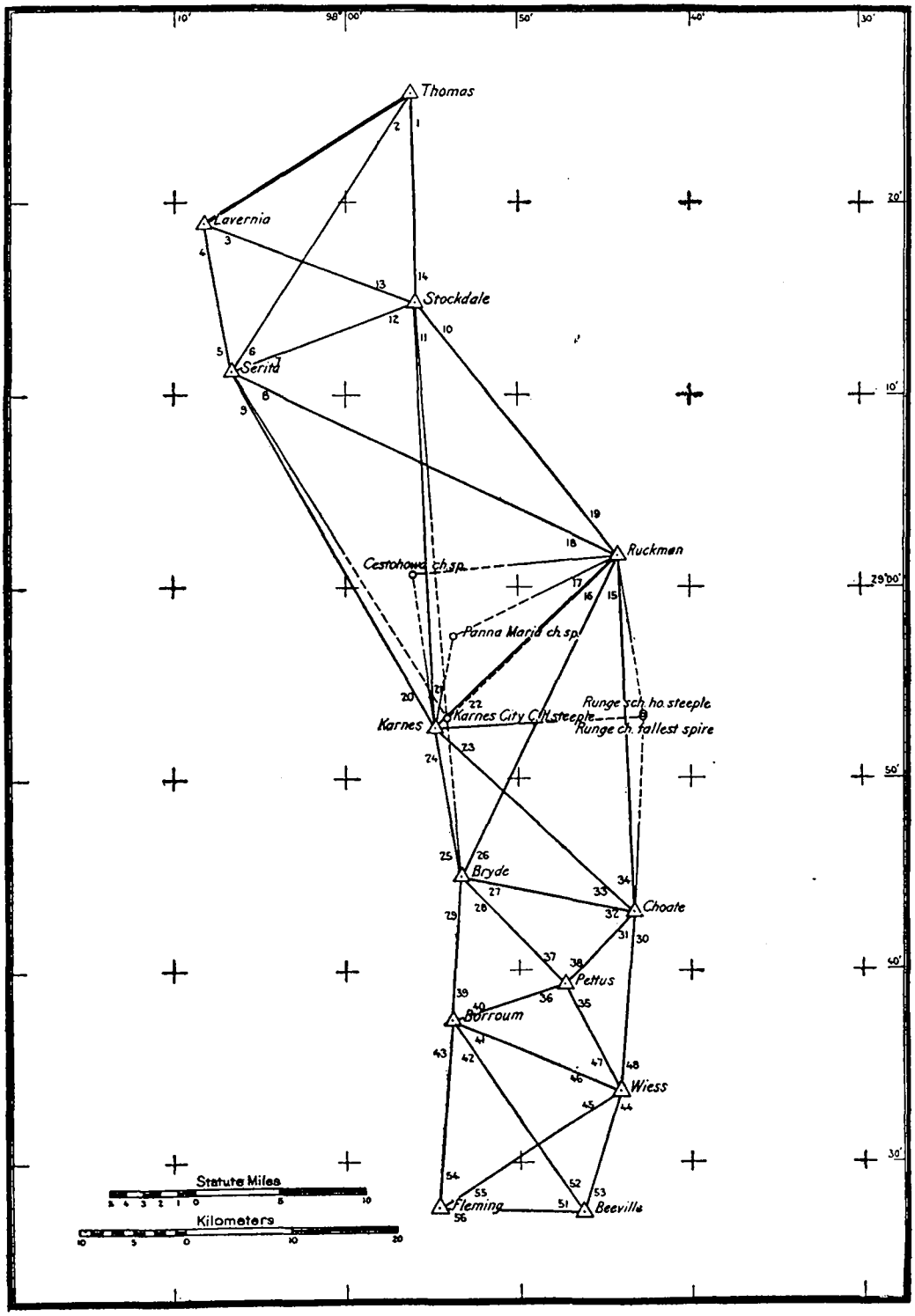
Index to positions, descriptions, sketches, and elevations—Continued.

Station	Position	Description	Sketch	Elevation
	Page	*Page*	*Number*	*Page*
King's ranch house	378	.....	2	409
Kingsbury	384	404	6	.....
Laguna Madre:				
North base	377	395	3, 4	409
South base	377	395	3, 4	409
Lavernia	375	386	1	409
Lomalto	381	398	5, 6	.....
McGloins Bluff	377	394	3, 4	409
McHarry's barn	380	.....	3	409
McManus	384	404	6	.....
McNeill's (P. E.) house windmill	378	.....	2	409
Mathis	376	390	2	409
Mathis:				
Gin stack	378	.....	2	409
Methodist Church	378	.....	2	409
Mesena	384	403	6	.....
Mesena 2	384	404	6	.....
Methodist Church:				
Mathis	378	.....	2	409
Skidmore	377	.....	2	409
Miller	376	389	2	409
Mosquito	383	402	5	.....
Mott	380	397	4	.....
Murdocks Landing	383	402	5	.....
Mustang	377	394	3	409
New	382	402	5	.....
Nolan	376	391	2	409
North base:				
Laguna Madre	377	395	3, 4	409
Water tank near	379	.....	3	.....
Observatory, Rio Grande	384	404	6	.....
Oil	383	403	6	.....
O'Neill	376	389	2	409
Padre	377	396	3	409
Panna Maria church	379	.....	1	409
Parkman's gin stack	380	.....	2	409
Pavilion, Epworth League	379	.....	3	409
Peat Island	380	396	4	.....
Peg	382	401	4	.....
Pelican	383	.....	6	.....
Penescal	382	401	4	.....
Penescal house	383	.....	4	.....
Pettus	376	388	1	409
Point Isabel:				
East base	381	400	6, 7	.....
Lighthouse	384	.....	6	.....
South base	381	400	6, 7	.....
West base	381	400	6, 7	.....
Point of Rocks	380	397	4	.....
Pool	381	400	6	.....
Portalis	383	403	5	.....
Portland	377	394	3	409
Post office, Brighton	380	.....	3	.....
Rabbit	382	401	4	.....
Rainy	383	403	5	.....
Ranch house:				
King's	378	.....	2	409
Rosita	380	.....	3	409
Wood's	378	.....	2	409
Recitation hall, Bay View College	378	.....	3	409
Reynolds	376	391	2	409
Richards	380	397	4	.....
Rifle	381	398	6	.....

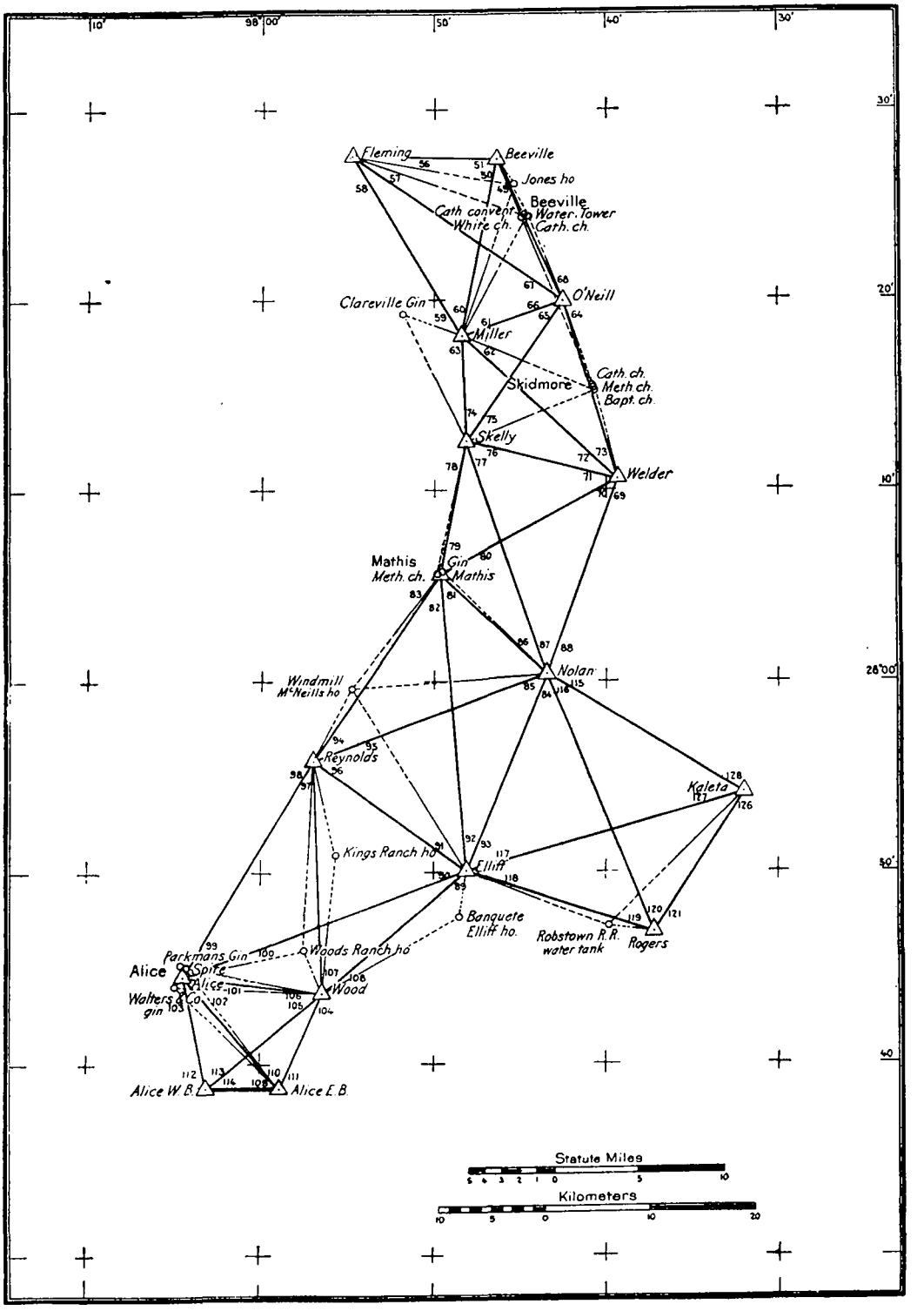
Index to positions, descriptions, sketches, and elevations—Continued.



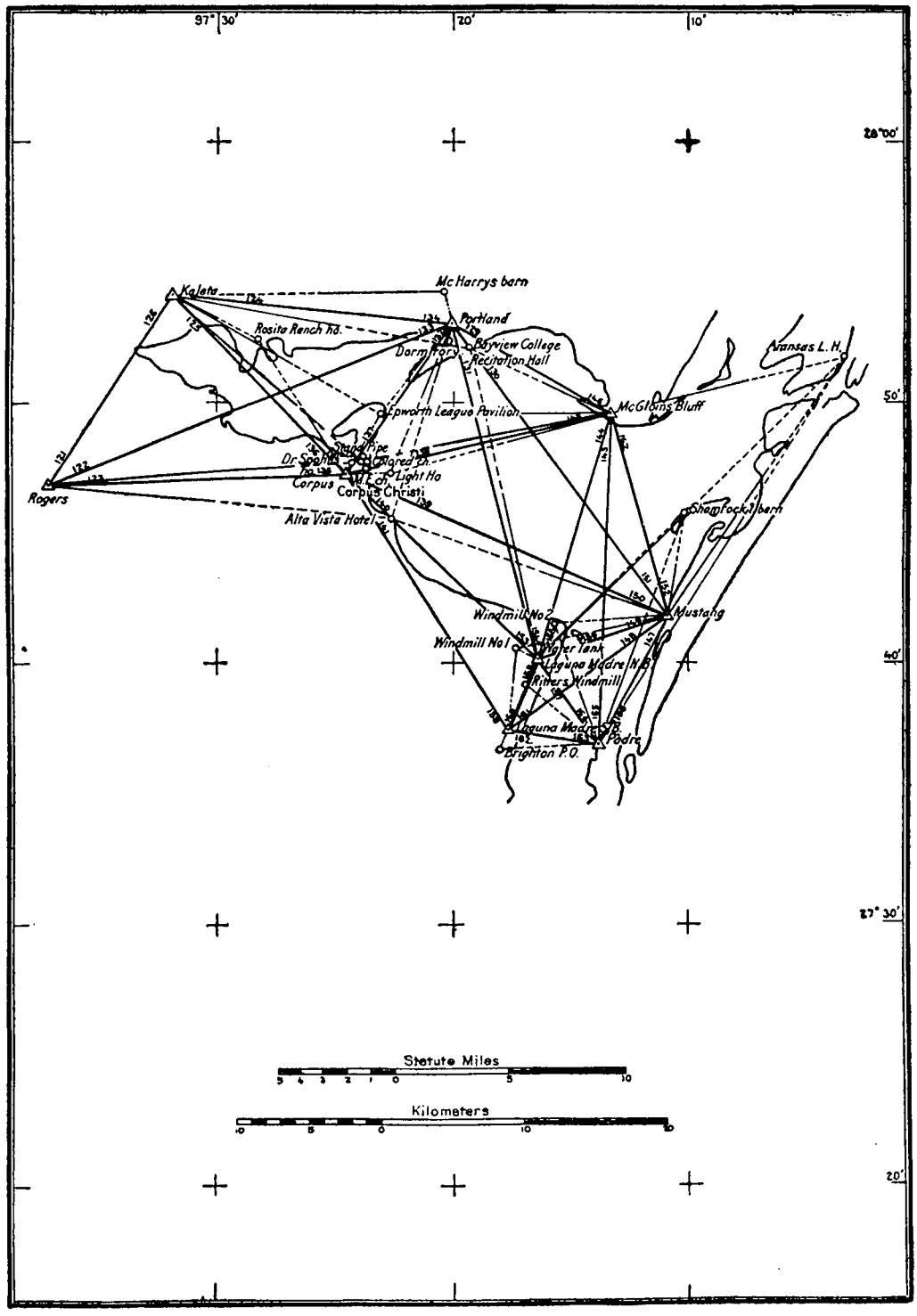
INDEX MAP TO TRIANGULATION SKETCHES.



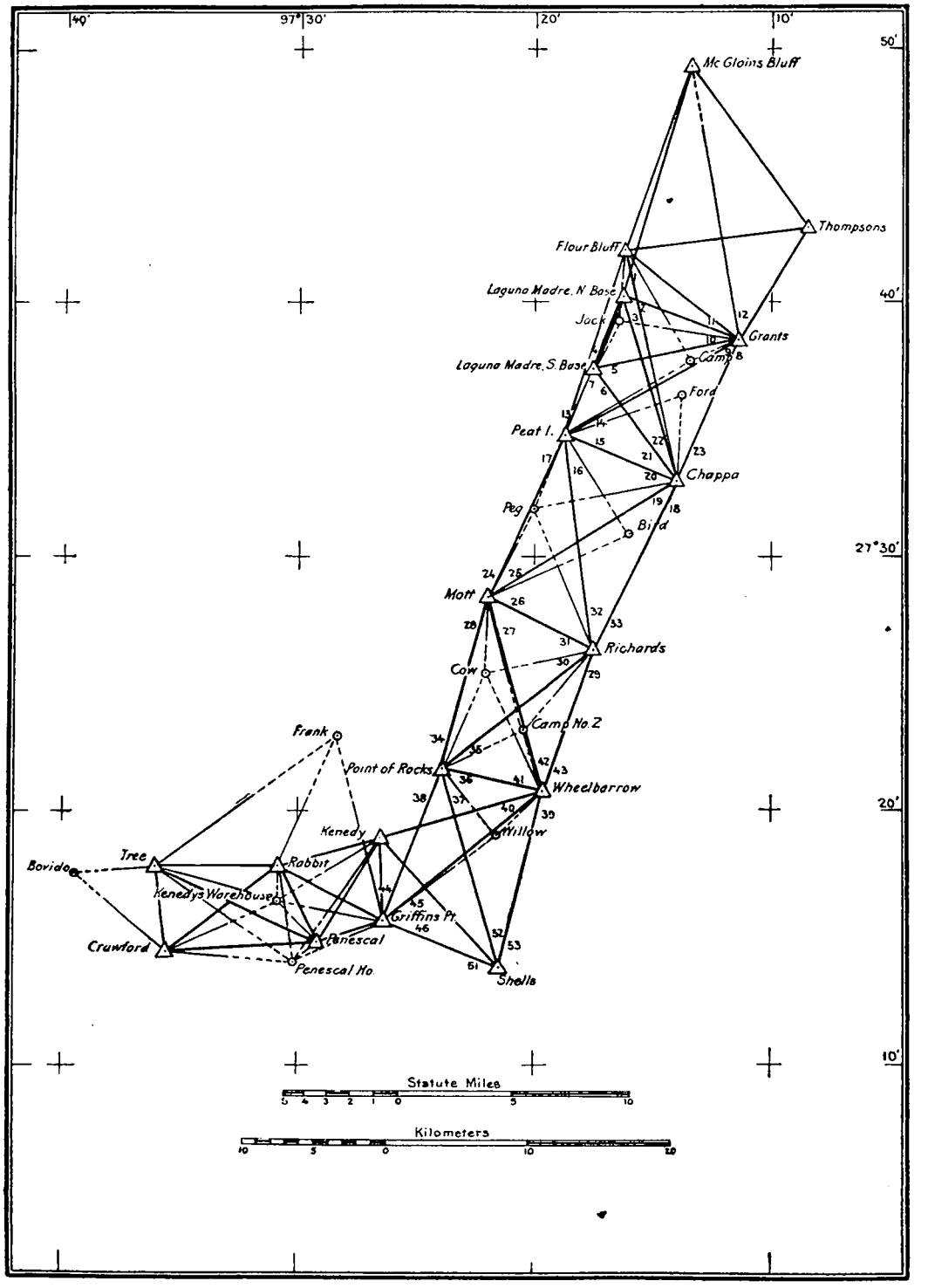
SEGUIN BASE NET TO BEEVILLE.



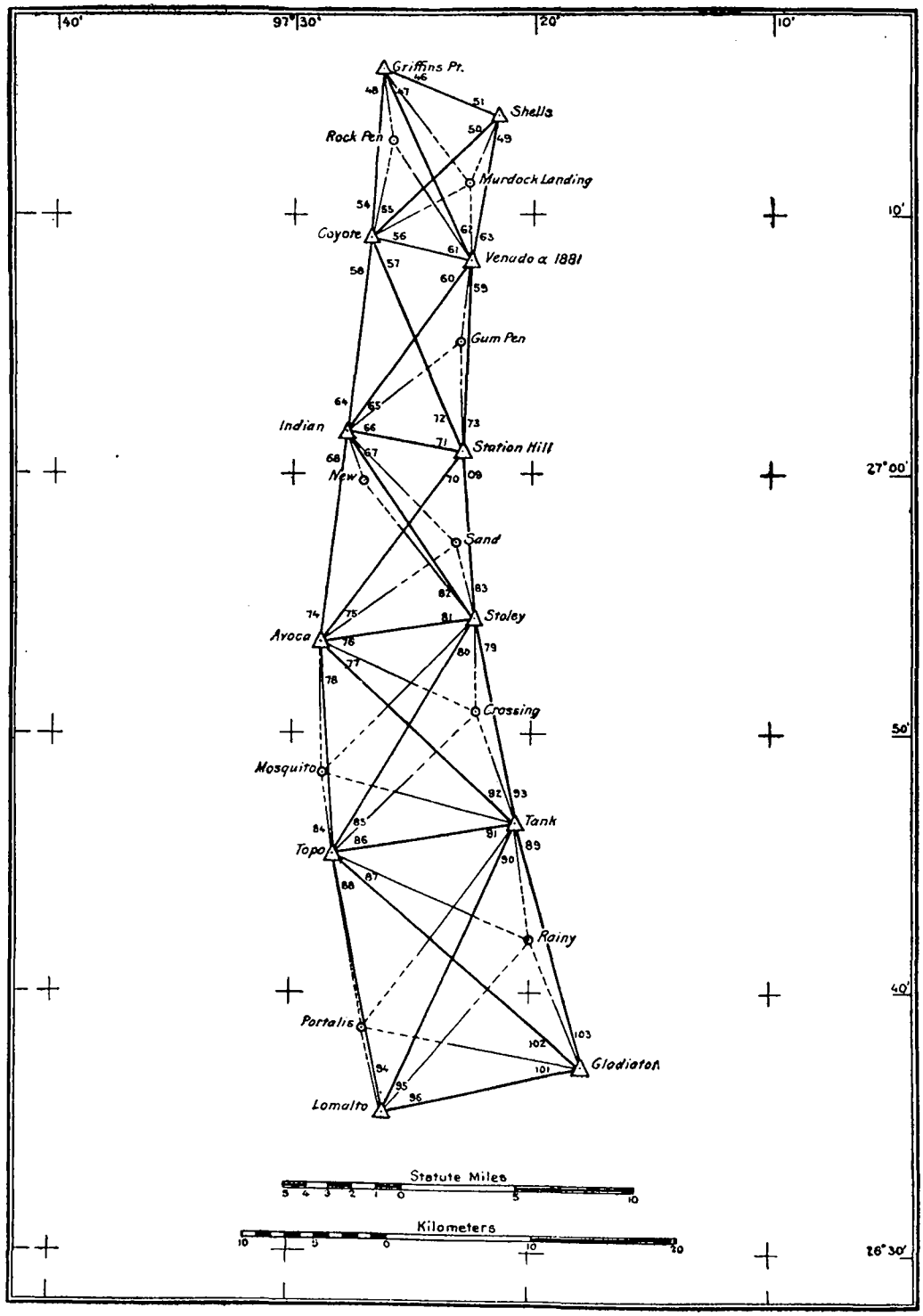
BEEVILLE TO ALICE.



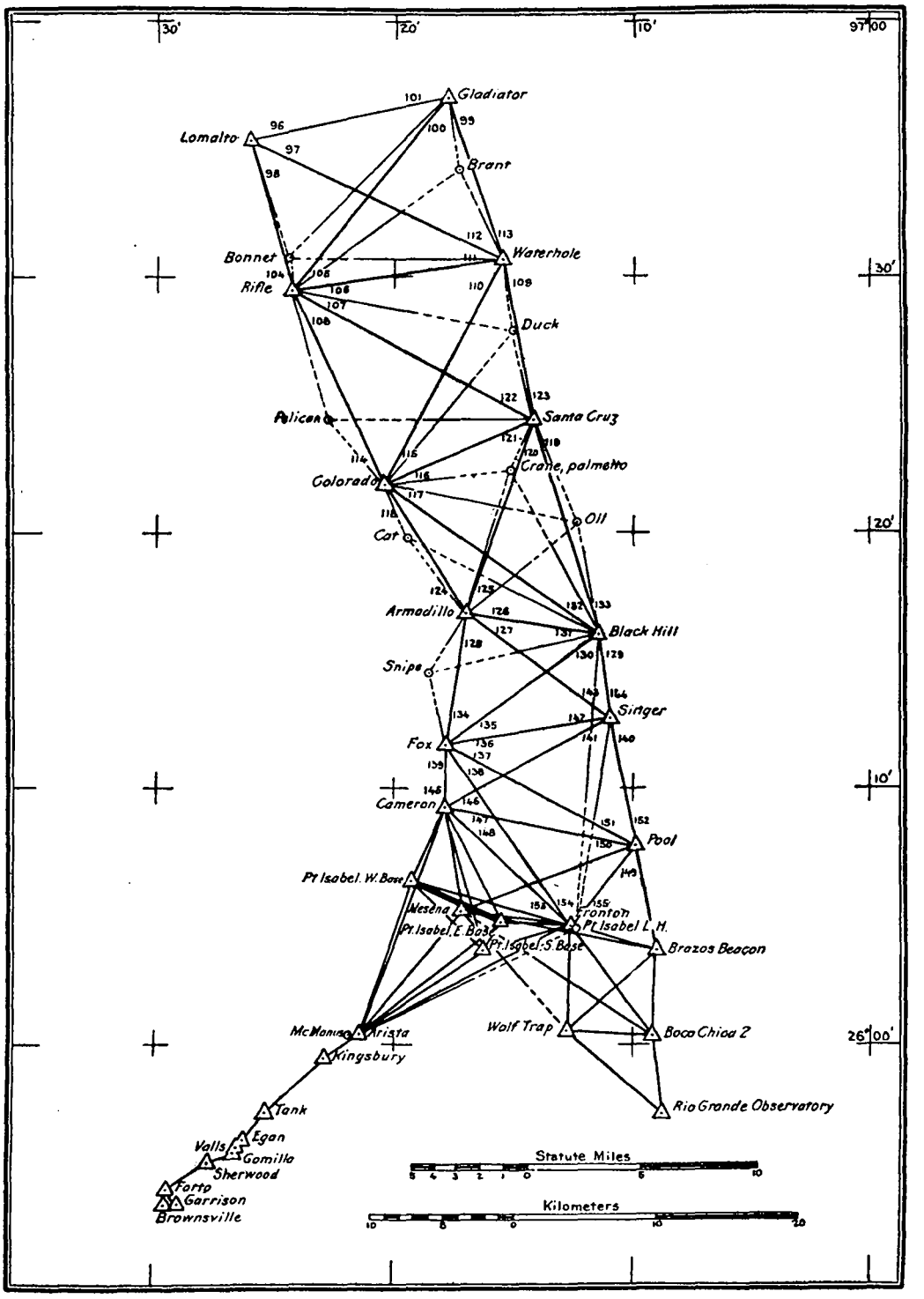
NINETY-EIGHTH MERIDIAN TO LAGUNA MADRE BASE.



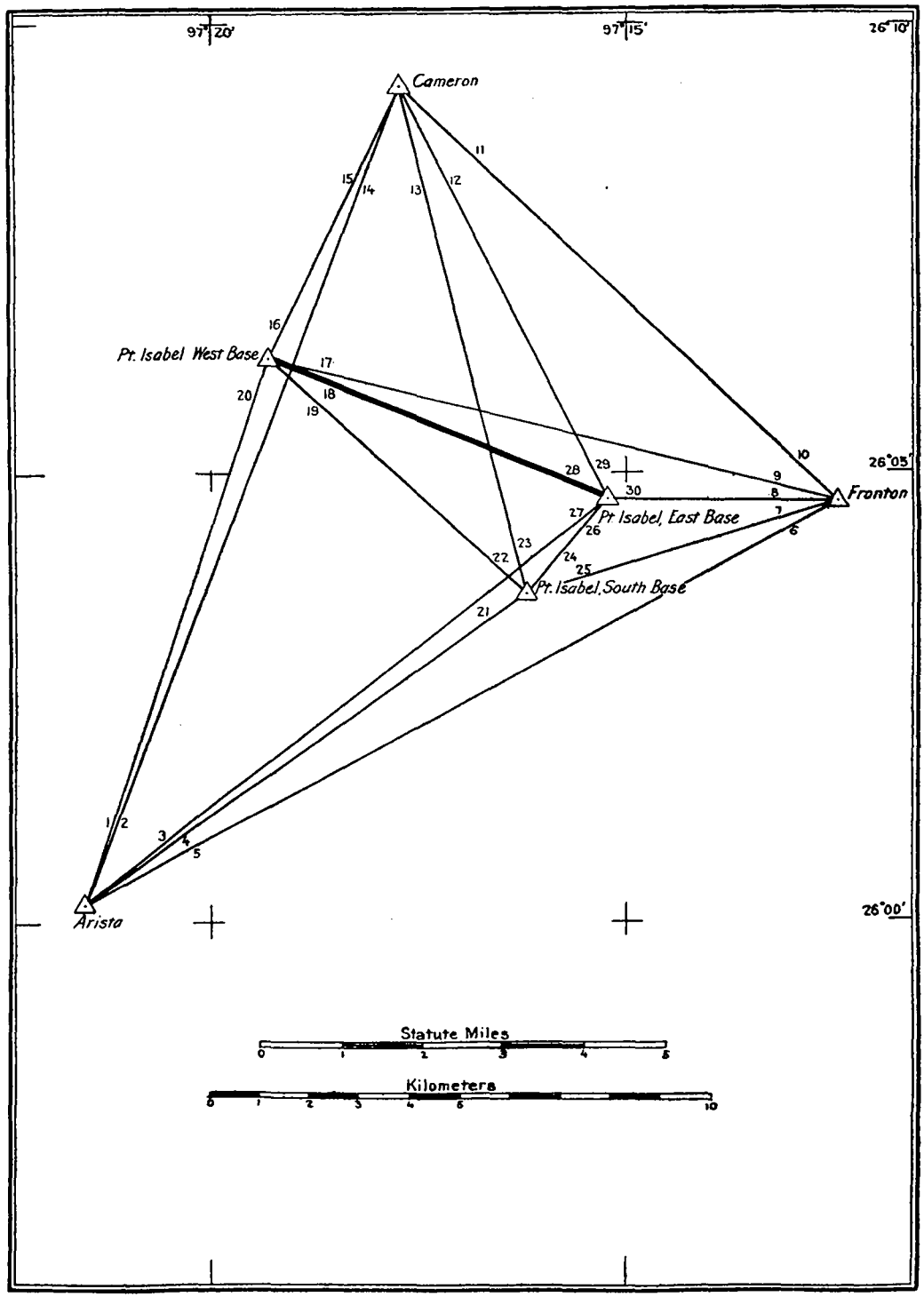
CORPUS CHRISTI BAY TO BAFFINS BAY.



BAFFINS BAY TO LOMALTO-GLADIATOR.



LOMALTO-GLADIATOR TO BROWNSVILLE.



POINT ISABEL BASE NET.

APPENDIX 6

REPORT 1911

TRIANGULATION ALONG THE EAST COAST OF FLORIDA, AND ON THE FLORIDA KEYS

By

HUGH C. MITCHELL

Computer, Coast and Geodetic Survey

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CONTENTS.

ILLUSTRATIONS.

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TRIANGULATION ALONG THE EAST COAST OF FLORIDA, AND ON THE FLORIDA KEYS.

By HUGH C. MITCHELL,

Computer, Coast and Geodetic Survey.

GENERAL STATEMENT.

The main and in fact the only large purpose of this publication is to present to the engineering public as complete a list as possible of the trigonometrical data along the east coast of Florida, on the Florida Keys, and from Fernandina inland to Gainesville.

This triangulation presents no unusual geodetic features, is not of primary degree of accuracy, was done under methods now largely superseded (except that which was done since 1900), and consequently offers little or no material for discussion. If its scientific value be small, on the other hand its practical value is large, for it offers to the engineer and to the geographer the positions of a large number of points determined trigonometrically and all correlated on one geodetic datum, known as the United States Standard Datum. (See p. 422.)

THE TRIANGULATION.

In describing the triangulation and the computation thereof it behooves us to be as brief as possible, not entering into any of those details of field or office work which characterize and greatly enhance in value our publications of primary triangulation results, but dwelling only in a general way on the historical aspects of the work, touching lightly on the computations made in reducing and correlating the observations, and then proceeding to the main body of the appendix: The list of geographic positions with explanation thereof, followed by as complete descriptions as are available of the stations and their markings, and all supplemented by a series of sketches and an index, by the aid of which it is possible to find at once all data relating to a given station, or to locate with ease the trigonometrical data in any given locality.

The observations involved in this triangulation were begun as early as 1849, and extend to as late a date as June, 1911, at which time the geodetic connection between Key West and Dry Tortugas was established. Ordinarily, triangulation which has been done many years prior to the date of the publication of its results is largely reduced in value to the engineer by the loss of stations, either through the destroying agencies of time or the building agencies of man. In many cases the engineer fails to recover a station which still exists, and still possesses its original geographic value; this failure may be due to changes in the surrounding topography, or to the destruction of surface and reference marks; the whole appearance of things around the station may be so changed that the description no longer fits the facts, but the station mark—probably

only the underground mark—may still remain in place, undisturbed and unmoved since it was set in place years before and its geographic position determined. Digging at the proper place would discover the mark and recover the station, but without the guidance of the reference marks or of the local topography to help in finding the point, it can be recovered only by relocating the point within a few feet by means of triangulation carried from near-by or even distant triangulation stations.

This may be accomplished by intersecting lines from near-by stations, obtaining the needed directions from the table of azimuths, or it may sometimes be more easily accomplished by establishing a temporary station (such as a flag in a tree) in the immediate vicinity of the old station, as near as can be determined, and then obtaining the position of this temporary station by triangulation from other stations whose recovery is certain. The geographic position of the temporary station can then be compared with that of the old station, their linear relation determined, and offsets measured to the spot indicated by the comparison as the probable location of the old station.

During the years 1905 to 1909 an officer of this Survey visited the localities of the various stations included in this appendix with the view of providing a sufficient number of recoverable triangulation stations along the coast to completely control any topographic or hydrographic surveys that might be undertaken. Many old stations were not recovered by this officer—some of them, it was determined, had been destroyed by nature or by man; others, it seemed probable, still existed, but the expense of cutting trees and brush, and other expenses incident to a complete search, were so great as to put a limit to the search made for them. Many stations were recovered, the marks, one or both, being still intact, some reference marks being still in existence—in many cases the local topography being still determinate in character. Such stations were usually re-marked in a more permanent manner, and complete and up-to-date descriptions made of them.

In some cases, unfortunately not rare, the recovery of the station was uncertain, only a part of the marks being recovered, their identification being uncertain, and in some cases the marks found did not tally with those named in the original description. In such cases it was assumed that the station was recovered, and it was re-marked in a permanent manner. The recovery or nonrecovery of such a station can be proven only by using it in connection with a sufficient number of other stations of known positions to insure that if it be a nonrecovery a discrepancy will develop which will serve as an index. A caution is always placed in the description of such a station, and it should be heeded. Such a station should always be used in connection with at least two other stations whose positions are known, and whose integrity is unquestioned.

In some localities where insufficient stations to provide the required control were recovered, new triangulation was executed. This new triangulation always depended on old stations for positions and lengths; no more of this new triangulation was done than was needed to provide the required control. In addition to this systematic revision work for the purpose indicated above, there are in various localities triangulations of recent date done in connection with special surveys of limited extent, this including the connection of astronomic stations with the main triangulation, and work done in connection with local hydrographic surveys. There are also included in this appendix the results, computed at this Office, of the resurvey of the St. Johns River, made since 1900 by the United States Engineers.

The latest work included in this appendix is the geodetic connection between Dry Tortugas and the main Florida Keys. This connection, made by means of signals placed on shoals and reefs, was completed in 1911, and makes it possible to include in the list of positions published on the United States Standard Datum all geographic positions in the vicinity of Dry Tortugas.

It will be seen from the sketches at the end of this appendix that the triangulation consisted, as a rule, of a chain of quadrilaterals with all angles observed. In the revision work of 1905–1909 concluded angles were used extensively. Along one section of the beach, length measures made with long wires were substituted for triangles; positions were carried ahead by means of these beach measures, the horizontal angles in the traverse being measured. Rough checks were had by an imperfect scheme of triangles, which usually had one point unoccupied. These beach measures were made between the Indian River and Miami. Traverse of a high degree of accuracy was measured along the railroad between Baldwin and Cedar Keys, the results of this traverse only as far west as Gainesville being included in this appendix.

ADJUSTMENT OF THE TRIANGULATION.

It is proposed here to make only a general statement of the adjustment of the triangulation, giving rather a geographic description of the various chains and loops than a technical discussion of the methods used in making the adjustments; that is, in distributing the discrepancies which were developed in the computation of the triangulation.

From stations of the eastern oblique arc above Atlanta a chain of primary triangulation extends down to Augusta, Ga.; this chain was adjusted in the ordinary way to eliminate discrepancies of triangle closures and ratios of lengths. From Augusta, Ga., to Beaufort, S. C., there extends a primary traverse, which was so adjusted as to bring out an observed azimuth at Beaufort. Thus adjusted this triangulation and traverse were held fixed, not being altered in any way because of any loop into which they subsequently entered. In a similar manner the triangulation extending down the coast from Beaufort to Fernandina, Fla., the triangulation from Fernandina to Baldwin, part way across the Florida peninsula, and the traverse from Baldwin to Cedar Keys on the Gulf coast of Florida, were held fixed after being adjusted for discrepancies of triangle closures, ratios of sides and lengths, and made to conform to observed azimuths. In other words, all discrepancies except those developed in closing loops of triangulation were eliminated, and when loop closures were developed the portions of triangulation mentioned in the foregoing paragraphs were held fixed, receiving none of the correction thereby made necessary.

The chain of triangulation (including a small section of measured traverse) along the Gulf coast between Cedar Keys and Mobile Bay, which is on the Eastern Oblique Arc, was then adjusted, holding fixed the triangulation at Mobile Bay, at Cedar Keys, and all observed azimuths and measured lengths along the coast.

In a similar manner the chain of triangulation, and sections of measured traverse extending down the east coast of Florida, around Cape Sable, and up the west coast to Cedar Keys was adjusted, holding fixed the triangulation at Fernandina. at Cedar Keys, and all observed azimuths, and measured lengths.

In each of these two pieces of triangulation all observed azimuths were held fixed and the triangulation adjusted to them, it being reasonably certain that the observed azimuths were superior to any that might be computed through the triangulation. All measured lengths were also held. The discrepancies remaining in the triangulation after all conditions noted above had been satisfied were distributed along the weaker sections of the triangulation by means of latitude and longitude equations, it being believed that the character of the triangulation warranted this, and that the corrections fell close to where they belonged. This also made considerable saving in the computation.

The spur of triangulation extending out to Key West and thence to Dry Tortugas was adjusted in the usual manner, as was also the triangulation of the St. Johns River, except that triangulation of two periods covering the same portion of the St. Johns River had to be correlated. All observed azimuths and measured lengths were held.

The geodetic connection with the triangulation of Dry Tortugas was made through a single point (Rebecca Shoal Lighthouse), through which was carried the United States standard latitude, longitude, and azimuth, but no length. The lengths of lines west of Rebecca Shoal Lighthouse were fixed by a base measured on one of the Dry Tortugas keys.

THE UNITED STATES STANDARD DATUM.

All of the positions and azimuths have been computed upon the Clarke spheroid of 1866, as expressed in meters, which has been in use in the Coast and Geodetic Survey for many years.

After a spheroid has been adopted and all the angles and lengths in a triangulation have been fully fixed, it is still necessary, before the computation of latitudes, longitudes, and azimuths can be made, to adopt a standard latitude and longitude for a specified station and a standard azimuth of a line from that station. For convenience, the adopted standard position (latitude and longitude) of a given station, together with the adopted standard azimuth of a line from that station, is called the geodetic datum.

The primary triangulation in the United States was commenced at various points, and existed at first as a number of detached portions in each of which the geodetic datum was necessarily dependent only upon the astronomic stations connected with that particular portion. As examples of such detached portions of triangulation there may be mentioned the early triangulation in New England and along the Atlantic coast, a detached portion of the transcontinental triangulation centering on St. Louis and another portion of the same triangulation in the Rocky Mountain region, and three separate portions of triangulation, in California in the latitude of San Francisco, in the vicinity of Santa Barbara Channel, and in the vicinity of San Diego. With the lapse of time these separate pieces have expanded until they have touched or overlapped.

The Transcontinental Triangulation, of which the office computation was completed in 1899, joins all of the detached portions mentioned and makes them one continuous triangulation. As soon as this took place the logical necessity existed of discarding the old geodetic data used in these various pieces and substituting one datum for the whole country, or at least for as much of the country as is covered by continuous triangulation. To do this is a very heavy piece of work, and involved much preliminary study to determine the best datum to be adopted. On March 13, 1901, the Superintendent adopted what is now known as the United States Standard Datum, and it was decided to reduce the positions to that datum as rapidly as possible. The datum adopted was that formerly in use in New England, and therefore its adoption did not

affect the positions which had been used for geographic purposes in New England and along the Atlantic coast to North Carolina, nor those in the States of New York, Pennsylvania, New Jersey, and Delaware. The adopted datum does not agree, however, with that used in "The Transcontinental Triangulation" and in "The Eastern Oblique Arc of the United States," publications which deal primarily with the purely scientific problem of the determination of the figure of the earth and which were prepared for publication before the adoption of the new datum.

As the adoption of such a standard datum is a matter of considerable importance, it is in order here to explain the desirability of this step more fully.

The main objects to be attained by the geodetic operations of the Coast and Geodetic Survey are, first, the control of the charts published by the Survey; second, the furnishing of geographic positions (latitudes and longitudes), of accurately determined elevations and of distances and azimuths, to officers connected with the Coast and Geodetic Survey and to other organizations; third, the determination of the figure of the earth. For the first and second objects it is not necessary that the reference spheroid should be accurately that which most closely fits the geoid within the area covered, nor that the adopted geodetic datum should be absolutely the best that can be derived from the astronomic observations at hand. It is simply desirable that the reference spheroid and the geodetic datum adopted shall be, if possible, such a close approximation to the truth that any correction which may hereafter be derived from the observations which are now or may hereafter become available shall not greatly exceed the probable errors of such corrections. It is, however, very desirable that one spheroid and one geodetic datum be used for the whole country. In fact, this is absolutely necessary if a geodetic survey is to perform fully the function of accurately coordinating all surveys within the area which it covers. This is the most important function of a geodetic survey. To perform this function it is also highly desirable that when a certain spheroid and geodetic datum have been adopted for a country they should be rigidly adhered to without change for all time, unless shown to be largely in error.

In striving to attain the third object, the determination of the figure of the earth, the conditions are decidedly different. This problem concerns itself primarily with astronomic observations of latitude, longitude, and azimuth, and with the geodetic positions of the points at which the astronomic observations were made, but it is not concerned with the geodetic positions of other points fixed by the triangulations. The geodetic positions (latitudes and longitudes) of comparatively few points are therefore concerned in this problem. However, in marked contrast to the statements made in preceding paragraphs, it is desirable in dealing with this problem that, with each new important accession of data, a new spheroid fitting the geoid with the greatest possible accuracy, and new values of the geodetic latitudes, longitudes, and azimuths of the highest degree of accuracy, should be derived.

The United States Standard Datum was adopted with reference to positions furnished for geographic positions, but has no reference to the problem of the determination of the figure of the earth. It is adopted with reference to the engineer's problem of furnishing standard positions, and does not affect the scientist's problem of the determination of the figure of the earth.

The principles which guided in the selection of the datum to be adopted were: First, that the adopted datum should not differ widely from the ideal datum for which the sum of the station errors in latitude, longitude, and azimuth should each be zero; second, it was desirable that the adopted datum should produce minimum changes in

the publications of the Survey, including its charts; and, third, it was desirable, other things being equal, to adopt that datum which allowed the maximum number of positions already in the office registers to remain unchanged, and therefore necessitated a minimum amount of new computation. These considerations led to the adoption as the United States Standard of the datum which had been in use for many years in the northeastern group of States and along the Atlantic coast as far as North Carolina.

An examination of the station errors available in 1903, on the United States Standard Datum, at 246 latitude stations, 76 longitude stations, and 152 azimuth stations scattered widely over the United States from Maine to Louisiana and to California, indicated that this datum approaches closely the ideal with which the algebraic sum of the station errors of each class would be zero.[1]

The adopted United States Standard Datum, upon which the positions and azimuths given in this publication depend, may be defined in terms of the position of the station Meades Ranch as follows:

	°	′	″
ϕ =	39	13	26.686
λ =	98	32	30.506
α to Waldo =	75	28	14.52

Points are then said to be upon the United States Standard Datum when they are connected with the station Meades Ranch by a continuous triangulation, through which the corresponding latitudes, longitudes, and azimuths have been computed on the Clarke spheroid of 1866, as expressed in meters, starting from the above data.

The principal lists of geographic positions heretofore published upon the United States Standard Datum throughout the whole United States are contained in the following publications of the Coast and Geodetic Survey and of other organizations:

Appendix 8 of the Report for 1885, positions in Massachusetts and Rhode Island; Appendix 8 of the Report for 1888, positions in Connecticut; Appendix 8 of the Report for 1893, positions in Pennsylvania, Delaware, and Maryland; Appendix 10 of the Report for 1894, positions in Massachusetts; Appendix 6 of the Report for 1901, positions in Kansas and Nebraska; Appendix 3 of the Report for 1902, positions in Kansas, Missouri, Nebraska, and Colorado; Appendix 4 of the Report for 1903, positions in Kansas, Oklahoma, and Texas; Appendix 9 of the Report for 1904, positions in California; Appendix 5 of the Report for 1905, positions in Texas; Appendix 3 of the Report for 1907, positions in California; Appendix 5 of the Report for 1910, positions in California; Appendix EEE, pages 2905–3031, Annual Report of the Chief of Engineers, 1902, positions of points on and near the Great Lakes; in publications of the Massachusetts Harbor and Land Commission; and in various bulletins of the United States Geological Survey. In the present report, in addition to this appendix, there are two other appendixes giving positions on the standard datum—Appendix 4, positions in Nebraska, North and South Dakota, and Minnesota; Appendix 5, positions in Texas.

TABLES OF POSITIONS.

In the tables of positions the latitude and longitude of each point are given on the United States Standard Datum (see p. 422), also the length and azimuth of each line observed over, whether in one or both ways. This is, in a way, a duplication, as the

[1] This is further borne out in the reduction of 765 astronomic stations in connection with the "Supplementary investigation in 1909 of the figure of the earth and isostasy," by J. F. Hayford, published by the Coast and Geodetic Survey.

lengths and azimuths are implicitly contained in the corresponding latitudes and longitudes, while, on the other hand, from the latitude and longitude of a single point all the remaining latitudes and longitudes may be derived by means of the given lengths and azimuths. The amount of computation involved in transforming one of these systems of coordinates into the other is so great that it is necessary to have the double system for the convenient use of the tables. Along with the latitude and longitude of each point the lengths and azimuths are given of lines from that point to other points of the triangulation. No lengths or azimuths are repeated, and for a given line the length and azimuth will generally be found opposite the position of the last mentioned of the two stations involved.

For the convenience of the draftsman a column of "seconds in meters" is given, in which is placed the length (in meters) of each small arc of a meridian or parallel corresponding to the seconds of the given latitude or longitude. To facilitate further the use of the tables, a column is given of the logarithms of the lengths. It must be remembered that it is the logarithm which is derived first in the computation, the lengths given in this table being then derived from the corresponding logarithms.

The rule followed in recent publications of this Office has been to give latitudes and longitudes to thousandths of seconds for all points the positions of which are fixed by fully adjusted triangulation. Points, the positions of which are given to hundredths of seconds only, are marked by footnotes as being without check or checked by verticals only. These notes mean that the object was pointed on from only two triangulation stations and that therefore an error in either pointing or in the identification of the object from either occupied station would not be detected in the computation, except that where vertical as well as horizontal observations were made on the object, a valuable check is obtained, and only a small error could pass undetected in the computation.

In the columns giving azimuths, distances, and logarithms of distances the accuracy is indicated to a certain extent by the number of decimal places given, it being understood that in each case two doubtful figures are given. In some cases there is very little doubt of the correctness of the second figure from the right, while in a few cases some doubt may be cast on the third figure from the right.

These tables may be conveniently consulted by using as finders the 22 sketches at the end of this appendix and the index on pages 561 to 579. In the third column of the index will be found for each point a reference to the page on which its description will be found, and in the fourth column the number of the sketch on which it appears.

For the convenience of those who wish to convert the distances given in the table from meters into feet the following conversion table is here inserted:

Meters	Feet	Feet	Meters
1	3. 280833	1	0. 3048006
2	6. 561667	2	0. 6096012
3	9. 842500	3	0. 9144018
4	13. 123333	4	1. 2192024
5	16. 404167	5	1. 5240030
6	19. 685000	6	1. 8288037
7	22. 965833	7	2. 1336043
8	26. 246667	8	2. 4384049
9	29. 527500	9	2. 7432055
10	32. 808333	10	3. 0480061

Fernandina to Gainesville.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
O'Neil	30 36 09.242	284.6	158 56 52.9	338 55 39.1	Cooper	10733.1	4.030724
1856	81 31 57.783	1539.3	218 55 57.2	38 58 03.7	Fernandina	10514.0	4.021766
Braddock	30 37 03.025	93.2	218 47 41.8	38 49 50.6	Cooper	10728.7	4.030548
1856	81 38 35.218	938.0	278 51 48.5	98 55 10.9	O'Neil	10715.2	4.030000
Dunns Creek	30 31 38.550	1187.1	158 52 36.9	338 51 23.2	Braddock	10712.3	4.029884
1856	81 36 10.279	274.0	218 53 37.2	38 55 45.6	O'Neil	10712.6	4.029896
Bear Branch	30 32 28.787	886.5	215 48 04.6	35 50 01.0	Braddock	10414.4	4.017633
1856	81 42 23.947	638.3	278 48 04.9	98 51 14.7	Dunns Creek	10080.5	4.003482
Cedar Creek	30 27 23.865	734.9	158 53 55.4	338 52 46.4	Bear Branch	10065.2	4.002822
1858	81 40 08.005	213.6	218 56 05.8	38 58 06.4	Dunns Creek	10084.7	4.003665
Kings Road	30 28 50.076	1542.0	230 45 53.5	50 48 30.7	Bear Branch	10653.0	4.027472
1858	81 47 33.501	893.5	282 33 40.4	102 37 26.3	Cedar Creek	12176.7	4.085531
Pickett	30 22 22.981	707.6	159 43 26.5	339 42 02.9	Kings Road	12708.3	4.104087
1858	81 44 48.387	1292.0	218 54 28.2	38 56 50.2	Cedar Creek	11909.9	4.075908
Brandy Branch	30 24 13.345	410.9	230 42 29.9	50 45 47.8	Kings Road	13464.3	4.129183
1858	81 54 04.186	111.7	282 51 39.1	102 56 20.3	Pickett	15222.5	4.182487
McGirts Creek	30 17 14.106	434.4	154 09 24.5	334 07 26.1	Brandy Branch	14346.1	4.156734
1858	81 50 09.908	264.8	222 03 37.2	42 06 19.0	Pickett	12815.2	4.107727
Big Creek	30 18 38.692	1191.5	231 06 59.8	51 11 01.9	Brandy Branch	16427.9	4.215583
1858–1897	82 02 03.257	87.0	277 43 51.0	97 49 50.9	McGirts Creek	19238.9	4.284180
Padgett	30 11 04.938	152.1	147 46 50.0	327 44 03.9	Big Creek	16519.5	4.217998
1858	81 56 33.610	899.2	222 02 26.2	42 05 39.4	McGirts Creek	15312.8	4.185055
Baldwin	30 17 59.096	1819.8	102 11 34.0	282 09 47.3	Big Creek	5779.9	3.761924
1897	81 58 31.808	849.9					
Lane	30 15 24.087	741.7	145 54 48.4	325 53 31.9	Big Creek	7236.4	3.859525
1897	81 59 31.466	841.1	198 28 03.9	18 28 34.0	Baldwin	5032.4	3.701776
Curve	30 08 56.351	1735.1	198 20 30.1	18 21 44.0	Lane	12579.0	4.099646
1897	82 01 59.537	1593.3					
Highland	30 06 28.648	882.1	197 26 16.0	17 26 42.8	Curve	4767.3	3.678268
1897	82 02 52.918	1416.8					
Starke	29 56 34.053	1048.5	197 47 26.6	17 49 16.4	Highland	19229.5	4.2839674
1897	82 06 32.368	868.0					
Waldo	29 47 30.839	949.5	197 42 55.0	17 44 34.2	Starke	17559.8	4.2445206
1897	82 09 51.611	1386.2					
Mathews	29 43 02.034	62.6	230 09 46.3	50 12 49.7	Waldo	12926.7	4.1114866
1860–1897	82 16 01.183	31.8					
Gainesville	29 39 32.237	992.5	210 33 03.6	30 34 13.9	Mathews	7501.7	3.8751574
1897–98	82 18 23.052	619.9					
Odd Fellow	29 38 58.769	1809.4	210 42 56.2	30 43 07.5	Gainesville	1198.6	3.0786873
1897	82 18 45.817	1232.4					
Gainesville courthouse spire	29 39 04.711	145.0	244 18 51.3	64 19 23.7	Gainesville	1955.7	3.291300
1897	82 19 28.586	768.8	279 02 00.4	99 02 21.6	Odd Fellow	1164.8	3.066235
Gainesville longitude station	29 39 08.08	248.8					
1890	82 19 25.69	690.8					
Waldo 2	29 47 26.54	817.2	230 19 24	50 19 27	Waldo	207.5	2.31692
1897	82 09 57.55	1545.7					

Cumberland Sound to St. Johns River.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Point Peter (Georgia)	30 43 37.744	1162.3					
1855–1905	81 30 43.873	1167.2					
Tiger Island north base	30 42 29.718	915.1	125 50 47.1	305 49 51.4	Point Peter	3577.8	3.553619
1855	81 28 54.864	1459.9					
Cumberland (Georgia)	30 43 22.700	699.1	47 22 10.8	227 21 36.8	Tiger Island N. base	2408.8	3.381804
1855	81 27 48.263	1284.1	95 40 30.9	275 39 01.2	Point Peter	4695.1	3.671642
Tiger Island south base	30 41 41.733	1285.1	134 59 00.7	314 57 52.0	Point Peter	5054.6	3.703689
1855–1871	81 28 29.492	784.8	155 26 40.1	335 26 27.1	Tiger Island N. base	1624.65	3.210761
			199 25 56.2	19 26 17.2	Cumberland	3297.1	3.518136
Martins Island	30 41 14.971	461.0	187 28 02.7	7 28 13.7	Point Peter	4434.3	3.646824
1856–1905	81 31 05.534	147.3	233 08 33.1	53 10 13.8	Cumberland.	6559.7	3.816881
			236 29 21.6	56 30 28.4	Tiger Island N. base	4170.3	3.620166
			258 45 54.1	78 47 13.8	Tiger Island S. base	4234.0	3.626749
Cooper	30 41 34.497	1062.3	236 52 55.3	56 54 47.0	Point Peter	6949.4	3.841948
1856	81 34 22.648	602.7	279 56 36.2	99 59 56.8	Fernandina	10622.7	4.026236
Clarke	30 39 51.685	1591.6	154 59 33.5	334 59 10.6	Martins Island	2830.1	3.451807
1861	81 30 20.583	547.9	221 05 56.0	41 06 52.7	Tiger Island S. base	4497.6	3.652980
Jackson	30 39 15.185	467.6	111 38 10.2	291 37 15.9	Clarke	3049.5	3.484228
1860	81 28 34.106	908.1	181 33 30.8	1 33 33.2	Tiger Island S. base	4514.6	3.654615
Pine Island	30 38 01.407	43.3	160 18 19.4	340 17 56.1	Clarke	3607.0	3.557149
1860	81 29 34.922	930.0	215 28 34.1	35 29 05.1	Jackson	2790.0	3.445605
Amelia	30 36 57.914	1783.4	136 07 39.5	316 07 03.5	Pine Island	2712.5	3.433364
1861	81 28 24.330	648.0	176 28 36.1	356 28 31.1	Jackson	4235.2	3.626870
Harrison	30 36 05.324	164.0	174 57 35.6	354 57 29.6	Pine Island	3588.6	3.554919
1861	81 29 23.083	614.9	224 00 59.0	44 01 28.9	Amelia	2252.1	3.352587
Vaughan	30 35 19.531	601.5	128 31 34.7	308 31 00.9	Harrison	2264.2	3.354910
1861	81 28 16.590	442.0	176 06 26.6	356 06 22.7	Amelia	3036.6	3.482390
Sterrett	30 34 23.024	709.1	179 03 01.3	359 03 00.3	Harrison	3150.7	3.498401
1861–1905	81 29 21.123	562.8	224 39 14.6	44 39 47.4	Vaughan	2446.3	3.388510
McRory	30 33 31.279	963.2	123 48 02.8	303 47 17.4	Sterrett	2864.8	3.457093
1861–1905	81 27 51.785	1380.2	168 47 11.6	348 46 59.0	Vaughan	3398.4	3.531276
Nassau	30 32 41.044	1263.9	168 52 30.3	348 52 18.6	Sterrett	3200.5	3.505221
1861–1905	81 28 57.948	1544.8	228 44 14.2	48 44 47.8	McRory	2345.8	3.370285
Shellbank	30 31 44.517	1370.8	121 39 09.3	301 38 15.5	Nassau	3317.8	3.520848
1861–1871	81 27 11.991	319.7	162 07 16.1	342 06 55.9	McRory	3454.5	3.538385
Anderson	30 31 36.183	1114.2	151 30 56.6	331 30 35.9	Nassau	2272.5	3.356499
1861–1871	81 28 17.288	460.9	190 51 20.1	10 51 33.0	McRory	3608.9	3.557370
			261 36 31.8	81 37 05.0	Shellbank	1759.6	3.245410
Crane	30 30 31.374	966.1	178 21 04.3	358 21 03.2	Anderson	1996.5	3.300277
1861	81 28 15.133	403.5	216 46 16.2	36 46 48.3	Shellbank	2812.0	3.449010
Christopher	30 30 10.865	334.6	115 44 39.5	295 44 14.6	Crane	1454.1	3.162607
1861–1905	81 27 26.011	693.6	152 30 42.7	332 30 16.7	Anderson	2961.7	3.471539
			187 23 04.9	7 23 12.0	Shellbank	2908.0	3.463596
Braddock	30 29 29.231	900.1	171 27 02.1	351 26 56.6	Crane	1935.1	3.286707
1861–1905	81 28 04.344	115.9	218 33 50.4	38 34 09.8	Christopher	1639.7	3.214771
Skeleton	30 28 54.900	1690.6	117 54 54.5	297 54 16.5	Braddock	2258.5	3.353818
1861	81 26 49.513	1320.7	157 24 35.7	337 24 17.2	Christopher	2533.7	3.403749
Breward	30 27 44.071	1357.1	172 16 42.2	352 16 33.8	Braddock	3267.9	3.514265
1861	81 27 47.880	1277.3	215 30 59.7	35 31 29.3	Skeleton	2679.8	3.428096
George	30 26 41.790	1286.9	136 23 34.6	316 22 59.9	Breward	2648.9	3.423058
1861	81 26 39.397	1051.3	176 14 03.1	356 13 58.0	Skeleton	4107.8	3.613609
Horseshoe	30 26 03.208	98.8	171 56 55.4	351 56 47.1	Breward	3136.8	3.496490
1853–1905	81 27 31.411	838.2	229 25 58.7	49 26 25.1	George	1827.0	3.261729

Cumberland Sound to St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Mount Cornelia	30 25 53.949	1661.3	95 22 37.4	275 21 39.8	Horseshoe	3047.2	3.483904
1853–1905	81 25 37.721	1006.7	131 50 14.5	311 49 43.3	George	2208.8	3.344155
			134 19 34.8	314 18 28.9	Breward	4853.8	3.686083
Round Pond	30 24 49.503	1524.3	136 29 16.5	316 28 35.6	Horseshoe	3129.8	3.495523
1853–1905	81 26 10.657	284.4	167 29 43.7	347 29 29.1	George	3541.7	3.549217
			203 53 15.1	23 53 31.8	Mount Cornelia	2170.5	3.336553
St. Johns River east base	30 24 22.943	706.5	111 09 54.2	291 09 14.2	Round Pond	2265.8	3.355216
1853	81 24 51.493	1374.5	156 14 27.8	336 14 04.4	Mount Cornelia	3062.0	3.485999
Sand Hill 3	30 23 30.028	924.7	167 42 48.6	347 42 38.6	Round Pond	2504.6	3.398747
1853	81 25 50.688	1353.2	224 07 01.6	44 07 31.6	St. Johns River E. base	2269.8	3.355985
Sand Hill 2	30 23 41.911	1290.6	74 45 26.0	254 45 00.5	Sand Hill 3	1391.4	3.143467
1853	81 25 00.400	10.7	190 39 25.6	10 39 30.1	St. Johns River E. base	1285.7	3.109131
St. Johns River west base	30 24 16.066	494.7	257 52 16.7	77 52 35.4	St. Johns River E. base	1008.1	3.003495
1853	81 25 28.416	758.4	324 34 56.0	144 35 10.2	Sand Hill 2	1290.5	3.110766
			22 45 13.7	202 45 02.4	Sand Hill 3	1537.3	3.186749
Ross	30 24 00.708	21.8	178 27 41.5	358 27 39.6	Horseshoe	3773.5	3.576749
1905	81 27 27.614	737.1	233 48 39.2	53 49 18.1	Round Pond	2545.0	3.405696
Fort	30 23 17.198	529.6	210 21 52.8	30 22 49.6	Horseshoe	5925.2	3.772702
1905	81 29 23.654	631.4	241 06 01.3	61 07 39.0	Round Pond	5883.9	3.769667
			246 36 10.7	66 37 09.4	Ross	3375.1	3.528286
Four Pines	30 22 13.593	418.6	127 41 25.9	307 40 37.9	Fort	3203.9	3.505685
1905	81 27 48.687	1300.1	189 40 42.2	9 40 52.9	Ross	3346.0	3.524531
St. Johns River Lighthouse	30 23 36.011	1108.9	54 40 26.1	234 39 18.3	Four Pines	4388.1	3.642272
1905	81 25 34.612	924.0	84 36 14.5	264 34 18.7	Fort	6142.0	3.788312
			104 09 28.3	284 08 31.1	Ross	3111.0	3.492896
			145 29 22.5	325 28 23.5	Horseshoe	5501.2	3.740459
R. 2 B. (U. S. E.)	30 23 47.287	1456.1	42 21 15.8	222 20 26.0	Four Pines	3903.7	3.591478
1905	81 26 10.194	272.1	79 50 34.2	259 48 56.4	Fort	5247.1	3.719920
			101 18 48.0	281 18 08.8	Ross	2107.6	3.323792
Warehouse (U. S. E.)	30 23 35.196	1083.8	50 48 51.2	230 47 52.8	Four Pines	3976.3	3.599477
1905	81 25 53.265	1422.0	84 22 46.2	264 20 59.8	Fort	5644.0	3.751584
			107 19 47.9	287 19 00.2	Ross	2638.3	3.421329
			129 29 09.8	309 29 01.2	R. 2 B. (U. S. E.)	585.5	2.767560
Supplementary points.							
Fernandina	30 40 34.767	1070.6	140 33 05.7	320 31 36.7	Point Peter	7298.3	3.863219
1856	81 27 49.574	1319.6	180 23 11.3	0 23 11.9	Cumberland	5171.5	3.713619
Fernandina astronomic station	30 40 17.100	526.6	179 59 56.8	359 59 56.8	Fernandina	544.0	2.73563
1856–7	81 27 49.574	1319.6					
Tiger Island north range rear light	30 42 38.759	1193.5	48 50 26.1	228 49 29.3	Martins Island	3919.8	3.593264
1905	81 29 14.654	390.0	127 25 43.7	307 24 58.1	Point Peter	2989.1	3.475537
Amelia Island Lighthouse	30 40 22.498	692.8	102 36 58.8	282 34 40.1	Martins Island	7409.0	3.869759
1905	81 26 33.885	902.0	134 27 09.2	314 25 47.1	Tiger Island N. range rear light	5992.9	3.777638
Tiger Island south range front light	30 41 35.887	1105.1	137 37 51.5	317 37 17.6	Tiger Island N. range rear light	2620.8	3.418426
1905	81 28 08.281	220.4					
Pilots' Lookout	30 41 21.286	655.5	128 38 10.2	308 37 12.7	Tiger Island N. range rear light	3821.7	3.582259
1905	81 27 22.465	597.8					
Fernandina courthouse	30 40 14.284	439.9	109 04 39.0	289 02 55.2	Martins Island	5721.8	3.757533
1905	81 27 42.362	1127.7	151 06 12.2	331 05 25.1	Tiger Island N. range rear light	5082.1	3.706041
Fernandina water tower	30 40 13.523	416.4	107 44 16.1	287 42 22.5	Martins Island	6216.2	3.793527
1905	81 27 23.081	614.4	146 25 33.1	326 24 36.2	Tiger Island N. range rear light	5368.5	3.729852

Cumberland Sound to St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Quarantine wharf, stack 1905	30 41 53.191 81 27 41.926	1637.9 1115.8	119 37 57.7	299 37 10.4	Tiger Island N. range rear light	2838.7	3.453117
Fernandina Methodist Church [1] 1905	30 40 24.07 81 27 37.55	741.2 999.5	105 49 21 148 04 49	285 47 35 328 03 59	Martins Island Tiger Island N. range rear light	5753.6 4886.9	3.759940 3.689030
Fernandina Convent [1] 1905	30 40 28.08 81 27 41.28	864.7 1098.9	104 53 22 148 18 39	284 51 38 328 17 51	Martins Island Tiger Island N. range rear light	5625.2 4729.8	3.750140 3.674840
Old beacon on house [1] 1905	30 42 10.60 81 26 48.71	326.4 1296.3	102 35 48	282 34 34	Tiger Island N. range rear light	3979.3	3.599806
Tiger Island north range front light 1905	30 42 37.628 81 28 59.162	1158.7 1574.3	94 49 52.7	274 49 44.9	Tiger Island N. range rear light	413.7	2.616686
Tiger Island south range rear light [1] 1905	30 41 32.42 81 28 09.69	998.3 257.9	199 19 05	19 19 06	Tiger Island S. range front light	113.00	2.053078
Fernandina longitude station 1907	30 40 14.14 81 27 43.02	435.4 1145.2			Fernandina court-house	18.01	1.25551
Number IX (U. S. E.) 1905	30 24 06.518 81 25 57.648	200.7 1538.8	353 05 03.1 29 29 30.6	173 05 05.3 209 29 24.2	Warehouse (U. S. E.) R. 2 B. (U. S. E.)	971.6 680.3	2.987480 2.832720
Mayport range front light 1905	30 23 37.942 81 25 18.222	1168.3 486.4	84 50 18.7 101 43 19.9 129 54 07.5	264 50 01.0 281 42 53.6 309 53 47.6	Warehouse (U. S. E.) R. 2 B. (U. S. E.) Number IX (U. S. E.)	939.3 1417.0 1371.9	2.972817 3.151355 3.137312
Mayport Hotel flagstaff 1905	30 23 30.939 81 25 53.308	952.7 1423.1	52 17 55.6 85 42 20.8 110 00 51.3	232 16 57.2 265 40 34.4 290 00 03.6	Four Pines Fort Ross	3893.9 5631.5 2679.2	3.590383 3.750624 3.428009
Mile Point Cut Range front light 1905	30 23 03.267 81 27 58.750	100.7 1568.5	100 43 20.5 205 10 05.5 350 02 12.2	280 42 37.6 25 10 21.3 170 02 17.3	Fort Ross Four Pines	2307.0 1954.4 1553.0	3.363045 3.291005 3.191178
Batton Island Shoal No. 2 Beacon light 1905	30 23 00.836 81 26 39.246	25.8 1047.9	51 53 12.7 96 33 35.2 208 27 58.4	231 52 37.6 276 32 12.0 28 28 13.0	Four Pines Fort R. 2 B. (U. S. E.)	2356.7 4418.2 1627.1	3.372300 3.645242 3.211425
Coal elevator 1905	30 23 18.949 81 26 03.670	583.5 98.0	54 20 18.6 89 26 07.1 119 51 13.0	234 19 25.5 269 24 25.9 299 50 30.5	Four Pines Fort Ross	3451.4 5339.3 2583.7	3.537997 3.727485 3.412236
Wharf 1905	30 23 06.427 81 26 14.302	198.0 381.9	57 09 40.0 93 46 01.0 130 30 13.6	237 08 52.3 273 44 25.2 310 29 36.5	Four Pines Fort Ross	2999.6 5066.1 2573.8	3.477067 3.704677 3.410567
Mile Point Cut Range rear light [1] 1905	30 23 04.89 81 28 16.62	150.6 443.7	334 43 18 101 57 50	154 43 32 281 57 16	Four Pines Fort	1746.8 1829.3	3.242233 3.262293

St. Johns River.

Principal points.							
Sherman (U. S. E.) 1908	30 22 56.629 81 26 22.302	1743.8 595.4	191 42 23.6 213 07 58.6	11 42 29.7 33 08 13.3	R. 2 B. (U. S. E.) Warehouse (U. S. E.)	1593.1 1418.2	3.202232 3.151740
Mile Point A (U. S. E.) 1908	30 23 02.460 81 26 56.420	75.8 1506.3	221 47 40.3 239 07 19.0 281 08 55.2	41 48 03.7 59 07 51.0 101 09 12.5	R. 2 B. (U. S. E.) Warehouse (U. S. E.) Sherman (U. S. E.)	1851.6 1964.4 928.4	3.267545 3.293233 2.967751
Pablo (U. S. E.) 1908	30 22 24.022 81 26 43.987	739.7 1174.5	164 20 02.3 209 58 05.5	344 19 56.0 29 58 16.5	Mile Point A (U. S. E.) Sherman (U. S. E.)	1229.3 1159.0	3.089655 3.064099

[1] No check on this position.

St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Island 1 (U. S. E.) 1908	30 22 37.476 81 27 20.028	1154.0 534.7	219 19 36.3	39 19 48.2	Mile Point A (U. S. E.)	994.6	2.997641
			249 03 22.4	69 03 51.6	Sherman (U. S. E.)	1650.3	3.217553
			293 17 21.0	113 17 39.2	Pablo (U. S. E.)	1047.7	3.020248
Island 2 (U. S. E.) 1908	30 23 05.948 81 28 16.705	183.2 446.0	272 51 50.0	92 52 30.6	Mile Point A (U. S. E.)	2146.2	3.331667
			300 05 02.8	120 05 51.5	Island 1 (U. S. E.)	1748.9	3.242764
White Shells (U. S. E.) 1908	30 23 34.926 81 28 07.409	1075.5 197.8	297 48 24.4	117 49 00.3	Mile Point A (U. S. E.)	2142.7	3.330968
			324 25 47.5	144 26 11.5	Island 1 (U. S. E.)	2174.8	3.337421
			15 32 39.4	195 32 34.7	Island 2 (U. S. E.)	926.2	2.966689
Marsh (new) (U. S. E.) 1908	30 23 53.195 81 29 19.485	1638.0 520.1	286 17 34.9	106 18 11.4	White Shells (U. S. E.)	2004.6	3.302037
			310 57 20.6	130 57 52.4	Island 2 (U. S. E.)	2219.4	3.346228
St. Johns (U. S. E.) 1908	30 23 20.178 81 29 25.562	621.3 682.4	189 03 57.9	9 04 01.0	Marsh (new) (U. S. E.)	1029.6	3.012651
			257 42 54.9	77 43 34.5	White Shells (U. S. E.)	2135.3	3.329453
			283 24 06.1	103 24 40.9	Island 2 (U. S. E.)	1889.8	3.276418
K (U. S. E.) 1908	30 23 55.084 81 30 16.921	1696.2 451.6	272 10 08.3	92 10 37.4	Marsh (new) (U. S. E.)	1534.4	3.185925
			308 05 29.0	128 05 55.0	St. Johns (U. S. E.)	1742.2	3.241095
Fulton (U. S. E.) 1908	30 23 24.643 81 30 31.468	758.8 840.1	202 30 08.4	22 30 15.8	K (U. S. E.)	1014.6	3.006315
			245 24 34.5	65 25 11.0	Marsh (new) (U. S. E.)	2113.2	3.324949
			274 27 47.6	94 28 21.0	St. Johns (U. S. E.)	1764.9	3.246712
Creek east base (U. S. E.) 1908	30 23 46.082 81 31 06.493	1419.0 173.3	258 09 54.6	78 10 19.7	K (U. S. E.)	1352.1	3.130993
			305 13 16.7	125 13 34.4	Fulton (U. S. E.)	1144.6	3.058656
Beacon No. 6 (U. S. E.) 1908	30 24 19.940 81 30 40.115	614.0 1070.8	321 01 40.1	141 01 51.8	K (U. S. E.)	984.4	2.993190
			352 16 45.3	172 16 49.6	Fulton (U. S. E.)	1718.3	3.235109
			34 02 09.6	214 01 56.2	Creek east base (U. S. E.)	1258.1	3.099712
Coon (U. S. E.) 1908	30 24 35.089 81 31 40.676	1080.5 1085.7	286 05 35.4	106 06 06.1	Beacon No. 6 (U. S. E.)	1682.5	3.225947
			328 50 19.2	148 50 36.5	Creek east base (U. S. E.)	1763.5	3.246375
Jack west base (U. S. E.) 1908–9	30 23 51.763 81 32 14.594	1593.9 389.5	214 09 31.6	34 09 48.8	Coon (U. S. E.)	1612.4	3.207462
			251 00 29.3	71 01 17.2	Beacon No. 6 (U. S. E.)	2667.1	3.426036
			275 29 28.1	95 30 02.6	Creek east base (U. S. E.)	1826.4	3.261585
Teach (U. S. E.) 1908	30 24 44.024 81 32 12.628	1355.6 337.0	287 52 40.6	107 52 56.8	Coon (U. S. E.)	896.1	2.952371
			1 52 02.6	181 52 01.6	Jack west base (U. S. E.)	1610.2	3.206868
Alligator (U. S. E.) 1908	30 24 10.192 81 32 45.786	313.8 1222.2	220 20 46.9	40 21 03.7	Teach (U. S. E.)	1367.0	3.135769
			246 11 28.0	66 12 01.1	Coon (U. S. E.)	1899.5	3.278649
			304 16 26.6	124 16 42.4	Jack west base (U. S. E.)	1007.6	3.003305
Calder (U. S. E.) 1908	30 23 44.030 81 33 14.862	1355.8 396.7	223 55 51.9	43 56 06.6	Alligator (U. S. E.)	1118.7	3.048707
			261 34 34.6	81 35 05.1	Jack west base (U. S. E.)	1626.4	3.211223
Radcliffe (U. S. E.) 1908–9	30 23 18.342 81 32 51.584	564.8 1377.1	141 50 53.7	321 50 41.9	Calder (U. S. E.)	1005.9	3.002566
			185 32 12.3	5 32 15.2	Alligator (U. S. E.)	1604.1	3.205238
			223 48 50.1	43 49 08.8	Jack west base (U. S. E.)	1426.3	3.154207
Lighthouse (U. S. E.) 1908	30 22 55.987 81 33 33.253	1724.0 887.8	198 21 29.8	18 21 39.1	Calder (U. S. E.)	1558.8	3.192777
			238 14 52.7	58 15 13.8	Radcliffe (U. S. E.)	1308.2	3.116683
Jones (U. S. E.) 1908	30 23 28.510 81 33 52.288	877.9 1395.9	244 25 57.4	64 26 16.3	Calder (U. S. E.)	1107.5	3.044352
			280 55 49.3	100 56 20.0	Radcliffe (U. S. E.)	1650.5	3.217626
			333 05 39.4	153 05 49.0	Lighthouse (U.S.E.)	1123.0	3.050392

St. Johns River—Continued

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Pauline (U. S. E.) 1908	30 22 34.678	1067.8	216 26 44.8	36 27 08.0	Jones (U. S. E.)	2060.8	3.314030
	81 34 38.145	1018.5	244 41 49.2	64 42 43.0	Radcliffe (U. S. E.)	3146.8	3.497864
			249 15 08.5	69 15 41.3	Lighthouse (U.S.E.)	1852.7	3.267802
Crab (U. S. E.) 1908	30 23 27.687	852.6	269 23 16.1	89 24 01.5	Jones (U. S. E.)	2396.9	3.379653
	81 35 22.067	589.0	324 18 13.2	144 18 35.4	Pauline (U. S. E.)	2009.9	3.303105
Beacon No. 20 (U. S. E.) 1908	30 24 16.094	495.6	317 10 52.5	137 11 18.2	Jones (U. S. E.)	1997.5	3.300482
	81 34 43.143	1151.6	357 33 11.6	177 33 14.2	Pauline (U. S. E.)	3125.8	3.494955
			34 52 56.2	214 52 36.5	Crab (U. S. E.)	1817.0	3.259357
Ben (U. S. E.) 1908	30 23 22.420	690.4	245 35 35.7	65 36 44.8	Beacon No. 20 (U. S. E.)	4001.3	3.602203
	81 36 59.649	1592.4	266 25 50.4	86 26 39.8	Crab (U. S. E.)	2610.2	3.416669
Merrill 2 (U. S. E.) 1908	30 24 00.151	4.6	263 33 42.6	83 35 05.2	Beacon No. 20 (U. S. E.)	4385.9	3.642061
	81 37 26.417	705.1	286 45 02.2	106 46 05.1	Crab (U. S. E.)	3466.8	3.539932
			328 24 17.0	148 24 30.5	Ben (U. S. E.)	1364.0	3.134821
Chase (U. S. E.) 1908	30 22 47.893	1474.8	174 33 15.3	354 33 11.3	Merrill 2 (U. S. E.)	2235.1	3.349300
	81 37 18.471	493.2	205 17 47.8	25 17 57.3	Ben (U. S. E.)	1175.9	3.070388
Cummer (U. S. E.) 1908	30 22 50.886	1566.9	203 49 01.0	23 49 18.8	Merrill 2 (U. S. E.)	2331.4	3.367626
	81 38 01.686	45.0	239 36 51.6	59 37 22.8	Ben (U. S. E.)	1919.9	3.283285
			274 33 49.6	94 34 11.4	Chase (U. S. E.)	1157.5	3.063522
Bank (new) (U. S. E.) 1908	30 22 15.812	486.9	121 51 33.2	301 51 00.3	Cummer (U. S. E.)	2046.4	3.310992
	81 36 56.587	1511.0	149 23 50.1	329 23 39.0	Chase (U. S. E.)	1147.7	3.059843
Fertilizer (U. S. E.) 1908	30 21 59.584	1834.8	150 11 34.4	330 11 17.2	Cummer (U. S. E.)	1820.7	3.260231
	81 37 27.790	742.0	189 29 41.0	9 29 46.4	Chase (U. S. E.)	1508.3	3.178478
			239 02 34.7	59 02 50.5	Bank (new) (U.S.E.)	971.6	2.987475
Mill (U. S. E.) 1908	30 21 13.774	424.2	177 38 46.7	357 38 45.6	Fertilizer (U. S. E.)	1411.8	3.149769
	81 37 25.619	684.2	202 05 11.6	22 05 26.3	Bank (new) (U. S. E.)	2061.7	3.314216
Driggs (U. S. E.) 1908	30 21 20.556	633.0	79 50 18.0	259 49 55.9	Mill (U. S. E.)	1183.4	3.073131
	81 36 42.003	1121.7	134 30 26.4	314 30 03.2	Fertilizer (U. S. E.)	1714.4	3.234120
			167 06 30.1	347 06 22.7	Bank (new) (U. S. E.)	1745.5	3.241918
Wilson (U. S. E.) 1908	30 20 34.645	1066.8	180 08 27.2	0 08 27.2	Mill (U. S. E.)	1204.9	3.080948
	81 37 25.730	687.2	219 33 22.7	39 33 44.8	Driggs (U. S. E.)	1833.7	3.263333
Bigelow (U. S. E.) 1908	30 20 11.317	348.5	122 29 04.6	302 28 43.3	Wilson (U. S. E.)	1337.6	3.126329
	81 36 43.486	1161.6	149 40 11.7	329 39 50.3	Mill (U. S. E.)	2228.3	3.347966
			181 03 51.0	1 03 51.8	Driggs (U. S. E.)	2132.4	3.328876
Terminal (U. S. E.) 1908–9	30 19 53.075	1634.3	196 34 09.1	16 34 16.3	Wilson (U. S. E.)	1335.5	3.125653
	81 37 39.989	1068.2	249 34 55.2	69 35 23.7	Bigelow (U. S. E.)	1610.5	3.206949
Matthews (U. S. E.) 1908–9	30 19 20.804	640.6	124 10 08.2	304 09 40.5	Terminal (U. S. E.)	1769.5	3.247844
	81 36 45.182	1207.1	154 31 54.4	334 31 33.8	Wilson (U. S. E.)	2518.6	3.401153
			181 40 07.3	1 40 08.1	Bigelow (U. S. E.)	1556.1	3.192035
Commodore A (U. S. E.) 1908–9	30 19 09.519	293.1	191 58 56.5	11 59 01.9	Terminal (U. S. E.)	1371.1	3.137059
	81 37 50.645	1353.0	223 18 31.5	43 19 05.4	Bigelow (U. S. E.)	2615.3	3.417521
			258 45 27.1	78 46 00.2	Matthews (U. S. E.)	1783.1	3.251165
Bluff 1876–1909	30 18 39.202	1207.1	156 00 59.6	336 00 51.8	Commodore A (U. S. E.)	1021.8	3.009349
	81 37 35.099	937.8	176 42 49.0	356 42 46.6	Terminal (U. S. E.)	2278.5	3.357645
Bigelow's (Robert) house N. chimney	30 20 31.354	965.5	26 18 19.4	206 17 47.1	Bluff	3852.3	3.585718
	81 36 31.205	833.5	40 06 24.3	220 05 44.2	Commodore A (U. S. E.)	3294.4	3.517782
1855–1909			57 19 19.7	237 18 45.0	Terminal (U. S. E.)	2182.9	3.339040
Jacksonville NE. base 1876	30 19 52.986	1631.6	239 06 11.1	59 06 48.5	Bigelow's N. chimney	2301.2	3.361951
	81 37 45.133	1205.6	353 16 13.2	173 16 18.3	Bluff	2287.8	3.359415
Jacksonville SW. base 1876	30 19 18.170	559.5	211 10 45.2	31 10 57.4	Jacksonville NE. base	1253.1	3.097994
	81 38 09.420	251.6	322 36 42.8	142 37 00.1	Bluff	1510.2	3.179026
Wallace 1876–1909	30 19 24.718	761.1	235 27 46.4	55 28 10.3	Jacksonville NE. base	1535.5	3.186250
	81 38 32.484	867.8	237 38 32.5	57 39 33.9	Bigelow's N. chimney	3834.8	3.583746
			288 07 05.9	108 07 17.6	Jacksonville SW. base	648.3	2.811792
			312 25 43.8	132 26 12.9	Bluff	2077.2	3.317485

St. Johns River—Continued

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Marsh	30 18 53.116	1635.6	192 47 57.1	12 48 01.3	Wallace.	997.9	2.999091
1876	81 38 40.760	1089.0	227 20 24.4	47 20 40.2	Jacksonville SW. base	1138.5	3.056340
			283 43 11.9	103 43 45.2	Bluff	1805.9	3.256686
Custom-house (U.S.E.)	30 19 39.136	1205.1	252 06 07.6	72 07 41.8	Bigelow's N. chimney	5235.8	3.718984
1908–9	81 39 37.744	1008.3	299 22 55.3	119 23 57.2	Bluff	3700.6	3.575255
Water tower E. O. P.	30 18 57.546	1772.0	141 09 43.2	321 09 23.7	Custom-house (U.S.E.)	1644.2	3.215958
1909	81 38 59.145	1580.2	233 49 32.3	53 50 47.0	Bigelow's N. chimney	4895.1	3.689764
			284 06 52.4	104 07 34.8	Bluff	2315.5	3.364638
Lancaster 2 (U.S.E.)	30 18 37.229	1146.4	220 28 20.6	40 28 51.3	Custom-house (U.S.E.)	2506.1	3.398992
1909	81 40 38.635	1032.2	256 44 56.1	76 45 46.3	Water tower E. O. P.)	2730.8	3.436286
Club (U.S.E.)	30 18 07.450	229.4	229 35 47.7	49 36 50.4	Custom-house (U.S.E.)	4356.6	3.639145
1909	81 41 41.932	1120.5	241 31 45.4	61 32 17.4	Lancaster 2 (U.S.E.)	1923.9	3.284174
			250 27 38.4	70 29 00.7	Water tower E. O. P.	4614.9	3.664165
Beacon No. 25	30 16 39.275	1209.4	135 06 02.7	315 05 11.6	Club (U.S.E.)	3833.5	3.583597
1909	81 40 00.665	17.8	164 23 39.3	344 23 20.2	Lancaster 2 (U.S.E.)	3771.2	3.576479
			186 18 31.4	6 18 43.0	Custom-house (U.S.E.)	5572.2	3.746024
Bight	30 15 55.010	1693.9	185 06 32.5	5 06 39.4	Club (U.S.E.)	4094.4	3.612195
1876–1909	81 41 55.577	1485.6	202 22 08.4	22 22 47.2	Lancaster 2 (U.S.E.)	5401.8	3.732542
			246 03 42.2	66 04 40.1	Beacon No. 25	3360.4	3.526386
La Vista reference mark	30 16 44.936	1383.7	50 29 22.8	230 29 18.8	Beacon No. 25	274.0	2.437713
1876–1909	81 39 52.756	1410.0	64 54 54.3	244 53 52.4	Bight	3625.0	3.559309
			131 03 32.4	311 02 37.4	Club (U.S.E.)	3868.9	3.587584
			160 28 50.1	340 28 27.0	Lancaster 2 (U.S.E.)	3668.7	3.564516
Lancaster	30 18 38.680	1191.1	340 44 32.4	160 44 55.5	La Vista reference mark	3710.0	3.569375
1876	81 40 38.538	1029.6	22 13 33.4	202 12 54.6	Bight	5444.1	3.735930
La Vista	30 16 41.891	1289.9	65 38 41.9	245 37 41.9	Bight	3499.4	3.543993
1876	81 39 56.314	1505.1	162 35 00.7	342 34 39.6	Lancaster	3769.1	3.576239
			225 24 14.0	45 24 15.8	La Vista reference mark	133.6	2.125708
Tyson	30 15 22.813	702.5	101 37 43.3	281 36 12.4	Bight	4923.9	3.692305
1876	81 38 55.156	1474.5	146 07 41.6	326 07 10.8	La Vista	2932.9	3.467294
Pine	30 13 50.272	1548.0	135 11 19.1	315 10 07.2	Bight	5415.1	3.733607
1876	81 39 32.804	877.2	173 13 08.2	353 12 56.3	La Vista	5321.8	3.726059
			199 27 09.8	19 27 28.8	Tyson	3022.1	3.480310
Goodsby	30 12 55.488	1708.6	116 27 00.6	296 25 56.7	Pine	3788.4	3.578461
1876	81 37 25.958	694.1	152 16 23.4	332 15 38.5	Tyson	5125.2	3.709714
Black Point wharf flag	30 13 04.942	152.2	203 21 22.6	23 21 57.1	Tyson	4624.5	3.665063
1876	81 40 03.736	99.9	273 56 07.4	93 57 26.8	Goodsby	4229.6	3.626303
Mulberry	30 12 05.844	180.0	213 36 24.6	33 37 04.7	Pine	3861.2	3.586718
1876	81 40 52.726	1410.3	215 45 04.8	35 45 29.4	Black Pt. wharf flag	2242.4	3.350711
			254 32 01.6	74 33 45.6	Goodsby	5737.6	3.758732
Buckley	30 12 02.753	84.8	91 36 23.3	271 35 19.1	Mulberry	3414.5	3.533330
1876–1909	81 38 45.121	1206.9	132 19 51.0	312 19 11.4	Black Pt. wharf flag	2844.0	3.453924
			158 56 14.9	338 55 50.8	Pine	3547.9	3.549970
Mandarin	30 09 26.458	814.7	170 15 55.0	350 15 39.2	Mulberry	4979.6	3.697192
1876–1909	81 40 21.248	568.6	208 06 45.1	28 07 33.4	Buckley	5456.7	3.736930
Doctor	30 09 11.304	348.1	194 31 42.6	14 32 08.8	Mulberry	5552.1	3.744455
1876	81 41 44.797	1198.8	222 18 28.2	42 19 58.5	Buckley	7140.0	3.853697
			258 12 21.6	78 13 03.6	Mandarin	2284.0	3.358695
Wreck Beacon	30 09 31.687	975.7	281 39 40.2	101 39 54.9	Mandarin	796.5	2.901205
1876	81 40 50.400	1348.7	66 40 49.0	246 40 21.7	Doctor	1585.2	3.200096
Ragged	30 07 09.830	302.7	171 23 07.2	351 22 56.6	Doctor	3783.1	3.577847
1876	81 41 23.622	632.4	191 30 15.2	11 30 31.8	Wreck Beacon	4457.6	3.649103
			201 38 24.7	21 38 56.0	Mandarin	4526.1	3.655728
Huntington	30 07 53.793	1656.4	65 19 22.9	245 18 27.7	Ragged	3241.4	3.510735
1876–1909	81 39 33.596	899.3	124 12 46.4	304 11 40.5	Doctor	4245.8	3.617956

St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Moore	30 06 43.660	1344.5	100 09 01.4	280 07 36.9	Ragged	4588.3	3.660654
1876	81 38 35.296	944.9	131 52 57.4	311 51 22.3	Doctor	6811.5	3.833243
			144 08 54.2	324 08 24.9	Huntington	2664.4	3.425607
False	30 06 15.155	466.6	178 31 22.2	358 31 21.4	Ragged	1684.1	3.226367
1876	81 41 22.000	589.0	223 41 18.2	43 42 12.5	Huntington	4200.8	3.623329
			258 51 46.7	78 53 10.3	Moore	4548.7	3.657887
Cuckoo	30 04 16.168	497.8	145 50 04.8	325 49 18.2	False	4428.3	3.646239
1876–1909	81 39 49.117	1315.5	203 31 00.3	23 31 37.3	Moore	4953.1	3.694874
Middle	30 04 54.375	1674.3	183 35 02.3	3 35 05.2	False	2492.2	3.396586
1876	81 41 27.819	744.9	233 55 00.7	53 56 27.2	Moore	5715.2	3.757031
			293 59 05.3	113 59 54.8	Cuckoo	2893.4	3.461404
Hibernia	30 04 06.046	186.1	183 22 38.1	3 22 39.7	Middle	1490.7	3.173394
1876	81 41 31.098	832.9	263 29 00.1	83 29 51.2	Cuckoo	2749.1	3.439195
Magnolia	30 01 14.648	451.0	180 03 39.3	0 03 39.4	Hibernia	5277.6	3.722437
1876	81 41 31.307	838.8	180 47 28.2	0 47 29.8	Middle	6766.4	3.830356
			206 05 19.8	26 06 11.0	Cuckoo	6223.7	3.794051
Remington	30 02 08.877	273.4	53 35 03.1	233 34 20.8	Magnolia	2812.4	3.449073
1876–1909	81 40 06.849	183.5	147 58 40.3	327 57 58.1	Hibernia	4255.6	3.628958
			156 57 02.2	336 56 21.4	Middle	5538.3	3.743377
Hallowe's wharf house, N. gable	30 01 34.871	1073.7	76 28 07.0	256 27 18.7	Magnolia	2660.0	3.424879
1876–77	81 39 54.797	1468.3	162 51 40.9	342 51 34.9	Remington	1095.7	3.039712
White	29 59 13.006	400.5	144 54 11.5	324 53 22.4	Magnolia	4578.2	3.660696
1876–1909	81 39 53.075	1422.7	176 06 05.4	356 05 58.6	Remington	5427.8	3.734627
			179 23 41.6	359 23 40.7	Hallowe's wharf house N. gable	4368.4	3.640325
Hampton	30 00 55.214	1700.1	41 43 09.7	221 42 17.4	White	4215.8	3.624882
1876–77	81 38 08.413	225.4	96 17 41.4	276 16 00.0	Magnolia	5469.9	3.737977
			113 11 41.4	293 10 48.2	Hallowe's wharf house, N. gable	3101.3	3.491537
Sappho	29 58 43.174	1329.3	128 26 21.6	308 24 31.8	Magnolia	7504.8	3.875341
1876–1909	81 37 51.940	1392.4	173 48 12.4	353 48 04.2	Hampton	4089.6	3.611678
Patricio	29 59 14.984	461.4	68 08 24.6	248 07 39.1	Sappho	2629.8	3.419928
1876–77	81 36 20.895	560.1	89 24 05.3	209 22 19.2	White	5688.0	3.754956
			113 54 35.6	293 52 00.4	Magnolia	9098.8	3.958985
			136 58 13.6	316 57 19.8	Hampton	4222.4	3.625560
Eliza	29 56 51.550	1587.3	127 34 00.1	307 32 36.8	Sappho	5638.9	3.751192
1876–77	81 35 05.213	139.8	155 19 45.7	335 19 08.0	Patricio	4860.3	3.686664
Hogarth's wharf	29 59 03.061	94.2	353 15 16.4	173 15 25.3	Eliza	4077.6	3.610402
1876–77	81 35 23.073	618.5	81 17 12.8	261 15 58.4	Sappho	4037.4	3.606103
			103 19 45.3	283 19 16.4	Patricio	1592.9	3.202176
Red	29 57 28.009	862.4	186 31 44.5	6 31 51.6	Patricio	3315.4	3.520533
1876–77	81 36 34.958	937.3	213 21 34.6	33 22 10.5	Hogarth's wharf	3504.3	3.544601
			295 00 08.6	115 00 53.4	Eliza	2655.5	3.424144
Bayard 2	29 56 17.139	527.7	178 38 58.7	358 38 56.3	Patricio	5477.6	3.738588
1878	81 36 16.079	431.2	240 51 15.4	60 51 50.8	Eliza	2175.9	3.337634
Hale	29 55 24.107	742.3	146 00 57.2	326 00 36.7	Bayard 2	1969.3	3.294317
1876–1878	81 35 35.034	939.7	170 11 21.1	350 10 58.2	Patricio	7214.5	3.858207
			196 32 31.4	16 32 46.3	Eliza	2808.7	3.448510
Stream	29 55 28.984	892.4	222 43 53.6	42 44 19.1	Bayard 2	2018.7	3.305073
1878	81 37 07.156	191.9	232 07 53.8	52 08 54.8	Eliza	4142.3	3.617246
			273 28 16.3	93 29 02.3	Hale	2475.5	3.393664
Hicks	29 53 26.782	824.6	176 07 07.7	356 07 02.9	Stream	3771.4	3.576498
1878	81 36 57.639	1546.5	191 59 45.6	12 00 06.3	Bayard 2	5362.6	3.729376
			211 31 13.6	31 31 54.8	Hale	4238.1	3.627170
Straight	29 53 23.026	709.0	92 33 39.0	272 32 50.9	Hicks	2595.2	3.414170
1878	81 35 21.014	563.9	143 43 16.2	323 42 23.3	Stream	4811.4	3.682275
			164 35 57.1	344 35 29.7	Bayard 2	5560.9	3.745143

St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Water	29 52 10.068	310.0	121 58 33.3	301 57 23.1	Hicks	4461.7	3.649424
1878	81 34 36.586	981.9	152 02 51.5	332 02 29.4	Straight	2543.2	3.405377
Cypress (ash)	29 50 40.351	1242.4	171 09 59.3	351 09 44.5	Hicks	5186.1	3.714837
1878	81 36 27.958	750.4	199 43 40.5	19 44 13.7	Straight	5321.3	3.726020
			227 15 03.4	47 15 58.8	Water	4070.2	3.609621
Tocoi	29 50 33.703	1037.7	92 31 30.4	272 30 04.0	Cypress (ash)	4668.3	3.669158
1878	81 33 34.222	918.7	134 19 23.2	314 17 42.1	Hicks	7629.2	3.882478
			150 34 29.7	330 33 58.7	Water	3406.7	3.532338
Cedar	29 48 14.605	449.7	148 02 34.4	328 01 42.5	Cypress (ash)	5289.6	3.723423
1878	81 34 43.663	1172.6	203 31 11.5	23 31 46.0	Tocoi	4671.1	3.669420
Racy	29 48 06.127	188.6	95 30 52.4	275 30 02.3	Cedar	2719.9	3.434552
1878–1909	81 33 02.850	76.5	130 47 04.4	310 45 22.4	Cypress (ash)	7271.7	3.861636
			169 29 59.9	349 29 44.3	Tocoi	4621.4	3.664769
Cohanzy	29 46 56.696	1745.6	147 59 36.1	327 59 08.4	Cedar	2829.0	3.451631
1878	81 33 47.829	1284.7	209 28 01.6	29 28 24.0	Racy	2455.5	3.390142
Nine Mile Point	29 46 21.623	665.8	151 40 05.1	331 39 54.3	Cohanzy	1226.9	3.088805
1878–1909	81 33 26.152	702.5	191 00 19.6	11 00 31.2	Racy	3278.0	3.515610
Chafer	29 47 14.006	431.2	60 55 17.4	240 54 23.8	Nine Mile Point	3317.9	3.520859
1878–1885	81 31 38.210	1026.3	81 18 19.2	261 17 14.8	Cohanzy	3522.1	3.546804
			110 32 58.6	290 31 26.5	Cedar	5318.7	3.725809
Deep 2	29 45 41.128	1266.3	121 33 50.8	301 33 13.3	Nine Mile Point	2382.3	3.377005
1885	81 32 10.588	284.5	196 54 51.6	16 55 07.7	Chafer	2989.1	3.475538
Bridgeport	29 45 13.479	415.0	198 50 41.5	18 50 54.8	Nine Mile Point	2217.0	3.345775
1885–1909	81 33 52.810	1419.0	224 14 46.6	44 15 53.5	Chafer	5181.4	3.714444
			252 46 15.0	72 47 05.8	Deep 2	2875.3	3.458690
Federal Point	29 44 52.282	1609.7	112 11 26.8	292 10 57.2	Bridgeport	1728.2	3.237604
1885	81 32 53.251	1430.8	162 11 18.6	342 11 02.3	Nine Mile Point	2889.3	3.460799
Renz	29 44 28.967	891.9	193 12 42.3	13 12 48.2	Bridgeport	1407.8	3.148534
1885	81 34 04.785	128.6	249 30 55.9	69 31 31.4	Federal Point	2051.8	3.312143
Bob	29 43 46.295	1425.4	122 30 49.1	302 30 11.0	Renz	2444.7	3.388233
1885	81 32 48.065	1291.8	147 03 24.6	327 02 52.3	Bridgeport	3198.9	3.504995
			176 04 36.4	356 04 33.8	Federal Point	2036.5	3.308888
Lynwood	29 43 46.210	1422.8	195 27 46.9	15 27 53.6	Renz	1365.9	3.135428
1885	81 34 18.338	492.8	269 55 54.9	89 56 39.7	Bob	2426.0	3.384896
Cole	29 42 51.579	1588.1	136 45 23.6	316 44 54.4	Lynwood	2309.3	3.363474
1885	81 33 19.469	523.3	157 53 54.2	337 53 31.6	Renz	3236.4	3.510067
			206 36 30.0	26 36 45.6	Bob	1884.3	3.275147
George	29 43 09.084	279.7	204 54 35.4	24 54 45.2	Lynwood	1260.4	3.100492
1885	81 34 38.091	1023.8	284 18 11.2	104 18 50.2	Cole	2180.8	3.338625
Whetstone	29 42 45.393	1397.6	235 54 16.6	55 54 36.5	George	1301.3	3.114389
1885	81 35 18.186	488.8	266 34 34.1	86 35 33.0	Cole	3196.6	3.504694
Cowgill	29 42 03.642	112.1	170 46 16.8	350 46 12.9	Whetstone	1302.4	3.114731
1885	81 35 10.415	280.0	203 19 27.1	23 19 43.1	George	2194.3	3.341295
			243 39 39.8	63 40 34.8	Cole	3327.5	3.522121
Sunnyside	29 42 04.159	128.0	225 44 56.1	45 45 20.1	Whetstone	1819.5	3.259950
1885	81 36 06.672	179.3	270 35 58.5	90 36 26.4	Cowgill	1512.4	3.179668
Larson	29 42 50.485	1554.4	319 54 44.2	139 55 06.6	Cowgill	1885.1	3.275335
1885	81 35 55.572	1493.7	11 48 57.2	191 48 51.7	Sunnyside	1457.2	3.163527
Warner	29 42 01.970	60.7	236 29 19.2	56 30 00.8	Larson	2706.0	3.432323
1885	81 37 19.511	524.5	268 01 26.0	88 02 02.1	Sunnyside	1959.2	3.292086
Tally	29 42 49.502	1524.1	312 00 40.5	132 01 09.1	Sunnyside	2085.8	3.319278
1885	81 37 04.323	116.2	15 35 16.1	195 35 08.6	Warner	1519.4	3.181662
Bight	29 42 42.600	1311.6	264 03 25.4	84 04 03.1	Tally	2054.2	3.312652
1885	81 38 20.338	546.6	307 24 52.6	127 25 22.8	Warner	2058.8	3.313607
Stevens	29 41 49.043	1510.0	153 50 28.8	333 50 13.9	Bight	1837.2	3.264162
1885	81 37 50.205	1349.6	213 31 24.9	33 31 47.7	Tally	2233.0	3.348896

St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Sauble	29 41 40.097	1234.6	208 32 28.6	28 32 47.9	Bight	2190.7	3.340589
1885	81 38 59.280	1593.6	235 19 37.7	55 20 34.7	Tally	3757.1	3.574854
			261 33 30.3	81 34 04.5	Stevens	1877.3	3.273529
Shellbank	29 40 29.284	901.6	180 39 05.1	0 39 05.6	Sauble	2180.5	3.338550
1885	81 39 00.202	5.4	194 37 46.8	14 38 06.6	Bight	4242.4	3.627609
			217 27 33.8	37 28 08.5	Stevens	3093.9	3.490512
Quake	29 40 05.804	178.7	116 27 20.9	296 26 54.1	Shellbank	1623.0	3.210307
1885	81 38 06.166	165.8	153 48 40.6	333 48 14.3	Sauble	3235.5	3.509942
Washington	29 40 22.634	696.9	62 22 29.5	242 22 11.3	Quake	1117.5	3.048230
1885	81 37 29.348	789.1	94 47 49.7	274 47 04.7	Shellbank	2451.6	3.389448
			134 36 49.0	314 36 04.5	Sauble	3396.4	3.531015
Harding	29 40 00.256	7.9	97 38 56.7	277 38 33.3	Quake	1283.9	3.108537
1885	81 37 18.845	506.8	157 42 44.7	337 42 39.5	Washington	744.6	2.871952
Bog	29 39 46.826	1441.7	201 54 00.1	21 54 08.3	Washington	1188.3	3.074917
1885	81 37 45.831	1232.6	240 19 23.7	60 19 37.1	Harding	835.2	2.921803
Palatka Point	29 39 03.094	95.3	169 45 44.4	349 45 39.9	Bog	1368.3	3.136171
1885	81 37 36.788	989.4	195 19 50.7	15 19 59.6	Harding	1824.9	3.261248
Hart	29 38 30.932	952.4	138 52 47.6	318 52 31.7	Palatka Point	1314.6	3.118783
1885–1909	81 37 04.645	124.9	154 38 24.6	334 38 04.2	Bog	2586.0	3.412629
			172 05 41.6	352 05 34.6	Harding	2776.6	3.443521
Muck [1]	29 37 48.257	1485.8	177 37 32.7	357 37 30.9	Palatka Point	2306.2	3.362892
1885	81 37 33.236	894.0	210 20 24.5	30 20 38.6	Hart	1522.5	3.182545
South End [1]	29 38 27.000	831.3	266 08 10.6	86 08 43.6	Hart	1798.6	3.254943
1885–1909	81 38 11.362	305.6	319 18 35.6	139 18 54.5	Muck	1573.1	3.196763
Supplementary points.							
Sister	30 23 59.857	1843.2	178 08 38.1	358 08 35.8	Horseshoe	3800.4	3.579828
1855	81 27 26.798	715.3	233 02 40.0	53 03 18.6	Round Pond	2543.2	3.405376
Pelot	30 25 15.928	490.5	252 16 05.2	72 17 31.7	Horseshoe	4783.5	3.679749
1855	81 30 22.155	591.2	296 34 27.5	116 35 56.3	Sister	5234.0	3.718830
St. Johns bluff	30 23 21.242	654.1	157 46 19.1	337 45 51.8	Pelot	3815.1	3.581510
1855	81 29 28.078	749.5	211 58 14.6	31 59 13.7	Horseshoe	5879.8	3.769359
			242 42 17.8	62 43 57.9	Round Pond	5929.5	3.773016
			249 49 30.4	69 50 31.8	Sister	3449.1	3.537704
Palmetto	30 23 19.803	609.8	202 36 35.4	22 37 03.6	Pelot	3873.6	3.588120
1855–1909	81 31 17.956	479.4	269 07 36.3	89 08 31.9	St. Johns bluff	2933.8	3.467426
Merrill (U. S. E.)	30 18 51.399	1582.7	133 35 11.2	313 34 42.0	Customhouse (U. S. E.)	2132.3	3.328839
1908–9	81 38 39.928	1066.8	190 58 08.7	10 58 12.3	Wallace	1045.1	3.019150
			247 01 52.7	67 02 17.5	Commodore A (U. S. E.)	1430.0	3.155345
			282 13 47.1	102 14 19.8	Bluff (U. S. E.)	1772.3	3.248547
Beacon No. 26	30 19 12.676	390.3	180 34 05.6	0 34 05.8	Terminal (U. S. E.)	1244.0	3.094836
1909	81 37 40.451	1080.7	260 22 31.5	80 22 59.4	Matthews (U. S. E.)	1497.6	3.175392
			352 06 08.7	172 06 11.3	Bluff (U. S. E.)	1040.6	3.017293
Jacksonville:							
St. Andrews Church	30 19 32.497	1000.7	2 47 50.6	182 47 49.4	Merrill (U. S. E.)	1267.0	3.102788
1909	81 38 37.614	1004.9	97 15 27.4	277 14 57.0	Customhouse (U. S. E.)	1619.3	3.209319
			241 46 00.8	61 47 04.6	Bigelow's N. chimney	3832.3	3.583460
St. Lukes Hospital	30 19 34.295	1056.0	310 20 30.7	130 21 08.4	Bluff (U. S. E.)	2620.4	3.418364
1909	81 38 49.851	1331.8	348 39 03.8	168 39 08.8	Merrill (U. S. E.)	1347.2	3.129444
			96 38 57.7	276 38 33.5	Customhouse (U. S. E.)	1288.1	3.109934
Presbyterian Church spire	30 19 40.284	1240.4	303 13 41.4	123 14 35.6	Bluff (U. S. E.)	3431.8	3.535516
1909	81 39 22.540	602.1	85 01 40.3	265 01 32.6	Customhouse (U. S. E.)	406.7	2.610311
			251 01 28.9	71 02 55.4	Bigelow's N. chimney	4839.3	3.684785

[1] No check on this position.

St. Johns River—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.							
Jacksonville—Continued.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Water tower (Armour's) 1909	30 20 41.732 81 37 29.284	1285.0 782.1	281 38 09.3	101 38 38.6	Bigelow's N. chimney	1583.8	3.199713
			2 21 28.9	182 21 25.9	Bluff (U. S. E.)	3776.2	3.577060
			10 48 17.9	190 48 12.5	Terminal (U. S. E.)	1525.4	3.183370
Mount Zion A. M. E. Church 1909	30 19 51.200 81 39 14.890	1576.6 397.7	254 11 51.6	74 13 14.3	Bigelow's N. chimney	4543.7	3.657414
			309 44 23.3	129 45 13.7	Bluff (U. S. E.)	3467.4	3.539999
			333 06 08.9	153 06 26.6	Merrill (U. S. E.)	2064.8	3.314873
Catholic Church 1909	30 19 43.983 81 39 21.392	1354.4 571.4	252 11 52.2	72 13 18.1	Bigelow's N. chimney	4774.3	3.678909
			305 04 45.0	125 05 38.6	Bluff (U. S. E.)	3470.3	3.540370
			325 37 13.2	145 37 34.1	Merrill (U. S. E.)	1961.9	3.292672
Baptist Church 1909	30 19 49.587 81 39 34.682	1526.9 926.5	255 16 57.8	75 18 30.5	Bigelow's N. chimney	5066.9	3.704741
			304 08 42.8	124 09 43.2	Bluff (U. S. E.)	3860.5	3.586646
			14 15 42.2	194 15 40.7	Customhouse (U. S. E.)	332.0	2.521186
City water tower 1909	30 20 10.168 81 39 22.529	313.1 601.7	261 52 27.8	81 53 54.3	Bigelow's N. chimney	4622.4	3.664872
			314 17 48.1	134 18 42.3	Bluff (U. S. E.)	4010.3	3.603181
			23 02 34.8	203 02 27.1	Customhouse (U. S. E.)	1038.4	3.016360
Courthouse 1909	30 19 35.150 81 39 16.531	1082.4 441.6	248 35 18.1	68 36 41.6	Bigelow's N. chimney	4743.2	3.676073
			302 26 20.5	122 27 11.7	Bluff (U. S. E.)	3211.1	3.506660
			102 13 25.3	282 13 14.6	Customhouse (U. S. E.)	579.8	2.763291
Windsor Hotel flagstaff 1909	30 19 45.457 81 39 37.179	1399.7 993.2	254 06 21.0	74 07 54.8	Bigelow's N. chimney	5164.8	3.713053
			4 25 57.0	184 25 56.7	Customhouse (U. S. E.)	195.2	2.290512
			38 00 42.2	218 00 11.2	Lancaster 2 (U.S.E.)	2666.4	3.425921
City Hall 1909	30 19 37.197 81 39 25.489	1145.4 680.9	301 11 17.9	121 12 13.6	Bluff (U. S. E.)	3447.8	3.537536
			319 11 55.7	139 12 18.7	Merrill (U. S. E.)	1862.9	3.270190
Anhauser (U. S. E.) 1909	30 19 18.573 81 40 14.535	571.9 388.3	237 12 21.0	57 12 39.6	Customhouse (U. S. E.)	1169.2	3.067875
			26 49 50.3	206 49 38.2	Lancaster 2 (U.S.E.)	1426.7	3.154319
Dad (U. S. E.) 1909	30 19 04.526 81 39 44.331	139.4 1184.4	59 55 06.7	239 54 39.3	Lancaster 2 (U.S.E.)	1676.8	3.224473
			118 11 42.7	298 11 27.4	Anhauser (U. S. E.)	915.5	2.961679
			189 22 31.5	9 22 34.8	Customhouse (U. S. E.)	1080.2	3.033494

St. Johns River to St. Augustine.

Principal points.							
Palmer 1858–1905	30 22 04.328 81 25 00.402	133.3 10.7	153 02 16.8 180 00 02.7	333 01 51.4 0 00 02.7	Sand Hill 3 Sand Hill 2	2960.9 3004.9	3.471420 3.477826
Haynes 1858	30 21 41.855 81 26 49.113	1288.9 1311.5	205 05 26.2 256 35 04.4	25 05 55.7 76 35 59.3	Sand Hill 3 Palmer	3678.2 2984.3	3.565631 3.474845
Pine Island 1858	30 20 25.611 81 26 02.998	788.7 80.1	152 19 21.2 208 48 14.6	332 18 57.9 28 48 46.2	Haynes Palmer	2651.2 3469.1	3.423445 3.540223
Sea 1858	30 20 20.588 81 23 49.384	634.0 1319.1	92 29 28.5 149 18 21.1	272 28 21.0 329 17 45.2	Pine Island Palmer	3572.3 3715.1	3.552942 3.569971
Drumruck 1858	30 18 37.891 81 23 37.074	1166.8 990.5	130 24 16.4 174 03 51.2	310 23 02.7 354 03 45.0	Pine Island Sea	5118.5 3179.4	3.709143 3.502342
Hopkins 1858	30 18 23.347 81 25 06.654	718.9 177.8	158 12 42.9 259 23 45.1	338 12 14.5 79 24 30.3	Pine Island Drumruck	4054.6 2435.0	3.607949 3.386502
St. Isabelle 1858	30 16 53.224 81 23 15.378	1639.0 411.0	133 01 49.2 169 48 12.6	313 00 53.1 349 48 01.7	Hopkins Drumruck	4067.4 3274.7	3.609320 3.515174

St. Johns River to St. Augustine—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Mulatto Jack	30 16 38.674	1190.9	190 20 13.0	10 20 24.1	Hopkins	3276.4	3.515392
1858	81 25 28.657	765.9	262 49 19.1	82 50 26.3	St. Isabelle	3590.2	3.555119
Tam Smith	30 15 34.153	1051.7	116 14 28.6	296 13 12.6	Mulatto Jack	4495.1	3.652741
1858	81 22 57.807	1545.3	169 04 59.0	349 04 50.2	St. Isabelle	2479.7	3.394398
Maill	30 14 37.661	1159.7	171 03 58.6	351 03 47.6	Mulatto Jack	3772.1	3.576580
1858	81 25 06.741	180.2	243 12 47.7	63 13 52.7	Tam Smith	3861.0	3.586703
Point Solana	30 12 43.263	1332.2	126 58 09.1	306 56 41.0	Maill	5859.1	3.767831
1858	81 22 11.656	311.7	166 48 18.2	346 47 55.0	Tam Smith	5404.9	3.732784
Blake	30 12 31.466	968.9	192 25 14.8	12 25 38.1	Tam Smith	5760.2	3.760440
1858	81 23 44.154	1181.0	261 38 25.3	81 39 11.8	Point Solana	2500.5	3.398020
Persimmon	30 10 58.610	1840.7	131 17 02.9	311 16 01.7	Blake	4334.3	3.636914
1859	81 21 42.381	1133.8	166 20 37.6	346 20 22.9	Point Solana	3316.3	3.520648
Masters	30 10 33.281	1024.8	172 13 44.4	352 13 35.1	Blake	3672.9	3.565010
1859	81 23 25.586	684.5	254 13 10.0	74 14 01.9	Persimmon	2869.2	3.457759
Diego	30 08 32.527	1001.6	161 27 15.4	341 26 52.0	Masters	3922.0	3.593505
1859	81 22 38.962	1042.7	198 35 54.7	18 36 23.1	Persimmon	4746.1	3.676341
Mickler	30 08 24.829	764.5	95 25 27.1	275 24 40.2	Diego	2510.5	3.399766
1859	81 21 05.579	149.3	168 15 15.6	348 14 57.1	Persimmon	4836.5	3.684534
Travis	30 07 15.882	489.0	194 56 22.3	14 56 34.1	Diego	2442.6	3.387855
1859	81 23 02.490	66.7	235 50 18.3	55 51 17.0	Mickler	3781.5	3.577669
Jenks	30 06 12.725	391.8	115 52 37.5	295 51 22.3	Travis	4457.5	3.649091
1859	81 20 32.673	874.9	167 46 59.8	347 46 43.3	Mickler	4162.0	3.619301
Smith	30 05 33.289	1025.1	165 52 05.8	345 51 50.9	Travis	3257.6	3.512903
1859	81 22 32.779	877.8	249 18 19.6	69 19 19.9	Jenks	3437.6	3.536250
Hernandez	30 03 19.012	585.4	133 42 33.5	313 41 12.5	Smith	5984.7	3.777044
1859	81 19 51.221	1372.1	168 16 41.4	348 16 20.6	Jenks	5462.9	3.737422
Deep Creek	30 03 02.032	62.6	179 39 41.8	359 39 41.3	Smith	4657.5	3.668155
1859	81 22 31.751	850.6	208 29 57.5	28 30 57.1	Jenks	6681.9	3.824900
			263 03 23.6	83 04 44.0	Hernandez	4332.0	3.636684
Mauran	30 01 27.281	840.0	154 08 47.2	334 08 20.8	Deep Creek	3242.1	3.510823
1859	81 21 38.976	1044.5	219 59 37.7	40 00 31.6	Hernandez	4491.1	3.652356
Big Sand Hill	30 01 33.160	1021.1	86 46 05.8	266 45 06.1	Mauran	3202.7	3.505512
1859	81 19 39.645	1062.3	120 41 57.4	300 40 31.3	Deep Creek	5361.9	3.729322
			174 33 53.5	354 33 47.7	Hernandez	3274.1	3.515086
Casacola	29 58 11.003	338.8	160 55 34.9	340 54 55.9	Mauran	6394.9	3.805835
1859	81 20 20.988	562.7	190 05 28.3	10 05 49.0	Big Sand Hill	6322.5	3.800890
Harrison	29 58 54.630	1682.1	62 03 08.8	242 02 21.6	Casacola	2865.7	3.457228
1859	81 18 46.567	1248.3	135 30 01.8	315 28 35.7	Mauran	6591.3	3.818970
			163 45 21.5	343 44 55.0	Big Sand Hill	5084.4	3 706239
Sanchez	29 56 56.606	1743.0	156 15 43.5	336 15 24.7	Casacola	2502.5	3.398381
1859	81 19 43.413	1164.1	202 44 57.0	22 45 25.4	Harrison	3940.8	3.595581
Cocked Hat	29 57 10.711	329.8	79 14 31.3	259 13 48.8	Sanchez	2325.4	3.366498
1859	81 18 18.220	488.6	119 25 50.5	299 24 49.0	Casacola	3779.2	3.577395
			166 38 27.3	346 38 13.1	Harrison	3288.8	3.517040
Allen	29 55 52.872	1628.0	122 41 52.0	302 40 55.1	Sanchez	3633.5	3.560328
1859	81 17 49.387	1324.6	162 07 15.4	342 07 01.0	Cocked Hat	2518.4	3.401121
Baya	29 55 41.846	1288.5	213 34 56.2	33 35 30.0	Cocked Hat	3284.6	3.516481
1859	81 19 25.974	696.6	262 31 38.4	82 32 26.6	Allen	2612.7	3.417095
St. Augustine Lighthouse (old)	29 53 13.097	403.3	141 41 54.8	321 40 47.5	Baya	5837.1	3.766194
	81 17 11.090	297.5	149 18 44.3	329 17 28.4	Sanchez	8003.6	3.903285
1859			168 12 24.7	348 12 05.6	Allen	5025.7	3.701199
St. Augustine north base	29 54 27.583	849.3	218 14 52.2	38 16 05.8	Cocked Hat	6396.7	3.805953
1859	81 20 45.897	1231.3	240 58 21.5	60 59 49.5	Allen	5414.2	3.733536
			291 41 06.8	111 42 53.9	St. Augustine Lighthouse (old)	6202.8	3.792590

St. Johns River to St. Augustine—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
St. Augustine south base 1859	29 52 05.575 81 20 07.036	171.6 188.8	166 35 22.1 246 13 20.6	346 35 02.7 66 14 48.3	St. Augustine N. base St. Augustine Lighthouse (old)	4495.1 5159.0	3.652744 3.712566
St. Augustine Presbyterian Church 1859	29 53 19.345 81 18 43.320	595.6 1162.4	44 41 23.5 122 34 57.1 197 00 49.4 274 26 18.9	224 40 41.8 302 33 56.0 17 01 16.3 94 27 04.9	St. Augustine S. base St. Augustine N. base Allen St. Augustine Lighthouse (old)	3194.7 3902.6 4943.7 2482.2	3.504430 3.591353 3.694050 3.394840
Supplementary points.							
Continental Hotel chimney 1905	30 20 01.706 81 23 51.262	52.5 1369.3	124 10 02.2 151 54 11.6 152 10 51.4	304 07 14.2 331 53 01.4 332 09 00.1	Fort R. 2 B. (U. S. E.) Horseshoe	10725.2 7875.0 12588.2	4.030404 3.896248 4.099964
St. Augustine Lighthouse (new) 1882–1905	29 53 06.934 81 17 19.603	213.5 526.0	345 06 33.6 346 28 22.4 31 52 09.0	165 07 08.3 166 28 34.2 211 51 26.0	Anastasia 2 Scrub Canova 2	7257.1 2716.4 4391.9	3.860761 3.433989 3.642657
St. Augustine: Catholic Cathedral spire 1905	29 53 33.499 81 18 46.060	1031.4 1235.9	289 24 58.0 319 28 53.4 359 58 36.8	109 25 41.1 139 29 48.2 179 58 36.8	St. Augustine Lighthouse (new) Scrub Canova 2	2459.8 4549.6 4548.1	3.390903 3.657974 3.657828
Ponce de Leon Hotel, east tower 1905	29 53 33.093 81 18 53.368	1018.9 1432.0	287 44 44.1 317 33 06.5 357 30 02.0	107 45 30.8 137 34 05.0 177 30 05.7	St. Augustine Lighthouse (new) Scrub Canova 2	2641.7 4670.1 4539.9	3.421884 3.669329 3.657046
Water tower 1905	29 53 42.045 81 18 45.585	1294.6 1223.1	295 06 02.8 321 39 48.0 0 07 49.2	115 06 45.6 141 40 42.6 180 07 49.0	St. Augustine Lighthouse (new) Scrub Canova 2	2547.7 4744.7 4811.3	3.406156 3.676212 3.682260
Alcazar Hotel chimney 1905	29 53 24.035 81 18 48.830	740.0 1310.2	282 23 50.8 316 15 58.9 358 58 29.1	102 24 35.2 136 16 55.1 178 58 30.5	St. Augustine Lighthouse (new) Scrub Canova 2	2451.4 4383.3 4257.4	3.389414 3.641798 3.629141
Presbyterian Church dome [1] 1905	29 53 36.95 81 19 01.48	1137.7 39.7	288 40 17 316 36 36	108 41 07 136 37 38	St. Augustine Lighthouse (new) Scrub	2885.6 4905.3	3.460236 3.690666
Methodist Church spire [1] 1905	29 53 41.22 81 18 54.92	1269.2 1473.6	292 25 28 319 10 22	112 26 15 139 11 21	St. Augustine Lighthouse (new) Scrub	2766.9 4884.9	3.441996 3.688859
Ponce de Leon Hotel chimney [1] 1905	29 53 35.76 81 18 56.00	1101.1 1502.6	288 55 47 317 35 23	108 56 35 137 36 23	St. Augustine Lighthouse (new) Scrub	2734.5 4778.3	3.436885 3.679273
St. Augustine latitude station 1906	29 53 13.21 81 17 17.50	406.7 469.6	16 17 44	196 17 43	St. Augustine Lighthouse (new)	201.3	2.30376

St. Augustine to Mosquito Lagoon.

Principal points.							
Canova 1859	29 51 05.579 81 18 46.329	171.8 1243.6	130 27 47.6 181 07 22.3 213 03 23.4	310 27 07.4 1 07 23.8 33 04 10.8	St. Augustine S. base St. Augustine Presbyterian Church St. Augustine Lighthouse (old)	2846.9 4119.5 4685.0	3.454373 3.614847 3.670709
Scrub 1859–1905	29 51 41.160 81 16 55.930	1267.3 1501.1	69 43 01.9 136 22 40.1 171 49 20.4	249 42 06.9 316 21 46.6 351 49 12.8	Canova St. Augustine Presbyterian Church St. Augustine Lighthouse (old)	3159.2 4176.7 2859.9	3.499583 3.620836 3.456349
Anastasia 2 1859–1867	29 49 19.152 81 16 10.147	589.7 272.4	128 01 13.0 164 18 12.7	307 59 55.3 344 17 49.9	Canova Scrub	5321.5 4541.9	3.726035 3.657242
Manly 1859–1871	29 49 26.240 81 18 00.465	807.9 12.5	202 37 57.5 274 12 23.6	22 38 29.6 94 13 18.5	Scrub Anastasia 2	4501.0 2970.0	3.653309 3.472760

[1] No check on this position.

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Merritt	29 49 19.123	588.8	94 14 12.3	274 13 17.4	Manly	2971.4	3.472965
1871–1906	81 16 10.098	271.1	164 17 25.1	344 17 02.3	Scrub	4543.1	3.657357
Government	29 47 16.365	503.8	154 56 10.4	334 55 35.8	Manly	4414.8	3.644907
1859–1906	81 16 50.810	1364.8	196 06 27.2	16 06 47.5	Anastasia 2	3935.2	3.594964
			196 07 47.3	16 08 07.5	Merritt	3934.7	3.594913
Canova 2	29 51 05.789	178.2	249 45 18.7	69 46 13.5	Scrub	3148.5	3.498107
1882–1905	81 18 45.992	1234.5	308 06 48.5	128 08 06.1	Anastasia	5318.4	3.725779
March	29 47 44.321	1364.6	64 37 40.3	244 37 06.7	Government	2008.5	3.302874
1871–1906	81 15 43.243	1161.5	130 25 40.7	310 24 32.5	Manly	4840.0	3.684848
			166 07 29.0	346 07 15.6	Merritt	3006.7	3.478095
Braddocks Point	29 45 35.772	1101.4	163 33 25.2	343 33 08.3	Government	3229.4	3.509120
1871–1906	81 16 16.776	450.8	192 49 06.2	12 49 22.9	March	4059.3	3.608447
Anastasia	29 45 14.056	432.8	106 03 10.6	286 02 27.6	Braddocks Point	2418.8	3.383597
1871–1906	81 14 50.257	1350.4	139 18 51.8	319 17 51.9	Government	4966.9	3.696082
			162 54 13.4	342 53 47.1	March	4840.7	3.684905
Dunham	29 43 41.402	1274.8	159 13 58.1	339 13 33.4	Braddocks Point	3766.2	3.575907
1872–1906	81 15 27.071	727.4	199 07 19.5	19 07 37.8	Anastasia	3019.5	3.479933
Last	29 43 48.877	1504.9	83 03 51.2	263 03 16.4	Dunham	1904.6	3.279803
1872–1906	81 14 16.721	449.3	135 34 58.2	315 33 58.7	Braddocks Point	4608.6	3.663570
			161 02 22.3	341 02 05.7	Anastasia	2773.2	3.442978
Swamp	29 41 37.716	1161.3	160 38 48.1	340 38 23.4	Dunham	4036.4	3.605998
1872–1906	81 14 37.298	1002.8	187 47 50.4	7 48 00.6	Last	4076.1	3.610247
Camp	29 41 53.587	1649.9	75 27 17.7	255 26 43.0	Swamp	1945.1	3.288945
1872	81 13 27.265	732.9	135 52 43.1	315 51 43.8	Dunham	4624.9	3.665104
			159 28 25.4	339 28 00.9	Last	3790.5	3.578696
Dupont	29 40 07.679	236.4	132 29 22.3	312 28 26.6	Swamp	4104.8	3.613294
1872	81 12 44.708	1202.2	160 40 01.0	340 39 39.9	Camp	3455.8	3.538549
Hemmings Point	29 39 55.407	1706.0	163 42 08.2	343 41 51.2	Swamp	3282.0	3.516136
1872	81 14 03.039	81.7	259 49 30.1	79 50 08.9	Dupont	2140.1	3.330425
Virgil	29 38 15.965	491.6	156 13 17.7	336 12 52.9	Hemmings Point	3345.9	3.524511
1872–1906	81 13 12.873	346.3	192 25 04.3	12 25 18.2	Dupont	3522.1	3.546796
Buena Vista	29 38 25.919	798.0	80 49 45.3	260 49 10.5	Virgil	1922.1	3.283770
1872	81 12 02.331	62.7	130 19 47.1	310 18 47.6	Hemmings Point	4258.1	3.629212
			160 00 48.9	340 00 27.9	Dupont	3334.0	3.522964
Hernandez	29 36 22.323	687.3	160 16 18.2	340 15 55.1	Virgil	3717.2	3.570220
1872	81 12 26.225	705.7	189 35 09.7	9 35 21.4	Buena Vista	3859.4	3.586517
Mala Compra	29 36 33.210	1022.5	80 11 59.7	260 11 24.1	Hernandez	1968.4	3.294124
1872	81 11 14.136	380.3	159 30 58.7	339 30 34.9	Buena Vista	3704.6	3.568736
De Leon	29 35 00.729	22.4	160 17 12.0	340 16 55.5	Hernandez	2668.7	3.426294
1872	81 11 52.770	1420.2	200 03 19.2	20 03 38.3	Mala Compra	3031.3	3.481629
De Soto	29 35 12.613	388.3	79 23 07.1	259 22 31.3	De Leon	1985.4	3.297853
1872	81 10 40.262	1083.6	159 49 57.6	339 49 40.9	Mala Compra	2643.7	3.422207
Bikes Prairie	29 33 18.206	560.5	160 15 38.3	340 15 17.5	De Leon	3353.7	3.525527
1872	81 11 10.684	287.6	193 05 05.2	13 05 20.2	De Soto	3616.4	3.558278
Rebaut	29 32 52.912	1629.1	107 22 31.7	287 21 46.1	Bikes Prairie	2608.8	3.416435
1872–1906	81 09 38.202	1028.4	158 46 44.4	338 46 13.8	De Soto	4614.3	3.664104
De Luna	29 32 12.013	369.9	145 48 46.9	325 48 21.5	Bikes Prairie	2463.8	3.391610
1872	81 10 19.259	518.6	221 16 34.8	41 16 55.0	Rebaut	1675.6	3.224172
De Solas	29 31 30.786	947.9	145 17 03.0	325 16 46.9	De Luna	1544.3	3.188732
1872	81 09 46.596	1254.8	185 06 26.0	5 06 30.1	Rebaut	2538.7	3.404606
Campbell	29 31 46.024	1417.0	67 11 09.2	247 10 48.8	De Solas	1209.8	3.082725
1872–1906	81 09 05.184	139.6	156 39 11.5	336 38 55.2	Rebaut	2243.1	3.350854
Leonardo	29 30 53.212	1638.3	170 59 03.9	350 59 00.5	De Solas	1171.4	3.068689
1873	81 09 39.780	1071.3	209 48 31.3	29 48 48.3	Campbell	1874.0	3.272777

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Haulover	29 30 09.288	286.0	122 30 42.2	302 30 03.4	Leonardo	2516.5	3.400803
1873	81 08 20.982	565.1	137 25 33.8	317 24 51.6	De Solas	3407.8	3.532468
			158 13 03.0	338 12 41.2	Campbell	3207.5	3.506165
Sheppard	29 29 45.527	1401.7	171 29 35.4	351 29 26.5	De Solas	3276.9	3.515461
1873	81 09 28.595	770.2	248 06 36.6	68 07 09.9	Haulover	1962.6	3.292842
Griffith	29 28 37.317	1149.0	151 07 44.3	331 07 23.2	Sheppard	2398.2	3.379892
1873–1906	81 08 45.606	1228.7	193 10 56.9	13 11 09.1	Haulover	2908.3	3.463644
Bard	29 28 04.346	133.8	113 19 43.4	293 19 00.4	Griffith	2564.0	3.408921
1873–1906	81 07 18.217	490.9	156 16 35.7	336 16 04.8	Haulover	4202.0	3.623456
Bulow	29 26 25.072	771.9	158 37 02.8	338 36 33.7	Griffith	4372.7	3.640754
1873–1906	81 07 46.431	1251.3	193 58 00.3	13 58 14.2	Bard	3149.7	3.498264
Nelson	29 25 50.203	1545.7	114 04 12.4	294 03 28.6	Bulow	2632.9	3.420433
1873–1906	81 06 17.235	464.6	158 18 22.0	338 17 52.0	Bard	4445.1	3.647877
Coligny	29 24 10.525	324.0	158 33 39.9	338 33 10.2	Bulow	4450.6	3.648417
1873	81 06 46.073	1242.1	194 12 46.2	14 13 00.3	Nelson	3165.9	3.500493
Oso	29 23 39.417	1213.6	113 10 10.7	293 09 30.0	Coligny	2434.8	3.386466
1873	81 05 23.049	621.5	160 03 51.1	340 03 24.5	Nelson	4283.5	3.631797
Tomoka	29 22 23.654	728.3	158 58 10.8	338 57 47.8	Coligny	3525.3	3.547193
1873	81 05 59.151	1595.2	202 39 03.6	22 39 21.3	Oso	2527.6	3.402712
Paloma	29 21 49.454	1522.6	113 21 28.8	293 20 44.5	Tomoka	2656.5	3.424302
1873	81 04 28.724	774.6	156 36 15.3	336 35 48.7	Oso	3689.0	3.566904
Oswald	29 20 39.188	1206.6	151 50 36.0	331 50 04.7	Tomoka	3648.2	3.562076
1873	81 04 55.318	1492.4	198 20 36.4	18 20 49.4	Paloma	2279.2	3.357783
Esperanza	29 22 15.561	479.1	113 33 31.0	293 33 20.6	Tomoka	623.5	2.794823
1873–1906	81 05 37.960	1023.7	293 17 03.0	113 17 36.9	Paloma	2033.0	3.308132
			338 48 31.9	158 48 52.8	Oswald	3182.3	3.502737
Arena	29 20 05.258	161.9	116 20 55.9	296 20 17.6	Oswald	2354.1	3.371829
1873–1906	81 03 37.120	1001.5	156 32 46.2	336 32 20.9	Paloma	3497.0	3.543698
			156 34 46.5	336 33 54.6	Oso	7189.0	3.856671
Quixote	29 19 04.713	145.1	157 24 49.1	337 24 27.1	Oswald	3150.4	3.498369
1873–4	81 04 10.465	282.3	205 45 43.8	25 46 00.1	Arena	2069.8	3.315937
Hercules	29 18 06.562	202.0	126 04 09.1	306 03 24.5	Quixote	3041.3	3.483064
1873	81 02 39.361	1062.4	156 54 23.6	336 53 55.3	Arena	3972.9	3.599108
Halifax	29 16 58.859	1812.2	156 30 20.2	336 29 49.6	Quixote	4225.2	3.625847
1874	81 03 08.042	217.1	200 22 18.5	20 22 32.5	Hercules	2223.5	3.347046
Homer	29 16 03.044	93.7	125 40 04.7	305 39 21.3	Halifax	2947.5	3.469458
1874–1906	81 01 39.330	1061.8	156 55 31.1	336 55 01.7	Hercules	4133.7	3.616338
Pine Point	29 15 10.935	336.7	158 09 05.3	338 08 41.2	Halifax	3580.0	3.553878
1874	81 02 18.685	504.5	213 30 49.2	33 31 08.4	Homer	1924.3	3.284268
Chaucer	29 14 39.121	1204.5	114 23 02.7	294 22 23.6	Pine Point	2373.0	3.375298
1874–1906	81 00 58.638	1583.4	156 58 00.1	336 57 40.2	Homer	2807.7	3.448352
Orange Island	29 13 46.994	1446.9	152 31 17.4	332 30 53.1	Pine Point	2913.1	3.464355
1874	81 01 28.903	780.6	206 59 09.5	26 59 24.3	Chaucer	1801.0	3.255515
Mollison	29 13 05.846	180.0	121 55 12.2	301 54 35.4	Orange Island	2396.3	3.379549
1874–1906	81 00 13.589	367.0	157 02 35.5	337 02 13.5	Chaucer	3118.8	3.493988
Bethune Point	29 11 50.048	1540.9	154 53 02.5	334 52 32.0	Orange Island	3976.6	3.599512
1874–1906	81 00 26.405	713.3	188 26 13.6	8 26 19.9	Mollison	2359.2	3.372760
Swatow	29 11 45.731	1408.0	95 16 31.6	275 16 05.6	Bethune Point	1446.7	3.160367
1874–1906	80 59 33.082	893.7	156 04 47.0	336 04 27.2	Mollison	2698.4	3.431101
Snow	29 10 07.917	243.7	163 20 11.5	343 19 54.5	Bethune Point	3282.2	3.516169
1874	80 59 51.566	1393.5	189 24 54.6	9 25 03.6	Swatow.	3052.6	3.484665
Dobbin	29 10 37.470	1153.7	57 52 01.7	237 51 35.6	Snow	1710.5	3.233117
1874	80 58 57.965	1566.3	133 05 10.6	313 04 27.6	Bethune Point	3271.5	3.514743
			155 42 15.8	335 41 58.7	Swatow	2305.8	3.362826

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Weiser	29 08 51.423	1583.2	128 16 31.3	308 15 37.5	Snow	3802.5	3.580071
1874	80 58 01.099	29.7	154 47 52.1	334 47 24.4	Dobbin	3608.5	3.557328
McDaniel	29 08 28.133	866.2	157 05 44.2	337 05 20.8	Snow	3335.1	3.523112
1874–1906	80 59 03.532	95.5	182 09 49.0	2 09 51.7	Dobbin	3984.8	3.600406
			246 58 28.6	66 58 59.0	Weiser	1833.5	3.263292
Sutton	29 07 01.637	50.4	154 35 05.8	334 34 43.0	McDaniel	2948.4	3.469581
1874–1906	80 58 16.719	452.0	187 07 11.5	7 07 19.1	Weiser	3406.3	3.532280
Patroclus	29 07 16.911	520.6	76 03 04.6	256 02 30.5	Sutton	1950.2	3.290071
1874–1906	80 57 06.715	181.5	124 46 57.1	304 46 00.2	McDaniel	3844.5	3.584839
			153 11 57.9	333 11 31.4	Weiser	3260.0	3.513222
Weiser 2	29 08 51.475	1584.8	333 12 56.2	153 13 22.7	Patroclus	3261.2	3.513374
1906	80 58 01.074	29.0	7 07 47.9	187 07 40.3	Sutton	3408.0	3.532495
Odyssey	29 04 52.019	1601.6	157 45 03.2	337 44 33.8	Sutton	4311.7	3.634646
1874	80 57 16.336	441.8	183 20 13.2	3 20 17.9	Patroclus	4468.4	3.650149
Odyssey 2	29 04 52.069	1603.0	157 44 10.5	337 43 41.1	Sutton	4310.5	3.634527
1906	80 57 16.314	441.3	183 19 50.9	3 19 55.6	Patroclus	4466.8	3.649999
Iliad	29 05 14.181	436.6	75 06 13.1	255 05 27.0	Odyssey	2653.0	3.423742
1874	80 55 41.538	1123.4	128 15 45.9	308 14 30.4	Sutton	5343.4	3.727818
			148 38 29.8	328 37 48.4	Patroclus	4425.1	3.645923
Osceola	29 03 37.208	1145.6	152 22 21.9	332 22 00.2	Odyssey	2599.7	3.414919
1874	80 56 31.762	859.2	204 27 46.1	24 28 10.5	Iliad	3280.0	3.515878
North base (proposed)	29 03 09.682	298.1	102 56 48.7	282 55 42.5	Osceola	3785.0	3.578064
1874	80 54 15.400	416.7	122 47 00.3	302 45 32.5	Odyssey	5820.6	3.764970
			148 42 41.8	328 42 00.0	Iliad	4485.5	3.651813
Palo Blanco	29 02 15.863	488.4	142 57 17.9	322 56 44.0	Osceola	3137.8	3.496628
1874–1906	80 55 21.881	592.0	227 20 40.3	47 21 12.6	North base (proposed)	2445.5	3.388371
South base (proposed)	29 02 16.508	508.2	89 33 58.7	269 33 12.2	Palo Blanco	2586.0	3.412623
1874	80 53 46.309	1253.0	119 02 36.2	299 01 15.8	Osceola	5119.4	3.709223
			154 19 30.9	334 19 16.8	North base (proposed)	1816.4	3.259215
Palo Alto	29 00 02.757	84.9	161 41 53.5	341 41 29.2	Palo Blanco	4316.3	3.635112
1874–1906	80 54 31.786	860.3	196 38 13.6	16 38 35.7	S. base (proposed)	4297.7	3.633239
Palo Negro	28 59 16.507	508.1	108 27 08.0	288 25 51.5	Palo Alto	4501.2	3.653326
1874–1906	80 51 54.037	1462.8	151 16 17.8	331 15 23.4	S. base (proposed)	6320.0	3.800716
Los Pinos	28 57 11.402	351.0	151 44 26.0	331 43 35.2	Palo Alto	5989.7	3.777402
1874–1906	80 52 47.012	1273.0	200 25 17.7	20 25 43.4	Palo Negro	4109.9	3.613833
Alden	28 57 45.725	1407.6	71 10 12.5	251 09 17.1	Los Pinos	3272.6	3.514892
1874–1906	80 50 52.627	1424.9	149 15 25.7	329 14 56.0	Palo Negro	3252.0	3.512146
Turtle Mound	28 55 50.717	1561.3	115 59 21.4	295 57 50.3	Los Pinos	5671.2	3.753674
1874–1906	80 49 38.760	1049.8	149 58 27.7	329 57 22.3	Palo Negro	7318.2	3.864404
			150 32 23.8	330 31 48.1	Alden	4066.7	3.609240
St. Agnan	28 55 46.130	1420.1	180 51 34.6	0 51 34.4	Palo Negro	6477.5	3.811406
1874	80 51 57.626	1560.8	205 32 49.1	25 33 20.6	Alden	4081.0	3.610768
			267 50 24.9	87 51 32.1	Turtle Mound	3763.8	3.575632
Live Oak	28 52 45.402	1397.7	157 17 47.3	337 17 05.8	St. Agnan	6031.5	3.780425
1874	80 50 31.678	858.4	194 06 07.2	14 06 32.8	Turtle Mound	5882.5	3.769562
Wallace	28 53 39.078	1203.0	63 25 25.9	243 24 27.0	Live Oak	3692.5	3.567326
1874	80 48 29.810	807.6	124 48 18.1	304 46 37.6	St. Agnan	6855.1	3.836016
			155 15 36.8	335 15 03.5	Turtle Mound	4462.4	3.649567
Bear	28 51 01.212	37.3	115 02 40.2	295 00 37.8	Live Oak	7582.0	3.879785
1874–1906	80 46 18.187	493.0	143 43 56.5	323 42 52.9	Wallace	6028.6	3.780215
			148 38 25.7	328 36 48.7	Turtle Mound	10438.9	4.018656
Ross Point	28 48 16.372	504.0	151 58 26.5	331 57 08.0	Live Oak	9383.5	3.972565
1874–1906	80 47 48.972	1328.0	173 38 41.5	353 38 21.8	Wallace	9996.3	3.999838
			205 52 05.5	25 52 49.3	Bear	5640.1	3.751288

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Deer	28 46 53.868	1658.3	110 23 27.4	290 21 25.9	Ross Point	7295.6	3.863060
1874–1906	80 43 36.796	998.0	150 07 30.8	330 06 13.0	Bear	8782.5	3.943620
Campbell (or NW. base)	28 45 08.183	251.9	150 30 19.4	330 29 21.2	Ross Point	6656.6	3.823255
1875–1906	80 45 48.116	1305.5	175 42 39.2	355 42 24.7	Bear	10898.8	4.037377
			227 35 07.5	47 36 10.7	Deer	4824.5	3.683455
Mosquito Lagoon SE. base	28 44 08.490	261.4	143 28 14.8	323 27 50.7	Campbell	2287.0	3.359274
1875–1906	80 44 57.941	1572.3	203 22 40.4	23 23 19.5	Deer	5546.8	3.744042
Scorpion	28 45 22.255	685.1	41 03 59.5	221 03 24.4	Mosquito Lagoon SE. base	3011.8	3.478823
1875–1906	80 43 45.027	1221.7					
			82 37 01.0	262 36 01.8	Campbell	3367.5	3.527304
			184 31 33.7	4 31 37.7	Deer	2829.2	3.451659
Whale	28 43 46.211	1422.6	96 38 27.3	276 36 42.6	Mosquito Lagoon SE. base	5943.7	3.774058
1875	80 41 20.371	552.8					
			109 10 22.5	289 08 13.7	Campbell	7690.8	3.885973
			127 01 02.5	306 58 52.9	Scorpion	4914.1	3.691443
			147 21 44.8	327 20 39.2	Deer	6861.1	3.836391
Dummitt	28 42 27.916	859.4	141 06 07.6	321 04 57.0	Campbell	6340.4	3.802119
1875	80 43 21.371	580.1	177 04 28.6	357 04 21.1	Deer	8198.1	3.913714
			233 42 50.3	53 43 48.4	Whale	4073.5	3.609970
Panther	28 40 51.571	1587.6	112 41 08.8	292 39 03.2	Dummitt	7696.0	3.886265
1875	80 38 59.767	1622.7	146 02 16.2	326 00 03.1	Deer	13450.4	4.128736
			144 38 23.6	324 37 16.1	Whale	6593.2	3.819095
Supplementary points.							
Fort	29 42 54.237	1669.9	322 19 50	142 20 17	Camp	2359.1	3.37274
1872–1906	81 14 20.892	561.5	10 36 11	190 36 03	Swamp	2397.0	3.37967
Damon	29 19 59.495	1831.7	156 51 56	336 51 31	Oswald	1329.2	3.12358
1872–1905	81 04 35.962	970.3	263 37 03	83 37 32	Arena	1597.4	3.20341
			337 48 29	157 48 42	Quixote	1821.6	3.26044
Ormond Hotel, chimney	29 17 26.649	820.4	332 35 06.3	152 36 21.6	Mollison	9044.5	3.956384
1906	81 02 47.769	1289.3	333 22 54.6	153 24 29.7	Swatow	11739.0	4.069632
			343 08 31.0	163 09 19.9	Hendricks	9316.8	3.969265
Daytona	29 12 35.944	1106.6	303 37 22.8	123 38 04.8	Swatow	2791.5	3.445833
1906	81 00 59.123	1597.2	327 58 19.3	147 58 35.3	Bethune Point	1666.7	3.221852
Hendricks	29 12 37.029	1140.1	238 45 30.0	58 45 56.4	Mollison	1710.8	3.233193
1906	81 01 07.743	209.2	301 41 38.0	121 42 24.2	Swatow	3005.6	3.477926
Burgoyne's water tower	29 13 19.264	593.1	337 03 40.5	157 03 43.7	Mollison	448.6	2.651850
1906	81 00 20.062	541.9	336 12 51.3	156 13 14.2	Swatow	3146.9	3.497883
			44 43 40.6	224 43 17.3	Hendricks	1830.2	3.262487
Gamble's water tower and windmill	29 12 42.614	1312.0	202 46 40.6	22 46 46.1	Mollison	775.8	2.889728
1906	81 00 24.709	667.4	321 27 52.8	141 28 18.0	Swatow	2238.8	3.350007
			1 37 17.2	181 37 16.4	Bethune Point	1619.0	3.209253
			77 32 43.7	257 32 26.9	Daytona	952.0	2.978634
McLaren's windmill	29 12 33.214	1022.5	188 51 30.0	8 51 32.8	Mollison	1016.8	3.007229
1906	81 00 19.386	523.6	319 26 42.6	139 27 05.2	Swatow	1924.0	3.284206
			8 07 11.0	188 07 07.6	Bethune Point	1342.4	3.127893
			94 28 47.9	274 28 28.5	Daytona	1076.7	3.032079
Wilder's water tower and windmill	29 12 22.580	695.2	179 36 09.8	359 36 09.6	Mollison	1332.1	3.124537
1906	81 00 13.247	357.8	316 16 24.6	136 16 44.2	Swatow	1569.8	3.195852
			19 32 23.8	199 32 17.4	Bethune Point	1062.8	3.026436
			108 22 15.8	288 21 53.4	Daytona	1305.7	3.115858
Auto Club flagstaff	29 12 46.556	1433.3	336 29 00.3	156 29 15.0	Swatow	2042.3	3.310110
1906	81 00 03.245	87.6	80 26 51.7	260 26 20.2	Hendricks	1766.7	3.247163
			154 48 23.7	334 48 18.6	Mollison	656.3	2.817115
Colonnade Hotel flag	29 13 58.044	1787.1	319 51 23.3	139 51 47.8	Mollison	2102.2	3.322672
1906	81 01 03.767	101.8	328 58 30.9	148 59 15.2	Swatow	4753.3	3.676998
			2 27 57.0	182 27 55.1	Hendricks	2496.6	3.397344
Methodist Church spire	29 13 29.646	912.8	310 24 37.1	130 24 52.6	Mollison	1130.3	3.053191
1906	81 00 45.453	1227.8	328 34 08.1	148 34 43.4	Swatow	3749.3	3.573947
			20 23 21.9	200 23 11.0	Hendricks	1728.2	3.237598

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.							
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Daytona:							
Ridgewood Hotel flagstaff	29 12 28.433	875.4	236 44 43.9	56 45 15.6	Mollison	2100.8	3.322380
	81 01 18.631	503.3	246 18 23.2	66 18 32.7	Daytona	575.5	2.760013
1906			294 44 48.5	114 45 40.0	Swatow	3139.8	3.496903
			309 56 52.2	129 57 17.7	Bethune Point	1840.4	3.264913
First Congregational Church spire	29 12 44.269	1362.9	249 27 54.9	69 28 26.9	Mollison	1894.2	3.277427
	81 01 19.263	520.3	302 08 06.3	122 08 58.1	Swatow	3387.5	3.529885
1906			305 36 49.5	125 36 55.1	Hendricks	382.8	2.582936
St Paul's Catholic Church spire	29 12 38.403	1182.3	242 52 39.4	62 53 09.2	Mollison	1853.5	3.268003
	81 01 14.668	396.2	282 44 34.3	102 44 37.7	Hendricks	191.8	2.282770
1906			300 34 24.6	120 35 14.2	Swatow	3187.5	3.503456
Yacht Club jackstaff	29 12 26.984	830.8	184 09 20.5	4 09 20.9	Daytona	276.6	2.441811
	81 00 59.865	1617.1	226 14 58.9	46 15 21.5	Mollison	1730.3	3.238120
1906			298 26 28.9	118 27 11.3	Swatow	2666.3	3.425910
			321 31 05.3	141 31 21.7	Bethune Point	1452.6	3.162160
Desplands Hotel flag	29 12 33.499	1031.4	237 58 00.7	57 58 29.5	Mollison	1877.8	3.273641
	81 01 12.527	338.4	258 15 09.7	78 15 16.2	Daytona	369.8	2.567979
1906			317 01 55.2	137 02 17.7	Bethune Point	1828.1	3.261996
City Hotel cupola	29 12 26.695	821.9	200 04 39.1	20 04 41.0	Daytona	303.2	2.481724
	81 01 02.976	80.4	297 26 18.9	117 27 02.8	Swatow	2736.4	3.437177
1906			318 47 27.2	138 47 45.0	Bethune Point	1499.7	3.175994
Ice plant smokestack	29 12 37.742	1162.0	247 09 51.5	67 10 28.6	Mollison	2230.0	3.348309
	81 01 29.681	801.7	272 07 06.2	92 07 16.9	Hendricks	593.0	2.773051
1906			296 56 23.9	116 57 20.8	Swatow	3533.5	3.548199
Daytona longitude station	29 12 36.03	1109.3	69 01 30	249 01 30	Daytona	9.35	0.97081
1907	81 00 58.79	1588.2					
Port Orange:							
Hotel wharf, E. end of house	29 08 37.678	1160.0	256 25 11.4	76 25 43.1	Weiser 2	1809.8	3.257625
	80 59 06.160	166.5	307 35 30.6	127 36 28.8	Patroclus	4075.4	3.610167
1906			335 40 22.3	155 40 46.4	Sutton	3244.9	3.511195
Hotel, chimney at S. end [1]	29 08 36.86	1134.9	256 28 46	76 29 19	Weiser 2	1924.8	3.28438
	80 59 10.31	278.7	306 22 18	126 23 19	Patroclus	4150.0	3.61805
1906							
Christiancy's house flag	29 07 47.306	1456.4	211 10 29.0	31 10 50.5	Weiser 2	2309.1	3.363445
	80 58 45.298	1224.6	289 20 26.3	109 21 14.3	Patroclus	2824.6	3.450959
1906			331 12 32.8	151 12 46.7	Sutton	1604.3	3.205291
House chimney (Halifax River) [1]	29 07 29.06	894.7	278 45 45	98 46 29	Patroclus	2452.5	3.38960
	80 58 36.37	983.3	327 48 47	147 48 50	Sutton	997.4	2.99886
1906							
Ponce Park Hotel flag	29 04 59.826	1841.9	82 37 52.9	262 37 19.7	Odyssey 2	1860.8	3.269709
	80 56 08.079	218.5	137 09 40.4	317 08 37.8	Sutton	5115.1	3.708855
1906			159 24 50.8	339 24 22.3	Patroclus	4508.5	3.654029
Mosquito Inlet Lighthouse	29 04 49.943	1537.6	91 28 15.3	271 27 29.3	Odyssey 2	2560.8	3.408370
	80 55 41.663	1126.9	134 02 56.3	314 01 40.8	Sutton	5832.6	3.765862
1906			153 03 43.7	333 03 02.4	Patroclus	5075.7	3.705494
Alden's house chimney	29 02 11.441	352.3	94 26 37.7	274 26 06.1	Palo Blanco	1758.7	3.245202
	80 54 17.076	462.0	157 54 11.0	337 53 29.9	Iliad	6072.2	3.783347
1874–1906			181 26 54.1	1 26 54.9	N. base (proposed)	1793.6	3.253731
			259 23 01.6	79 23 16.5	S. base (proposed)	846.9	2.927850
Duss	29 03 02.950	90.8	4 47 14.9	184 47 12.5	Alden's house	1591.4	3.201767
	80 54 12.167	329.2	52 27 33.4	232 26 59.6	Palo Blanco	2378.9	3.376373
1906							
House on beach (A), chimney	29 03 23.451	722.0	340 26 53.8	160 26 57.7	Duss	669.8	2.825911
	80 54 20.451	553.3	357 38 25.4	177 38 27.0	Alden's house	2218.8	3.346121
1906			38 37 07.8	218 36 38.0	Palo Blanco	2663.0	3.425379
Duss, house (on river) chimney	29 02 56.946	1753.1	357 38 51.5	177 38 52.5	Alden's house	1402.1	3.146793
	80 54 19.202	519.5	53 17 11.9	233 16 41.4	Palo Blanco	2115.6	3.325424
1906			225 50 21.5	45 50 24.9	Duss	265.3	2.423774

[1] No check on this position.

St. Augustine to Mosquito Lagoon—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Duss' house (on beach) chimney	29 03 06.439	198.2	337 01 44.7	157 01 45.5	Duss	116.7	2.066962
	80 54 13.849	374.6	2 57 02.4	182 57 00.8	Alden's house	1695.5	3.229291
1906			49 46 28.2	229 45 55.2	Palo Blanco	2410.9	3.382176
Detweiler's house, cupola [1]	29 02 04.927	151.7	100 57 18.8	280 56 47.6	Palo Blanco	1772.3	3.248542
1906	80 54 17.572	475.5	184 40 46.8	4 40 49.4	Duss	1792.3	3.253417
Boathouse, N. gable [1]	29 01 57.896	1782.5	121 34 17.7	301 33 01.6	Palo Blanco	1057.1	3.024105
1906	80 54 48.590	1314.8	206 11 46.7	26 12 04.4	Duss	2232.1	3.348719
Sam's Hotel, cupola	29 01 32.627	1004.5	175 05 16.6	355 05 14.6	Palo Blanco	1336.0	3.125809
1906	80 55 17.653	477.7	212 30 00.6	32 30 32.4	Duss	3297.3	3.518157
Allen's (T. B.) house [1]	28 52 13.40	412.6	289 07 25	109 09 19	Bear	6778.5	3.831132
1906	80 50 14.46	391.9	331 35 57	151 37 08	Ross Point	8294.9	3.918809
Channel beacon, W. entrance to canal [1]	28 51 26.78	824.4	279 10 15	99 11 41	Bear	4932.0	3.693023
	80 49 17.82	483.0	337 39 23	157 40 06	Ross Point	6337.3	3.801907
1906							
Sanchez's house [1]	28 51 05.97	183.8	271 31 32	91 33 09	Bear	5451.3	3.736499
1906	80 49 39.23	1063.4	330 12 02	150 12 56	Ross Point	6016.3	3.779328
House of Refuge (Mosquito Lagoon) chimney	28 51 28.500	877.4	329 42 12.3	149 42 21.0	Bear	972.9	2.988067
	80 46 36.294	983.7	353 37 46.9	173 38 10.1	Campbell	11780.9	4.071179
1906			18 25 44.7	198 25 09.6	Ross Point	6234.3	3.794788
House in water, S. or E. gable	28 47 00.385	11.9	330 04 06.1	150 05 00.2	Mosquito Lagoon, SE. base	6105.9	3.785748
	80 46 50.214	1362.0					
1906			333 59 52.5	154 00 22.5	Campbell	3843.1	3.584679
			145 44 28.5	325 44 00.2	Ross Point	2830.5	3.451860
			186 40 42.6	6 40 58.1	Bear	7464.7	3.873012
Channel beacon	28 45 00.605	18.6	255 09 24.1	75 10 08.7	Scorpion	2602.9	3.415451
	80 45 17.765	482.0	341 27 48.4	161 27 57.9	Mosquito Lagoon, SE. base	1692.1	3.228437
1906			105 49 15.6	285 49 01.0	Campbell	855.9	2.932413
Channel beacon	28 45 30.586	941.6	274 34 33.2	94 35 29.9	Scorpion	3209.1	3.506385
	80 45 42.937	1164.8	334 12 51.1	154 13 12.7	Mosquito Lagoon, SE. base	2806.8	3.448206
1906			11 31 07.3	191 31 04.8	Campbell	703.8	2.847477
			146 11 38.4	326 10 37.7	Ross Point	6142.9	3.788376
Haulover Canal, E. entrance, N. pile	28 44 35.773	1101.3	231 56 32.8	51 57 05.2	Scorpion	2321.5	3.365775
	80 44 52.404	1421.8	10 08 26.6	190 08 23.9	Mosquito Lagoon, SE. base	853.2	2.931073
1906			123 25 53.6	303 25 26.8	Campbell	1811.2	3.257966
Haulover Canal, E. entrance, S. pile	28 44 34.900	1074.4	231 03 52.6	51 04 24.6	Scorpion	2320.0	3.365485
	80 44 51.544	1398.6	12 03 04.4	192 03 01.3	Mosquito Lagoon, SE. base	831.4	2.919795
1906			123 43 42.4	303 43 15.2	Campbell	1845.5	3.266117

Indian and Banana Rivers.

Principal points.							
Black Point	28 41 02.211	68.1	197 51 21.0	17 52 04.2	Campbell	7955.8	3.900683
1875–1906	80 47 18.028	489.5	247 39 22.2	67 41 15.8	Dummitt	6944.9	3.841669
Sand Point	28 37 05.229	161.0	193 13 16.3	13 13 46.5	Black Point	7494.2	3.874727
1875	80 48 21.162	574.9	195 36 12.5	15 37 26.0	Campbell	15437.5	4.188576
			219 18 49.9	39 21 13.7	Dummitt	12843.4	4.108679
Otter	28 35 01.771	54.5	107 43 00.5	287 39 30.5	Sand Point	12509.1	4.097227
1875–1906	80 41 02.526	68.6	164 39 25.3	344 38 18.7	Dummitt	14242.8	4.153594
Wild Cat	28 37 34.761	1070.1	56 56 16.6	236 54 09.2	Otter	8629.0	3.935960
1875	80 36 36.403	988.8	129 24 12.4	309 20 58.1	Dummitt	14225.4	4.153064
			147 17 06.2	327 15 57.3	Panther	7201.8	3.857443
Addison Point	28 32 01.765	54.3	165 37 49.3	345 37 07.1	Sand Point	9644.0	3.984255
1875–1906	80 46 53.056	1442.5	239 47 39.7	59 50 27.3	Otter	11022.1	4.042263

[1] No check on this position.

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Moore	28 31 47.275	1455.3	95 03 52.2	275 02 23.5	Addison Point	5065.6	3.704630
1875	80 43 47.463	1290.4	142 47 08.6	322 44 57.7	Sand Point	12293.7	4.089683
			216 48 50.2	36 50 09.0	Otter	7479.9	3.873898
Bend	28 29 34.555	1063.7	133 44 09.2	313 42 46.0	Addison Point	6556.5	3.816670
1875	80 43 58.811	1599.6	184 19 07.3	4 19 12.7	Moore	4097.3	3.612499
Jones Point	28 27 59.547	1833.1	165 39 14.0	345 38 40.5	Addison Point	7696.7	3.886303
1876	80 45 42.910	1167.3	204 07 07.5	24 08 02.7	Moore	7681.4	3.885442
			224 03 59.5	44 04 49.1	Bend	4070.9	3.609692
Sanders	28 25 40.847	1257.4	138 31 10.1	318 30 04.0	Jones Point	5700.0	3.755878
1876–1906	80 43 24.128	656.6	172 31 49.8	352 31 33.3	Bend	7256.1	3.860704
Higs	28 24 45.391	1397.3	167 49 28.1	347 49 05.5	Jones Point	6114.5	3.786362
1876	80 44 55.506	1510.7	189 49 39.3	9 50 06.3	Bend	9034.3	3.955895
			235 31 37.8	55 32 21.3	Sanders	3016.5	3.479508
Aqua	28 23 11.662	359.0	134 48 16.1	314 47 25.3	Higs	4095.0	3.612255
1876	80 43 08.759	238.4	174 47 47.3	354 47 40.0	Sanders	4611.5	3.663843
City Point	28 22 48.126	1481.5	159 29 58.6	339 29 35.0	Higs	3854.0	3.585914
1876	80 44 05.916	161.1	192 04 23.4	12 04 43.3	Sanders	5437.3	3.735386
			245 01 49.7	65 02 16.9	Aqua	1716.6	3.234659
Oleander Point	28 21 02.350	72.3	159 15 43.7	339 15 22.2	City Point	3481.8	3.541807
1876	80 43 20.634	562.0	179 21 53.0	359 21 51.5	Sanders	8573.7	3.933170
			184 38 35.6	4 38 41.2	Aqua	3993.8	3.601387
Gopher	28 21 28.110	865.4	61 27 08.1	241 26 42.7	Oleander Point	1659.2	3.219888
1876	80 42 27.119	738.5	132 29 03.5	312 28 16.6	City Point	3647.6	3.562001
			160 25 24.5	340 25 04.7	Aqua	3383.4	3.529347
Cleveland	28 20 23.867	734.7	121 41 14.1	301 40 40.6	Oleander Point	2255.6	3.353259
1876	80 42 10.159	276.7	144 38 20.3	324 37 25.3	City Point	5445.9	3.736071
			166 51 16.4	346 51 08.3	Gopher	2030.9	3.307683
Coquina	28 19 23.256	715.9	159 27 45.1	339 27 25.2	Oleander Point	3257.6	3.512893
1876–1906	80 42 38.671	1053.5	184 40 45.8	4 40 51.2	Gopher	3856.3	3.586172
			202 35 53.1	22 36 06.6	Cleveland	2021.0	3.305566
Hill	28 18 59.337	1826.6	109 26 56.6	289 26 20.3	Coquina	2211.9	3.344770
1876–1906	80 41 22.107	602.3	153 17 59.4	333 17 36.6	Cleveland	2912.8	3.464309
Stewart	28 16 49.806	1533.2	157 04 42.0	337 04 07.2	Coquina	5128.9	3.710022
1876	80 41 25.342	690.6	169 30 20.1	349 29 58.8	Cleveland	6701.7	3.826185
			181 15 59.4	1 16 00.9	Hill	3988.4	3.600797
Georgiana	28 17 33.081	1018.4	34 16 53.9	214 16 38.1	Stewart	1612.2	3.207412
1876–1906	80 40 52.021	1417.5	139 25 09.3	319 24 18.7	Coquina	4466.1	3.649926
			162 50 45.6	342 50 31.3	Hill	2778.9	3.443875
Cultus	28 15 58.394	1797.6	130 33 29.8	310 32 57.6	Stewart	2434.2	3.386356
1876	80 40 17.480	476.5	162 06 16.9	342 06 00.5	Georgiana	3063.0	3.486146
Meta	28 15 06.153	189.4	159 54 53.4	339 54 33.1	Stewart	3397.5	3.531156
1876	80 40 42.528	1159.3	176 43 37.5	356 43 33.0	Georgiana	4530.3	3.656130
			203 00 08.6	23 00 20.5	Cultus	1747.1	3.242318
Cape Cod	28 15 13.638	419.8	79 20 55.0	259 20 33.7	Meta	1246.3	3.095615
1876	80 39 57.597	1570.1	141 04 22.6	321 03 41.0	Stewart	3805.7	3.580432
			158 31 42.4	338 31 33.0	Cultus	1480.5	3.170412
Plover	28 13 12.526	385.6	159 58 18.9	339 57 56.8	Meta	3723.0	3.570895
1876	80 39 55.753	1520.3	179 13 39.6	359 13 38.7	Cape Cod	3728.6	3.571542
File	28 13 56.294	1733.0	38 58 39.4	218 58 20.5	Plover	1733.1	3.238814
1876	80 39 15.774	430.0	132 17 05.3	312 16 24.2	Meta	3196.6	3.504687
			154 24 50.8	334 24 31.0	Cape Cod	2639.8	3.421575
Mangrove	28 13 02.586	79.6	99 22 41.9	279 22 09.8	Plover	1878.7	3.273865
1876–1906	80 38 47.774	1302.7	140 34 12.4	320 33 18.2	Meta	4925.2	3.692421
			155 12 55.8	335 12 42.6	File	1821.1	3.260329
Keno	28 11 16.373	504.0	161 43 00.6	341 42 40.1	Plover	3765.7	3.575849
1876–1906	80 39 12.428	339.0	191 37 08.4	11 37 19.9	Mangrove	3338.0	3.523484

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Cove	28 12 03.413	105.1	48 42 34.8	228 42 06.2	Keno	2194.3	3.341284
1876	80 38 11.983	326.8	126 56 37.3	306 55 48.3	Plover	3540.4	3.549049
			151 49 06.5	331 48 49.6	Mangrove	2066.5	3.315245
Centennial	28 11 04.508	138.8	97 39 51.3	277 39 04.3	Keno	2741.0	3.437897
1876	80 37 32.836	895.6	135 19 30.0	315 18 22.5	Plover	5542.7	3.743721
Bluff	28 10 12.735	392.0	156 32 33.2	336 52 18.5	Keno	2135.5	3.329491
1876	80 38 41.263	1125.6	193 11 27.5	13 11 41.4	Cove	3499.3	3.543986
			229 30 15.5	49 30 47.8	Centennial	2454.4	3.389940
Banana	28 32 56.301	1733.2	118 35 50.4	298 33 45.6	Otter	8074.1	3.907093
1876–1906	80 36 41.653	1132.2	180 57 11.7	0 57 14.2	Wild Cat	8573.5	3.933156
De Soto	28 34 03.513	108.1	60 01 34.5	240 00 31.4	Banana	4140.3	3.617036
1876	80 34 29.714	807.6	99 33 45.8	297 30 37.8	Otter	10825.1	4.034424
			152 06 54.8	332 05 54.2	Wild Cat	7358.1	3.866763
Burnham	28 29 51.861	1596.5	130 54 12.5	310 52 17.3	Banana	8674.2	3.938228
1875–1906	80 32 40.475	1100.7	159 01 55.5	339 01 03.3	De Soto	8296.8	3.918908
Moccasin	28 28 22.111	680.7	202 27 26.2	22 28 27.5	Banana	9134.0	3.960659
1877–1906	80 38 50.006	1360.4	213 56 24.7	33 58 28.9	De Soto	12670.8	4.102805
			254 36 20.7	74 39 17.0	Burnham	10424.0	4.018036
Wesson	28 25 39.993	1231.2	126 47 33.0	306 45 36.1	Moccasin	8335.9	3.920955
1877	80 34 44.611	1214.0	203 31 42.2	23 32 41.4	Burnham	8457.1	3.927222
Scrub	28 24 17.942	552.3	192 03 12.0	12 03 40.1	Moccasin	7686.0	3.885703
1877–1906	80 39 49.007	1334.0	253 01 30.6	73 03 54.9	Wesson	8661.4	3.937588
Stone	28 21 15.675	482.5	134 54 13.8	314 52 35.5	Scrub	7950.2	3.900378
1876	80 36 22.137	602.9	198 03 56.6	18 04 43.0	Wesson	8558.9	3.932419
			213 13 32.3	33 15 47.1	Cape Canaveral L.H.	14059.8	4.147980
Crane	28 21 19.592	603.1	177 59 15.2	357 59 11.8	Scrub	5493.6	3.739859
1876	80 39 41.919	1141.6	228 26 56.0	48 30 45.9	Cape Canaveral L.H.	17557.3	4.244457
			271 15 24.5	91 16 59.4	Stone	5442.0	3.735762
Georges Island	28 17 35.853	1103.7	174 50 29.3	354 50 18.5	Crane	6915.5	3.839823
1876	80 39 19.086	520.1	215 27 08.3	35 28 32.3	Stone	8308.2	3.919505
Sea Bean	28 16 24.252	746.6	114 34 27.6	294 33 03.7	Georges Island	5302.3	3.724467
1876	80 36 22.123	603.0	149 06 15.1	329 04 40.3	Crane	10596 4	4.025160
			179 59 51.7	359 59 51.7	Stone	8970.9	3.952838
			200 23 01.3	20 25 16.0	Cape Canaveral L.H. (old)	22117.2	4.344729
Buck	28 20 29.488	807.8	235 01 14.0	55 01 52.4	Crane	2690.8	3.429880
1876	80 41 02.876	78.3	332 06 53.0	152 07 42.2	Georges Island	6046.9	3.781532
			84 36 32.4	264 35 60.5	Cleveland	1840.7	3.264989
Prairie	28 21 43.320	1333.6	285 38 56.7	105 39 42.2	Crane	2706.8	3.432461
1876	80 41 17.630	480.1	349 58 25.7	169 58 32.7	Buck	2308.1	3.363246
			30 19 36.4	210 19 11.5	Cleveland	2833.6	3.452331
			76 06 22.5	256 05 49.5	Gopher	1949.4	3.289904
Alligator	28 14 19.270	593.2	177 45 17.8	357 45 13.7	Georges Island	6056.1	3.782192
1876–1906	80 39 10.379	282.9	229 59 50.2	50 01 09.9	Sea Bean	5986.4	3.777167
			336 04 05.5	156 04 51.6	Centennial	6558.9	3.816833
Porpoise	28 11 49.161	1513.4	65 46 33.4	245 45 40.5	Centennial	3349.1	3.524924
1876–1906	80 35 40.866	1114.5	128 58 49.6	308 57 10.5	Alligator	7347.8	3.866159
			150 52 41.7	330 50 58.4	Georges Island	12240.8	4.087810
			172 26 12.0	352 25 52.5	Sea Bean	8542.5	3.931586
			192 42 04.6	12 43 59.6	Cape Canaveral L.H. (old)	29932.2	4.476138
Beach	28 08 42.766	1316.5	135 18 50.9	315 17 36.2	Centennial	6138.1	3.788032
1876	80 34 54.590	1489.5	167 35 41.3	347 35 19.5	Porpoise	5875.0	3.769007
			188 39 41.8	8 41 14.9	Cape Canaveral L.H. (old)	35339.9	4.548265
College	28 07 55.984	1723.4	156 12 37.7	336 12 05.6	Bluff	4600.6	3.662817
1876 1906	80 37 33.235	907.0	180 06 27.1	0 06 27.3	Centennial	5803.3	3.763674
			251 35 25.1	71 36 39.9	Beach	4562.4	3.659191

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
King	28 05 49.115	1512.0	124 22 44.3	304 21 05.7	College	6918.6	3.840021
1877	80 34 03.996	109.1	165 31 08.7	345 30 44.8	Beach	5520.9	3.742008
Peter Wright	28 04 51.954	1599.4	157 45 05.3	337 44 25.3	College	6120.8	3.786810
1877–1906	80 36 08.314	227.0	195 48 29.9	15 49 04.6	Beach	7384.4	3.868317
			242 35 16.3	62 36 14.8	King	3823.0	3.582401
Turkey Creek	28 02 24.568	756.3	154 19 54.8	334 19 17.2	Peter Wright	5033.8	3.701897
1877–1906	80 34 48.453	1323.5	190 54 34.6	10 54 55.5	King	6412.4	3.807020
Dante	28 03 13.620	419.3	62 42 24.2	242 41 33.8	Turkey Creek	3292.1	3.517473
1878	80 33 01.340	36.6	120 40 28.9	300 39 00.9	Peter Wright	5935.4	3.773451
			160 20 10.3	340 19 40.8	King	5083.1	3.706125
Hawthorne	28 00 41.754	1285.4	122 50 12.7	302 48 48.3	Turkey Creek	5838.3	3.766287
1878	80 31 48.852	1334.5	157 02 58.4	337 02 24.4	Dante	5076.8	3.705588
Malabar	27 59 53.161	1636.3	156 46 22.1	336 45 47.7	Turkey Creek	5071.9	3.705167
1878	80 33 35.219	962.3	188 31 39.6	8 31 55.6	Dante	6239.6	3.795154
			242 45 29.3	62 46 19.2	Hawthorne	3268.5	3.514351
Killer	27 58 58.993	1815.8	111 10 22.5	291 09 08.5	Malabar	4618.6	3.664510
1878	80 30 57.597	1574.0	156 07 20.3	336 06 56.3	Hawthorne	3459.4	3.538996
Rock	27 58 17.506	538.8	152 42 17.7	332 41 51.6	Malabar	3313.5	3.520284
1878–1906	80 32 39.609	1082.6	197 20 36.2	17 21 00.0	Hawthorne	4651.8	3.667624
			245 22 55.3	65 23 43.2	Killer	3066.5	3.486637
Opera	27 56 56.927	1752.2	118 31 12.7	298 29 54.4	Rock	5196.6	3.715720
1879	80 29 52.543	1436.3	154 40 48.8	334 40 18.3	Killer	4156.9	3.618766
Trout	27 56 08.387	258.2	158 32 18.8	338 31 52.0	Rock	4270.7	3.630499
1879	80 31 42.437	1160.2	193 08 02.0	13 08 23.0	Killer	5392.7	3.731804
			243 32 59.3	63 33 50.8	Opera	3355.3	3.525731
Smith	27 54 36.462	1122.3	155 08 08.9	335 07 46.4	Trout	3118.8	3.493982
1879	80 30 54.472	1489.6	201 22 53.3	21 23 22.3	Opera	4643.5	3.666841
Shell	27 54 48.594	1495.7	83 58 43.7	263 57 43.2	Smith	3555.0	3.550843
1879	80 28 45.187	1235.6	116 53 15.0	296 51 51.9	Trout	5433.3	3.735063
			155 00 37.4	335 00 05.8	Opera	4358.5	3.639335
White	27 52 08.656	266.4	155 53 15.0	335 52 40.2	Smith	4984.8	3.697649
1879	80 29 40.002	1094.3	196 56 00.5	16 56 26.2	Shell	5146.3	3.711498
Brig	27 53 10.370	319.2	59 34 22.5	239 33 27.2	White	3750.1	3.574040
1879–1906	80 27 41.799	1143.3	116 42 39.8	296 41 09.6	Smith	5898.2	3.770723
			150 10 32.4	330 10 02.7	Shell	3485.2	3.542229
White 2	27 52 08.604	264.8	196 58 33.8	16 58 59.5	Shell	5149.2	3.711740
1880	80 29 40.167	1098.9	239 34 15.2	59 35 10.5	Brig	3754.8	3.574584
Wind 2	27 50 17.279	531.8	120 38 18.7	300 36 39.9	White 2	6726.8	3.827807
1880	80 26 08.598	235.3	154 25 54.9	334 25 11.4	Brig	5906.7	3.771342
Parks	27 48 56.788	1747.9	155 45 10.3	335 44 24.9	White 2	6475.9	3.811302
1880	80 28 02.950	80.7	184 14 19.4	4 14 29.3	Brig	7827.0	3.893597
			231 37 24.1	51 38 17.5	Wind 2	3991.5	3.601135
White 3	27 52 07.154	220.2	238 52 02.7	58 52 57.8	Brig	3764.5	3.575703
1906	80 29 39.607	1083.5	300 20 56.8	120 22 35.4	Wind 2	6691.0	3.825488
Smith 2	27 54 35.213	1083.8	296 23 01.5	116 24 31.5	Brig	5874.3	3.768956
1906	80 30 54.196	1482.1	335 52 48.2	155 53 23.1	White 3	4993.2	3.698381
Check	27 54 48.732	1499.9	330 07 32.0	150 08 01.6	Brig	3491.6	3.543019
1906	80 28 45.383	1241.0	16 36 26.9	196 36 01.5	White 3	5190.0	3.715168
			83 16 14.3	263 15 14.0	Smith 2	3546.9	3.549855
Fustic	27 47 25.304	778.8	116 48 10.5	296 46 35.5	Parks	6247.8	3.795726
1881	80 24 39.200	1073.1	155 11 54.5	335 11 12.8	Wind 2	5831.7	3.765798
Duck Point	27 46 46.162	1420.8	149 31 15.0	329 30 34.7	Parks	4665.8	3.668927
1881–1906	80 26 36.481	998.7	186 41 47.3	6 42 00.3	Wind 2	6543.1	3.815784
			249 25 27.0	69 26 21.7	Fustic	3429.4	3.535224
Two Dollar Bluff	27 45 12.532	385.7	155 15 21.6	335 14 59.0	Duck Point	3173.5	3.501533
1881	80 25 47.965	1313.6	204 43 52.3	24 44 24.3	Fustic	4499.7	3.653185

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Gale	27 44 41.675	1264.3	102 45 01.7	282 43 48.9	Two Dollar Bluff	4390.6	3.642523
1881	80 23 11.591	317.5	124 28 25.5	304 26 50.1	Duck Point	6804.6	3.832801
			154 37 09.9	334 36 29.1	Fustic	5595.4	3.747834
Hole in the Wall	27 43 45.454	1399.1	150 36 51.0	330 36 25.3	Two Dollar Bluff	3076.2	3.488020
1881–1906	80 24 52.845	1447.4	152 58 29.4	332 57 41.1	Duck Point	6244.6	3.795502
			183 09 34.0	3 09 40.3	Fustic	6777.5	3.831070
			238 18 15.6	58 19 02.7	Gale	3259.3	3.513106
Squall	27 42 18.947	583.2	122 41 55.3	302 40 44.9	Hole in the Wall	4930.3	3.692874
1881	80 22 21.374	585.6	162 32 55.1	342 32 31.8	Gale	4586.0	3.661432
Narrows	27 41 43.273	1331.9	152 11 34.9	332 11 01.2	Hole in the Wall	4252.0	3.628590
1881–1906	80 23 40.430	1107.8	188 12 43.0	8 12 56.4	Gale	5529.6	3.742694
			243 06 43.8	63 07 20.5	Squall	2428.4	3.385329
Eggs	27 40 29.383	904.4	125 37 30.5	305 36 36.7	Narrows	3905.4	3.591663
1881–1906	80 21 44.572	1221.4	163 21 18.1	343 21 01.0	Squall	3520.0	3.546542
May	27 40 01.599	49.2	160 11 54.2	340 11 35.1	Narrows	3326.3	3.521965
1881–1907	80 22 59.304	1625.3	193 48 34.7	13 48 52.3	Squall	4353.5	3.638843
			247 19 53.5	67 20 28.2	Eggs	2219.5	3.346248
Bight	27 38 09.954	306.4	138 53 29.0	318 52 38.2	May	4561.4	3.659096
1882–1906	80 21 09.876	270.7	167 30 28.2	347 30 12.1	Eggs	4395.8	3.643036
Scorpion	27 37 56.729	1746.1	168 24 37.1	348 24 23.7	May	3923.6	3.593680
1882–1907	80 22 30.543	837.3	195 00 31.7	15 00 53.1	Eggs	4864.8	3.687062
			259 33 54.3	79 34 31.7	Bight	2248.6	3.351916
Crawford 2	27 35 37.433	1152.2	166 14 51.8	346 14 34.0	Scorpion	4414.2	3.644848
1882	80 21 52.266	1433.2	193 54 11.9	13 54 31.5	Bight	4836.4	3.684521
Point	27 36 03.773	116.1	74 48 39.8	254 47 49.4	Crawford 2	3093.1	3.490387
1882	80 20 03.424	93.9	130 46 03.7	310 44 55.4	Scorpion	5325.5	3.726357
			154 52 18.3	334 51 47.5	Bight	4290.0	3.632461
Palmetto	27 33 23.489	723.0	168 42 16.8	348 42 02.9	Crawford 2	4204.3	3.623690
1860–1906	80 21 22.240	610.2	203 39 26.5	23 40 03.0	Point	5386.4	3.731299
Lost Base	27 32 56.120	1727.4	103 23 05.8	283 22 06.1	Palmetto	3641.2	3.561246
1882	80 19 13.120	360.0	138 41 16.4	318 40 09.7	Crawford 2	6611.4	3.820294
			166 34 03.4	346 33 40.1	Point	5938.5	3.773676
Ridge 2	27 30 01.039	32.0	170 59 51.3	350 59 34.6	Palmetto	6309.1	3.799970
1882	80 20 46.254	1269.2	205 22 02.8	25 22 45.8	Lost Base	5964.3	3.775562
Inlet 2	27 30 20.047	617.0	81 44 40.6	261 43 32.9	Ridge 2	4070.0	3.609596
1882	80 18 19.511	535.6	138 24 18.8	318 22 54.4	Palmetto	7551.3	3.878024
			162 58 38.0	342 58 13.2	Lost Base	5024.1	3.701060
Bell	27 27 57.385	1766.3	155 17 43.2	335 17 13.8	Ridge 2	4189.6	3.622172
1882–1906	80 19 42.461	1165.8	207 24 18.5	27 24 56.8	Inlet 2	4946.4	3.694289
Robinson	27 27 25.563	786.8	103 10 57.4	283 09 47.1	Bell	4298.0	3.633264
1882	80 17 10.050	276.0	128 53 27.1	308 51 47.4	Ridge 2	7624.5	3.882209
			160 27 21.5	340 26 49.5	Inlet 2	5699.0	3.755802
Cole	27 25 24.533	755.1	164 20 03.1	344 19 40.9	Bell	4886.3	3.688979
1882	80 18 54.407	1494.5	217 33 56.6	37 34 44.5	Robinson	4700.1	3.672109
Brayton	27 25 44.733	1376.9	80 55 02.0	260 53 56.9	Cole	3934.6	3.594905
1882	80 16 32.955	905.1	161 49 47.2	341 49 30.1	Robinson	3266.4	3.514072
Spruce Ridge	27 15 09.708	298.8	156 58 15.7	336 56 01.2	Cole	20565.3	4.313134
1883	80 14 01.511	41.6	167 59 10.8	347 58 01.2	Brayton	19983.8	4.300679
Richards	27 18 31.140	958.5	12 00 51.4	192 00 29.4	Spruce Ridge	6338.6	3.801993
1882	80 13 13.549	372.5	157 41 21.4	337 39 49.7	Brayton	14426.8	4.159171
Refuge	27 11 58.953	1814.6	131 04 41.7	311 02 49.7	Spruce Ridge	8937.9	3.951236
1882–1906	80 09 56.595	1557.6	155 50 23.2	335 48 53.0	Richards	13231.2	4.121598
Pisgah	27 13 04.106	126.4	158 40 48.7	338 40 23.6	Spruce Ridge	4150.0	3.618043
1883	80 13 06.664	183.4	178 55 21.3	358 55 18.2	Richards	10067.4	4.002919
			290 57 47.8	110 59 14.7	Refuge	5602.0	3.748340

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Ten 2	27 04 55.968	1722.7	147 28 15.0	327 25 36.0	Pisgah	17824.0	4.251004
1883	80 07 18.366	506.0	161 30 20.1	341 29 07.9	Refuge	13728.5	4.137622
Jupiter Inlet L. H.	26 56 54.498	1677.4	165 11 28.3	345 10 23.7	Ten 2	15328.2	4.185491
1883	80 04 56.166	1549.3					
Thomas	27 02 19.616	603.8	348 28 13.7	168 28 47.3	Jupiter Inlet L. H.	10212.2	4.009120
1883–1906	80 06 10.163	280.1	158 40 14.1	338 39 43.1	Ten 2	5166.2	3.713167
Rifle	27 03 08.223	253.1	197 54 39.4	17 54 57.1	Ten 2	3485.1	3.542215
1883–1906	80 07 57.268	1578.3	296 52 09.3	116 52 58.0	Thomas	3309.3	3.519735
			336 31 21.4	156 32 43.6	Jupiter Inlet L. H.	12539.3	4.098275
Supplementary points.							
River	28 41 13.860	426.7	275 21 14.7	95 22 22.2	Black Point	3836.5	3.583940
1875	80 49 38.727	1051.4	344 36 28.2	164 37 05.4	Sand Point	7938.6	3.899746
Hood	28 43 55.353	1704.0	253 11 27.5	73 13 39.0	Campbell	7761.4	3.889942
1875–1906	80 50 21.964	596.0	316 51 41.3	136 53 09.6	Black Point	7303.2	3.863511
			346 42 55.8	166 43 16.6	River	5108.2	3.708269
Watton	28 45 24.581	756.7	2 33 45.7	182 33 39.3	Black Point	8085.2	3.907691
1875	80 47 04.713	127.9	62 50 39.0	242 49 04.2	Hood	6015.8	3.779296
Watton's house [1]	28 45 04.96	152.7	71 59 13	251 57 16	Hood	6923.9	3.840349
1906	80 46 19.32	524.2	116 07 38	296 07 16	Watton	1371.7	3.137250
Beacon [1]	28 43 33.79	1040.2	95 15 12	275 13 04	Hood	7275.7	3.861877
1906	80 45 54.97	1491.8	150 59 01	330 58 28	Watton	3900.6	3.591132
Brace's (J. H.) house, flag [1]	28 44 08.31	255.8	228 12 17	48 13 02	Scorpion	3416.0	3.533515
1906	80 45 18.90	512.8	269 26 49	89 26 59	Mosquito Lagoon SE. base	568.7	2.754883
Channel Beacon	28 41 39.846	1226.6	140 18 15.0	320 17 13.7	Hood	5422.3	3.734181
1906	80 48 14.340	389.2	195 16 15.8	15 16 49.2	Watton	7171.9	3.855637
			307 09 13.7	127 09 40.7	Black Point	1918.1	3.282879
Stump	28 35 26.217	807.1	4 21 17.0	184 21 08.0	Moore	6759.5	3.829917
1906	80 43 28.585	776.8	41 27 29.4	221 25 51.6	Addison Point	8396.4	3.924095
Titusville:							
Indian River Hotel flag	28 36 40.203	1237.7	285 51 35.6	105 53 56.7	Stump	8324.3	3.920348
1906	80 48 23.269	632.2	320 14 48.7	140 17 00.7	Moore	11726.3	4.069162
			344 01 54.0	164 02 37.2	Addison Point	8915.3	3.950138
Presbyterian Church spire	28 36 36.093	1111.1	284 38 37.0	104 41 01.8	Stump	8497.7	3.929300
	80 48 31.153	846.4	319 03 00.7	139 05 16.5	Moore	11768.6	4.070725
1906			342 28 22.8	162 29 09.7	Addison Point	8855.9	3.947233
Methodist Church spire [1]	28 36 44.30	1363.8	286 27 32	106 29 55	Stump	8473.7	3.928072
1906	80 48 27.65	751.3	343 31 38	163 32 24	Addison Point	9069.6	3.957587
Catholic Church spire [1]	28 36 51.56	1587.3	287 45 41	107 48 05	Stump	8603.7	3.934683
1906	80 48 30.12	818.3	320 37 38	140 39 53	Moore	12114.5	4.083306
Lorillard's repair shop, E. gable	28 36 45.249	1393.0	287 39 27.2	107 41 41.7	Stump	8012.8	3.903782
	80 48 09.573	260.1	322 09 01.2	142 11 06.6	Moore	11614.2	4.064990
1906			346 35 30.9	166 36 07.5	Addison Point	8971.3	3.952854
Titusville latitude station	28 36 39.40	1212.9	236 36 56	56 36 57	Indian River Ho.	44.8	1.65125
1906	80 48 24.65	669.7					
Red Beacon, No. 2 [1]	28 37 03.00	92.4	292 01 13	112 03 22	Stump	7940.0	3.899821
1906	80 47 59.47	1615.6	348 58 52	168 59 24	Addison Point	9447.3	3.975306
Channel Beacon (off Addison Point)	28 32 06.606	203.4	216 55 20.5	36 56 41.8	Stump	7687.6	3.885788
	80 46 18.540	504.1	278 14 03.2	98 15 15.4	Moore	4150.3	3.618084
1906			80 58 40.5	260 58 23.9	Addison Point	950.2	2.977802
Oleander Point 2	28 21 02.312	71.2	319 27 31.4	139 28 27.9	Hill	4980.9	3.697308
1906	80 43 20.947	570.5	339 18 33.1	159 18 53.2	Coquina	3259.5	3.513148
			343 28 17.3	163 28 26.3	Indian River Hotel, flag (Rock Ledge)	1811.1	3.257948

[1] No check on this position.

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Gopher 2	28 21 34.307	1056.1	339 09 19.2	159 09 50.9	Hill	5104.5	3.707952
1906	80 42 28.780	783.7	3 49 16.8	183 49 12.1	Coquina	4043.2	3.606725
			18 24 33.4	198 24 17.6	Indian River House, flag (Rockledge)	2867.9	3.457571
			55 16 15.6	235 15 50.8	Oleander Point 2	1728.7	3.237721
Channel Beacon, red, No. 8 (Rock Ledge)	28 22 59.354	1827.2	319 19 56.5	139 20 35.7	Gopher 2	3451.3	3.537984
1906	80 43 51.370	1398.6	343 25 15.6	163 25 50.0	Coquina	6940.6	3.841399
			347 02 56.4	167 03 10.8	Oleander Point 2	3697.0	3.567847
Indianola, wharf house, W. gable [1]	28 23 42.71	1314.8	351 35 54	171 36 14	Coquina	8073.4	3.907056
1906	80 43 21.97	598.1	359 40 32	179 40 32	Oleander Point 2	4937.6	3.693515
Crawford's white house, Indianola	28 23 17.358	534.3	334 45 45.6	154 46 11.7	Gopher 2	3506.9	3.544928
1906	80 43 23.688	644.9	350 20 33.5	170 20 54.9	Coquina	7310.0	3.863919
			358 58 17.8	178 58 19.1	Oleander Point 2	4157.9	3.618872
Lapham's white flag	28 22 58.354	1796.4	333 03 47.1	153 04 10.0	Gopher 2	2902.1	3.462707
1906	80 43 17.056	464.4	351 01 33.8	171 01 51.9	Coquina	6703.5	3.826302
			1 41 57.4	181 41 55.5	Oleander Point 2	3573.8	3.553127
Merritts Episcopal Church spire	28 22 02.81	86.5	359 37 39	179 37 39	Coquina	4911.8	3.691236
1906	80 42 39.84	1084.8	31 00 37	211 00 17	Oleander Point 2	2172.8	3.337028
Dardonville's flag	28 21 36.193	1114.2	353 42 45.8	173 42 45.9	Gopher 2	58.4	1.766432
1906	80 42 29.014	790.1	3 40 41.1	183 40 36.5	Coquina	4100.7	3.612860
			53 35 46.9	233 35 22.2	Oleander Point 2	1757.3	3.244840
Cocoa:							
Taylor's windmill	28 21 15.488	476.8	251 03 13.2	71 03 42.6	Gopher 2	1784.6	3.251545
1906	80 43 30.763	837.8	326 36 43.2	146 36 47.8	Oleander Point 2	485.8	2.686436
			337 40 11.6	157 40 36.3	Coquina	3734.9	3.572278
Ronald & Fiske store, E. gable	28 21 18.674	574.9	254 12 08.1	74 12 37.8	Gopher 2	1768.2	3.247524
1906	80 43 31.257	851.2	320 38 06.5	140 39 07.8	Hill	5547.3	3.744084
			330 51 42.4	150 51 47.3	Oleander Point 2	576.6	2.760909
Episcopal Church spire [1]	28 21 12.07	371.6	247 35 19	67 35 48	Gopher 2	1795.6	3.254218
1906	80 43 29.74	809.9	319 36 01	139 37 02	Hill	5364.8	3.729556
Rock Ledge:							
Indian River Hotel flag	28 20 05.909	181.9	306 58 07.3	126 58 54.7	Hill	3407.2	3.532396
1906	80 43 02.031	55.3	334 08 33.6	154 08 44.7	Coquina	1459.1	3.164075
Plaza Hotel, cupola	28 20 11.589	356.7	163 55 44.3	343 55 36.5	Oleander Point 2	1625.0	3.210842
1906	80 43 04.430	120.7	200 52 10.8	20 52 27.7	Gopher 2	2725.2	3.435398
			308 34 54.2	128 35 42.8	Hill	3566.0	3.552178
			334 45 00.7	154 45 12.9	Coquina	1645.0	3.216167
Indian River Hotel, chimney [1]	28 20 04.35	133.9	199 17 26	19 17 43	Gopher 2	2934.0	3.467456
1906	80 43 04.37	119.0	305 41 13	125 42 02	Hill	3430.1	3.535311
New Rock Ledge, house cupola [1]	28 20 02.10	64.6	196 45 21	16 45 36	Gopher 2	2964.2	3.471908
1906	80 43 00.16	4.4	333 55 04	153 55 14	Coquina	1331.5	3.124331
Channel Beacon, off Rock Ledge	28 20 15.166	466.9	319 41 51.5	139 42 26.0	Hill	3060.6	3.485802
1906	80 42 34.773	947.1	3 48 06.9	183 48 05.0	Coquina	1601.5	3.204524
			139 05 37.7	319 05 15.8	Oleander Point 2	1920.4	3.283391
			183 49 57.9	3 50 00.8	Gopher 2	2441.7	3.387696
Day's windmill [1]	28 18 55.95	1722.3	169 36 17	349 36 14	Coquina	854.6	2.931779
1906	80 42 33.01	899.3	266 54 18	86 54 52	Hill	1934.4	3.286556
Day's boathouse flag [1]	28 18 56.83	1749.4	161 19 44	341 19 40	Coquina	858.8	2.933877
1906	80 42 28.58	778.6	267 33 10	87 33 42	Hill	1812.6	3.258290
Georgiana wharf flag [1]	28 17 22.68	698.2	46 35 06	226 34 48	Stewart 2	1440.9	3.158639
1906	80 40 47.40	1291.7	158 31 57	338 31 55	Georgiana	343.9	2.536445
Stewart 2	28 16 50.512	1554.9	157 06 53.5	337 06 18.9	Coquina	5103.9	3.707903
1906	80 41 25.810	703.3	181 27 25.8	1 27 27.5	Hill	3967.0	3.598458
			215 05 29.1	35 05 45.1	Georgiana	1601.5	3.204539

[1] No check on this position.

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Beacon off Cape Cod 1906	28 15 10.049 80 40 09.946	309.3 271.1	146 14 17.3 164 26 12.0 165 24 17.1	326 13 41.4 344 25 37.8 345 23 57.2	Stewart 2 Hill Georgiana	3721.0 7327.1 4549.9	3.570561 3.864931 3.657999
Hancock's boathouse [1] 1906	28 13 52.53 80 39 14.56	1617.0 397.0	334 35 28 359 18 28	154 35 40 179 18 29	Mangrove Keno	1702.1 4807.4	3.230992 3.681911
Cape Canaveral lighthouse (old) 1877	28 27 37.656 80 31 38.971	1159.2 1060.4	54 22 09.5 65 16 54.2 96 41 07.1 122 44 18.3 131 46 39.5 140 01 07.3 145 11 28.1 153 54 59.6 156 16 34.1 158 39 44.6 157 57 32.7 20 25 16.0 33 15 47.1	234 20 41.1 245 13 00.9 276 37 41.6 302 36 19.0 311 42 10.2 319 58 43.1 325 05 52.0 333 51 28.8 336 14 12.2 338 38 23.3 337 57 03.5 200 23 01.3 213 13 32.3	Wesson Scrub Moccasin Sand Point Otter Banana Dummitt Panther Wild Cat De Soto Burnham Sea Bean Stone	6215.8 14684.5 11805.7 32366.7 20535.8 12805.4 33398.1 27218.6 20081.4 12753.5 4457.3 22117.2 14059.8	3.793494 4.166858 4.072093 4.510098 4.312512 4.107393 4.523722 4.434865 4.302793 4.105630 3.649069 4.344729 4.147980
Cape Canaveral lighthouse (new) 1906	28 27 36.764 80 32 37.102	1131.8 1009.4	62 31 15.6 97 51 34.8 145 57 14.1	242 27 49.9 277 48 37.0 325 55 17.4	Scrub Moccasin Banana	13251.7 10240.4 11874.0	4.122273 4.010315 4.074596
Lou 1876–1906	28 10 39.334 80 37 28.529	1210.9 778.2	1 27 46.9 67 34 51.1 111 55 21.6 139 35 49.8 155 23 56.9	181 27 44.7 247 34 16.8 291 54 32.6 319 34 40.3 335 23 36.5	College Bluff Keno Plover Cove	5030.0 2146.4 3054.8 6193.6 2846.7	3.701566 3.331710 3.484982 3.791940 3.454338
Merrill's (C.) boathouse cupola 1906	28 10 17.436 80 37 16.742	536.7 456.7	119 54 12.0 153 58 35.6 5 48 36.5 154 29 58.4	299 53 17.4 333 57 52.4 185 48 28.7 334 29 52.8	Keno Mangrove College 2 Lou	3640.0 5657.7 4393.3 746.8	3.561101 3.752639 3.642789 2.873222
College 2 1906	28 07 55.450 80 37 33.040	1706.9 901.6	156 19 59.3 181 23 49.2	336 19 12.4 1 23 51.3	Keno Lou	6753.3 5046.3	3.829514 3.702972
Channel Beacon, red, No. 12 (Eau Gallie) 1906	28 09 10.604 80 37 58.098	326.4 1585.3	152 21 41.4 196 27 07.0 343 31 56.9	332 21 06.3 16 27 20.9 163 32 08.6	Keno Lou College 2	4370.4 2848.0 2412.4	3.640522 3.454538 3.382444
Houstons Hill 1876–1906	28 08 30.871 80 36 01.272	950.3 34.7	152 09 47 258 37 05	332 09 04 78 37 37	Centennial Beach	5348.6 1856.0	3.72824 3.26858
Horton's wharf house, W. gable [1] 1906	28 05 41.10 80 34 52.87	1265.0 1443.3	358 51 28 53 42 38	178 51 30 233 42 02	Turkey Creek Peter Wright	6050.8 2555.5	3.781811 3.407482
Cistern 1906	28 03 13.796 80 33 01.689	424.7 46.1	62 32 47.9 120 40 36.3	242 31 57.7 300 39 08.5	Turkey Creek Peter Wright	3286.1 5924.4	3.516682 3.772648
Carleton Hotel, water tower [1] 1906	28 04 50.08 80 36 08.97	1541.7 244.9	300 05 00 333 50 57	120 06 28 153 51 35	Cistern Turkey Creek	5910.8 4989.9	3.771648 3.698088
Carleton Hotel flag [1] 1906	28 04 50.01 80 36 08.58	1539.3 234.3	300 06 55 333 56 49	120 08 23 153 57 27	Cistern Turkey Creek	5900.4 4983.1	3.770884 3.697496
Melbourne, house on wharf, E. gable [1] 1906	28 04 54.74 80 35 52.08	1684.9 1422.0	339 23 45 79 04 03	159 24 15 259 03 55	Turkey Creek Peter Wright	4938.2 451.5	3.693573 2.654622
Melbourne Beach, house on wharf, W. gable [1] 1906	28 04 06.06 80 34 04.88	186.4 133.1	20 51 25 112 45 05	200 51 05 292 44 07	Turkey Creek Peter Wright	3343.0 3654.6	3.524135 3.562836
Melbourne Beach, Whiting's house, chimney [1] 1906	28 04 06.67 80 33 56.08	205.3 1531.4	24 28 14 111 07 09	204 27 50 291 06 07	Turkey Creek Peter Wright	3453.0 3870.2	3.538200 3.587731
Beacon B (7) [1] 1906	28 04 38.08 80 34 59.27	1172.3 1618.3	355 53 20 102 46 00	175 53 25 282 45 27	Turkey Creek Peter Wright	4120.5 1932.9	3.614948 3.286215
Bojeir's house, chimney [1] 1906	28 04 27.87 80 34 08.79	857.9 240.0	15 55 48 102 48 23	195 55 30 282 47 27	Turkey Creek Peter Wright	3947.0 3346.6	3.596271 3.524603

[1] No check on this position.

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
White house, S. gable	28 04 07.932	244.2	327 43 15.7	147 43 33.8	Cistern	1971.0	3.294680
1906	80 33 40.232	1098.5	30 21 20.6	210 20 48.5	Turkey Creek	3687.1	3.566684
			108 32 18.0	288 31 08.3	Peter Wright	4264.3	3.629851
Turner's house	28 03 05.778	177.9	61 09 42.1	241 09 02.5	Turkey Creek	2629.5	3.419878
1906	80 33 24.119	658.6	126 06 03.0	306 04 45.8	Peter Wright	5548.4	3.744167
			248 03 16.5	68 03 27.1	Cistern	660.4	2.819798
Beacon R (16)	27 54 13.520	416.2	294 06 37.9	114 07 52.2	Brig	4756.6	3.677296
1906	80 30 20.531	561.5	343 56 35.0	163 56 54.1	White 3	4047.6	3.607194
			125 57 21.6	305 57 05.9	Smith 2	1137.3	3.055866
Beacon 9¼	27 54 10.758	331.1	291 15 56.0	111 17 17.7	Brig	5122.5	3.709484
1906	80 30 36.329	993.6	337 48 43.5	157 49 10.0	White 3	4108.9	3.613723
			147 00 48.1	327 00 39.8	Smith 2	897.4	2.952990
Wreck	27 54 02.456	75.6	290 40 05.2	110 41 17.9	Brig	4540.4	3.657093
1906	80 30 17.114	468.1	343 52 30.9	163 52 48.4	White 3	3694.5	3.567552
			134 50 18.1	314 50 00.7	Smith 2	1430.0	3.155340
House, brick chimney [1]	27 55 18.629	573.4	2 00 55	182 00 51	White 3	5897.5	3.770669
1906	80 29 32.027	875.8	59 15 42	239 15 03	Smith 2	2614.3	3.417353
Gibson Cut (U. S. E.)	27 51 38.510	1185.2	334 52 13.3	154 52 33.3	Wind 2	2761.7	3.441181
1906	80 26 51.458	1407.9	24 50 15.1	204 49 36.9	Sebastian 2	5325.1	3.726324
			154 02 11.4	334 01 47.8	Brig	3145.1	3.497633
Sebastian 2	27 49 01.508	46.4	186 23 38.4	6 23 53.1	Brig	7708.3	3.886957
1900	80 28 13.184	360.9	235 37 01.6	55 37 59.8	Wind 2	4130.9	3.616044
Sebastian longitude station	27 49 01.43	44.0			Sebastian 2	2.95	0.4698
1907	80 28 13.25	362.6					
House of Refuge No. 1 (Bethel Creek) N. gable	27 39 55.816	1718.0	94 20 45	274 20 05	May	2352.1	3.37145
1880	80 21 33.730	924.5	163 57 23	343 57 18	Eggs	1075.1	3.03144
Payne 2	27 29 25.785	793.6	12 33 49.9	192 33 39.7	Bell	2787.6	3.445236
1882	80 19 20.376	559.3	114 43 22.9	294 42 43.3	Ridge 2	2595.1	3.414149
Russell	27 29 18.756	577.3	260 33 30.9	80 33 52.8	Payne 2	1319.4	3.120374
1906	80 20 07.789	213.8	344 28 54.3	164 29 06.0	Bell	2599.3	3.414851
Pierce	27 27 56.089	1726.4	90 56 13.9	270 55 32.7	Bell	2455.6	3.390166
1906	80 18 13.036	357.9	128 56 00.8	308 55 07.9	Russell	4049.6	3.607414
Iron pipe in water [1]	27 29 52.59	1618.7	324 45 53	144 46 03	Payne 2	1010.1	3.004345
1906	80 19 41.60	1142.0	34 36 55	214 36 43	Russell	1265.3	3.102208
St. Lucies Club, boathouse gable	27 29 03.295	101.4	345 19 48.2	165 19 57.0	Bell	2097.0	3.321602
1906	80 20 01.803	49.5	160 57 00.3	340 56 57.5	Russell	503.4	2.701954
			238 40 06.0	58 40 25.1	Payne 2	1331.4	3.124293
			304 42 16.3	124 43 06.4	Pierce	3632.7	3.560224
Quay's boathouse, front gable	27 29 00.320	9.8	345 39 46.3	165 39 54.6	Bell	1999.3	3.300888
1906	80 20 00.493	13.5	160 33 31.7	340 33 28.3	Russell	601.8	2.779423
			234 33 24.1	54 33 42.6	Payne 2	1351.7	3.130888
			303 49 13.2	123 50 02.7	Pierce	3551.4	3.550394
Channel Beacon (near Fort Pierce)	27 27 51.581	1587.7	106 14 29.2	286 14 18.9	Bell	638.9	2.805436
1906	80 19 20.120	552.4	154 00 10.1	333 59 48.1	Russell	2985.4	3.474995
			179 51 40.7	359 51 40.6	Payne 2	2899.6	3.462336
Fort Pierce:							
Ice plant, iron stack	27 26 55.735	1715.5	167 06 52.2	347 06 35.3	Russell	4515.9	3.654744
1906	80 19 31.103	854.1	170 40 03.7	350 39 58.5	Bell	1923.1	3.283991
			183 38 53.8	3 38 58.8	Payne 2	4627.9	3.665382
			229 04 58.8	49 05 34.8	Pierce	2836.6	3.452794
Coal elevator, N. gable	27 26 48.886	1504.7	167 25 50.6	347 25 41.3	Russell	4726.2	3.674514
1906	80 19 30.328	832.8	171 01 09.6	351 01 12.0	Bell	2134.6	3.329311
			183 14 08.1	3 14 20.7	Payne 2	4837.0	3.684580
			225 43 54.1	45 44 29.7	Pierce	2963.6	3.471825
Methodist Church spire	27 26 58.998	1815.9	170 00 08.9	350 00 03.6	Bell	1824.9	3.261231
1906	80 19 30.923	849.2	183 39 59.3	3 40 04.2	Payne 2	4527.3	3.655842
			230 35 12.9	50 35 48.8	Pierce	2768.0	3.442165

[1] No check on this position.

Indian and Banana Rivers—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.							
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Fort Pierce—Continued							
Baptist Church spire [1]	27 26 52.82	1625.8	184 56 13	4 56 20	Payne 2	4725.7	3.674462
1906	80 19 35.19	966.4	229 11 36	49 12 14	Pierce	2980.1	3.474237
Rocky Point	27 11 24.329	748.8	118 17 33.5	298 15 58.7	Pisgah	6482.0	3.811706
1882–1906	80 09 39.251	1080.4	155 52 13.1	335 52 05.2	Refuge	1167.7	3.067330
Sewall	27 10 26.688	821.4	219 25 56.0	39 26 34.8	Refuge	3676.9	3.565486
1906	80 11 21.452	590.5	237 45 25.6	57 46 12.3	Rocky Point	3325.9	3.521915
Cemetery	27 15 08.930	274.9	311 04 17.7	131 06 09.2	Refuge	8897.0	3.949246
1906	80 14 00.301	8.3	338 59 00.9	158 59 25.5	Pisgah	4115.6	3.614430
Jensen	27 15 19.285	593.6	10 59 54.3	190 59 40.9	Pisgah	4238.4	3.627204
1906	80 12 37.279	1025.5	82 03 39.6	262 03 01.6	Cemetery	2306.0	3.362859
Jensen ice plant	27 14 43.332	1333.7	237 15 27.6	57 15 56.2	Jensen	2046.2	3.310947
1906	80 13 39.844	1096.2	343 21 18.0	163 21 33.2	Pisgah	3187.5	3.503455
			144 27 45.4	324 27 36.0	Cemetery	968.2	2.985983
Jensen Hotel water tower	27 14 41.622	1281.0	233 58 41.5	53 59 08.0	Jensen	1971.3	3.294752
1906	80 13 35.237	969.4	345 19 10.8	165 19 23.9	Pisgah	3102.7	3.491734
			140 38 14.6	320 38 03.1	Cemetery	1087.1	3.036281
Jensen schoolhouse cupola	27 14 36.877	1135.0	233 57 26.6	53 57 56.5	Jensen	2218.6	3.346078
1906	80 13 42.491	1169.0	340 57 03.2	160 57 19.6	Pisgah	3020.7	3.480110
			153 35 24.6	333 35 16.5	Cemetery	1101.5	3.041992
Pavilion, north gable	27 11 19.311	594.4	119 19 38.0	299 18 02.6	Pisgah	6587.9	3.818749
1909	80 09 37.943	1044.4	157 10 52.4	337 10 43.9	Refuge	1323.7	3.121792
			166 52 41.8	346 52 41.2	Rocky Point	158.6	2.200258
Borden Hill	27 02 52.071	1602.6	111 00 45.5	291 00 24.1	Rifle	1386.6	3.141945
1883	80 07 10.300	283.9	176 39 53.0	356 39 49.3	Ten 2	3819.8	3.582035
			301 04 20.2	121 04 47.5	Thomas	1935.2	3.286715
Simpson Hill	27 02 21.732	668.9	126 51 51.0	306 51 19.5	Rifle	2385.4	3.377558
1883–1906	80 06 48.017	1323.5	146 40 09.2	326 39 59.1	Borden Hill	1117.6	3.048294
			170 00 37.9	350 00 24.1	Ten 2	4820.1	3.683060
			273 34 06.5	93 34 23.7	Thomas	1045.4	3.019269
Peck flag	27 07 23.540	724.5	325 22 56.9	145 23 48.7	Ten 2	5518.6	3.741825
1883	80 09 12.156	334.8	336 50 35.5	156 51 41.1	Simpson Hill	10102.3	4.004420
Landing	27 06 50.285	1547.7	335 22 07.2	155 22 33.8	Ten 2	3870.5	3.587770
1883–1906	80 08 16.917	455.9	123 56 01.4	303 55 36.2	Peck flag	1833.7	3.263321
Bar	27 08 14.460	445.1	341 35 57.7	161 36 31.3	Ten 2	6438.2	3.808763
1882–3	80 08 32.129	884.8	350 48 46.6	170 48 53.5	Landing	2624.4	3.419030
Conch Bar Hill	26 59 18.549	570.9	342 49 17.7	162 49 40.2	Jupiter Inlet L. H.	4640.4	3.666559
1883–1909	80 05 45.852	1264.3	20 49 00.7	200 48 32.5	Prosper 2	4835.6	3.684450
			152 52 25.6	332 51 25.9	Rifle	7943.0	3.899986
Wilner	26 58 59.224	1822.7	355 54 47.4	175 54 51.9	Jupiter Inlet L. H.	3848.5	3.585293
1883	80 05 06.109	168.5	118 29 32.1	298 29 14.1	Conch Bar Hill	1246.9	3.095833
Wilner 2	26 58 59.233	1823.0	355 55 19.3	175 55 23.8	Jupiter Inlet L. H.	3848.7	3.585319
1906	80 05 06.088	167.9	118 28 06.4	298 27 48.4	Conch Bar Hill	1247.3	3.095964
Jupiter Inlet longitude station	26 56 53.69	1652.6	122 16.7	302 16.7	Jupiter Inlet L. H.	46.54	1.6678
1907	80 04 54.74	1509.9					

Jupiter Inlet to Miami.

Principal points.							
Tug	26 50 08.597	264.6	162 03 33.3	342 02 27.0	Jupiter Inlet L. H.	13131.62	4.118319
1883–1906	80 02 29.523	815.2					
Haulover	26 50 01.055	32.5	170 08 47.2	350 08 10.9	Jupiter Inlet L. H.	12915.3	4.111105
1883–1906	80 03 36.039	995.1	262 47 31.5	82 48 01.5	Tug	1851.2	3.267459

[1] No check on this position.

Jupiter Inlet to Miami—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Tom	26 52 35.540	1093.8	346 51 50.0	166 52 07.2	Tug	4643.9	3.666881
1883	80 03 07.746	213.8	9 19 50.8	189 19 38.0	Haulover	4818.3	3.682894
			159 25 59.0	339 25 09.9	Jupiter Inlet L. H.	8513.0	3.930082
Spencer	26 44 12.531	385.6	167 22 54.6	347 22 15.4	Haulover	10992.1	4.041079
1883	80 02 09.074	250.8	168 52 52.5	348 51 37.0	Jupiter Inlet L. H.	23900.2	4.378401
			177 03 02.1	357 02 52.9	Tug	10973.0	4.040327
Worth	26 44 15.154	466.4	180 51 37.2	0 51 39.6	Haulover	10646.9	4.027222
1883–1906	80 03 41.828	1156.0	190 23 59.6	10 24 32.1	Tug	11059.6	4.043740
			271 47 53.3	91 48 35.0	Spencer	2564.5	3.409009
Shell Mound	26 36 14.647	450.8	170 47 17.3	350 46 38.4	Worth	14981.5	4.175556
1883–1906	80 02 15.042	416.2	180 38 33.1	0 38 35.9	Spencer	14708.3	4.167562
Ham	26 40 59.442	1829.3	1 24 36.4	181 24 32.9	Shell Mound	8767.5	3.942874
1883–1906	80 02 07.244	200.3	156 32 32.2	336 31 49.7	Worth	6566.2	3.817315
			179 30 44.8	359 30 44.1	Spencer	5942.8	3.773988
Lane	26 36 25.526	785.6	188 37 15.2	8 37 50.6	Spencer	14537.0	4.162475
1883	80 03 27.924	772.5	194 49 15.1	14 49 51.0	Ham	8720.3	3.940532
			279 25 22.3	99 25 55.0	Shell Mound	2044.0	3.310483
Low	26 32 13.313	409.7	171 29 39.9	351 29 21.1	Lane	7848.4	3.894781
1883	80 02 45.966	1272.6	186 34 16.0	6 34 29.8	Shell Mound	7476.4	3.873690
House	26 27 47.038	1447.6	188 42 39.3	8 42 59.5	Low	8290.4	3.918574
1883–1906	80 03 31.320	867.6					
False	26 24 08.923	274.6	185 37 02.9	5 37 13.5	House	6744.9	3.828975
1883–1906	80 03 55.154	1528.6	187 19 17.7	7 19 48.6	Low	15029.9	4.176955
Andrews	26 27 50.959	1568.3	199 16 20.5	19 17 05.9	Low	8553.7	3.932153
1883	80 04 27.948	774.2	274 23 43.5	94 24 08.7	House	1573.3	3.196805
			352 25 24.3	172 25 38.9	False	6893.3	3.838427
Boca	26 20 45.535	1401.4	184 28 53.2	4 29 01.1	False	6278.4	3.797851
1883–1906	80 04 12.854	356.4	186 28 59.9	6 29 38.6	Low	21302.9	4.328438
			185 04 07.2	5 04 25.7	House	13022.7	4.114700
Bowers	26 24 22.952	706.4	193 32 17.8	13 32 42.1	House	6460.3	3.810255
1883	80 04 25.915	718.2	296 51 26.7	116 51 40.4	False	955.6	2.980288
			356 54 06.7	176 54 12.5	Boca	6700.7	3.826123
Raton	26 20 49.062	1509.9	192 58 30.0	12 58 52.7	False	6311.9	3.800161
1883	80 04 46.287	1283.4	276 40 32.9	96 40 47.7	Boca	933.4	2.970065
Hills	26 15 32.673	1005.5	180 46 30.7	0 46 32.8	Raton	9737.6	3.988451
1883	80 04 51.038	1416.2	186 16 32.1	6 16 49.0	Boca	9686.2	3.986155
Junction	26 13 17.267	531.4	193 03 54.3	13 04 09.7	Hills	4277.78	3.631218
1883–1906	80 05 25.886	718.6					
Midway	26 10 44.015	1354.6	188 00 05.8	8 00 16.3	Junction	4762.6	3.677841
1883–1906	80 05 49.769	1382.0	190 23 46.0	10 24 11.9	Hills	9031.6	3.955763
Lauderdale	26 06 18.725	576.3	186 01 15.9	6 01 29.6	Midway	8209.26	3.914304
1883	80 06 20.779	577.3	188 18 39.5	8 19 19.1	Hills	17228.4	4.236244
New River	26 04 57.074	1756.5	185 29 02.5	5 29 06.3	Lauderdale	2524.26	3.402134
1883–1906	80 06 29.461	818.7					
Inlet	26 03 15.935	490.4	186 08 31.7	6 08 37.0	New River	3130.37	3.495596
1883	80 06 41.513	1154.1					
Savanna	26 00 02.325	71.6	184 40 41.4	4 40 49.1	Inlet	5978.0	3.776554
1883	80 06 59.052	1642.4	185 10 50.0	5 11 03.0	New River	9107.6	3.959405
Dumfounding	25 56 45.447	1398.5	183 25 18.2	3 25 23.9	Savanna	6069.37	3.783144
1883–1906	80 07 12.078	336.0					
Baker	25 54 28.538	878.2	183 22 08.8	3 22 12.7	Dumfounding	4220.36	3.625349
1883–1906	80 07 20.992	584.3					
Charles	25 51 26.692	821.3	177 16 42.6	357 16 38.4	Baker	5602.3	3.748364
1883	80 07 11.435	318.5	179 53 43.8	359 53 43.5	Dumfounding	9808.9	3.991620
Frank	25 48 50.270	1546.9	182 48 16.9	2 48 20.6	Charles	4819.2	3.682979
1883	80 07 19.904	554.4					

Jupiter Inlet to Miami—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Cape Florida Lighthouse (old tower) 1850–1906	25 39 58.907 80 09 22.408	1812.6 625.0	191 47 15.1	11 48 08.3	Frank	16703.8	4.222816
Norris Cut 1883	25 45 21.755 80 08 14.091	669.4 392.7	193 14 13.0 10 51 24.0	13 14 36.6 190 50 54.4	Frank Cape Florida L. H.	6591.7 10115.6	3.818998 4.004991
Supplementary points.							
Prosper [2] 1906	26 56 51.686 80 06 48.152	1590.7 1328.2	170 39 59.0 268 23 17.4	350 39 27.6 88 24 08.1	Rifle Jupiter Inlet L. H.	11744.5 3090.2	4.069834 3.489992
B-2 1883	26 56 38.538 80 04 17.492	1186.1 482.5	114 43 34.4 153 40 39.6 162 47 48.2	294 43 16.9 333 39 59.6 342 47 26.3	Jupiter Inlet L. H. Conch Bar Hill Wilner	1174.4 5494.7 4532.8	3.069831 3.739941 3.656366
Jupiter 1907	26 56 16.776 80 04 14.196	516.3 391.6	135 04 56.9 164 01 46.3	315 04 37.9 344 01 22.8	Jupiter Inlet L. H. Wilner 2	1639.6 5200.8	3.214735 3.716070
Jupiter Inlet wireless-telegraph pole 1907	26 56 53.916 80 05 01.615	1659.4 44.6	164 40 32.9 178 10 05.2 311 08 44.5	344 40 12.9 358 10 03.2 131 09 06.0	Conch Bar Hill Wilner 2 Jupiter	4615.6 3858.9 1737.1	3.664228 3.586464 3.239830
Jupiter Inlet Weather Bureau display pole 1907	26 56 52.118 80 04 52.957	1604.0 1460.8	162 04 01.4 174 42 43.8 315 29 18.1	342 03 37.5 354 42 37.9 135 29 35.7	Conch Bar Hill Wilner 2 Jupiter	4737.0 3929.0 1525.3	3.675501 3.594281 3.183345
Life-saving station, cupola 1907	26 55 39.602 80 04 06.103	1218.8 168.4	149 04 33.7 157 47 49.3 164 55 56.3 168 57 31.4	329 04 11.0 337 47 04.2 344 55 29.1 348 57 27.7	Jupiter Inlet L. H. Conch Bar Hill Wilner 2 Jupiter	2687.1 7278.6 6363.0 1165.7	3.429291 3.862047 3.803659 3.066582
Spencer 2 1907	26 44 12.507 80 02 09.110	384.9 251.8	359 30 09.5 91 49 35.5	179 30 10.3 271 48 53.8	Ham Worth	5942.0 2563.6	3.773936 3.408846
Lake 2 1907	26 47 45.961 80 01 55.144	1414.5 1523.1	3 21 44.3 24 26 20.4	183 21 38.0 204 25 32.4	Spencer 2 Worth	6580.7 7126.1	3.818272 3.852849
Munyon's house, flag on cupola [1] 1907	26 48 43.03 80 02 43.84	1324.4 1210.9	322 33 06 353 25 23	142 33 28 173 25 39	Lake 2 Spencer 2	2212.3 8380.9	3.344842 3.923291
Rivera Hotel, flag 1907	26 46 15.680 80 03 11.165	482.6 308.5	217 04 34.0 335 39 31.2 12 52 07.5	37 05 08.2 155 39 59.1 192 51 53.7	Lake 2 Spencer 2 Worth	3482.9 4160.6 3804.9	3.541935 3.619151 3.580343
Palm Beach Gun Club, flag [1] 1907	26 44 29.54 80 02 28.48	909.1 787.1	314 23 31 77 41 02	134 23 40 257 40 29	Spencer 2 Worth	749.2 2074.6	2.874618 3.316943
Bethseda Episcopal Church spire [1] 1907	26 44 01.50 80 02 29.62	46.1 818.4	101 53 51 239 07 18	281 53 19 59 07 28	Worth Spencer 2	2039.4 660.3	3.309505 2.819715
West Palm Beach: Catholic Church [1] 1907	26 42 55.08 80 03 06.81	1695.2 188.2	213 47 20 335 10 02	33 47 46 155 10 29	Spencer 2 Ham	2867.2 3921.5	3.457464 3.593448
Ice-plant smokestack [1] 1907	26 42 45.17 80 03 21.60	1390.2 597.2	216 41 50 327 42 46	36 42 22 147 43 19	Spencer 2 Ham	3352.5 3848.9	3.525370 3.585334
Palm Beach: Breaker Hotel, north flag 1907	26 42 53.342 80 02 07.447	1641.7 205.8	359 54 30.1 133 59 36.0 178 55 10.3 182 09 39.6	179 54 30.2 313 58 53.6 358 55 09.6 2 09 45.2	Ham Worth Spencer 2 Lake 2	3505.4 3625.5 2436.9 9012.2	3.544738 3.559362 3.386830 3.954831
Breaker Hotel chimney 1907	26 42 56.461 80 02 07.095	1737.6 196.1	0 03 56.1 132 46 30.9 178 38 14.1 182 07 18.6	180 03 56.0 312 45 48.3 358 38 13.2 2 07 24.0	Ham Worth Spencer 2 Lake 2	3601.4 3566.6 2341.1 8915.9	3.556472 3.552251 3.369417 3.950165
Royal Ponciana Hotel flag 1907	26 42 53.452 80 02 31.876	1645.0 881.1	142 26 54.9 186 25 48.4 194 29 54.1 349 00 57.2	322 26 23.5 6 26 05.0 14 30 04.4 169 01 08.3	Worth Lake 2 Spencer 2 Ham	3171.8 9059.4 2513.1 3574.3	3.501305 3.957101 3.400204 3.553186

[1] No check on this position.

Jupiter Inlet to Miami—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.							
Palm Beach—Continued.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Royal Ponciana Hotel chimney	26 42 53.034	1632.2	141 06 45.4	321 06 12.2	Worth	3247.1	3.511499
1907	80 02 28.062	775.6	185 45 32.8	5 45 47.6	Lake 2	9061.1	3.957179
			192 05 11.5	12 05 20.0	Spencer 2	2501.3	3.398174
			350 39 01.8	170 39 11.1	Ham	3543.0	3.549369
Pier end	26 42 50.385	1550.6	6 57 51.4	186 57 44.6	Ham	3439.8	3.536527
1907	80 01 52.160	1441.7	169 30 02.8	349 29 55.2	Spencer 2	2570.5	3.410013
			179 28 50.2	359 28 51.0	Lake 2	9097.1	3.958904
Hillsboro Inlet Lighthouse	26 15 32.350	995.5	10 19 19.4	190 18 53.6	Midway	9019.1	3.955163
1906	80 04 51.572	1431.0	12 54 19.9	192 54 04.7	Junction	4264.8	3.629894
			41 04 35.1	221 03 37.7	Burton	5484.4	3.739129
Burton	26 13 17.990	553.6	270 28 29.2	90 29 11.4	Junction	2651.2	3.423441
1906	80 07 01.391	38.6	337 13 47.8	157 14 19.4	Midway	5138.8	3.710858

Miami to Long Key and Cape Sable.

Principal points.							
Bluff	25 45 15.160	466.5	268 00 26.7	88 01 58.2	Norris Cut	5874.4	3.768961
1883	80 11 44.755	1247.3	337 48 23.3	157 49 25.1	Cape Florida L. H.	10509.8	4.021593
Shoal Point	25 38 21.368	657.5	210 36 24.3	30 38 21.5	Bluff	14796.7	4.170166
1849	80 16 15.083	420.8	255 21 37.4	75 24 36.0	Cape Florida L. H.	11895.3	4.075375
Fowey Rocks Lighthouse	25 35 25.412	782.0	107 15 49.5	287 11 18.9	Shoal Point	18283.1	4.262049
1883–1906	80 05 49.194	1373.0	144 45 37.7	324 44 05.5	Cape Florida L. H.	10305.7	4.013078
			167 35 24.8	347 34 22.2	Norris Cut	18790.1	4.273930
Key Biscayne south base	25 39 55.230	1699.5	75 57 07.7	255 54 08.9	Shoal Point	11878.4	4.074759
1855	80 09 21.996	613.5	174 12 09.9	354 12 09.7	Cape Florida L. H.	113.7	2.055831
Soldier Key	25 35 26.192	806.0	116 05 42.5	296 02 51.7	Shoal Point	12265.2	4.088674
1849	80 09 40.216	1122.4	183 23 13.2	3 23 21.0	Cape Florida L. H.	8406.6	3.924618
			183 30 44.8	3 30 52.7	Key Biscayne S. base	8294.3	3.918780
Elliotts Beach	25 41 25.249	776.9	285 47 47.0	105 50 12.6	Cape Florida L. H.	9747.9	3.988913
1849	80 14 58.734	1637.8	286 24 54.1	106 27 20.0	Key Biscayne S. base	9790.4	3.990802
			321 10 32.5	141 12 50.3	Soldier Key	14178.1	4.151619
			20 37 36.3	200 37 03.3	Shoal Point	6045.7	3.781446
Key Biscayne north base	25 43 03.190	98.2	357 32 06.5	177 32 10.4	Key Biscayne S. base	5789.2	3.762620
1855	80 09 30.923	862.0	71 46 09.0	251 43 47.1	Elliotts Beach	9623.6	3.983336
Key Biscayne	25 42 39.646	1220.0	4 19 37.4	184 19 31.5	Key Biscayne S. base	5073.8	3.705335
1849–1906	80 09 08.270	230.6	4 33 28.2	184 33 22.0	Cape Florida L. H.	4961.9	3.695650
			76 50 06.0	256 47 34.2	Elliotts Beach	10036.0	4.001558
			138 55 23.8	318 55 14.0	Key Biscayne N. base	961.1	2.982774
Black Point	25 32 10.400	320.0	200 42 08.3	20 43 15.1	Shoal Point	12203.9	4.086500
1849	80 18 49.740	1378.7	248 31 23.6	68 35 20.7	Soldier Key	16479.6	4.216947
Sands Point	25 30 11.205	344.8	106 28 38.8	286 25 27.2	Black Point	12951.4	4.112318
1851	80 11 24.902	695.5	151 46 56.8	331 44 51.6	Shoal Point	17120.0	4.233504
			196 46 22.3	16 47 07.5	Soldier Key	10123.6	4.005333
Turkey Point	25 26 19.888	612.0	181 48 43.7	1 48 48.9	Black Point	10791.0	4.033061
1849	80 19 01.962	54.8	240 50 00.9	60 53 17.4	Sands Point	14617.7	4.164879
Rubicon Point	25 23 47.937	1475.1	123 38 40.7	303 36 52.7	Turkey Point	8442.5	3.926470
1852	80 14 50.429	1409.5	156 37 52.4	336 36 09.4	Black Point	16844.6	4.226461
			205 56 57.5	25 58 25.8	Sands Point	13117.1	4.117839
Mangrove	25 32 28.777	885.5	188 22 51.4	8 23 03.8	Soldier Key 2	5487.8	3.739397
1908	80 10 08.578	239.5	233 05 16.6	53 07 08.6	Fowey Rocks L. H.	9053.2	3.956802
Triumph Reef Beacon	25 28 45.686	1405.8	140 46 12.2	320 44 45.7	Mangrove	8863.7	3.947613
1908	80 06 47.788	1334.9	158 39 34.3	338 38 20.0	Soldier Key 2	13190.8	4.120567
			187 34 20.7	7 34 46.0	Fowey Rocks L. H.	12408.3	4.093713
Sands Cut	25 29 35.976	1107.0	188 27 07.7	8 27 32.3	Soldier Key 2	10864.5	4.036010
1849–1907	80 10 37.139	1037.2	188 31 41.8	8 31 54.1	Mangrove	5376.7	3.730519
			216 45 55.2	36 47 59.4	Fowey Rocks	13425.3	4.127925
			283 34 01.2	103 35 39.9	Triumph Reef Bn.	6590.2	3.818899

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Log	25 29 08.470	260.6	177 28 00.3	357 27 59.7	Sands Cut	847.2	2.928000
1908	80 10 35.798	999.8	187 01 42.9	7 01 54.6	Mangrove	6210.3	3.793116
			187 39 41.3	7 40 05.3	Soldier Key 2	11697.3	4.068086
			214 34 59.2	34 37 02.8	Fowey Rocks L. H.	14091.2	4.148947
			276 16 05.9	96 17 44.0	Triumph Reef Bn.	6407.2	3.806666
Baches Shoal Beacon	25 28 53.996	1661.5	99 34 33.9	279 33 53.2	Log	2678.7	3.427930
1908	80 09 01.229	34.3	115 44 59.1	295 44 17.8	Sands Cut	2974.0	3.473343
			164 07 09.4	344 06 40.3	Mangrove	6871.4	3.837047
			174 52 30.7	354 52 13.9	Soldier Key 2	12086.6	4.082303
			203 59 04.2	24 00 27.0	Fowey Rocks L. H.	13183.7	4.120038
Point Adelle 2	25 27 13.469	414.4	200 42 42.1	20 43 02.7	Log	3783.3	3.577866
1908	80 11 23.702	662.2	232 08 12.2	52 09 13.5	Baches Shoal Beacon	5040.7	3.702494
			249 46 20.6	69 48 19.2	Triumph Reef Bn.	8213.5	3.914528
Ajax Reef Beacon	25 24 06.625	203.9	135 02 59.0	315 01 30.8	Point Adelle 2	8125.4	3.909847
1908	80 07 58.229	1627.5	154 38 53.4	334 37 45.7	Log	10278.6	4.011933
Elliott 1908	25 25 03.129	96.3	199 47 31.1	19 48 12.9	Log	8023.6	3.904363
1908	80 12 13.067	365.2	209 13 11.0	29 15 56.4	Fowey Rocks L. H.	21945.0	4.341335
			217 01 21.6	37 02 44.1	Baches Shoal Beacon	8899.1	3.949344
			232 58 52.4	53 01 12.3	Triumph Reef Bn.	11379.5	4.056123
			283 42 10.3	103 43 59.7	Ajax Reef Beacon	7331.5	3.865192
Pacific Reef Beacon	25 22 17.071	525.3	129 13 02.2	309 11 26.1	Elliott 1908	8084.0	3.907624
1908	80 08 28.960	809.7	151 50 33.8	331 49 18.9	Point Adelle 2	10345.6	4.014754
			164 21 57.4	344 21 03.0	Log	13145.9	4.118789
Ragged Key No. 1	25 32 33.575	1033.1	87 12 30.3	267 08 47.0	Black Point	14481.2	4.160805
1850	80 10 11.673	325.9	136 33 44.6	316 31 07.8	Shoal Point	14744.0	4.168615
			189 23 04.2	9 23 17.8	Soldier Key	5383.7	3.731084
Elliotts Key No. 1	25 29 07.091	218.2	112 17 46.5	292 14 14.0	Black Point	14886.1	4.172781
1850	80 10 36.419	1017.2	186 12 20.2	6 12 30.8	Ragged Key No. 1	6391.2	3.805582
			187 39 27.6	7 39 51.8	Soldier Key	11770.5	4.070794
Triumph Reef	25 28 39.739	1222.8	97 31 08.4	277 29 30.0	Elliotts Key No. 1	6443.6	3.809127
1853	80 06 47.707	1322.6	141 38 50.4	321 37 22.5	Ragged Key No. 1	9176.9	3.962696
			158 56 56.2	338 55 41.7	Soldier Key	13402.4	4.127182
Elliotts Key No. 2	25 24 54.711	1683.5	64 56 19.9	244 55 12.7	Rubicon Point	4848.8	3.685635
1853	80 12 13.288	371.4	140 27 57.9	320 25 07.4	Black Point	17388.9	4.240272
			199 12 27.3	19 13 08.9	Elliotts Key No. 1	8224.0	3.915084
			232 42 09.9	52 44 29.8	Triumph Reef	11432.2	4.058131
Christmas Point	25 23 25.968	799.1	109 04 53.4	289 04 23.4	Rubicon Point	2068.5	3.315654
1853	80 13 40.492	1131.8	221 44 47.4	41 45 24.8	Elliotts Key No. 2	3660.2	3.563508
Caesars Creek Bank	25 22 57.850	1780.1	105 14 16.9	285 13 28.2	Christmas Point	3293.3	3.517634
1853	80 11 46.817	1308.5	168 22 29.4	348 22 18.1	Elliotts Key No. 2	3671.2	3.564809
Ajax Reef	25 24 11.954	367.8	70 27 09.0	250 25 30.5	Caesars Creek Bank	6810.4	3.833170
1853	80 07 57.237	1599.8	100 25 58.0	280 24 08.1	Elliotts Key No. 2	7276.2	3.861904
			153 55 00.0	333 53 51.5	Elliotts Key No. 1	10112.2	4.004847
Pacific Reef	25 22 16.163	497.4	103 01 59.7	283 00 34.7	Caesars Creek Bank	5693.1	3.755349
1853	80 08 28.409	794.3	103 50 59.4	283 48 45.9	Christmas Point	8984.9	3.953512
			127 49 45.1	307 48 08.9	Elliotts Key No. 2	7957.0	3.900747
			164 12 40.6	344 11 45.8	Elliotts Key No. 1	13140.8	4.118622
Old Rhodes	25 20 59.056	1817.2	194 30 07.5	14 30 25.4	Christmas Point	4669.4	3.669258
1853–1907	80 14 22.322	624.1	206 26 25.6	26 27 20.8	Elliotts Key No. 2	8098.9	3.908424
			229 56 06.5	49 57 13.1	Caesars Creek Bank	5680.1	3.754358
			241 06 25.1	61 09 10.2	Ajax Reef	12293.3	4.089670
			256 29 45.0	76 32 16.2	Pacific Reef	10175.8	4.007569
Turtle Reef	25 16 55.126	1696.2	157 39 48.4	337 39 01.2	Old Rhodes	8115.0	3.909290
1853	80 12 32.028	896.0	182 01 57.2	2 02 05.2	Elliotts Key No. 2	14766.3	4.169271
			186 27 37.3	6 27 56.6	Caesars Creek Bank	11232.5	4.050477
Angelfish Key	25 19 24.620	757.5	218 17 00.5	38 17 35.6	Old Rhodes	3702.2	3.568458
1853–1908	80 15 44.350	1240.4	246 33 39.8	66 36 46.2	Pacific Reef	13283.9	4.123326
			310 31 12.1	130 32 34.3	Turtle Reef	7078.3	3.849929
El Camino	25 16 48.471	1491.4	211 01 06.3	31 01 50.4	Angelfish Key	5606.8	3.748714
1853	80 17 27.654	773.6	213 54 07.0	33 55 26.1	Old Rhodes	9291.1	3.968067
			219 57 52.9	40 00 18.6	Caesars Creek Bank	14833.9	4.171254
			268 33 51.3	88 35 57.5	Turtle Reef	8273.6	3.917694

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Carysfort Reef Lighthouse 1853	25 13 18.027 80 12 41.980	554.7 1175.1	129 01 23.9 155 40 13.9 168 48 44.3 184 56 24.2	308 59 22.0 335 38 56.0 348 48 01.3 4 56 47.6	El Camino Angelfish Key Old Rhodes Caesars Creek Bank	10288.0 12380.6 14461.0 17907.8	4.012332 4.092740 4.160199 4.253043
Basin Bank 1853	25 12 22.398 80 15 47.019	689.2 1316.3	161 01 19.4 180 19 45.2 213 01 26.3 251 42 10.1	341 00 36.5 0 19 46.3 33 02 49.4 71 43 28.9	El Camino Angelfish Key Turtle Reef Carysfort Reef L. H.	8658.0 12992.0 10010.2 5455.4	3.937416 4.113676 4.000441 3.736824
Point Elizabeth 1853–1908	25 14 17.462 80 18 58.969	537.3 1650.4	208 48 07.4 209 56 08.0 245 50 32.5 279 48 36.8 303 22 16.7	28 48 46.4 29 57 31.1 65 53 17.6 99 51 17.5 123 23 38.5	El Camino Angelfish Key Turtle Reef Carysfort Reef L. H. Basin Bank	5302.8 10907.6 11864.9 10709.1 6434.6	3.724507 4.037729 4.074263 4.029754 3.808521
Upper Sound Point 1853–1908	25 10 07.568 80 20 59.920	232.9 1678.1	203 45 37.3 205 42 19.1 244 38 32.4 247 10 13.5	23 46 28.8 25 43 49.6 64 40 45.6 67 13 45.6	Point Elizabeth El Camino Basin Bank Carysfort Reef L. H.	8401.7 13692.0 9693.7 15122.8	3.924368 4.136468 3.986489 4.179633
Grecian Shoals 1853	25 07 24.902 80 17 55.114	766.2 1544.0	134 02 54.1 171 59 11.0 182 32 12.4 201 23 31.2	314 01 35.6 351 58 43.9 2 32 24.2 21 24 25.7	Upper Sound Point Point Elizabeth El Camino Basin Bank	7200.3 12819.6 17357.9 9831.6	3.857352 4.107874 4.239497 3.992625
Point Willie 1853–1908	25 08 13.134 80 22 16.899	404.1 473.3	211 28 29.0 281 25 30.6	31 29 01.7 101 27 21.8	Upper Sound Point Grecian Shoals	4128.7 7481.9	3.615815 3.874013
Lower Sound Point 1853–1908	25 06 21.549 80 23 59.918	663.0 1678.8	220 02 36.2 259 10 48.5	40 03 19.9 79 13 23.3	Point Willie Grecian Shoals	4485.2 10404.6	3.651784 4.017225
French Reef 1853	25 02 08.732 80 21 02.788	268.7 78.1	147 27 57.4 169 30 38.8 180 18 44.1	327 26 42.4 349 30 07.4 0 18 45.3	Lower Sound Point Point Willie Upper Sound Point	9228.0 11403.1 14733.7	3.965108 4.057022 4.168311
Dry Rocks 1853–1908	25 02 37.371 80 22 09.759	1149.9 273.6	155 53 41.4 178 53 27.4 188 02 10.2	335 52 54.7 358 53 24.4 8 02 39.7	Lower Sound Point Point Willie Upper Sound Point	7557.1 10333.1 13989.8	3.878357 4.014231 4.145811
Point Charles 1853–1908	25 04 33.692 80 26 36.078	1036.7 1011.1	232 48 49.4 295 30 08.4 295 36 03.9	52 49 55.6 115 32 29.6 115 37 56.8	Lower Sound Point French Reef Dry Rocks	5492.0 10352.1 8278.2	3.739728 4.015029 3.917938
Pickles Reef 1853	24 59 24.615 80 24 52.730	757.4 1478.8	163 03 43.8 186 34 46.5	343 03 00.1 6 35 08.9	Point Charles Lower Sound Point	9941.5 12913.8	3.997454 4.111055
Dove Key 1853	25 02 50.551 80 28 29.357	1555.4 822.9	225 00 22.6 272 09 36.5 275 50 31.9 316 11 58.8	45 01 10.6 92 12 17.2 95 53 40.9 136 13 30.4	Point Charles Dry Rocks. French Reef Pickles Reef	4189.1 10648.6 12584.5 8777.3	3.652162 4.027291 4.099836 3.943360
Tavanier Key 1853	24 59 47.095 80 30 17.853	1449.0 500.6	208 18 48.7 215 10 19.7 249 01 20.1 254 19 26.2 274 19 08.9	28 19 34.6 35 11 53.5 69 04 46.7 74 23 20.9 94 21 26.3	Dove Key Point Charles Dry Rocks French Reef Pickles Reef	6412.2 10789.7 14653.6 16161.9 9143.8	3.807007 4.033008 4.165945 4.208492 3.961128
Conch Reef 1853	24 57 06.272 80 27 47.046	193.0 1319.9	139 29 06.3 173 36 41.7	319 28 02.6 353 36 23.8	Tavanier Key Dove Key	6509.8 10659.3	3.813568 4.027729
Plantation Point 1857–1908	24 57 23.121 80 33 57.714	711.4 1619.1	234 17 39.8 272 49 56.8	54 19 12.6 92 52 33.2	Tavanier Key Conch Reef	7592.8 10411.1	3.880402 4.017496
Crockers Reef 1857	24 54 36.098 80 31 40.021	1110.7 1123.1	143 04 25.8 193 32 19.5	323 03 27.8 13 32 54.2	Plantation Point Tavanier Key	6429.2 9842.7	3.808160 3.993114
Tea Table Key 1857–1908	24 53 32.060 80 39 30.244	986.5 848.8	232 40 29.8 261 28 50.1 58 49 42.5	52 42 49.9 81 32 08.1 238 47 46.3	Plantation Point Crockers Reef Matecumbe	11730.4 13342.9 9069.3	4.069313 4.125249 3.957576
Alligator Reef 1857	24 51 05.296 80 37 07.963	163.0 223.6	89 08 35.5 122 11 34.5 138 30 59.1 204 39 25.1	269 05 39.6 302 09 25.4 318 29 59.3 24 40 45.2	Matecumbe Lignum Vitae Tea Table Key Plantation Point	11756.0 10177.0 6028.6 12792.5	4.070259 4.007621 3.780213 4.106956

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Indian Key	24 52 37.766	1162.0	227 54 01.9	47 54 29.6	Tea Table Key	2492.0	3.396544
1857–1908	80 40 36.123	1014.0	231 49 57.2	51 52 45.1	Plantation Point	14215.3	4.152755
			256 21 57.0	76 25 42.7	Crockers Reef	15480.6	4.189788
			295 56 53.4	115 58 20.9	Alligator Reef	6499.5	3.812878
Long Arsenicker Key	25 22 37.274	1147.0	165 59 36.0	345 59 09.8	Turkey Point	7060.0	3.848804
1852	80 18 00.808	22.6	247 45 54.8	67 47 16.4	Rubicon Point	5748.8	3.759581
Snapper Point	25 19 26.818	825.2	170 48 29.4	350 48 14.9	Long Arsenicker Key	5936.7	3.773542
1852–1854	80 17 20.886	751.9	208 33 24.4	28 34 31.4	Rubicon Point	9148.4	3.961345
Cards Point (S)	25 19 23.452	721.6	215 47 31.7	35 48 37.6	Long Arsenicker Key	7353.4	3.866486
1854	80 20 34.642	968.9	268 51 32.7	88 52 53.0	Snapper Point	5252.2	3.720345
Jew Point	25 17 13.051	401.6	161 58 09.8	341 57 49.8	Cards Point (S)	4219.8	3.625287
1854	80 19 47.942	1341.2	196 42 35.8	16 43 21.0	Long Arsenicker Key.	10416.6	4.017727
			223 46 52.5	43 47 52.8	Snapper Point	5701.8	3.756009
Mud Point	25 18 24.165	743.6	240 58 39.2	60 59 29.5	Cards Point (S)	3761.0	3.575306
1854	80 22 32.230	901.6	295 27 01.5	115 28 11.7	Jew Point	5090.2	3.706735
Mosquito Creek	25 16 41.530	1277.9	147 58 50.3	327 58 20.1	Mud Point	3724.9	3.571118
1854	80 21 21.625	605.0	194 46 27.9	14 46 47.9	Cards Point (S)	5152.8	3.712043
Narrow Point	25 17 15.923	490.0	219 24 07.6	39 24 33.9	Mud Point	2717.6	3.434188
1854	80 23 33.899	948.4	285 57 03.5	105 58 00.0	Mosquito Creek	3849.1	3.585356
Main Key	25 14 48.428	1490.2	184 50 23.0	4 50 28.9	Narrow Point	4554.7	3.658458
1854	80 23 47.635	1333.1	229 34 02.4	49 35 04.7	Mosquito Creek	5367.0	3.729729
Largo North (S)	25 14 07.926	243.9	101 44 41.5	281 43 10.1	Main Key	6128.9	3.787383
1854–1906	80 20 13.220	370.0	157 57 20.8	337 56 51.6	Mosquito Creek	5099.3	3.707512
Largo Point	25 12 01.593	49.0	162 16 32.3	342 16 07.3	Main Key	5389.4	3.731540
1854	80 22 49.008	1372.1	228 16 38.2	48 17 44.6	Largo North (S)	5841.9	3.766555
Clay Point	25 13 11.317	348.2	226 09 19.2	46 10 06.6	Main Key	4314.2	3.634896
1854–1906	80 25 38.815	1086.5	294 16 49.5	114 18 01.8	Largo Point	5215.3	3.717281
Crab Point	25 11 29.628	911.6	133 18 34.4	313 17 43.9	Clay Point	4562.2	3.659171
1854	80 23 40.221	1126.1	178 03 25.5	358 03 22.3	Main Key	6120.6	3.786792
Shell Key	25 10 42.069	1294.5	192 45 08.5	12 45 24.3	Clay Point	4708.5	3.672884
1854	80 26 15.945	446.5	251 26 18.1	71 27 24.4	Crab Point	4599.3	3.662691
Alligator	25 12 27.218	837.5	249 31 51.6	69 32 46.9	Clay Point	3881.6	3.589012
1854–1870	80 27 48.728	1364.1	321 13 59.1	141 14 38.6	Shell Key	4149.3	3.617970
Batti	25 09 37.421	1151.4	178 35 29.1	358 35 27.1	Alligator	5226.2	3.718185
1860–1890	80 27 44.139	1236.2	231 08 45.9	51 09 23.4	Shell Key	3171.2	3.501225
Duck Key	25 10 46.598	1433.8	219 35 09.9	39 35 48.8	Alligator	4017.7	3.603973
1855–1890	80 29 20.180	565.1	271 32 12.0	91 33 30.3	Shell Key	5160.7	3.712711
			308 21 13.4	128 21 54.2	Batti	3429.9	3.535280
Moat	25 08 54.488	1676.6	205 08 04.3	25 08 28.9	Duck Key	3810.5	3.580982
1860–1870	80 30 17.981	503.6	252 56 43.4	72 57 48.8	Batti	4506.6	3.653851
Spit	25 09 43.938	1352.0	252 38 08.0	72 39 41.7	Duck Key	6464.9	3.810562
1861–1870	80 33 00.537	15.0	288 28 14.3	108 29 23.4	Moat	4800.2	3.681260
Pie	25 06 41.366	1272.9	165 03 14.3	345 02 51.6	Spit	5814.4	3.764507
1860	80 32 06.990	195.8	216 41 53.2	36 42 39.5	Moat	5100.1	3.708341
Sever	25 06 33.429	1028.6	93 00 17.2	272 59 06.4	Pie	4674.1	3.669695
1860	80 29 20.389	571.2	159 36 46.1	339 36 21.6	Moat	4630.4	3.665622
			205 27 34.4	25 28 15.3	Batti	6270.5	3.797304
Pigeon	25 03 24.467	752.8	159 33 20.1	339 32 45.9	Pie	6465.9	3.810628
1859–1870	80 30 46.377	1299.9	202 30 22.6	22 30 59.1	Sever	6293.8	3.798911
Low	25 03 04.150	127.7	193 17 59.0	13 18 43.0	Spit	12640.5	4.101765
1859–1860	80 34 44.370	1243.8	213 24 39.6	33 25 46.3	Pie	8007.6	3.903501
			264 37 57.3	84 39 38.1	Pigeon	6700.2	3.826085

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Middle Plantation 1859	24 58 42.572 80 33 24.694	1309.9 692.6	164 29 30.2 207 05 34.4	344 28 56.5 27 06 41.3	Low Pigeon	8352.8 9743.5	3.921832 3.988715
East 1859	24 59 53.061 80 36 36.493	1632.6 1023.4	208 07 28.6 211 00 08.0 236 26 52.1 291 56 55.5	28 08 16.0 31 02 01.9 56 29 20.0 111 58 16.5	Low. Pie Pigeon Middle Plantation	6667.2 14659.4 11775.5 5799.8	3.823946 4.166116 4.070980 3.763410
Mark Key 1859	24 57 15.492 80 35 56.062	476.7 1572.7	166 50 15.7 237 44 13.8	346 49 58.6 57 45 17.7	East Middle Plantation	4979.1 5020.6	3.697147 3.700752
West Key 1859–1890	24 58 58.026 80 39 00.021	1785.4 0.6	247 10 30.2 272 52 28.9 301 25 52.7	67 11 30.8 92 54 50.4 121 27 10.3	East Middle Plantation Mark Key	4366.8 9416.8 6047.9	3.640168 3.973902 3.781608
Upper Matecumbe 1858–1890	24 55 25.848 80 37 56.790	795.3 1593.5	164 48 11.6 195 18 57.5 225 06 27.6	344 47 44.9 15 19 31.2 45 07 18.5	West Key East Mark Key	6765.1 8524.8 4780.6	3.830275 3.930682 3.679480
Torry 1858	24 59 17.247 80 40 16.472	530.7 461.9	297 08 15.2 331 09 56.5	117 10 05.2 151 10 55.4	Mark Key Upper Matecumbe	8208.8 8126.9	3.914282 3.909923
Lignum Vitae 1857	24 54 01.429 80 42 14.839	44.0 416.4	198 51 37.6 250 15 08.6	18 52 27.5 70 16 57.3	Torry Upper Matecumbe	10269.0 7693.2	4.011530 3.886105
Twin Key 1857	24 58 00.583 80 44 38.003	17.9 1066.0	252 09 29.0 259 25 08.3 292 54 13.7 331 21 45.5	72 11 19.4 79 27 30.8 112 57 02.8 151 22 45.9	Torry West Key Upper Matecumbe Lignum Vitae	7705.2 9643.1 12221.3 8383.4	3.886784 3.984215 4.087119 3.923419
Buchanan 1857	24 55 04.920 80 46 46.998	151.4 1318.9	213 47 51.6 284 19 53.1	33 48 46.0 104 21 47.7	Twin Key Lignum Vitae	6504.6 7883.4	3.813223 3.896714
Matecumbe 1857	24 50 59.419 80 44 06.634	1828.6 186.3	149 13 08.0 209 15 30.7	329 12 00.5 29 16 17.7	Buchanan Lignum Vitae	8793.1 6419.5	3.944141 3.807500
Jew Fish 1857	24 50 34.596 80 47 36.542	1064.4 1026.0	189 29 20.2 234 48 30.9 262 36 12.4	9 29 41.0 54 50 46.1 82 37 40.6	Buchanan Lignum Vitae Matecumbe	8432.9 11047.7 5942.9	3.925978 4.043273 3.773995
Rabbit Key 1858	24 58 49.643 80 49 33.563	1527.4 941.3	280 18 09.5 305 44 44.1 325 56 22.1	100 20 14.3 125 47 49.0 145 57 32.4	Twin Key Lignum Vitae Buchanan	8426.3 15170.5 8345.3	3.925635 4.181001 3.921443
Horseneck Shoal East 1857	24 53 20.910 80 51 40.954	643.3 1149.5	199 27 15.8 248 46 49.5 288 49 14.6 306 42 06.7	19 28 09.5 68 48 53.3 108 52 26.1 126 43 49.7	Rabbit Key Buchanan Matecumbe Jew Fish	10727.6 8848.6 13476.1 8559.4	4.030502 3.946873 4.129564 3.932442
Middle Shoal 1857	24 51 51.727 80 57 00.772	1591.5 21.7	224 16 28.5 252 59 05.7	44 19 36.9 73 01 20.2	Rabbit Key Horseneck Shoal East	17967.0 9387.3	4.254475 3.972542
Long Key 1857	24 48 17.356 80 50 55.498	534.0 1558.8	122 45 54.2 172 13 17.3 232 54 25.9	302 43 20.8 352 12 58.2 52 55 50.2	Middle Shoal Horseneck Shoal East Jew Fish	12194.5 9426.6 7003.3	4.086164 3.974356 3.845301
Schooner Bank 1858	24 58 13.319 80 58 31.586	409.8 886.0	265 43 57.5 307 57 41.9 347 44 56.0	85 47 44.7 128 00 35.0 167 45 34.7	Rabbit Key Horseneck Shoal East Middle Shoal	15131.7 14618.2 12014.4	4.179887 4.164894 4.079702
Man of War Bush 1858	25 01 56.104 80 54 45.416	1726.3 1273.2	303 14 60.1 42 47 19.9	123 17 11.9 222 45 44.3	Rabbit Key Schooner Bank	10458.7 9338.8	4.019476 3.970290
Sandy Key 1858	25 02 05.875 81 00 46.203	180.8 1295.3	271 40 53.0 287 42 41.4 332 10 41.4	91 43 25.7 107 47 25.7 152 11 38.3	Man of War Bush Rabbit Key Schooner Bank	10119.0 19804.1 8090.2	4.005137 4.296754 3.907958
Oyster Key 1858	25 06 12.879 80 57 10.728	396.3 300.6	332 43 16.8 8 44 17.3 38 28 59.0	152 44 18.4 188 43 43.0 218 27 27.7	Man of War Bush Schooner Bank Sandy Key	8888.7 14928.7 9707.3	3.948837 4.174022 3.987097
Cape Sable east base 1855	25 08 31.359 81 00 33.076	964.9 926.4	306 55 09.7 1 46 37.7	126 56 35.6 181 46 32.1	Oyster Key Sandy Key	7091.5 11866.8	3.850736 4.074332

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Cape Sable west base 1855–1886	25 07 19.512	600.2	249 52 59.3	69 54 30.8	Cape Sable east base	6431.59	3.808318
	81 04 08.686	243.3	279 54 23.6	99 57 21.0	Oyster Key	11887.9	4.075104
			329 31 56.2	149 33 22.0	Sandy Key	11195.0	4.049026
Cape Sable latitude station 1886–1890	25 06 59.582	1833.3	251 18 22.8	71 18 50.3	Cape Sable west base	1913.7	3.281876
	81 05 13.394	375.5					
Sandy Key 2 1886–1890	25 02 39.026	1200.8	139 49 18.3	319 47 35.8	Cape Sable Lat. Sta.	10495.2	4.020992
	81 01 11.701	328.0	150 07 30.9	330 06 15.9	Cape Sable west base	9954.0	3.997996
Cape Sable middle base 1855–1886	25 07 55.453	1706.3	348 44 00.4	168 44 29.7	Sandy Key 2	9927.4	3.996836
	81 02 20.892	585.2	69 53 31.6	249 52 45.8	Cape Sable west base	3215.8	3.507289
Supplementary points.							
Elliotts Beach 2 1907–8	25 41 25.260	777.3	217 23 26.0	37 24 50.2	Bluff	8905.5	3.949660
	80 14 58.803	1639.7	285 47 43.4	105 50 09.2	Cape Florida L. H.	9749.9	3.988999
			305 48 20.3	125 52 18.1	Fowey Rocks L. H.	18912.0	4.276738
			20 36 30.8	200 35 57.8	Shoal Point	6045.4	3.781422
Soldier Key 2 1907	25 35 25.214	775.9	116 12 14.5	296 09 23.8	Shoal Point	12286.0	4.089410
	80 09 39.915	1113.8	141 15 30.5	321 13 12.6	Elliotts Beach 2	14208.3	4.152543
			183 19 04.8	3 19 12.4	Cape Florida L. H.	8436.1	3.926142
			269 55 54.0	89 57 33.7	Fowey Rocks L. H.	6438.7	3.808798
South Hill 1905	25 45 47.904	1474.1	348 26 42.2	168 27 43.0	Fowey Rocks L. H.	19550.8	4.291165
	80 08 09.524	265.4	10 43 04.3	190 42 32.7	Cape Florida L. H.	10929.9	4.038615
Miami:							
Courthouse dome 1905	25 46 27.693	852.2	281 36 36.7	101 38 09.5	South Hill	6077.2	3.783701
	80 11 43.144	1202.2	334 08 14.4	154 10 47.7	Fowey Rocks L. H.	22643.9	4.354951
			341 50 09.2	161 51 10.2	Cape Florida L. H.	12590.6	4.100045
Halcyon Hall, flagstaff 1905	25 46 28.036	862.8	282 36 37.2	102 38 03.2	South Hill	5651.3	3.752146
	80 11 27.430	764.3	335 09 20.9	155 11 47.4	Fowey Rocks L. H.	22465.9	4.351523
			343 45 52.2	163 46 46.4	Cape Florida L. H.	12471.2	4.095907
			88 37 35.8	268 37 29.0	Miami courthouse dome	438.0	2.641440
North base 1905	25 46 29.666	912.9	275 39 21.6	95 39 29.5	Halcyon Hall Flg.	509.1	2.706813
	80 11 45.613	1271.0	311 25 06.6	131 25 07.7	Miami courthouse dome	91.7	1.962551
			341 37 32.0	161 38 34.1	Cape Florida L. H.	12669.8	4.102771
South base 1905	25 46 25.541	786.0	179 32 27.0	359 32 27.0	Miami north base	126.9	2.103557
	80 11 45.576	1269.9	225 39 35.1	45 39 36.2	Miami courthouse dome	94.8	1.976655
			261 22 07.9	81 22 15.9	Halcyon Hall flagstaff	511.4	2.708767
Longitude station 1905	25 46 29.008	892.6	273 57 14.3	93 57 21.2	Halcyon Hall flagstaff	434.1	2.637614
	80 11 42.974	1197.4	6 41 44.3	186 41 44.3	Miami courthouse dome	40.7	1.609858
			34 12 34.1	214 12 33.0	Miami south base	129.0	2.110586
			105 23 24.4	285 23 23.3	Miami north base	76.3	1.882397
Royal Palm Hotel flagstaff 1905	25 46 17.413	535.8	110 05 48.3	290 05 37.6	Miami south base	728.0	2.862138
	80 11 21.040	586.3	118 50 32.2	298 50 21.5	Miami north base	781.7	2.893018
			279 38 41.6	99 40 04.8	South Hill	5413.4	3.733469
			344 08 30.6	164 09 22.1	Cape Florida L. H.	12107.8	4.083065
Catholic Church spire 1905	25 46 32.724	1007.0	60 25 40.4	240 25 34.2	Miami south base	447.8	2.651088
	80 11 31.599	880.5	76 27 15.8	256 27 09.7	Miami north base	401.7	2.603855
			283 45 02.5	103 46 30.3	South Hill	5797.3	3.763223
			343 26 29.1	163 27 25.1	Cape Florida L. H.	12642.4	4.101828
Methodist Church spire 1905	25 46 30.436	936.6	68 55 50.1	248 55 43.8	Miami south base	419.0	2.622247
	80 11 31.543	878.9	82 08 27.0	262 08 21.8	Miami longitude station	321.5	2.507193
			283 04 35.3	103 06 03.1	South Hill.	5779.4	3.761885
			343 21 24.5	163 22 20.5	Cape Florida L. H.	12574.4	4.099489
Presbyterian Church spire 1905	25 46 25.678	790.2	100 58 01.2	280 57 51.4	Miami north base	645.3	2.809733
	80 11 22.878	637.4	282 09 45.5	102 11 09.6	South Hill	5511.8	3.741295
			344 14 07.1	164 14 59.4	Cape Florida L. H.	12366.4	4.092245

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.							
Miami—Continued	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Standpipe	25 46 14.142	435.2	182 05 07.3	2 05 07.6	Miami north base	478.0	2.679458
1905	80 11 46.237	1288.4	183 00 16.5	3 00 16.8	Miami south base	351.3	2.545643
			340 50 31.7	160 51 34.2	Cape Florida L. H.	12223.1	4.087180
Power-house stack	25 46 15.522	477.7	192 18 16.6	12 18 18.1	Miami north base	445.5	2.648807
1905	80 11 49.020	1365.9	197 17 13.8	17 17 15.3	Miami south base	322.9	2.509047
			340 33 55.2	160 34 58.9	Cape Florida L. H.	12288.8	4.089509
Ice factory smokestack	25 46 48.156	1481.9	13 05 39.2	193 05 36.7	Miami south base	714.5	2.854011
1905	80 11 39.767	1108.0	287 32 57.1	107 34 28.5	South Hill	6144.7	3.788502
			343 04 48.0	163 05 47.7	Cape Florida L. H.	13162.7	4.119344
Lewis (U. S. E.)	25 45 25.243	776.8	262 39 15.6	82 40 40.1	South Hill	5462.8	3.737413
1907	80 11 23.949	667.4	39 03 20.6	219 01 47.4	Elliotts Beach 2	9508.2	3.978097
			61 50 52.5	241 50 43.5	Bluff	657.6	2.817982
Mattheson's tower	25 43 16.049	493.9	303 47 07.1	123 49 28.0	Cape Florida L. H.	10903.7	4.037572
1908	80 14 47.350	1320.0	313 56 32.8	134 00 25.8	Fowey Rocks L. H.	20857.5	4.319263
			329 21 45.8	149 23 58.9	Soldier Key 2	16835.7	4.226231
Florida Reef Beacon	25 45 04.668	143.6	30 55 46.7	210 54 19.0	Cape Florida L. H.	10967.3	4.040098
(north end)	80 06 00.286	8.0	49 35 28.1	229 34 06.4	Key Biscayne	6898.6	3.838758
1908			110 17 00.0	290 16 03.8	South Hill	3839.5	3.584272
Beacon (white)	25 39 46.240	1422.9	114 49 11.6	294 47 29.2	Elliotts Beach 2	7262.8	3.861102
1908	80 11 02.394	66.8	173 20 49.7	353 20 31.4	Bluff	10190.2	4.008182
			262 02 12.3	82 02 55.6	Cape Florida L. H.	2815.6	3.449578
			312 33 00.9	132 35 16.3	Fowey Rocks L. H.	11864.5	4.074249
			344 00 33.8	164 01 09.4	Soldier Key 2	8355.3	3.921961
Key Biscayne Bay chan-	25 39 13.856	426.4	241 26 09.7	61 26 49.3	Cape Florida L. H.	2899.8	3.462364
nel light	80 10 53.728	1498.6	309 35 00.0	129 37 17.7	Fowey Rocks L. H.	11027.3	4.042470
1908			343 40 52.2	163 41 24.1	Soldier Key 2	7330.9	3.865156
			79 48 17.7	259 45 58.7	Shoal Point	9108.1	3.959428
			120 37 28.0	300 35 41.9	Elliotts Beach 2	7941.1	3.899883
			172 42 39.9	352 42 17.9	Bluff	11208.6	4.049553
Cape Florida Shoal Light	25 38 26.324	810.0	324 51 00.6	144 52 01.3	Fowey Rocks L. H.	6807.7	3.833002
1908	80 08 09.637	268.8	24 19 37.6	204 18 58.5	Soldier Key 2	6115.8	3.786453
			144 32 10.4	324 31 38.9	Cape Florida L. H.	3498.0	3.543825
Fowey Rocks Beacon	25 35 38.751	1192.4	282 58 02.0	102 58 29.6	Fowey Rocks L. H.	1828.6	3.262119
1908	80 06 53.048	1480.4	43 02 42.6	223 01 18.3	Mangrove	7997.4	3.902948
			84 53 53.3	264 52 41.2	Soldier Key 2	4675.3	3.669805
Bowles Bank South Bea-	25 29 06.890	212.0	31 38 43.5	211 37 32.3	Elliott 1908	8809.9	3.944969
con	80 09 27.675	773.0	42 53 22.1	222 52 32.2	Point Adelle 2	4763.0	3.677878
1908			91 28 04.2	271 27 34.9	Log	1903.4	3.279522
			114 46 08.1	294 45 38.2	Sands Cut	2136.6	3.329729
			169 35 03.5	349 34 45.7	Mangrove	6316.4	3.800471
			178 19 09.2	358 19 03.7	Soldier Key 2	11646.5	4.066194
			207 37 39.6	27 39 13.8	Fowey Rocks L. H.	13148.1	4.118863
Margot Fish Shoal Beacon	25 26 46.142	1419.8	46 20 56.7	226 20 05.5	Elliott 1908	4591.5	3.661958
1908	80 10 14.190	396.5	113 24 55.2	293 24 25.3	Point Adelle 2	2116.3	3.325587
			172 09 13.0	352 09 03.7	Log	4421.0	3.645517
			173 00 27.9	353 00 18.1	Sands Cut	5264.9	3.721390
			180 51 04.9	0 51 07.4	Mangrove	10546.7	4.023118
			183 25 37.1	3 25 51.8	Soldier Key 2	16000.9	4.204145
Caesars Creek Bank Bea-	25 22 53.669	1651.4	168 50 28.2	348 50 16.1	Elliott 1908	4060.4	3.608564
con	80 11 44.949	1256.6	184 14 48.5	4 14 57.6	Point Adelle 2	8016.2	3.903971
1908			189 30 26.2	9 30 55.8	Log	11693.7	4.067951
Turtle Reef Beacon	25 16 55.240	1699.8	65 52 19.7	245 48 34.9	Point Elizabeth	11861.5	4.074140
1908	80 12 32.264	902.6	130 33 21.9	310 31 59.8	Angelfish Key	7071.0	3.849482
			157 41 50.1	337 41 03.1	Old Rhodes	8109.3	3.908983
Long Reef	25 26 48.381	1488.7	66 58 02.4	246 55 56.1	Elliotts Key No. 2	8933.2	3.951009
1852	80 07 19.122	534.3	127 45 59.0	307 44 34.2	Elliotts Key No. 1	6971.0	3.843298
			155 36 24.3	335 35 09.8	Ragged Key No. 1	11664.0	4.066849
			166 07 11.8	346 06 10.8	Soldier Key	16413.5	4.215200
Caesars Creek Point	25 22 57.431	1767.2	190 18 37.4	10 18 39.9	Christmas Point	892.5	2.950610
1852	80 13 46.207	1291.7	269 46 18.1	89 47 09.3	Caesars Creek Bank	3337.5	3.523423
			15 29 46.6	195 29 31.2	Old Rhodes	3779.8	3.577471

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Old Rhodes Bank	25 20 30.406	935.6	125 34 46.1	305 34 27.2	Old Rhodes	1515.2	3.180483
1852	80 13 38.250	1069.6	179 20 07.3	359 20 06.3	Christmas Point	5402.5	3.732592
			214 28 17.9	34 29 05.6	Caesars Creek Bank	5503.7	3.740652
Basin Hill	25 13 08.381	257.9	211 50 01.5	31 50 21.6	Point Elizabeth	2502.0	3.398289
1852	80 19 46.122	1291.1	281 55 18.3	101 57 00.2	Basin Bank	6841.3	3.835138
			20 22 42.5	200 22 11.0	Upper Sound Point	5934.9	3.773410
Point Mary	25 11 42.760	1315.7	208 41 49.4	28 42 11.4	Basin Hill	3003.5	3.477634
1852	80 20 37.644	1054.0	210 07 11.0	30 07 53.0	Point Elizabeth	5503.5	3.740640
			261 27 27.8	81 29 31.5	Basin Bank	8227.4	3.915261
			330 08 51.6	150 10 00.7	Grecian Shoals	9147.1	3.961285
			12 01 22.3	192 01 12.8	Upper Sound Point	2994.7	3.476352
Basin Hill Beacon	25 13 05.698	175.3	42 41 32.8	222 40 15.9	Upper Sound Point	7455.8	3.872495
1908	80 17 59.390	1662.5	60 03 59.1	240 02 51.7	Point Mary	5112.8	3.708656
			142 56 35.6	322 56 10.2	Point Elizabeth	2767.1	3.442028
			197 56 52.7	17 57 50.3	Angelfish Key	12256.4	4.088363
Elbow Reef Beacon	25 08 20.616	634.3	110 39 29.7	290 37 17.1	Upper Sound Point	9336.0	3.970161
1908	80 15 47.973	1343.8	127 29 46.5	307 27 43.3	Point Mary	10122.1	4.009541
			154 02 35.2	334 01 13.9	Point Elizabeth	12213.1	4.086825
Wreck Point	25 01 23.175	713.1	216 48 28.2	36 48 58.6	Dove Key	3358.1	3.526089
1857–1908	80 29 41.131	1153.2	221 29 38.6	41 30 57.0	Point Charles	7827.6	3.893627
			294 15 45.5	114 17 47.5	Pickles Reef	8871.7	3.948005
			337 57 24.4	157 58 12.7	Conch Reef	8527.6	3.930826
			19 12 19.6	199 12 04.1	Tavanier Key	3130.4	3.495606
			44 16 00.1	224 14 11.9	Plantation Point	10311.8	4.013336
Rodriguez Bank	25 02 53.830	1656.3	186 08 14.1	6 08 19.1	Point Charles	3090.4	3.490012
1852	80 26 47.867	1341.8	216 21 31.8	36 22 43.0	Lower Sound Point	7937.4	3.899680
Excelsior	25 05 25.411	781.9	36 22 34.2	216 22 16.4	Point Charles	1976.4	3.295876
1852–1908	80 25 54.252	1520.2	241 39 37.2	61 40 25.7	Lower Sound Point	3639.6	3.561058
			309 23 56.5	129 25 31.6	Dry Rocks	8143.8	3.910825
			17 51 40.3	197 51 17.5	Rodriguez Bank	4900.1	3.690205
			40 29 03.6	220 27 27.4	Wreck Point	9797.6	3.991121
Libra	25 00 08.694	267.5	224 51 51.8	44 52 26.2	Wreck Point	3233.6	3.509681
1857	80 31 02.490	69.8	297 57 43.8	117 58 02.7	Tavanier Key	1417.2	3.151435
			315 39 58.2	135 41 20.8	Conch Reef	7845.6	3.894627
			5 52 33.1	185 52 17.2	Crockers Reef	10287.6	4.012313
			43 58 47.3	223 57 33.4	Plantation Point	7078.5	3.849944
			277 25 48.2	97 28 24.5	Pickles Reef	10457.5	4.019427
Taurus	24 59 00.095	2.9	230 09 31.4	50 10 09.5	Libra	3294.9	3.517846
1857–1908	80 32 32.710	917.4	249 03 59.8	69 04 56.8	Tavanier Key	4049.1	3.607354
			266 37 33.4	86 40 47.7	Pickles Reef	12922.2	4.111337
			349 40 59.2	169 41 21.4	Crockers Reef	8256.3	3.916784
			38 37 56.0	218 37 20.2	Plantation Point	3819.4	3.581993
			227 31 52.3	47 33 04.8	Wreck Point	6521.5	3.814347
Mosquito Bank Beacon	25 04 21.670	666.8	94 11 14.1	274 09 57.5	Point Charles	5078.9	3.705769
1908	80 23 35.334	990.3	116 44 47.6	296 43 48.8	Excelsior	4359.1	3.639397
			169 25 21.5	349 25 11.1	Lower Sound Point	3752.4	3.574305
French Reef Beacon	25 02 08.766	269.7	115 34 37.6	295 32 16.7	Point Charles	10336.3	4.014365
1908	80 21 03.396	95.2	126 36 01.6	306 33 58.5	Excelsior	10152.1	4.006558
			147 33 05.9	327 31 51.1	Lower Sound Point	9218.0	3.964636
Pickles Reef Beacon	24 59 26.778	823.9	114 05 34.2	294 03 33.4	Wreck Point	8779.0	3.943446
1908	80 24 55.285	1550.4	163 20 51.7	343 20 09.0	Point Charles	9857.1	3.993751
			171 29 02.4	351 28 37.5	Excelsior	11157.9	4.047583
Dove Key 2	25 02 52.112	1603.2	225 01 49.0	45 02 36.3	Point Charles	4423.0	3.645720
1908	80 28 27.736	777.4	229 20 05.7	49 21 59.3	Lower Sound Point	9892.5	3.995305
			251 23 53.9	71 25 57.7	Mosquito Bank Beacon.	8646.5	3.936840
			276 05 07.8	96 08 15.9	French Reef Beacon	12527.3	4.097856
			316 40 24.3	136 41 54.2	Pickles Reef Beacon	8683.2	3.938679
			36 56 37.0	216 56 06.0	Wreck Point	3423.8	3.534504
Triangles Beacon	25 00 38.813	1194.3	111 18 38.2	291 17 45.4	Wreck Point	3757.1	3.574855
1908	80 27 36.288	1017.5	160 37 40.4	340 37 18.6	Dove Key 2	4347.7	3.638262
			197 57 50.1	17 58 33.3	Excelsior	9270.6	3.967108

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Libra 2	25 00 08.619	265.2	44 02 39.8	224 01 25.7	Plantation Point	7083.0	3.850219
1908	80 31 02.175	61.0	50 17 55.4	230 17 17.1	Taurus	3300.2	3.518546
			224 43 26.6	44 44 00.9	Wreck Point	3229.0	3.509066
			260 50 45.8	80 52 12.8	Triangles Beacon	5847.5	3.766969
			277 06 38.1	97 09 13.1	Pickles Reef Beacon	10368.9	4.015732
Conch Reef Beacon	24 57 05.473	168.4	93 00 50.8	272 58 14.6	Plantation Point	10402.1	4.017120
1908	80 27 47.413	1330.2	135 54 09.3	315 52 47.0	Libra 2	7848.3	3.894773
			158 05 45.6	338 04 57.6	Wreck Point	8546.6	3.931791
			173 57 02.4	353 56 45.3	Dove Key 2	10725.5	4.030417
Walker Bank	24 56 48.114	1480.4	233 47 53.8	53 48 15.9	Plantation Point	1823.8	3.260980
1857–1908	80 34 50.178	1407.7	307 16 15.6	127 17 35.7	Crockers Reef	6705.7	3.826447
			20 08 28.0	200 07 30.1	Alligator Reef	11234.4	4.050551
			51 35 23.0	231 32 57.4	Indian Key	12392.6	4.093163
			52 30 25.0	232 28 27.2	Tea Table Key	9907.0	3.995941
Crockers Reef Beacon	24 54 36.188	1113.5	81 30 00.8	261 26 43.5	Tea Table Key	13306.7	4.124072
1908	80 31 41.336	1160.0	127 27 58.5	307 26 38.9	Walker Bank	6674.7	3.824433
			143 19 22.6	323 18 25.1	Plantation Point	6404.9	3.806513
Hen and Chickens Reef	24 55 47.766	1469.7	69 10 04.6	249 07 20.3	Tea Table Key	11728.7	4.069251
Beacon	80 32 59.672	1674.2	120 55 25.7	300 54 39.1	Walker Bank	3613.9	3.557974
1908			150 58 20.0	330 57 55.5	Plantation Point	3355.5	3.525762
			202 19 03.4	22 19 52.9	Libra 2	8676.4	3.938340
			208 20 19.9	28 21 43.7	Wreck Point	11726.6	4.069173
Alligator Reef Lighthouse	24 51 05.697	175.3	115 58 08.1	295 56 40.9	Indian Key	6472.1	3.811046
1908	80 37 08.832	248.0	138 36 46.8	318 35 47.3	Tea Table Key	6003.1	3.778379
			200 15 48.8	20 16 47.1	Walker Bank	11231.3	4.050429
			204 46 45.5	24 48 06.0	Plantation Point	12791.5	4.106923
			211 36 21.0	31 38 55.6	Libra 2	19618.7	4.292671
			213 26 37.8	33 29 46.7	Wreck Point	22775.6	4.357470
Rodriguez Bank (E.)	25 02 53.992	1661.3	46 53 19.7	226 51 47.1	Tavanier Key	8412.5	3.924924
1857	80 26 38.855	1089.1	61 20 20.2	241 19 03.1	Wreck Point	5824.1	3.765227
			88 02 57.1	268 02 10.3	Dove Key	3099.3	3.491268
			181 27 11.9	1 27 13.1	Point Charles	3068.7	3.486956
Hull Key	25 08 31.762	977.3	290 39 37.4	110 40 00.4	Point Willie	1624.3	3.210656
1852–1908	80 23 11.156	312.5	50 07 40.5	230 07 22.7	Largo Sound	1528.7	3.184320
Lesbos	25 07 47.330	1456.3	127 01 09.2	307 01 01.4	Largo Sound	642.9	2.808152
1852	80 23 34.714	972.4	205 45 52.8	25 46 02.8	Hull Key	1518.1	3.181291
Elba	25 07 30.505	938.6	201 15 09.2	21 15 14.3	Largo Sound	970.8	2.987134
1852–1908	80 24 05.602	156.9	239 06 18.7	59 06 31.8	Lesbos	1008.3	3.003596
Petit Coquille	25 07 33.680	1036.3	85 04 08.3	265 03 51.2	Elba	1136.1	3.055418
1852	80 23 25.196	705.8	135 58 51.7	315 58 39.9	Largo Sound	1122.4	3.050133
			192 24 39.0	12 24 44.9	Hull Key	1829.9	3.262428
Tartarus [1]	25 06 48.20	1483.1	295 55 50	115 56 16	Lower Sound Point	1875.4	3.27310
1852	80 25 00.12	3.4	30 46 23	210 46 00	Excelsior	2964.9	3.47201
Avernus [1]	25 06 14.18	436.3	264 47 15	84 47 53	Lower Sound Point	2498.9	3.39775
1852	80 25 28.74	805.2	25 28 31	205 28 20	Excelsior	1662.1	3.22067
Styx [1]	25 06 04.38	134.8	57 37 59	237 37 30	Excelsior	2239.4	3.35013
1852	80 24 46.75	1309.9	104 22 53	284 22 35	Avernus	1214.5	3.08439
Julia Island No. 5	25 07 16.005	492.5	339 41 14.4	159 42 07.3	French Reef	10081.0	4.003504
1852–1908	80 23 07.620	213.5	41 10 14.5	221 09 52.3	Lower Sound Point	2225.8	3.347492
Julia Island No. 4	25 07 49.731	1530.2	217 30 55.1	37 31 03.5	Point Willie	907.9	2.958017
1852	80 22 36.636	1026.2	275 30 59.2	95 32 58.8	Grecian Shoals	7923.3	3.898905
			345 55 22.3	165 56 02.1	French Reef	10816.8	4.034100
			39 54 41.9	219 54 28.8	Julia Island No. 5	1352.8	3.131248
Garden Cove No. 1	25 10 55.579	1710.2	214 25 06.7	34 25 21.8	Point Mary	1759.9	3.245481
1852	80 21 13.173	368.9	345 53 48.5	165 53 54.1	Upper Sound Point	1523.2	3.182753
Great Mangroves	25 09 57.430	1767.1	218 52 47.2	38 53 27.0	Point Mary	4163.6	3.619468
1852	80 22 10.989	307.7	222 08 13.2	42 08 37.8	Garden Cove No. 1	2413.0	3.382552
			261 05 16.1	81 05 46.3	Upper Sound Point	2014.5	3.304173
Julia Island No. 2	25 09 29.840	918.2	211 41 02.5	31 41 27.2	Garden Cove No. 1	3100.3	3.491407
1852	80 22 11.329	317.3	212 40 17.9	32 40 57.7	Point Mary	4858.9	3.686540
			239 51 40.2	59 52 10.5	Upper Sound Point	2312.3	3.364049

[1] No check on this position.

Miami to Long Key and Cape Sable—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Garden Cove No. 2 [1] 1852	25 10 01.87 80 21 49.68	57.5 1391.3	211 44 26 262 49 51	31 44 41 82 50 12	Garden Cove No. 1 Upper Sound Point	1943.1 1404.5	3.28850 3.14751
Julia Island No. 1 [1] 1852	25 09 42.14 80 21 35.18	1296.6 985.2	146 14 31 231 36 24	326 14 25 51 36 39	Garden Cove No. 2 Upper Sound Point	730.5 1260.0	2.86361 3.10038
Largo Sound 1852–1908	25 07 59.910 80 23 53.040	1843.4 1485.8	230 58 42.9 261 24 09.2 3 38 34.9	50 59 56.4 81 24 50.0 183 38 32.0	Upper Sound Point Point Willie Lower Sound Point	6240.1 2723.6 3032.6	3.795193 3.435145 3.481819
Julia Island No. 3 1852–1908	25 09 10.943 80 21 29.982	336.7 839.7	36 27 31.4 205 47 18.2 298 27 01.1	216 27 11.5 25 47 31.0 118 28 32.5	Point Willie Upper Sound Point Grecian Shoals	2211.5 1935.1 6846.1	3.344690 3.286701 3.835445
The Elbow 1852	25 08 34.793 80 15 37.989	1070.5 1064.1	107 35 14.7 124 35 36.8 168 34 51.1 177 55 57.3	287 32 57.9 304 33 29.4 348 34 04.5 357 55 53.5	Upper Sound Point Point Mary El Camino Basin Bank	9457.3 10191.5 15497.5 7007.9	3.975769 4.008239 4.190261 3.845587
Rodriguez Bank (W.) 1857	25 02 57.562 80 27 43.604	1771.2 1222.3	36 26 03.0 48 36 42.7 80 27 16.4 212 36 34.8	216 24 57.7 228 35 52.9 260 26 57.0 32 37 03.4	Tavanier Key Wreck Point Dove Key Point Charles	7283.4 4392.0 1300.5 3511.5	3.862334 3.642664 3.114122 3.545496
Road 1860–1909	25 04 25.968 80 27 58.204	799.0 1631.2	68 08 09.0 149 35 00.2	248 06 57.8 329 34 25.4	Pigeon Sever	5079.1 4548.0	3.705788 3.657825
Tony 1860–1908	25 07 54.973 80 27 43.072	1691.4 1206.5	3 46 22.8 47 22 55.6 112 53 26.8 179 27 24.3	183 46 14.9 227 22 14.3 292 52 21.0 359 27 23.8	Road Sever Moat Batti	6444.9 3705.1 4709.6 3152.4	3.809218 3.568804 3.672988 3.498644
Bruin 1860–1908	25 06 15.870 80 26 13.886	488.3 389.1	40 50 51.4 95 54 51.0 140 40 28.3	220 50 05.7 275 53 31.9 320 39 50.5	Road Sever Tony	4470.0 5253.3 3942.2	3.650304 3.720430 3.595744
Osceola Key 1857–1909	24 51 54.535 80 43 43.936	1678.0 1233.4	138 45 22.7 212 38 07.8	318 44 05.7 32 38 45.3	Buchanan Lignum Vitae	7791.8 4636.6	3.891640 3.666198
Bowlegs Key 1857	24 54 46.454 80 44 34.848	1429.3 977.9	289 24 49.3 344 52 47.1 353 31 49.5	109 25 48.2 164 53 08.5 173 32 02.1	Lignum Vitae Osceola Key Lower Matecumbe	4166.2 5479.3 7030.3	3.619739 3.738724 3.846971

Long Key to Key West.

Principal points.							
Grassy Key 1857	24 46 29.337 80 56 12.570	902.6 353.1	172 13 54.7 249 31 04.4	352 13 34.4 69 33 17.3	Middle Shoal Long Key	10011.3 9506.4	4.000490 3.978015
Horseneck West 1857	24 48 50.140 81 00 48.181	1542.7 1353.1	228 48 04.1 299 12 56.6	48 49 39.6 119 14 52.2	Middle Shoal Grassy Key	8484.6 8871.3	3.928630 3.947987
Stirrup Key 1857	24 44 34.528 81 02 30.703	1062.3 862.8	200 06 25.1 251 35 12.3	20 07 08.1 71 37 50.7	Horseneck West Grassy Key	8375.4 11196.1	3.923007 4.049068
Crescent Shoal 1857–1909	24 45 30.217 81 06 27.451	929.7 771.3	237 08 25.3 284 25 47.7	57 10 47.5 104 27 26.8	Horseneck West Stirrup Key	11343.0 6869.4	4.054728 3.836918
Eagle Cove 1856–57	24 42 01.324 81 04 46.345	40.7 1302.8	156 09 20.9 218 57 22.0	336 08 38.6 38 58 18.7	Crescent Shoal Stirrup Key	7027.2 6062.4	3.846785 3.782643
Pigeon Key 1856–1909	24 42 11.506 81 09 19.505	354.0 548.3	218 19 44.1 249 01 08.4 272 19 13.8	38 20 56.1 69 03 59.4 92 21 08.0	Crescent Shoal Stirrup Key Eagle Cove	7794.8 12303.1 7684.8	3.891805 4.090015 3.885631
Sombrero Key 1856	24 37 38.339 81 06 41.185	1179.6 1158.4	152 06 03.5 201 44 56.7	332 04 57.4 21 45 44.6	Pigeon Key Eagle Cove	9510.8 8711.9	3.978216 3.940113
Bahia Honda 1856	24 39 58.634 81 15 04.726	1804.0 132.9	247 08 16.4 286 55 25.0	67 10 40.6 106 58 55.0	Pigeon Key Sombrero Key	10531.2 14803.7	4.022477 4.170372
Cocoanut Key 1849–1856	24 44 37.451 81 14 05.478	1152.3 153.9	299 10 32.8 10 59 23.3	119 12 32.4 190 58 58.5	Pigeon Key Bahia Honda	9206.5 8738.7	3.964095 3.941447

[1] No check on this position.

Long Key to Key West—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Principal points—Contd.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Little Pine	24 42 56.004	1723.1	244 51 02.2	64 52 41.2	Cocoanut Key	7348.3	3.866187
1856	81 18 02.193	61.6	317 33 24.0	137 34 38.1	Bahia Honda	7394.0	3.868879
Horseshoe Key	24 46 04.000	123.1	297 50 22.6	117 51 37.7	Cocoanut Key	5700.2	3.755894
1856	81 17 04.854	136.4	15 34 08.4	195 33 44.4	Little Pine	6004.4	3.778472
Johnson	24 45 58.680	1805.5	267 40 39.1	87 41 39.5	Horseshoe Key	4053.6	3.607840
1856	81 19 29.019	815.3	336 31 45.4	156 32 21.7	Little Pine	6127.3	3.787267
Driftwood	24 44 27.213	837.3	235 56 55.6	55 57 57.7	Johnson	5027.1	3.701320
1856	81 21 57.272	1609.4	250 03 37.5	70 05 39.9	Horseshoe Key	8739.3	3.941475
			293 00 03.4	113 01 41.7	Little Pine	7177.9	3.855996
Soldier Crab	24 46 39.578	1217.7	284 16 52.6	104 18 06.3	Johnson	5097.6	3.707360
1856	81 22 24.851	698.1	349 13 32.5	169 13 44.1	Driftwood	4145.6	3.617592
Plover Key	24 44 25.214	775.8	228 41 09.0	48 42 19.1	Soldier Crab	6263.2	3.796798
1856	81 25 12.309	345.9	269 20 44.1	89 22 05.7	Driftwood	5481.0	3.738863
Harbor	24 48 45.101	1387.7	299 02 23.0	119 04 06.8	Soldier Crab	7952.7	3.900512
1856	81 26 32.351	908.6	344 17 20.5	164 17 54.1	Plover Key	8306.3	3.919416
Content	24 47 35.717	1098.9	248 17 57.3	68 19 17.5	Harbor	5776.3	3.761654
1856	81 29 43.451	1220.5	307 33 37.7	127 35 31.3	Plover Key	9611.7	3.982801
Budd	24 42 37.356	1149.4	182 34 54.0	2 35 00.2	Content	9189.3	3.963282
1856	81 29 58.187	1635.5	247 32 25.9	67 34 25.5	Plover Key	8692.7	3.939157
Sawyer	24 45 08.235	253.4	229 21 53.9	49 23 12.8	Content	6969.4	3.843199
1856	81 32 51.744	1453.9	313 34 27.9	133 35 40.5	Budd	6733.5	3.828238
Point Dora	24 41 33.911	1043.4	187 33 11.1	7 33 24.1	Sawyer	6652.0	3.822953
1854–1856	81 33 22.862	642.7	251 14 47.3	71 16 12.8	Budd	6075.5	3.783579
Johnstons Key	24 42 39.822	1225.2	225 10 12.8	45 11 21.2	Sawyer	6478.1	3.811450
1854–56	81 35 35.254	990.9	298 34 46.5	118 35 41.8	Point Dora	4238.1	3.627173
Douglas Key	24 40 24.223	745.3	160 02 45.9	340 02 23.4	Johnstons Key	4438.6	3.647246
1854–55	81 34 41.363	1162.9	225 49 20.7	45 49 53.5	Point Dora	3077.0	3.488126
Blake Key	24 40 39.841	1225.8	213 17 02.4	33 17 38.4	Johnstons Key	4416.2	3.645046
1854	81 37 01.478	41.6	254 50 28.9	74 52 00.2	Point Dora	6367.1	3.803946
			276 56 47.2	96 57 45.7	Douglas Key	3968.6	3.598637
Marvin Key	24 42 41.145	1265.9	270 26 42.1	90 27 58.2	Johnstons Key	5119.9	3.709262
1854	81 38 37.403	1051.3	324 08 46.3	144 09 26.4	Blake Key	4604.5	3.663179
Snipe Point	24 41 54.243	1668.9	245 37 11.9	65 37 59.3	Marvin Key	3496.8	3.543674
1854	81 40 30.719	863.5	260 23 55.0	80 25 58.5	Johnstons Key	8422.8	3.925454
			291 15 06.9	111 16 34.3	Blake Key	6312.0	3.800169
Wall Key	24 38 42.305	1301.6	160 02 22.5	340 01 50.7	Snipe Point	6283.0	3.798171
1854	81 39 14.418	405.5	225 56 27.1	45 57 22.6	Blake Key	5201.1	3.716090
Mud Key	24 40 02.681	82.5	208 20 42.2	28 21 09.7	Snipe Point	3900.2	3.591090
1854	81 41 36.594	1028.9	301 43 51.9	121 44 51.2	Wall Key	4701.0	3.672188
Half Moon Key	24 36 26.521	816.0	154 35 25.8	334 34 38.9	Mud Key	7363.3	3.867075
1854	81 39 44.225	1244.1	191 20 43.7	11 20 56.1	Wall Key	4261.0	3.629511
Channel Key	24 36 12.430	382.4	203 42 20.3	23 43 06.4	Mud Key	7737.4	3.888597
1853–54	81 43 27.229	766.0	266 02 01.1	86 03 34.0	Half Moon Key	6288.3	3.798533
Northwest Boca Chica	24 38 28.016	862.0	251 28 42.5	71 30 51.6	Mud Key	9177.5	3.962726
1853–55	81 46 46.091	1296.2	287 27 41.4	107 30 37.3	Half Moon Key	12440.7	4.094842
			306 42 14.7	126 43 37.5	Channel Key	6977.7	3.843715
Supplementary points.							
Molasses Key	24 40 57.093	1756.6	147 04 12.0	327 03 06.7	Cocoanut Key	8078.6	3.907334
1856–1909	81 11 29.193	820.8	237 51 49.9	57 52 44.1	Pigeon Key	4305.0	3.633975
			307 02 19.5	127 04 19.7	Sombrero Key	10148.2	4.006388
			73 28 51.7	253 27 21.7	Bahia Honda	6321.1	3.800795
			108 20 47.9	288 18 03.7	Little Pine	11637.3	4.065853
			124 33 34.9	304 30 14.3	Johnson	16369.3	4.214030
Little Pine 2	24 42 55.684	1713.3	156 45 26.0	336 44 50.0	Johnson	6128.0	3.787316
1909	81 18 02.944	82.7	288 13 20.1	108 16 04.6	Molasses Key	11654.3	4.066486

Long Key to Key West—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Horseshoe Key 2	24 46 03.998	123.0	15 44 27.1	195 44 02.8	Little Pine 2	6019.7	3.779573
1909	81 17 04.841	136.0	87 41 43.1	267 40 42.7	Johnson	4053.9	3.607877
Cocoanut Key 2	24 44 38.312	1178.7	327 09 31.3	147 10 36.5	Molasses Key	8100.3	3.908503
1909	81 14 05.447	153.1	64 41 42.6	244 40 03.3	Little Pine 2	7383.7	3.868272
			117 37 18.4	297 36 03.3	Horseshoe Key 2	5688.3	3.754985
Bahia Honda 2	24 40 00.967	29.7	136 25 45.2	316 24 29.2	Little Pine 2	7420.8	3.870453
1909	81 15 00.963	27.1	190 21 35.8	10 21 59.0	Cocoanut Key 2	8674.8	3.938258
			253 48 49.9	73 50 18.2	Molasses Key	6199.4	3.792351
Pigeon Key 2	24 42 11.074	340.7	57 52 47.3	237 51 53.4	Molasses Key	4280.1	3.631458
1909	81 09 20.253	569.3	119 29 28.9	299 27 29.6	Cocoanut Key 2	9206.9	3.964115
Sombrero Key Lighthouse	24 37 39.544	1216.6	107 11 00.8	287 07 31.7	Bahia Honda 2	14751.4	4.168832
1909	81 06 39.744	1118.0	126 45 58.4	306 43 57.6	Molasses Key	10158.1	4.006813
			151 37 47.1	331 36 40.1	Pigeon Key 2	9495.1	3.977501
Boot Key 2	24 41 18.529	570.1	2 26 09.5	182 26 05.3	Sombrero Key L. H.	6743.4	3.828879
1909	81 06 29.554	830.8	108 37 45.4	288 36 34.1	Pigeon Key 2	5063.5	3.704453
East Washerwoman Shoal Light	24 39 59.966	1845.0	43 11 06.6	223 10 06.5	Sombrero Key L. H.	5924.1	3.772621
1909	81 04 15.601	438.7	98 13 46.4	278 10 45.2	Molasses Key	12316.7	4.090496
			115 14 14.6	295 12 07.3	Pigeon Key 2	9467.2	3.976221
			122 42 05.2	302 41 09.3	Boot Key 2	4475.1	3.650800
East Sister Key 2	24 41 13.200	406.1	350 35 44.8	170 35 50.3	E. Washerwoman Shoal Lt.	2283.9	3.358680
1909	81 04 28.873	811.6	29 14 58.1	209 14 03.5	Sombrero Key L. H.	7533.3	3.876988
			92 46 26.8	272 45 36.3	Boot Key 2	3396.6	3.531046
Jacob's Harbor Heads Beacon	24 41 22.308	686.4	49 59 48.5	229 57 47.4	Sombrero Key L. H.	10657.8	4.027669
1909	81 01 49.480	1391.1	86 25 50.3	266 24 43.7	E. Sister Key 2	4489.7	3.652216
			89 10 13.0	269 08 15.9	Boot Key 2	7874.4	3.896217
West Bahia Honda 2	24 39 12.067	371.3	163 47 36.5	343 47 06.8	Little Pine 2	7165.0	3.855218
1909	81 16 51.794	1456.5	204 58 06.4	24 59 16.0	Cocoanut Key 2	11073.6	4.044289
			244 13 24.6	64 14 10.9	Bahia Honda 2	3460.6	3.539151
			279 21 15.3	99 25 30.6	Sombrero Key L. H.	17446.6	4.241710
Middle Summerland 2	24 39 12.085	371.8	184 02 46.0	4 02 53.2	Little Pine 2	6896.8	3.838647
1909	81 18 20.258	569.6	270 00 28.5	90 01 05.4	W. Bahia Honda 2	2487.6	3.395785
Crayfish	24 40 24.855	764.7	193 22 48.3	13 23 04.7	Little Pine 2	4770.2	3.678535
1909	81 18 42.218	1187.0	305 47 44.2	125 48 30.3	W. Bahia Honda 2	3828.3	3.583006
			344 34 48.2	104 34 57.3	Middle Summerland 2	2322.5	3.365961
Sand	24 40 14.177	436.2	263 17 15.4	83 17 56.9	Crayfish	2813.2	3.449195
1909	81 20 21.589	607.0	299 14 25.0	119 15 15.7	Middle Summerland 2	3910.1	3.592188
Pine	24 38 42.046	1293.6	158 39 47.4	338 39 31.0	Sand	3043.3	3.483342
1909	81 19 42.207	1186.9	208 03 56.7	28 04 21.8	Crayfish	3584.8	3.554469
			248 08 29.2	68 09 03.4	Middle Summerland 2	2482.9	3.394965
Knights Key Dock, outer end [1]	24 42 12.54	385.8	302 55 26	122 56 04	Boot Key 2	3056.8	3.48527
1909	81 08 00.82	23.0	344 48 32	164 49 06	Sombrero Key L. H.	8703.0	3.93967
Knights Key Beacon a	24 40 26.722	822.2	98 43 16.6	278 41 45.8	Molasses Key	6171.6	3.790400
1909	81 07 52.208	1468.0	142 22 32.9	322 21 56.1	Pigeon Key 2	4054.0	3.607882
			235 32 49.1	55 33 23.6	Boot Key 2	2817.9	3.449926
Knights Key Beacon b	24 40 58.969	1814.3	89 28 20.1	269 26 49.0	Molasses Key	6119.0	3.786681
1909	81 07 51.551	1449.3	131 39 52.6	311 39 15.5	Pigeon Key 2	3337.6	3.523432
			255 21 48.9	75 22 23.1	Boot Key 2	2382.5	3.377026
Knights Key Beacon c	24 41 00.944	29.0	88 51 49.7	268 50 21.7	Molasses Key	5912.3	3.771754
1909	81 07 58.937	1657.0	133 21 08.3	313 20 34.3	Pigeon Key 2	3143.4	3.497403
			257 50 38.4	77 51 15.7	Boot Key 2	2570.4	3.410004
Knights Key Beacon d	24 39 56.167	1728.1	106 07 01.4	286 05 25.0	Molasses Key	6758.1	3.829827
1909	81 07 38.256	1075.6	145 22 04.5	325 21 22.0	Pigeon Key 2	5044.9	3.702854
			217 18 44.1	37 19 12.8	Boot Key 2	3186.3	3.503287

[1] No check on this position—not a definite point.

Long Key to Key West—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm.
Supplementary points—Con.	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Coffins Patches Beacon	24 41 09.532	293.3	66 39 00.4	246 35 18.7	Sombrero Key L. H.	16279.9	4.211651
1909	80 57 48.331	1358.8	90 35 50.6	270 33 03.3	E. Sister Key 2	11261.0	4.051576
			91 06 45.1	271 03 07.3	Boot Key 2	14655.6	4.166004
Middle Summerland flagstaff	24 39 17.270	531.4	75 50 54.1	255 50 44.7	Middle Summerland 2	652.4	2.814528
1909	81 17 57.761	1624.4	113 25 04.3	293 24 04.2	Sand	4406.9	3.644136
			148 59 24.4	328 59 05.8	Crayfish	2426.2	3.384932
Middle Summerland office, east gable	24 39 16.012	492.6	79 12 34.9	259 12 25.5	Middle Summerland 2	645.3	2.809770
1909	81 17 57.715	1623.0	113 52 16.3	293 51 16.2	Sand	4423.6	3.645778
			149 25 43.8	329 25 25.2	Crayfish	2460.1	3.390958
Key Signal	24 39 51.538	1585.7	165 12 43.1	345 12 39.1	Crayfish	1060.2	3.025382
1909	81 18 32.593	916.4	293 11 15.4	113 11 57.4	W. Bahia Honda 2	3083.6	3.489059
			344 03 05.3	164 03 10.4	Middle Summerland 2	1262.5	3.101218
Channel Key 1857	24 47 36.273	1116.0	44 26 12.8	224 25 42.7	Grassy Key	2884.1	3.460013
1857–1888	80 55 00.693	19.5	103 07 45.0	283 05 19.3	Horseneck West	10020.9	4.000905
			156 47 14.9	336 46 24.5	Middle Shoal	8552.6	3.932099
Duck Key	24 45 56.595	1741.3	113 07 18.3	293 06 43.1	Grassy Key	2566.0	3.409251
1857–1889	80 54 48.569	1364.5	173 39 49.2	353 39 44.1	Channel Key 1857	3085.7	3.489360
Conch Key	24 47 20.241	622.8	43 59 41.3	223 59 04.2	Duck Key	3577.1	3.553532
1857	80 53 20.132	565.5	72 05 34.2	252 04 21.9	Grassy Key	5090.9	3.706797
			99 54 42.6	279 54 00.4	Channel Key 1857	2867.4	3.457494
Willie	24 45 35.802	1101.6	157 26 08.0	337 25 30.9	Horseneck West	6475.3	3.811261
1857–1909	80 59 19.707	553.7	242 59 25.3	63 01 13.8	Channel Key 1857	8166.1	3.912013
			252 35 37.1	72 36 55.5	Grassy Key	5509.5	3.741116
Bamboo	24 45 20.267	623.6	69 54 26.4	249 53 29.1	Stirrup Key	4094.9	3.612239
1857–1909	81 00 13.849	389.1	171 30 27.2	351 30 12.8	Horseneck West	6529.0	3.814847
Rockwell's No Name	24 41 53.582	1648.6	152 27 01.7	332 26 25.0	Driftwood	5331.6	3.726861
1856	81 20 29.517	829.7	159 47 12.7	339 46 24.3	Soldier Crab	9377.4	3.972081
			192 42 05.5	12 42 30.7	Johnson	7730.4	3.888201
			245 06 36.3	65 07 37.9	Little Pine	4564.7	3.659416

Key West Harbor and Hawk Channel.

Tifts Oservatory	24 33 34.536	1062.6	197 29 50.8	17 30 33.0	NW. Boca Chica	9467.9	3.976254
1853	81 48 27.312	768.6	240 04 05.0	60 06 09.8	Channel Key	9741.1	3.988606
East Point	24 34 17.124	526.9	74 15 10.3	254 14 01.6	Tifts Observatory	4825.2	3.683519
1849	81 45 42.283	1189.8	166 54 47.4	346 54 20.8	NW. Boca Chica	7925.2	3.899009
Fleming Key	24 34 43.472	1337.5	282 19 42.7	102 20 37.5	East Point	3794.3	3.579134
1849	81 47 54.017	1519.9	23 50 05.3	203 49 51.5	Tifts Observatory	2318.7	3.365238
			195 27 22.7	15 27 51.0	NW. Boca Chica	7168.0	3.855395
Barracks	24 33 41.333	1271.7	81 56 40.7	261 56 18.9	Tifts Observatory	1491.8	3.173701
1849	81 47 34.826	980.0	164 13 40.4	344 13 32.4	Fleming Key	1986.6	3.298118
			250 49 12.6	70 49 59.4	East Point	3352.9	3.525422
Cottrell Key	24 36 04.583	141.0	252 55 02.6	72 58 35.7	NW. Boca Chica	15048.3	4.177488
1849–1851	81 55 17.573	494.4	291 46 27.0	111 49 17.6	Tifts Observatory	12432.2	4.094550
West Crawfish Key	24 32 19.564	601.9	151 11 48.0	331 10 51.8	Cottrell Key	7901.2	3.897696
1849	81 53 02.252	63.4	242 56 27.2	62 58 34.0	Fleming Key	9738.9	3.988510
			253 23 04.6	73 24 58.8	Tifts Observatory	8074.3	3.907104
Man Key	24 31 27.405	843.2	207 28 50.4	27 29 56.0	Cottrell Key	9613.4	3.982875
1851	81 57 55.261	1555.5	256 13 03.1	76 16 58.9	Tifts Observatory	16456.6	4.216341
			258 58 20.2	79 00 21.8	West Crawfish Key	8402.2	3.924391
Sand Key	24 27 12.942	398.2	131 23 19.1	311 21 08.2	Man Key	11845.5	4.073553
1849	81 52 39.551	1113.9	176 07 30.6	356 07 21.2	West Crawfish Key	9455.4	3.975679
			211 09 12.3	31 10 56.9	Tifts Observatory	13721.0	4.137385
Stock Island	24 33 48.696	1498.2	86 57 54.6	266 55 53.9	Tifts Observatory	8183.3	3.912928
1853	81 43 36.926	1039.1	148 14 39.9	328 13 21.2	NW. Boca Chica	10108.1	4.004670

Key West Harbor and Hawk Channel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Western Sambo 1853	24 28 51.276 81 43 04.328	1577.6 121.9	133 48 20.9 174 16 31.4	313 46 06.9 354 16 17.9	Tifts Observatory Stock Island	12594.3 9196.6	4.100174 3.963626
Rock Point 1853–1855	24 33 30.895 81 41 08.805	950.5 247.8	20 42 48.8 97 29 37.7	200 42 00.8 277 28 36.1	Western Sambo Stock Island	9197.1 4204.1	3.963651 3.623672
Sand Key Lighthouse 1853–1905	24 27 13.423 81 52 39.576	413.0 1114.6	205 35 21.2 211 11 16.9 231 26 49.8 259 26 20.8	25 37 48.0 31 13 01.5 51 30 34.9 79 30 19.0	NW. Boca Chica Tifts Observatory Stock Island Western Sambo	23016.3 13708.7 19526.5 16477.5	4.362035 4.136997 4.290624 4.216890
Key West Lighthouse 1849–1905	24 33 01.504 81 48 03.718	46.3 104.6	35 57 57.7 81 17 10.5 146 50 35.1 192 15 37.2 239 40 58.8	215 56 03.3 261 15 06.5 326 50 25.3 12 16 09.7 59 41 57.8	Sand Key L. H. West Crawfish Key Tifts Observatory NW. Boca Chica East Point	13229.1 8500.6 1214.0 10280.5 4610.3	4.121530 3.929451 3.084217 4.012014 3.663726
NW. Passage Lighthouse 1903	24 37 07.465 81 53 57.405	229.7 1614.7	307 13 51.8 353 09 38.7	127 16 18.9 173.10 11.0	Key West L. H. Sand Key L. H.	12501.8 18407.6	4.096972 4.264998
Woman Key 1903–4	24 31 43.721 81 55 07.424	1345.2 209.0	191 11 04.8 258 37 42.9 333 23 59.6	11 11 33.9 78 40 38.9 153 25 00.9	NW. Passage L. H. Key West L. H. Sand Key L. H.	10153.6 12163.3 9300.0	4.006621 4.085051 3.968480
Boca Grande 1903	24 31 49.352 81 59 56.915	1518.4 1602.0	225 55 29.4 263 38 53.8 304 33 28.9	45 57 58.9 83 43 50.0 124 36 30.2	NW. Passage L. H. Key West L. H. Sand Key L. H.	14075.6 20195.7 14956.7	4.148468 4.305260 4.174835
Mule Key 1903	24 34 51.313 81 56 56.940	1578.7 1602.1	230 19 03.6 282 39 30.0 332 46 10.8	50 20 18.4 102 43 11.7 152 47 57.6	NW. Passage L. H. Key West L. H. Sand Key L. H	6561.8 15380.5 15841.6	3.817024 4.186970 4.199779
West Crawfish Key 1903–4	24 32 10.420 81 52 58.311	320.6 1641.2	356 41 42.0 169 41 31.1 259 14 57.9	176 41 49.8 349 41 06.6 79 17 00.3	Sand Key L. H. NW. Passage L. H. Key West L. H.	9152.8 9289.2 8439.0	3.961556 3.967980 3.926288
Middle-ground Beacon 1911	24 34 15.665 81 49 57.560	482.0 1619.7	19 21 18.2 128 05 14.3 305 27 10.9	199 20 11.0 308 03 34.4 125 27 58.1	Sand Key L. H. NW. Passage L. H. Key West L. H.	13768.5 8571.5 3933.2	4.138885 3.933056 3.594740
Western Dry Rocks Beacon 2 1903	24 26 46.344 81 55 37.109	1425.8 1045.2	188 20 55.1 227 51 12.6 260 31 47.5	8 21 36.5 47 54 20.6 80 33 01.0	NW. Passage L. H. Key West L. H. Sand Key L. H.	19315.0 17209.8 5069.3	4.285894 4.235777 3.704945
Eastern Dry Rock Beacon 4 1903	24 27 37.305 81 50 39.893	1147.8 1123.5	77 42 36.3 162 25 40.2 203 46 45.2	257 41 46.8 342 24 18.2 23 47 50.0	Sand Key L. H. NW. Passage L. H. Key West L. H.	3449.9 18401.9 10900.6	3.537808 4.264862 4.037452
Northwest Bar Light 1911	24 37 47.693 81 53 42.592	1467.4 1197.9	312 42 17.0 354 48 11.7 18 36 20.9	132 44 38.0 174 48 37.9 198 36 14.8	Key West L. H. Sand Key L. H NW. Passage L. H.	12978.1 19595.0 1306.0	4.113210 4.292145 3.115937
Middle-ground Beacon 3 [1] 1903	24 28 55.95 81 52 57.13	1721.4 1608.6	227 32 08 351 05 34	47 34 10 171 05 41	Key West L. H. Sand Key L. H.	11193.8 3193.0	4.048976 3.504199
East Crawfish Key [1] 1903	24 33 41.15 81 51 37.74	1266.1 1062.0	281 26 13 8 18 25	101 27 42 188 17 59	Key West L. H. Sand Key. L. H.	6145.2 12055.5	3.788537 4.081186
Man Key 1903 [1] 1903	24 31 16.19 81 57 51.89	498.1 1460.7	211 23 28 310 19 29	31 25 06 130 21 39	NW. Passage L. H. Sand Key L. H.	12662.6 11537.9	4.102524 4.062127
West Martello Tower 1905	24 32 48.629 81 47 10.180	1496.2 286.5	41 58 54.9 104 43 58.7	221 56 38.3 284 43 36.5	Sand Key L. H. Key West L. H.	13869.7 1557.9	4.142067 3.192552
East Martello Tower 1905–1909	24 33 07.732 81 45 18.276	237.9 514.3	48 45 43.5 79 26 06.5 87 39 09.7	228 42 40.5 259 25 20.0 267 38 01.1	Sand Key L. H. West Martello Tower Key West L. H.	16528.6 3203.8 4660.0	4.218236 3.505661 3.668386
Ship Channel Shoal Beacon 5 1905	24 28 22.280 81 45 53.742	685.5 1513.4	79 31 21.4 156 56 13.3 165 17 27.0 186 29 01.3	259 28 33.4 336 55 19.4 345 16 55.3 6 29 16.0	Sand Key L. H. Key West L. H. West Martello Tower East Martello Tower	11624.1 9337.7 8472.6 8839.1	4.065359 3.970238 3.928015 3.946407
Eastern Triangle Beacon 1903–5	24 30 33.608 81 48 12.814	1034.0 360.8	50 39 58.1 141 21 09.0 183 13 12.9 202 59 34.3 226 00 15.1	230 38 07.5 321 18 45.8 3 13 16.7 23 00 00.3 46 01 27.3	Sand Key L. H. NW. Passage L. H. Key West L. H. West Martello Tower East Martello Tower	9713.8 15520.0 4557.5 4512.8 6828.1	3.987390 4.190892 3.658728 3.654449 3.834298

[1] No check on this position.

Key West Harbor and Hawk Channel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Western Sambo Beacon R 1905	24 29 06.691 81 42 19.031	205.9 535.9	78 45 28.7 126 41 21.4 129 48 53.5 145 46 45.6	258 41 11.7 306 38 58.4 309 46 52.7 325 45 31.1	Sand Key L. H. Key West L. H. West Martello Tower East Martello Tower	17819.5 12097.3 10667.9 8969.9	4.250895 4.082687 4.028078 3.952786
Eastern Sambo Beacon A 1905–1909	24 29 34.617 81 39 50.894	1065.0 1432.9	78 41 48.4 114 40 31.6 125 27 02.2	258 36 30.0 294 37 07.1 305 24 46.2	Sand Key L. H. Key West L. H. East Martello Tower	22078.0 15263.5 11310.2	4.343960 4.183653 4.053471
Monte Cristo Tower flagstaff 1908	24 33 22.817 81 47 30.594	702.0 861.0	277 05 48.1 331 21 24.2 54 52 41.5	97 06 43.0 151 21 32.7 234 52 27.7	East Martello Tower West Martello Tower Key West L. H.	3752.6 1198.5 1139.7	3.574329 3.078047 3.056801
Tyne's (Ed.) house, windmill 1908	24 33 07.871 81 47 04.224	242.2 118.9	270 04 32.0 15 48 32.7 83 19 50.4	90 05 15.9 195 48 30.2 263 19 25.7	East Martello Tower West Martello Tower Key West L. H.	2981.7 615.3 1685.7	3.474465 2.789073 3.226792
Wireless pole (near La Brisa) 1908	24 32 48.822 81 47 44.749	1502.1 1259.5	126 09 49.5 261 57 28.7 270 20 53.5	306 09 41.6 81 58 29.4 90 21 07.9	Key West L. H. East Martello Tower West Martello Tower	661.2 4163.1 972.9	2.820355 3.619420 2.988082
Garrison flagstaff 1908	24 33 40.083 81 47 33.500	1233.2 942.7	284 38 59.5 337 28 57.0 35 37 16.7	104 39 55.6 157 29 06.7 215 37 04.1	East Martello Tower West Martello Tower Key West L. H.	3933.5 1713.7 1460.2	3.594777 3.233944 3.164403
Wireless pole, north 1908	24 33 23.389 81 48 21.375	719.6 601.6	275 19 47.7 298 05 13.0 323 34 12.7	95 21 03.7 118 05 42.6 143 34 20.0	East Martello Tower West Martello Tower Key West L. H.	5175.4 2271.2 836.8	3.713940 3.356255 2.922645
Key West Post Office flagstaff 1908	24 33 29.294 81 48 25.571	901.3 719.7	277 09 44.9 300 31 21.2 324 16 14.6	97 11 02.6 120 31 52.5 144 16 23.7	East Martello Tower West Martello Tower Key West L. H.	5312.5 2463.1 1053.2	3.725300 3.391489 3.022522
Key West longitude station 1896	24 33 28.28 81 48 26.02	870.1 732.3					
Key West longitude station 1907	24 33 28.24 81 48 25.99	868.8 731.4					
Key West latitude station 1896	24 33 28.28 81 48 26.06	870.1 733.6	270	90	Key West long. sta. '96	1.27	0.10380
Key West Naval Monument 1873–1896	24 33 29.65 81 48 24.09	912.3 678.0					
Key West naval storehouse flagstaff 1896	24 33 30.92 81 48 25.98	951.3 731.1					
Key West Russell House, flagstaff 1896	24 33 34.17 81 48 21.50	1051.3 605.1					
Havana-American Trust factory tower 1908	24 33 24.610 81 46 41.315	757.2 1162.8	282 31 23 36 16 24 72 57 42	102 31 57 216 16 12 252 57 08	East Martello Tower West Martello Tower Key West L. H.	2393.9 1373.1 2425.5	3.379110 3.137706 3.384809
Methodist Church spire (Eaton Street) 1908	24 33 26.954 81 48 08.016	829.3 225.6	277.02 51.6 305 55 04.5 351 13 07.6	97 04 02.0 125 55 28.5 171 13 09.4	EastMartello Tower West Martello Tower Key West L. H.	4813.3 2009.9 7923.1	3.682447 3.303172 2.898893
Kingfish Shoal 1907	24 33 23.093 81 50 21.745	710.5 612.0	18 50 47.5 138 41 55.4 279 41 44.4	198 49 50.3 318 40 25.7 99 42 41.7	Sand Key L. H. NW. Passage L. H. Key West L. H.	12017.3 9190.8 3940.8	4.079807 3.963355 3.595589
Rock Point 2 1909	24 33 29.999 81 41 07.462	923.0 210.0	343 25 19.6 13 58 09.7 84 28 14.6	163 25 51.4 193 57 40.0 264 26 30.4	East. Sambo Beacon West. Sambo Beacon East Martello Tower	7555.9 8347.9 7091.6	3.878287 3.921579 3.850747
Saddle Hills N. 2 1909	24 35 11.101 81 36 12.260	342.6 344.9	308 42 36.3 30 44 24.1 69 29 14.2	128 44 41.8 210 42 53.3 249 27 11.4	American Shoal L.H. East. Sambo Beacon Rock Point. 2	10890.3 12043.4 8869.8	4.037038 4.080748 3.947916
Saddle Hills S. 2 1909	24 34 29.930 81 38 37.048	920.9 1042.5	293 46 53.6 12 53 23.6 32 09 11.7 66 28 07.8	113 49 59.1 192 52 52.9 212 07 39.5 246 27 05.3	American Shoal L.H. East. Sambo Beacon West. Sambo Beacon Rock Point 2	13740.2 9320.6 9329.4 4616.8	4.137994 3.969444 3.969855 3.664340

Key West Harbor and Hawk Channel—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
American Shoal Lighthouse 1909	24 31 29.659	912.5	76 27 04.2	256 23 28.3	East. Sambo Beacon	15075.5	4.178271
	81 31 10.371	291.9	97 15 17.9	277 09 25.7	East Martello Tower	24055.1	4.381208
			102 27 33.4	282 23 25.4	Rock Point 2	17208.3	4.235739
			128 44 41.7	308 42 36.3	Saddle Hills N. 2	10890.3	4.037038
Maryland Shoal Beacon 1909	24 30 42.449	1306.0	113 56 01.4	293 53 09.9	Rock Point 2	12719.0	4.104454
	81 34 14.358	404.2	133 26 42.4	313 24 53.4	Saddle Hills S. 2	10180.7	4.007778
			158 08 03.0	338 07 14.0	Saddle Hills N. 2	8906.8	3.949721
			254 19 25.5	74 20 41.9	American Shoal L.H.	5379.2	3.730714
Sugarloaf 2 1909	24 36 12.516	385.1	333 02 57.6	153 04 02.9	American Shoal L.H.	9762.2	3.989548
	81 33 47.551	1337.7	4 15 10.8	184 14 49.7	Md. Shoal Beacon	10183.2	4.007884
			65 06 38.2	245 05 38.0	Saddle Hills N. 2	4488.3	3.652083
Pelican Key Light 1909	24 33 13.225	406.9	94 32 22.3	274 30 46.0	Rock Point 2	6540.1	3.815586
	81 37 15.790	444.4	135 54 33.5	315 53 59.7	Saddle Hills S. 2	3286.1	3.516676
			206 14 09.6	26 14 35.9	Saddle Hills N. 2	4043.4	3.606742
			226 42 53.8	46 44 20.4	Sugarloaf 2	8047.4	3.905653
			287 11 33.3	107 14 05.0	American Shoal L.H.	10767.3	4.032108
Fourfoot Shoal Beacon 1909	24 33 20.057	617.1	307 07 46.5	127 08 52.6	American Shoal L.H.	5626.0	3.750196
	81 33 49.715	1399.1	91 26 51.5	271 23 49.6	Rock Point 2	12322.8	4.090710
			104 54 20.8	284 52 21.4	Saddle Hills S. 2	8366.5	3.922542
			130 25 54.7	310 24 55.3	Saddle Hills N. 2	5268.8	3.721714
			180 39 28.4	0 39 29.2	Sugarloaf 2	5306.4	3.724801

Key West to Rebecca Shoal Lighthouse.

North 1911	24 35 48.951	1506.1	264 06 20.5	84 12 09.7	NW. Passage L. H.	23717.1	4.375062
	82 07 56.130	1579.1	301 31 45.2	121 38 05.6	Sand Key L. H.	30285.6	4.481230
South 1911	24 32 52.796	1624.4	207 35 27.1	27 36 09.0	North	6115.5	3.786433
	82 09 36.810	1036.1	253 26 00.7	73 32 31.5	NW. Passage L. H.	27568.0	4.440405
			289 58 20.0	110 05 21.8	Sand Key L. H.	30483.6	4.484066
Bad 2 1911	24 36 35.008	1077.1	274 35 16.4	94 39 35.7	North	17578.2	4.244975
	82 18 18.954	533.2	294 55 30.2	114 59 07.4	South	16204.4	4.209634
Quick 1911	24 32 39.449	1213.7	189 49 22.9	9 49 41.4	Bad 2	7355.3	3.866603
	82 19 03.563	100.3	252 42 53.4	72 47 31.0	North	19665.0	4.293694
			268 29 33.4	88 33 28.8	South	15956.2	4.202929
Squall 1911	24 36 46.183	1420.9	271 58 24.6	92 00 50.8	Bad 2	9882.4	3.994861
	82 24 10.055	282.8	311 20 19.9	131 22 27.4	Quick	11489.0	4.060282
Moon 1911	24 32 26.659	820.2	210 28 31.1	30 29 40.6	Squall	9265.6	3.966875
	82 26 57.112	1607.4	242 18 43.4	62 22 18.9	Bad 2	16460.7	4.216449
			268 16 53.5	88 20 10.2	Quick	13333.9	4.124957
Rebecca Shoal L. H. 1911	24 34 42.939	1321.1	258 22 33.1	78 27 06.7	Squall	18879.9	4.276001
	82 35 07.471	210.2	286 52 22.7	106 55 46.5	Moon	14422.3	4.159034
New 1911	24 40 21.374	657.6	344 19 04.7	164 19 32.2	Squall	6876.7	3.837381
	82 25 16.134	453.7	11 00 42.0	190 59 59.9	Moon	14879.3	4.172583
			57 59 07.4	237 55 01.0	Rebecca Shoal L. H.	19622.9	4.292763
Ground 1911	24 40 32.398	996.8	310 04 48.4	130 06 57.0	Bad 2	11339.6	4.054600
	82 23 27.395	770.2	9 46 56.7	189 46 38.9	Squall	7062.7	3.848968
			61 24 14.4	241 19 22.7	Rebecca Shoal L. H.	22434.7	4.350921
Shoal 1911	24 40 25.015	769.6	43 13 21.6	223 11 47.8	Squall	9237.6	3.965560
	82 20 25.157	707.3	67 04 06.9	246 58 01.7	Rebecca Shoal L. H.	26956.0	4.430655
			333 21 26.6	153 22 19.2	Bad 2	7916.9	3.898552

Dry Tortugas.

Loggerhead Key L. H. 1875–1901	24 37 59.161	1820.2	280 01 24.2	100 09 46.2	Rebecca Shoal L. H.	34449.4	4.537181
	82 55 13.127	369.2					
East Key 1901	24 39 05.615	172.8	289 49 47.7	109 55 18.7	Rebecca Shoal L. H.	23771.2	4.376051
	82 48 22.211	624.6	79 59 25.5	259 56 34.1	Loggerhead Key L. H.	11735.6	4.069506

Dry Tortugas—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
Garden Key L. H. 1901	24 37 40.634	1250.2	96 40 17.0	276 39 04.6	Loggerhead Key L. H.	4914.3	3.691463
	82 52 19.579	550.7	248 35 49.9	68 37 28.9	East Key	7169.4	3.855482
			280 36 14.7	100 43 24.4	Rebecca Shoal L. H.	29545.0	4.470484
Bastion A 1875–1896	24 37 46.458	1429.4	94 40 28.7	274 39 17.7	Loggerhead Key L. H.	4806.0	3.681783
	82 52 22.815	641.5	250 11 27.7	70 13 08.1	East Key	7191.5	3.856820
			333 04 15.2	153 04 16.5	Garden Key L. H. 1901	201.0	2.303211
Hospital Key 1875–1901	24 38 52.341	1610.4	265 01 59.2	85 03 09.0	East Key	4726.2	3.674511
	82 51 09.647	271.3	41 43 07.5	221 42 38.3	Garden Key L. H. 1901	2955.6	3.470647
			45 26 04.7	225 25 34.2	Bastion A	2888.5	3.460667
			76 34 30.7	256 32 49.2	Loggerhead Key L. H.	7040.2	3.847585
Middle Key 2 1901	24 38 59.575	1832.9	61 31 14.4	241 30 08.0	Garden Key L. H. 1901	5092.1	3.706894
	82 49 40.442	1137.2	63 46 58.1	243 45 50.4	Bastion A	5090.5	3.706763
			84 56 06.1	264 55 28.9	Hospital Key	2518.4	3.401129
Bird Key 2 1896–1901	24 37 18.298	563.0	109 34 13.0	289 33 20.6	Loggerhead Key L. H.	3754.8	3.574581
	82 53 07.336	206.4	235 19 07.3	55 19 25.9	Bastion A	1522.7	3.182626
			242 54 14.5	62 54 34.4	Garden Key L. H. 1901	1508.8	3.178646
Stack 1901	24 37 36.958	1137.1	98 08 19.1	278 07 08.2	Loggerhead Key L. H.	4831.2	3.684059
	82 52 23.079	649.1	221 02 46.5	41 02 47.9	Garden Key L. H. 1901	149.9	2.175863
			221 40 41.5	41 41 12.1	Hospital Key	3105.5	3.492134
Signal station 1901	24 37 45.022	1385.2	95 06 04.6	275 04 52.2	Loggerhead Key L. H.	4902.2	3.690391
	82 52 19.516	549.0	115 27 42.5	295 27 41.1	Bastion A	102.8	2.011829
			223 29 16.3	43 29 45.4	Hospital Key	2855.0	3.455608
Garden Key Lighthouse weather vane 1901	24 37 39.267	1208.1	97 13 48.7	277 12 37.1	Loggerhead Key L. H.	4870.0	3.687532
	82 52 21.347	600.4	169 25 23.2	349 25 22.6	Bastion A	225.1	2.352293
			221 53 03.1	41 53 33.0	Hospital Key	3020.1	3.480018
Hospital, north gable 1901	24 37 19.752	607.7	229 20 33.4	49 21 22.6	Hospital Key	4372.9	3.640772
	82 53 07.613	214.1	236 53 20.1	56 53 38.8	Bastion A	1504.2	3.177318
			244 33 55.7	64 34 15.7	Garden Key L. H. 1901	1496.0	3.174939
Garden Key L. H. 1875	24 37 40.972	1260.6	159 30 26.1	339 30 25.2	Bastion A	180.2	2.255756
	82 52 20.572	578.6	222 14 50.4	42 15 19.9	Hospital Key	2966.6	3.472253
Loggerhead Key northeast base 1875	24 38 07.749	238.4	258 09 11.6	78 10 48.7	Hospital Key	6690.5	3.825460
	82 55 02.493	70.1	278 17 22.4	98 18 29.0	Bastion A	4538.5	3.656912
			280 14 41.6	100 15 49.2	Garden Key L. H. 1875	4628.0	3.665393
Bird Key 1875–1901	24 37 18.129	557.8	115 14 10.7	295 13 22.7	Loggerhead NE. base	3581.7	3.554084
	82 53 07.297	205.2	228 46 25.9	48 47 15.0	Hospital Key	4398.9	3.643349
			235 08 04.7	55 08 23.3	Bastion A	1524.8	3.183217
			241 51 39.9	61 51 59.5	Garden Key L. H. 1875	1490.4	3.173291
Loggerhead Key southwest base 1875	24 37 46.435	1428.6	227 11 47.7	47 11 58.2	Loggerhead NE. base	965.1	2.984586
	82 55 27.671	778.3	254 22 21.6	74 24 09.2	Hospital Key	7534.6	3.877058
			269 58 53.5	90 00 10.5	Bastion A	5199.2	3.715937
			282 25 51.4	102 26 49.9	Bird Key	4043.1	3.606718
Long Key 1875	24 37 45.601	1403.0	68 12 35.0	248 12 03.6	Bird Key	2276.6	3.357285
	82 51 52.142	1466.6	91 45 04.5	271 44 51.7	Bastion A	863.1	2.936055
			210 11 51.8	30 12 09.5	Hospital Key	2375.9	3.375823
Middle Key 1875	24 39 05.363	165.0	56 20 13.6	236 19 19.0	Long Key	4426.4	3.646049
	82 49 41.154	1157.2	61 54 28.5	241 53 21.1	Bastion A	5154.0	3.712145
			80 51 32.4	260 50 55.5	Hospital Key	2520.6	3.401499
East Key south base 1875	24 38 59.607	1833.9	69 23 30.6	249 22 00.9	Long Key	6465.3	3.810591
	82 48 16.980	477.5	94 17 02.2	274 16 27.1	Middle Key	2373.7	3.375422

Dry Tortugas—Continued.

Station	Latitude and longitude	Seconds in meters	Azimuth	Back azimuth	To station	Distance	Logarithm
	° ′ ″		° ′ ″	° ′ ″		*Meters*	
East Key north base 1875	24 39 11.757	361.7	65 32 52.1	245 31 25.7	Long Key	6400.9	3.806243
	82 48 24.973	702.2	84 45 28.3	264 44 56.5	Middle Key	2151.3	3.332696
			328 58 57.5	148 59 00.8	East Key S. base	436.2	2.639682
House, south chimney 1875–1896	24 37 57.111	1757.1	224 17 40.0	44 17 44.7	Loggerhead Key NE. base	457.3	2.660189
	82 55 13.848	389.5	273 53 16.8	93 54 28.1	Bastion A	4821.5	3.683184
			288 36 51.7	108 37 44.4	Bird Key	3756.0	3.574728

DESCRIPTIONS OF STATIONS.

This list may be conveniently consulted by reference to the illustrations at the end of this publication or to the index. All azimuths given in the descriptions are reckoned continuously from true south around by west to 360°, south being 0°, west 90°, north 180°, and east 270°. Where magnetic azimuths are given they are indicated as such. In a number of cases where azimuths are not available, directions are given, referred to some initial point as 0°. These are not azimuths, and express only the angular relations at the station between the various objects enumerated.

In general, except where the contrary is specifically stated, the surface and the underground marks are not in contact, so that a disturbance of the surface mark will not necessarily affect the underground mark. The underground mark should be resorted to only in cases where there is evidence that the surface mark has been disturbed.

In a number of descriptions of stations the warning is given that the position of the station is uncertain, and that the station must be used with caution. Most of such cases are due to the incomplete recovery or unsatisfactory identification of the original station marks in later visits to the station, in some cases it being uncertain whether the mark recovered was a center or a reference mark. Such stations can usually be used for hydrographic or topographic purposes, but when used as a base for triangulation should always be connected with at least two stations whose recovery is unquestioned.

The initials and dates given in each description immediately after the county refer to the date of the establishment of the station, the man by whom it was established, and the date when the station was last searched for, whether it was recovered on that visit or not.

Any person who finds that one of the stations herein described has been disturbed, or that the description no longer fits the facts, is requested to send such information to the Superintendent, Coast and Geodetic Survey, Washington, D. C.

GENERAL NOTES REGARDING THE MARKING OF STATIONS.

NOTE 1.—The station marks were two 4-inch terra-cotta sewer pipes each 2½ feet long. They were placed one above the other, and separated by a layer of shell or sand or earth; some times a board was placed between them. Both pipes were filled with cement mortar or concrete, and a mass of the same material was placed around the bottom and top of the lower pipe and around the bottom *or* top of the upper pipe. The centers of the pipes mark the station.

NOTE 2.—Same as note 1, with the addition of a reference mark consisting of a 4-inch terra-cotta pipe, 2½ feet long, placed as indicated.

NOTE 3.—Same as note 1, except that the two pipes were placed one on the other in contact, and a mass of concrete or cement mortar was placed around their junction, and around the bottom of the lower pipe.

NOTE 4.—Same as note 3, with the addition of a reference mark consisting of a 4-inch terra-cotta pipe, 2½ feet long, placed as indicated.

NOTE 5.—The station was marked by an iron cone placed usually 2 feet below the surface of the ground. Through this cone was driven a stake with a tack in its top to mark the station. Around the station and at a distance therefrom of 3 feet were placed four other stubs, forming a square with the station at the intersection of its diagonals.

NOTE 6.—Same as note 5, except that no iron cone was used.

NOTE 7.—The station was marked by a bottle buried about 2 feet below the surface of the ground. Above this was placed a stub, in the top of which was a copper tack to mark the center of the station. Around the station and at a distance therefrom of 2 feet were placed four stubs in the form of a square, the station being at the intersection of its diagonals.

NOTE 8.—The station was marked by a bottle placed about 2 feet below the surface of the ground. Above the bottle was placed a coquina stone having in its top a hole into which was melted a lead bolt. The intersection of crosslines on this bolt marks the station. Sometimes a copper tack was driven in at this intersection. Four stakes placed around the station form a square with the station at the intersection of its diagonals.

NOTE 9.—Same as note 8, except that no mention was made in the original description of four stakes surrounding the station.

NOTE 10.—The station center was marked by a nail in the top of a nassau stone, which had its top face flush with the surface of the ground. Four stakes were driven in north, east, south, and west of the station; nails were driven in the tops of these stakes and lines connecting them diagonally intersect at the station.

NOTE 11.—The station was marked by a 5-inch terra-cotta pipe 26 inches long set in the ground flange up and projecting above the surface of the ground. The pipe was filled with cement, and a 4-inch pine plug 26 inches long was forced to the bottom. In the top of the plug was placed a 20-penny wire nail to mark the center.

FERNANDINA TO GAINESVILLE.

O'Neil (Nassau County, J. A. S., 1856).—About halfway between Amelia and Nassau Rivers, being 2⅛ miles from each. Marked by a nail driven in a log 12 feet long and 14 inches in diameter, set 5 feet into the ground.

Braddock (Nassau County, J. H. S., 1856).—About ¼ mile south of the railroad at a point 2 miles west of Harts Road depot. To reach from Fernandina take train to Harts Road, from which place follow the wagon road to William Braddock's place; the road from William Braddock's to John Braddock's passes very near the station. Marked by a cross on a freestone block 6 inches square and 18 inches long.

Dunns Creek (Duval County, J. H. S., 1856).—Very near the northeastern edge of a large swamp at the head of Dunns Creek. To reach from Fernandina take train

to Harts Road; thence follow Harts Road to Phineas Johnson's place; cross Nassau River to Braddocks Island, from which place the road to Yellow Bluff on the St. Johns River passes close to the station. No description of station mark available.

Bear Branch (Duval County, J. H. S., 1856).—In the edge of Bear Branch swamp, 2 miles from the mouth of the branch. To reach from Fernandina take the train to Kings Road, from there follow the road to the home of Owen Wingate, who lives on Bear Branch, 1 mile from the station; cross the branch at this place and follow down on its north side to the station. There is a road from Braddocks Island to Owen Wingate's place. A tripod signal was built at the station, but no description of the station marks is available.

Cedar Creek (Duval County, J. A. S., 1858).—To reach this station from Callahan railway station, follow Kings Road to Elijah Higginbottom's place, about 12 miles from Callahan; thence proceed to Mr. Hammond's place, distant about 5 miles; then to Mr. Geiger's place, distant about 1½ miles; from this place the station is distant about ¼ mile. A signal was erected, but no description of the station marks is available.

Kings Road (Duval County, J. A. S., 1858.—Near the Kings Road. Reached from Jacksonville by following the Kings Road to "Deadman's Swamp" in the vicinity of milepost 15, at which point the line between stations Kings Road and Cedar Creek will be crossed; continue along the road for ½ mile, at which point the line between stations Kings Road and Bear Branch will be reached; turn to the left and follow this line to the station, distant about ½ mile from the road. To reach the station from Fernandina take the train to Callahan and then follow the Kings Road for about 6½ miles, then turn to the right and go ½ mile to the station. A signal was erected, but no description of the station marks is available.

Pickett (Duval County, J. A. S., 1858).—On the Kings Road, on Mr. John S. Pickett's place, 6½ miles from Jacksonville. It is distant 16½ miles along the Kings Road from Callahan railway station. A signal was erected, but no description of the station marks is available.

Brandy Branch (Nassau County, J. A. S., 1858).—Near St. Marys railway station. From the railway station follow the Brandy Branch road for about 1¼ miles, when the line between stations McGirts Creek and Brandy Branch will be reached; turn to the left and follow that line for about ¾ mile to the station. A signal was erected, but no description of the station marks is available.

McGirts Creek (Duval County, J. A. S., 1856).—About 14 miles by road from Baldwin railway station. From Baldwin follow the "Alligator Road" toward Jacksonville until the "Jacksonville Railroad" is crossed, near milepost 12 and close to Mr. Townsend's house; then turn to the right and go through the woods about ¾ mile to Mr. Parishe's place, from which place a road can be followed which leads to the station, about 1 mile distant. A signal was erected, but no description of the station marks is available.

Big Creek (Nassau County, J. A. S., 1858; 1897).—About 3½ miles from Baldwin railway station, on the south side of Big Creek, and 16 feet from the edge of the bank. Follow the main road out of Baldwin leading west, and when within ¼ mile of the bridge over the creek take an old trail leading to the right and follow it for nearly 1 mile to the station. In 1897 a pine tree was felled across the creek about 20 feet north of the station to serve as a foot bridge. The station was marked in 1858 but the marking was not described; in 1897 the station was recovered, but no attempt was made to find

out if there was a subsurface mark. The surface mark is a stone monument, its top flush with the ground and marked with the letters USCS. A triangle cut in the stump of a pine tree with nails driven in it is distant 7 feet 8 inches from the station.

Padgett (Clay County, J. A. S., 1858; 1897).—This station is lost.

Baldwin (Duval County, H. G. O., 1897).—On the railway company's reservation at Baldwin Junction, on the Florida Central & Peninsular Railroad near the southeast corner of the reclaimed land on which the office building stands. The station is 33 feet 2½ inches west of the east rail of the north-and-south line and 206 feet 8 inches south of the south rail of the east-and-west line. Marked by an 8-inch terra-cotta pipe set in the ground and projecting a few inches; this pipe is filled with cement mortar in which is embedded a ¼-inch iron rod to mark the center.

Lane (Duval County, H. G. O., 1897).—About 5 kilometers south of Baldwin Junction, on the railroad reservation and 669 meters south of the fiftieth milepost. It is 13.4 meters west of the east rail of the track. The line opened to Big Creek station will aid in identifying the locality for many years. Marked by an iron rod embedded in cement mortar which fills an 8-inch terra-cotta pipe set in the ground.

Curve (Clay County, H. G. O., 1897).—On the railway company's reservation at the north end of Highland curve. It is 75 meters north of the south end of the cut, 6 meters from its west edge, and about 65 meters south of the bend in the fence marking the reservation. To recover the station closely measure 381.5 meters south from milepost 58 to subcurve, then lay off an angle of 99° 43′.3 to the left from the line of the east rail, and measure in this direction 16.5 meters to the station. Marked by a bottle buried under an 8-inch terra-cotta pipe, the pipe being filled with sand. A copper tack in a peg embedded in the sand marks the center. A blaze was made on a pine tree across the tracks from the station.

Highland (Bradford County, H. G. O., 1897).—About 610 meters south of the railway station at Highland, and 250 (or 300) meters south of the water tank, on the highest land along the railroad (about 210 feet above sea). The station is on the east side of the track, 9.74 meters from a point 4.82 feet above the east rail. To recover the station closely measure the distance from the water tank along the track, then lay off an angle of 86° 50′ to the left and measure in this direction 9.74 meters to the station. The underground mark is a bottle filled with cement and resting on a small triangular piece of iron about ½ inch thick. Over this is set an 8-inch terra-cotta pipe 2½ feet long and filled with cement mortar, in which is embedded a ¼-inch iron rod to mark the center. This pipe projects 6 inches above the ground.

Starke (Bradford County, H. G. O., 1897).—In the town of Starke near the junction of the railroad and Madison Street, on an unfenced vacant lot belonging to Dr. Gaskins. Marked by an iron rod that was an old shaft of some machinery. It is 3¾ feet long and 2⅞ inches in diameter. The rod was set in the ground with 2 inches of its top projecting.

Waldo (Alachua County, H. G. O., 1897).—In the town of Waldo, about ¼ mile from the railway station. It is in an orange orchard belonging to Mr. Stevens, and is very close to the intersection of the Waldo-Starke and the Waldo-Fairbanks tangents of the Florida Central & Peninsula Railroad. The southwest corner of Mr. Stevens's house is 123.5 meters from the station in azimuth (mag.) 258° 17′. The underground mark is a bottle filled with cement. The surface mark is an iron rod embedded in the cement mortar which fills a section of 6-inch sewer pipe set in the ground.

Mathews (Alachua County, M. L. S., 1860; 1897).—About ½ mile south of Fairbanks near the intersection of the tangents of the railroad from Waldo and Gainesville. Marked by a stone monument 7 inches square on top, in which is a 1¼-inch drill hole 3 inches deep. The northwest side of the stone has been broken off. It is 25.5 meters from the west rail of the track.

Gainesville (Alachua County, H. G. O., 1897; 1898).—About 1 kilometer north of the street running out from Gainesville and passing north of the courthouse. It is 9 meters east of the track, and 12 rails and 3 feet south of the middle of the road which crosses the track. Marked by a bottle buried underneath a section of gas pipe in the form of an inverted T; the bottle and the lower end of the pipe are set in cement, and the upper end of the pipe projects about 6 inches above the ground.

Odd Fellow (Alachua County, H. G. O., 1897).—One-half mile east of the city of Gainesville on the line of the Florida Central & Peninsular Railroad. It is 4½ meters north of the range of the courthouse on the east or north gable of the Odd Fellows' Home, and is 6 meters east of the east rail of the track. Marked by a bottle buried underneath a section of gas pipe in the form of an inverted T; the bottle and the lower end of the pipe are set in cement, and the upper end of the pipe projects about 6 inches above the ground.

Gainesville longitude station (Alachua County, C. H. S., 1890; 1897).—On the eastern side of the Western Union Telegraph office, in the inclosure formed by the Porter Block, a cross fence, and Mechanic Street. It is 15.83 feet from the rear wall of the Porter Block, at a point 29.5 feet from its north end and 85 feet from its south end; it is 31.6 feet from an outhouse, and 67.83 feet from the northwest corner of J. D. Matheson's brick store. Marked by a pier built of brick laid in cement; the pier was 25 by 16½ inches, 2½ feet in the ground and 3 feet above the ground.

Waldo 2 (Alachua County, H. G. O., 1897).—Established in 1860. On the prolongation of the Waldo-Fairbanks tangent of the railroad, and 207.45 meters from station Waldo. Marked by a stone 7 inches square on top, and projecting 6 inches above the ground.

CUMBERLAND SOUND TO ST. JOHNS RIVER.

PRINCIPAL POINTS.

Point Peter (Camden County, Ga., A. W. E., 1855; 1905).—On slightly elevated ground in a large open field, formerly cultivated, and separated on the southeast from Cumberland Sound and St. Marys River by extensive marshes. On the east side of the field is a creek which flows into St. Marys River. The field is surrounded by a narrow row of trees and bushes from the west around by south to the east, and avenues were cut through these trees in line to stations Beach, Beacon, and Martins Island. The station is marked by the intersection of two lines cut in the top of a granite monument surrounded by a mass of concrete extending from 2 inches below the surface of the ground to a depth of 14 inches. A circular trench 6 feet in radius and 18 inches in depth was dug around the station, and the earth therefrom piled around the center stone, forming a slight elevation.

Tiger Island north base (Nassau County, A. W. E., 1855; 1905).—On a sand bank on Tiger Island, opposite the bar and near the mouth of a large creek. Marked by a cross on a stone. In 1905 the station was reported as being probably lost, due to the erosion of the north end of the island in the vicinity of the station.

Cumberland (Camden County, Ga., A. W. E., 1855).—On a large long sand hill near the southeast point of Cumberland Island and fronting the sea. Marked by a cross on the head of a stone post set in the sand.

Tiger Island south base (Nassau County, A. W. E., 1856; 1905).—On the marsh of Tiger Island, west of the north end of Amelia Island, and near a break in the hammocks which line the east side of Tiger Island. Marked by a cross on a stone post. In 1905 the marsh in this location was being covered with sand, and the mark was not found.

Martins Island (Nassau County, A. W. E., 1856; 1905).—On the highest part of a large island in the marsh between Jolly and Bells Rivers. The island was formerly in cultivation, but is now abandoned. The station was on the tallest and most southerly of two old chimneys. In 1905 the foundation of this chimney was found and the station recovered. It is marked by two 4-inch earthenware drain tiles, with a 2 by 3 inch pine stub in their center. Cement and sand was placed around the bottom of the lower tile and around the junction of the two tiles, while cement was also poured into the tiles around the pine stub. A reference stone is 8.90 meters from the station in azimuth 110° 52′. The trees and bushes were cleared away in line to Point Peter, Beacon, and Clarke triangulation stations, and in line to the towns of Fernandina and St. Marys.

Cooper (Nassau County, J. H. S., 1856; 1905).—One-half mile west of Bells River marsh, 1 mile south of Roses Bluff, and 1¼ miles west of the junction of Bells and Jolly Rivers. Marked by a red freestone block 6 inches square and 18 inches long, set in a triangular mound of earth, 15 feet on the sides and 5 feet high, inclosed with pine poles. In 1905 this station was searched for but not found.

Clarke (Nassau County, F. P. W., 1861; 1905).—On a hammock on the south side of Lanceford Creek, and just west of the mouth of Soap Creek. It was first marked according to note 5, page 474. In 1870 this cone was found and the station re-marked (character of new mark not known); in 1905 the station was not found.

Jackson (Nassau County, F. P. W., 1860; 1905).—On the marsh about halfway between Amelia River and the hard land to the east, and on the north bank of a creek running to Amelia River from the hard land. Marked according to note 6, page 474. In 1905 the station was not recovered.

Pine Island (Nassau County, F. P. W., 1860; 1871).—On Pine Island, on the south side of Amelia River, and about 3 miles from Fernandina. It is about 150 meters south of a small house and about ¾ mile north of the railroad. Marked according to note 6, page 474.

Amelia (Nassau County, F. P. W., 1861).—On the marsh of Amelia Island, about 1 mile south of the railroad, ½ mile south of a two-story house, and about 200 meters to the eastward of Crane Island, a hammock ½ mile in length. Marked according to note 6, page 474.

Harrison (Nassau County, F. P. W., 1861).—On the mainland, about 1½ miles south of the railroad and ½ mile east of E. Harrison's plantation. Marked according to note 5, page 474.

Vaughan (Nassau County, F. P. W., 1861).—On the marsh on the southwest side of Inland Passage (South Amelia River), about ¼ mile west of a bluff on Amelia Island and about ½ mile from Vaughan's house, which is near the south end of the bluff. Station is about 3 miles south of the railroad bridge, and is marked according to note 6, page 474.

Sterrett (Nassau County, F. P. W., 1861; 1905).—On the marsh, 30 meters north of the north bank of a branch of Alligator Creek, known locally as Jackstaff Creek. It is about ½ mile northeast of Mr. Sterrett's plantation, 1 mile west of the Inland Passage (South Amelia River), and about 1¾ miles west of Vaughan's plantation. The station is 1 000 meters from the edge of the woods to the west, and was marked by a center stub (pine), around which was placed a joint of 4-inch terra-cotta pipe, extending to a point 16 inches below the top of the stake. Concrete was placed around the pipe and stub to within 2 inches of the surface of the ground, then mud and a pile of shells placed around the top of the pipe which extends 6 inches above the surface of the marsh. Four reference stubs are 3 feet from the station, and form a square with the station at the intersection of its diagonals. On the north side of the north reference stub was sunk a piece of terra-cotta pipe with its top level with the surface of the ground.

McRory (Nassau County, F. P. W., 1860; 1905).—Located in the soft marsh of Amelia Island, opposite a small house belonging to a negro named Gabe Means and occupied by Mahala Hopkins. It is 25 meters from the hard ground and about 2 miles south of Amelia Bluff. The center was marked by a stub from around which the mud was removed for a depth of 2 feet. Two joints of terra-cotta pipe were then placed around the center stake, the top of the upper pipe being 10 inches above the surface of the marsh. This projecting part of the upper pipe was filled with concrete. Concrete was placed around the pipes to within 6 inches of the surface of the ground, then sand and shells. Bushes were cut and placed around the station, and sand and shells piled on top of them to make the ground firm enough to stand on. Four stubs, their tops rotted off, are each 3 feet from the station and form a square with the station at the intersection of its diagonals. The following azimuths and distances are from the station (the distances were paced): West gable of house, 63 meters, 254°; oak stub, 30 meters, 267°; cedar tree, 40 meters, 314°.

Nassau (Nassau County, A. W. E., 1861; 1905).—On a marshy island in Nassau River; it is near the north end of the island, about ¾ mile from the mouth of the river, and 1¼ miles southeast from Mr. Sterrett's plantation. On the right bank of the river and about ¾ mile southwest of the station are some negro houses. The station was marked by a copper tack in top of a pine post. Mud was removed from around the post to a depth of 2½ feet, and two joints of 6-inch sewer pipe were then placed around it, the lower joint being forced 18 inches into the mud; around the junction of the two pipes was placed a mass of concrete about 18 inches thick. Cement and sand was placed in the pipes around the center post. The upper pipe projects 3 inches above the post. Four stubs were each 3 feet from the station and form a square with the station at the intersection of its diagonals. A pine log about 5 feet long was placed 4.5 meters from the station in azimuth 269° 52′. It projects 2½ feet above the surface of the marsh.

Shellbank (Nassau County, F. P. W., 1861; 1905).—This station has been destroyed.

Anderson (Duval County, F. P. W., 1861; 1905).—This station has been destroyed.

Crane (Duval County, F. P. W., 1861; 1905).—On the north bank of the Inland Passage (Sawpit Creek), about 1 mile from its junction with Nassau Sound. A one-story house stands on the same side of the passage as the station and about ¼ mile to the south. Marked according to note 5, page 474. In 1905 the station was not recovered, but being in a growth of pine trees the marks are probably not lost.

Christopher (Duval County, F. P. W., 1861; 1905).—On Talbot Island, on a grass-covered mound, 20 meters in diameter and 0.6 meter higher than the land in the immediate vicinity, most of which is covered at extreme high tides. It is about ½ mile to the eastward of the Inland Passage (Sawpit Creek) and ¼ mile southwest of Mr. Christopher's plantation. On the south edge of the mound are two cedar stumps, while just to the westward is a small elliptical-shaped water hole bordered with grass, beyond which are two small hammocks, the nearer and smaller of which has dead cedars on it, the other dead and live cedars and two palmettos. To the southeast is a hammock with cedars and palmettos. In line to station Crane is a large hammock with tall pine trees on it. A small creek leaves the Inland Passage just inside its mouth and leads to the vicinity of the station. The station was originally marked according to note 5, page 474. In 1905 the earth was removed from around the center stub until the iron cone was exposed and a 4-inch terra-cotta pipe placed around the stub, resting on the cone; the hole, about 18 inches in diameter, was then filled with concrete up to about 6 inches above the bottom of the pipe, which was also filled with cement. The remainder of the hole was then filled with sand. The terra-cotta pipe projects about 10 inches above the surface of the ground. The north and east reference stubs were found in 1905 well preserved; the south and west stubs were rotted at their tops. A piece of terra-cotta pipe was placed around the north stub.

Braddock (Duval County, F. P. W., 1861; 1905).—On Black Hammock in the marsh near the west bank of the Inland Passage and about 1½ miles from where the passage flows into Nassau Sound. It is about 1 mile south of a one-story house. Originally marked according to note 5, page 474. In 1905 the earth was removed from around the center stub and cone (which was then 1 foot below the surface) and a 4-inch terra-cotta pipe placed around the stub and rested on the cone; this pipe extends 1 foot above the surface of the marsh. Around this pipe and extending to within 8 inches of the surface of the ground was placed a mass of cement. The pipe was filled with cement and sand. A 4-inch terra-cotta pipe was placed on the north side of the north reference stub with its top projecting 4 inches above the ground; it was filled with sand; its center is 1 meter from the station. A 5-inch post of burnt pine was placed 4.9 meters from the station in azimuth 62° 08′; it is in line to an oak tree (three trees from one stump) which is on the edge of the hard ground 70 meters (paced) from the station. The azimuth of a lone pine at point of woods is 174° 17′, and of a lone palmetto on the marsh is 330° 18′.

Skeleton (Duval County, F. P. W., 1861).—On the edge of the marsh on the west side of Talbot Island, about ¼ mile from the Inland Passage and 1½ miles south of Mr. Christopher's plantation. On the edge of the marsh and about 200 meters to the southward of the station is a small dead tree. Marked according to note 5, page 474.

Breward (Duval County, F. P. W., 1861).—On the marsh on the east side of Black Hammock, about 3 miles south of Mr. Tyson's house; it is about 300 meters from hard land, ½ mile west of the Inland Passage. Marked according to note 6, page 474.

George (Duval County, F. P. W., 1861).—On the marsh on the west side of Fort George Island, on the south bank of Fort George Inlet. It is about halfway between the hard land and the Inland Passage, and is ¼ mile west of Mr. Gibbs's house on Fort George Island. Marked according to note 6, page 474.

Horseshoe (Duval County, G. A. F., 1853; 1905).—Five meters from the north bank of the Inland Passage, and 5 meters from the bank of a small creek which leaves the Inland Passage to the westward of the station. The bank of the creek is being eroded and in time the station will be destroyed. It is near where the Inland Passage (Sister Creek) makes a large bend in the form of a horseshoe. About 50 yards away is a small hammock, and 200 yards away another hammock on which are some tall pines. The original marking was changed in 1905 as follows: The center stone and the south and west reference stones were found in place and were not disturbed. Their tops are 4 inches below the surface of the ground. The mud was removed from around the center stone to a depth of 2 feet and a mass of cement and shells placed around it. This concrete mass is about 18 inches thick and 12 inches wide. The east reference stone was found out of place, and was buried 2 feet in the ground and 7.21 meters from the station on a line with and beyond the west reference stone. All these stones are square white granite posts 2½ feet long, with the upper 6 inches dressed 6 inches square. Each has a cross cut in its top and is lettered USCS. Three instrument stubs, 2 by 4 inches in size, were driven in around the station and were left in place. The following azimuths and distances are from the triangulation station: South reference stone, 4° 59′, 1.88 meters; west reference stones, 93° 59′, 1.62 and 7.21 meters; center of hammock, 113°; center of hammock, 163°.

Mount Cornelia (Duval County, G. A. F., 1853; 1905).—On Mount Cornelia, the highest point of land on Fort George Island, about 67 feet above low-water mark. The top of this hill has been leveled, is circular in form, and about 50 feet in diameter. A small wooden house stands on the eastern edge of the top of the hill and tall trees 45 feet higher that its summit surround the station from south around by west to north. A road leads to the top and vehicles are turned around on the level space at the top. In 1905 the center stone was not recovered, but the center was reproduced from the north and west reference stones which were recovered. The center was then marked according to note 3, page 474, the top of the upper pipe being 6 inches below the surface of the sand. The west and north reference stones which were recovered are of marble, are partly calcined and irregular in shape; rough crosses mark their centers. The upper part of a third reference stone was found out of place, and was buried with its top 10 inches below the surface and 2.45 meters to the southward of the station. The following directions and distances are from the triangulation station: Continental Hotel chimney, 0° 00′; west reference stone, 2.10 meters, 81° 49′; north reference stone, 3.76 meters, 170° 38′; northwest corner of house, 6.14 meters, 219° 20′; southwest corner of house, 8.07 meters, 310° 08′; live oak stump marked with 6 nails in form of triangle, 7.8 meters, 50° 19′; two live oak trees each marked with 6 nails in form of triangle, 14.75 meters, 118° 19′, and 18.40 meters, 158° 39′.

Round Pond (Duval County, G. A. F., 1853; 1905).—In the marsh west of the woods on Fort George Island, on the southwest end of a small hammock, and about 60 yards northwest of a round pond. This pond is well known to people in Pilot Town. A lone palmetto and a dead cedar tree stand on this hammock. In 1905 the station was re-marked as follows: A 4-inch terra-cotta pipe was placed with its top 2 feet below the surface of the ground, and its bottom resting on clay. Concrete, made of cement, shells, and sand, was placed around the top and bottom of this pipe, which was filled with the same kind of concrete. The center of the pipe marks the station. Over the

top of this pipe was placed a piece of 1-inch board, and the old center stone rested on this board with its top projecting 6 inches above the surface of the ground. The hole around the stone was then partly filled with concrete (to a depth of 1 foot), and the remainder of the hole filled with sand and clay, and a pile of shells placed around the top of the stone. These are the only shells in the vicinity. The reference marks are stones placed as follows: South stone with its top even with surface of ground, 2.54 meters from station in azimuth 20° 45′; west stone with top even with surface of ground, 2.04 meters from station in azimuth 111° 47′; east stone with top 4 inches above surface of ground, 2.575 meters from station in azimuth 290° 16′. The following distances and azimuths are from the triangulation station: Small cedar tree, 1.87 meters, 167° 52′; palmetto, 11.90 meters, 205° 59′; palmetto, 29 meters, 274° 13′; middle of round pond, 60 meters, 306°.

St. Johns River east base (Duval County, G. A. F., 1853).—A base line was measured on the sand spit on the northern side of the mouth of St. Johns River; the spit forms part of the sand shoal off Fort George Island, being connected with the island, and only partly covered by the very high spring tides. A stone marks the center of east base, while three other stones were placed as reference stones, one on the north side of the base line, one on the south side of the line, and the third nearly in prolongation of the line, each stone being 1.854 meters from the center stone.

Sandhill 3 (Duval County, G. A. F., 1853; 1905).—Reported in 1905 as having been destroyed.

Sandhill 2 (Duval County, G. A. F., 1853; 1905).—Reported in 1905 as having been destroyed.

St. Johns River west base (Duval County, G. A. F., 1853).—The description and marking of this station are identical with those of St. Johns River east base. (See above.)

Ross (Duval County, I. W., 1905).—On the largest of the Sister Islands, in the Inland Passage (Sister Creek), a short distance north of St. Johns River, and on the wide beach of shells left when the front portion of the island was excavated to a lower level. It is near the north side of the shell bank forming the dry portion of the island, being 2 meters from the foot of the shell bank in the direction of station Horseshoe, and 8 meters from the edge of the shell pit toward station Round Pond. The island is owned by Capt. Ross, of Jacksonville. An avenue was cleared along the line to station Fort (on St. Johns Bluff) on the island itself, and on a dense hammock about 1 mile distant. The station is so situated that nearby stations and various objects in Mayport can be seen without interference with the buildings on the island. The station was marked according to note 3, page 474. The northwest corner of a brick limekiln 3 by 6 meters and 6 meters high is 36 meters from the station in azimuth 304° 38′, while in azimuth 335° 13′ from the station is the northwest corner of a brick chimney, 2.3 meters square, at the west end of a two-story frame building. From the station the azimuth of a cedar tree at the southeast corner of a house is 234° 52′, and of a lone cedar tree is 17° 39′.

Fort (Duval County, I. W., 1905).—On St. Johns Bluff, on open ground at the top of the eastern slope of the bluff, which is bare and becomes precipitous a short distance below the station. The eastern slope shows as bare sand from the valley below. The station is some distance back from the point of the bluff. It was marked according to note 3, page 474.

Four Pines (Duval County, I. W., 1905).—On the northwest corner of a hammock south of Great Marsh Island, in St. Johns River, and a short distance above Mayport. Four tall pines mark the hammock as conspicuous, while a number of dead palmettos, without tops, stand near the station. This hammock is some distance across the hard marsh from the water on the south side of Great Marsh Island. The station was marked according to note 3, page 474, the upper pipe projecting 6 inches above the ground. The following azimuths and distances are from the triangulation station: Small palmetto, 43° 19′; small palmetto, 3.7 meters, 172° 11′; small palmetto, 3.2 meters, 266° 56′; tall pine, 22.35 meters, 302° 30′.

R. 2 B. (*U. S. E.*) (Duval County, I. W., 1905).—A station of the triangulation of the St. Johns River made under the direction of the Corps of Engineers, United States Army. On the marsh near the bank of the river, opposite Mayport, and just above the mouth of a small tidal creek. The signal is an old beacon about 30 feet high, the corner posts of which are supported by four brick piers. The piers nearest the river are gradually sinking into the mud, and the structure already leans toward the river. The station was marked by a 2-inch iron pipe sunk in the mud at about the center of the space inside the four brick piers. This pipe projects 1 foot above the surface of the marsh.

Warehouse (*U. S. E.*) (Duval County, I. W., 1905).—A station of the triangulation of St. Johns River made under the direction of the Corps of Engineers, United States Army. It is on top of the front portion of the United States Engineers warehouse and office at Mayport, which warehouse is directly back from the Government wharf. The station is at the center of a platform erected on top of the building, and is marked by an iron socket screwed to the platform. This socket was used to receive the bottom of a signal pole.

CUMBERLAND SOUND TO ST. JOHNS RIVER.

SUPPLEMENTARY POINTS.

Fernandina (Nassau County, J. H. S., 1856; 1905).—In the town of Fernandina, on the extension of the meridian passing through the observatory and 544.04 meters from it, on the summit of a ridge forming the Yellow Bluff and about 60 meters east of the bluff. Marked by a cross cut in the top of a red freestone block 6 inches square and 18 inches long. In 1905 the station mark could not be found.

Fernandina astronomical station (Nassau County, E. G., 1856; 1905).—In the town of Fernandina, 544.04 meters south of Fernandina triangulation station. Marked by a yellow-pine block 12 by 8 inches and 2 feet long sunk in the sand between two railroad crossties 12 by 8 inches and 5¾ feet long sunk 2¾ feet in the sand. A meridian line about ¼ mile long was established and its ends marked by marble pillars 5 inches square and 2 feet 10 inches long, their tops even with the surface of the ground. The letters U.S.C.S. and a cross were cut in the top of each block. In 1897 the north meridian stone was recovered, being 24.6 meters south of the corner of Calhoun and Second Streets and 6 meters back from the west building line of Second Street. In 1905 it was under a small two-story frame house, No. 227 Second Street. The south meridian stone was 33.23 meters north of the station.

Fernandina courthouse (Nassau County, I. W., 1905).—A small ornamental iron rod surmounting the cupola on top of the slate-roofed tower of the Fernandina courthouse,

situated at the southwest corner of Fifth and Center Streets. The center of the tower is 6.1 meters inside the building lines of both streets.

Quarantine wharf, stack (Nassau County, I. W., 1905).—The iron stack of a small building which stands on the outer end of the wharf in front of the quarantine station at Fernandina. The station is on the west side of Amelia Island north of "Old Town."

Fernandina Methodist Church (Nassau County, I. W., 1905).—The center of a square tower on a wooden building at the northwest corner of Sixth and Broome Streets. The tower has a red roof with white top, and is surmounted by an iron railing.

Fernandina convent (Nassau County, I. W., 1905).—The center of a square tower on St. Joseph's Academy, a two-story brick building, at the southeast corner of Fourth and Calhoun Streets. The building has a mansard roof, and the tower or cupola is surmounted by a cross. The center of the tower is about 7.6 meters from the building line on Calhoun Street and 23 meters from the building line of Fourth Street.

Old beacon on house (Nassau County, I. W., 1905).—On the north end of Amelia Island, near the shore of the entrance to Cumberland Sound. It was used at one time as a range light, but has been discontinued, and the house is no longer used as a dwelling.

Fernandina longitude station (Nassau County, W. B.–J. S. H., 1907).—On the south side of Center Street, between Fourth and Fifth Streets, on the west side of the courthouse and in the courthouse grounds. It is about 15 meters south of Center Street curb and about 9 meters west of the west side of the courthouse. Marked by a concrete pier 19 by 34 inches, 2 feet in the ground and 3 feet above. The upper surface of the pier is lettered U.S.C.G.S. 07. The center of the pier is 11.90 meters from the northwest corner of the courthouse, 4 feet above the ground, and 23.29 meters from the southwest corner of the courthouse, 4 feet above the ground. It is 4.29 meters south and 17.50 meters west of the courthouse spire.

Number IX (U. S. E.) (Duval County, I. W., 1905).—This is a station of the triangulation of St. Johns River made under the direction of the Corps of Engineers, United States Army. It is located outside the high-water mark in front of the storm-warning display station tower at Pilot Town, and is marked by a 2-inch iron pipe sunk in the ground and projecting 1 foot above the surface.

Coal elevator (Duval County, I. W., 1905).—The top of the coal elevator on the dock of the Florida East Coast Railway at Mayport.

Wharf (Duval County, I. W., 1905).—A flagpole nailed to the upper end of the wharf and coal dock of the Florida East Coast Railway at Mayport.

ST. JOHNS RIVER.

PRINCIPAL POINTS.

Sherman (U. S. E.) (Duval County, U. S. E., 1908).—A 2-inch galvanized-iron pipe driven on the edge of the marsh on the point just north of the mouth of Sherman Creek.

Mile Point A (U. S. E.) (Duval County, U. S. E., 1908).—On the north bank of St. Johns River, on Mile Point, and about 200 feet from the edge of the marsh, on a sand bank that was pumped there by dredges. Marked by observing tripod and scaffold.

Pablo (U. S. E.) (Duval County, U. S. E., 1908).—In the marsh on the east bank of Pablo Creek and very near its junction with the St. Johns River. Marked by a 2-inch galvanized-iron pipe.

Island 1 (*U. S. E.*) (Duval County, U. S. E., 1908).—Washed away.

Island 2 (*U. S. E.*) (Duval County, U. S. E., 1908).—In the marsh on the southwest side of Great Marsh Island, and about 265 feet in a northerly direction from the white light marking the back range from Mile Point dredged cut. Marked by a 2-inch galvanized-iron pipe.

White Shells (*U. S. E.*) (Duval County, U. S. E., 1908).—On the shore end of the White Shells training wall. Marked by a 2-inch galvanized-iron pipe.

Marsh (*new*) (*U. S. E.*) (Duval County, U. S. E., 1908).—On the north bank of St. Johns River, about 1 000 feet in a westerly direction from Cedar Point Creek, and 15 feet inside the marsh. Marked by a 2-inch galvanized-iron pipe.

St. Johns (*U. S. E.*) (Duval County, U. S. E., 1908).—On the northeast point of St. Johns Bluff, on the bluff. Marked by a 2-inch iron pipe surrounded by a 4-inch terra-cotta pipe filled with concrete.

K (*U. S. E.*) (Duval County, U. S. E., 1908).—On the left bank of St. Johns River, in about the first sand pile south of the lower entrance to Clapboard Creek. Marked by an upright piece of lumber 6 inches square.

Fulton (*U. S. E.*) (Duval County, U. S. E., 1908).—Washed away.

Creek east base (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—On the south bank of St. Johns River, about 1 mile above Fulton, on a point of marsh just at the mouth of a small creek. It is about on line with Beacon 6 and the lower end of Long Island Dam. Marked by a 2-inch iron pipe 9 feet in the ground and 2 feet above it.

Beacon 6 (*U. S. E.*) (Duval County, U. S. E., 1908).—Position shifted and station destroyed.

Coon (*U. S. E.*) (Duval County, U. S. E., 1908).—At the down-river end of the Coon Point Dam. Marked by an upright piece of lumber 6 inches square.

Jack west base (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—On the west side of the marsh on Mill Cove Point, about ½ mile north of the mouth of Alligator Creek. It is nearly on line with the extreme north point of Radcliffe Island and the mouth of Calder Creek. Marked by a 2-inch galvanized-iron pipe about 9 feet in the marsh.

Teach (*U. S. E.*) (Duval County, U. S. E., 1908).—On the lower end of Vicks Island and near the upper end of Coon Point Dam. Marked by a 1¼-inch iron pipe.

Alligator (*U. S. E.*) (Duval County, U. S. E., 1908).—On the north end of Alligator Island, 300 feet west of the upper end of cut-off dam. Marked by a 2-inch galvanized-iron pipe.

Calder (*U. S. E.*) (Duval County, U. S. E., 1908).—On the north bank of St. Johns River above New Berlin, on a small strip of sand about 350 feet north of Calder Creek. Marked by a 2-inch galvanized-iron pipe.

Radcliffe (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—On the west side of Radcliffe Island, about opposite the small creek which is between Dame Point and Calder Creek. Marked by a vertical post 6 inches square standing 3 feet above the surface of the ground.

Lighthouse (*U. S. E.*) (Duval County, U. S. E., 1908).—The extreme top point of the old lighthouse off Dame Point. Marked by a cross cut in the lead.

Jones (*U. S. E.*) (Duval County, U. S. E., 1908).—On the point of marsh just west of the first creek up river from Dame Point. The station is 660 feet down the river from Jones Dock at Eulalia. Marked by a 1½-inch iron pipe.

Pauline (*U. S. E.*) (Duval County, U. S. E., 1908).—On the north side of the marsh island known as Pauline Island. Marked by a 1½-inch iron pipe.

Crab (*U. S. E.*) (Duval County, U. S. E., 1908).—On the extreme western point of Crab Island. Marked by a 2-inch iron pipe.

Beacon No. 20 (*U. S. E.*) (Duval County, U. S. E., 1908).—Destroyed.

Ben (*U. S. E.*) (Duval County, U. S. E., 1908).—In the water off Reddie Point, about 230 feet from the shore. Marked by a 2-inch galvanized-iron pipe which stands about 3 feet above low water.

Merrill 2 (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—On the north bank of St. Johns River, on the first point below the mouth of Trout Creek and about opposite the front range beacon for Trout Creek cut. Marked by a 2-inch galvanized-iron pipe projecting about 1 foot above the ground. The station is in the water at high tide.

Chase (*U. S. E.*) (Duval County, U. S. E., 1908).—Near the right bank of St. Johns River, in the water, 175 feet from the shore and between A. R. Merrill's and Lucky Jim's docks at Chaseville. Marked by a 2-inch galvanized-iron pipe standing 4 feet above the water surface.

Cummer (*U. S. E.*) (Duval County, U. S. E., 1908).—On the property of the Cummer Lumber Co., about 20 feet from the last runway to the downstream storage house and about 35 feet inside of a wooden bulkhead. Marked by a 2-inch galvanized-iron pipe.

Bank (new) (*U. S. E.*) (Duval County, U. S. E., 1908).—On the right bank of St. Johns River, on the first point above the deep cove which is just above Chaseville. Marked by a 2-inch galvanized-iron pipe.

Fertilizer (*U. S. E.*) (Duval County, U. S. E., 1908).—On the head of the dock of the American Agricultural Chemical Co. It is 1.9 feet from the end of the dock, 13.8 feet from the downstream side, and 9.75 feet from the upstream side of the dock. Marked by 11 galvanized-iron tacks.

Mill (*U. S. E.*) (Duval County, U. S. E., 1908).—In the water, about 20 feet from the shore of what is known as Green Isle, on which isle there is a sawmill. Green Isle belongs to W. W. Laidlaw and is situated about 1 000 feet northeast of the monument on Talleyrand Avenue marking the limits of the city of Jacksonville. Marked by a 2-inch iron pipe.

Driggs (*U. S. E.*) (Duval County, U. S. E., 1908).—At about low-water mark on the right bank of the St. Johns River and in front of the Driggs property. Marked by a 1½-inch iron pipe with its top projecting 18 inches above the bottom of the river.

Wilson (*U. S. E.*) (Duval County, U. S. E., 1908).—On Wilson & Toomer's fertilizer dock, 225.6 feet from its inshore end. Marked by a 1½-inch galvanized-iron pipe set in the ground under the dock. The top of the pipe is flush with the top of the dock, a hole being cut through the dock planking.

Bigelow (*U. S. E.*) (Duval County, U. S. E., 1908).—On the right bank of St. Johns River, on the first point up the river from Floral Bluff. The station is about at low-water line and is marked by a 1½-inch galvanized-iron pipe projecting 2 feet above the ground.

Terminal (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—At the water's edge on the left bank of the St. Johns River, just beyond the Ostrich farm, on line with the south fence of what is known as the Weston property (now belonging to the Atlantic Coast Line Railroad Co.). Marked by a 2-inch galvanized-iron pipe projecting about 9 inches above the ground.

Matthews (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—On the right bank of St. Johns River, about 200 feet down the river from the lower dock at the place known as Matthews, and 500 or 600 feet north from the mouth of Arlington River. Marked by a 2-inch galvanized-iron pipe projecting about 1 foot above the ground. The station is in the water at high tide.

Commodore A (*U. S. E.*) (Duval County, U. S. E., 1908; 1909).—In the St. Johns River, 60 feet south from the marsh off Commodore Point. It is in 18 inches of water and is marked by a 2-inch galvanized-iron pipe, 10 feet long, projecting above the surface of high water.

Bluff (Duval County, H. G. O., 1876; 1909).—On the right bank of St. Johns River, on the bluff opposite Commodore Point. It is 8 meters from the edge of the bluff on the north. The underground mark is a bottle 4 feet below the surface of the ground. Above this is a piece of sandstone 5 by 12 inches and 20 inches long set in cement, and having in its top a drill hole in which is a nail set in cement to mark the center. The reference mark is a 4-inch terra-cotta pipe 2 feet long placed near the line fence between the Halliday and Eustis properties, and 18.32 meters from the station in azimuth 1° 58′. Other distances and azimuths from the triangulation station are as follows: Four live-oak trees each marked with a triangle, 4.3 meters, 207° 56′; 19.3 meters, 290° 26′; 25.2 meters, 6° 20′; 15.3 meters, 36° 17′; cedar tree marked with triangle, 13.9 meters, 359° 34′.

Bigelow's (Robert) north chimney (Duval County, A. W. E., 1855; 1909).—The center of the north chimney on the house of Charles F. Hemmenway; the place is called Oak Hall and is at Floral Bluff on the St. Johns River. The house originally belonged to Robert Bigelow and later to J. T. Bacon. The chimney has two flues, and has been rebuilt above the roof.

Jacksonville northeast base (Duval County, H. G. O., 1876; 1909).—This station was marked in 1876 by a glass bottle 2½ feet below the surface of the ground, above which was placed a cypress block 10 inches square and 3 feet long, projecting 1 foot above the surface. A cypress block 10 inches square and 5 feet 4 inches long was buried in the direction of the base from the station and 2 feet below the surface of the ground, its nearest end being 18 inches from the bottle. In 1909 this station was searched for and not found, as all points of reference had disappeared.

Jacksonville southwest base (Duval County, H. G. O., 1876; 1909).—This station was marked in 1876 in a manner similar to Jacksonville northeast base (see above) with the addition of a second cypress block with its near end 18 inches from the bottle. In 1909 this station was searched for without success, but it was not evident that the marks had been destroyed.

Wallace (Duval County, H. G. O., 1876; 1909).—On the southeast corner of the top of Wallace's store, a brick building on the shell road from Jacksonville to the Atlantic Hotel, and at the intersection of the street running up from the Alligator Mills. The station is 1½ inches from the inner corner in a westerly direction and ¼ inch inside the inside edge of the parapet. In 1909 the station was recovered, but the building was abandoned and partly in ruins.

Marsh (Duval County, H. G. O., 1876; 1909).—In 1909 this station was searched for without success. *Merrill* (*U. S. E.*) is in the same locality. (See p. 495.)

Customhouse (*U. S. E.*) (Duval County, U. S, E., 1908; 1909).—The center of the extreme top point of the tower of the post-office building in Jacksonville. This building is at the corner of Hagan and Forsyth Streets.

Water tower E. O. P. (Duval County, E. S., 1909).—In South Jacksonville. The finial on top of the high water tower just back of the E. O. Painter Fertilizer Works.

Lancaster 2 (*U. S. E.*) (Duval County, U. S. E., 1909).—Lancaster Point has been filled in 6 or 8 feet and a concrete sea wall built around it. About 8 meters back from the sea wall is a paved roadway. The station is on the extreme point less than 1 meter from the inner edge of the wall. The station is marked underground by a terra-cotta chimney pot set in cement 2½ feet below the surface of the ground. The surface mark is a 4-inch (?) terra-cotta pipe, 2 feet long set in cement and with its top flush with the ground. In this is centered a 2-inch galvanized iron pipe 3 feet long and projecting above the surface. Three witness marks were made in the sea wall as follows: A hole surrounded with a triangle, 1.03 meters to the east; a hole with an arrow, 10 meters to the north; a hole with an arrow, 9.99 meters to the south.

Club (*U. S. E.*) (Duval County, U. S. E., 1909).—On the left bank of St. Johns River above Jacksonville and just south of the Florida Yacht Clubhouse. It is near the edge of what will be the sidewalk of a street not yet opened, and is about 4 meters back from the wooden bulkhead. The underground mark is a terra-cotta chimney pot set in cement 2½ feet below the surface of the ground. The surface mark is a 4-inch terra-cotta pipe 2 feet long set in cement with its top flush with the surface of the ground. In this is centered a 2-inch galvanized iron pipe 3 feet long and projecting above the surface.

Beacon No. 25 (Duval County, E. S., 1909).—A black beacon with a white light in the St. Johns River, just above Jacksonville, off La Vista or Philips Point.

Bight (Duval County, H. G. O., 1876; 1909).—On the west side of St. Johns River about 1 mile above McGirts Creek. The underground mark is a bottle set in cement 3 feet below the surface of the ground. The surface mark is a 4-inch terra-cotta pipe 2 feet long set in cement, with its top projecting 3 inches above the ground. The reference mark consists of two paving bricks on end set in cement, and placed 9.95 meters from the station in azimuth 17° 34′. Three trees have triangles blazed on them and are at the following distances and azimuths from the station: (*a*) 5.3 meters, 357°; (*b*) 2.5 meters, 86°; (*c*) 4.8 meters, 132°. The distances between these trees are as follows: (*a*) to (*b*) 5.9 meters, (*b*) to (*c*) 3.5 meters, (*c*) to (*a*) 9.4 meters.

La Vista reference mark (Duval County, H. G. O., 1876; 1909).—On Philips Point on the right bank of St. Johns River, on top of and near the edge of the bluff in a northerly direction from the wharf close to which station La Vista was located. The underground mark is a bottle set in cement 3 feet below the surface of the ground; above this was set a 4-inch terra-cotta pipe 2 feet long, flange up, and projecting 3 inches above the ground. A reference mark was set on the line fence to the north; it consists of a white bottle set bottom up in cement 2 feet below the surface, above which is a concrete post with its top flush with the ground. In the top of the concrete post is a dark bottle mouth up to mark the center. It is 28.08 meters from the station in azimuth 194° 33′.4. Triangles were blazed on three live-oak trees at the following distances and azimuths from the station: (*a*) 3.1 meters, 106°; (*b*) 10.8 meters, 274°; (*c*) 5.1 meters, 325°. The distances between these trees are: (*a*) to (*b*) 13.8 meters, (*b*) to (*c*) 8.5 meters, (*c*) to (*a*) 7.7 meters.

Lancaster (Duval County, H. G. O., 1876; 1909).—Not recovered in 1909. (See *Lancaster 2*, p. 488.)

La Vista (Duval County, H. G. O., 1876; 1909).—Lost. (See *La Vista reference mark*, p. 488.)

Tyson (Duval County, H. G. O., 1876; 1909).—On the east side of St. Johns River, on the first point of land south of Philips Point, on the flat below the bluff. Marked by an ale bottle 2½ feet below the surface of the ground. The surface mark is a cypress block, 12 inches square and 2 feet long, with a copper tack in its top. In 1909 the station was searched for without success.

Pine (Duval County, H. G. O., 1876).—Reported in 1909 as lost.

Goodsby (Duval County, H. G. O., 1876; 1909).—Under a low bluff on a low marshy point at the mouth of Goodsbys Creek. Marked by a cypress stub 3 inches in diameter with a copper tack in its top. In 1909 the station was visited and a pine stub surrounded by three smaller stubs found, but this was not verified as a recovery of the old station.

Black Point wharf flag (Duval County, H. G. O., 1876).—Situated in the northwest corner of the pierhead of the wharf. The pole used in signaling river boats.

Mulberry (Duval County, H. G. O., 1876; 1909).—This station has been destroyed.

Buckley (Duval County, H. G. O., 1876; 1909).—On the east side of St. Johns River, on top of and near the edge of a high bluff point, Buckley Bluff, on land belonging to Cronin and Ives of Jacksonville. The underground mark is a bottle set in cement 2½ feet below the surface of the ground. The surface mark is a block of sandstone, 4 by 6 by 12 inches in size, set in cement, with its top 4 inches above the ground. The reference mark is an old dry battery set in cement 2 feet below the surface of the ground, with a 4-inch terra-cotta pipe 2 feet long set over it. This pipe is set in cement and its top projects 4 inches above the ground. It is 13.26 meters from the station in azimuth 346° 29′. A triangle cut on a live oak is 17.38 meters from the station in azimuth 199° 50′, and another tree with a triangle cut on its inshore side is 6.00 meters from the station in azimuth 359° 48′. The reference mark is 7.52 meters from this second tree.

Mandarin (Duval County, H. G. O., 1876; 1909).—On the east shore of St. Johns River, 33 meters from a fence that is 5 meters back from the hard land. The station is between Mandarin Point and the settlement called Mandarin. It is marked by a hard paving brick set in cement 2 feet below the surface of the ground. Above this is a solid block of concrete 18 inches square in which is set a 4-inch terra-cotta pipe 2 feet long projecting 4 inches above the concrete. The reference mark is a bottle set bottom up 2 feet below the surface of the ground, above it being placed a concrete post 10 inches square with diagonal lines cut on its top. It is 30.37 meters from the station in azimuth 359° 30′ 15″. Three trees marked with triangles are at the following distances and azimuths from the station: (*a*) 30.47 meters, 284° 37′; (*b*) 34.23 meters, 353° 17′; (*c*) 24.75 meters, 3° 27′. The distance from the reference mark to (*b*) is 5.42 meters, and to (*c*) is 6 meters. From (*b*) to (*c*) is 11 meters. Tree (*a*) is a live oak bearing an old blazed mark.

Doctor (Clay County, H. G. O., 1876; 1909).—This station has been destroyed.

Ragged (Clay County, H. G. O., 1876; 1909).—This station has been washed away.

Huntington (Duval County, H. G. O., 1876; 1909).—On the east shore of St. Johns River, about 1 mile north of Julington Creek, and on a low point below the bluff. The

underground mark is a brick surrounded with cement. Over this was placed a 4-inch terra-cotta pipe 2 feet long set in a block of concrete 15 inches square. The top of the pipe projects 6 inches above the concrete. Immediately back of the station on the bluff is set the reference mark consisting of a bottle bottom up, over which is a concrete post 8 inches square with diagonal line on it. It is 13.82 meters from the station in azimuth (magnetic) N. 50° E. An oak tree south of the reference mark on the bluff was marked with a triangle; it is 15 meters from the station in azimuth (magnetic) N. 74° E. An old cypress tree is 2.70 meters S. 70° W. (mag.) from the station, and a cypress stump 3.10 meters S. 1° W. (mag.)

Moore (St. John County, H. G. O., 1876; 1909).—On the east side of St. Johns River, near the shore below the bluff in front of Col. Moore's house. Marked underground by a brick, and on the surface by a cedar post. Could not be found in 1909.

False (Clay County, H. G. O., 1876).—On the west side of St. Johns River, on the first prominent point south of Ragged Point.

Cuckoo (St. John County, H. G. O., 1876; 1909).—On the east side of St. Johns River, about ¾ mile north of New Switzerland Point, on a flat point below the bluff. It is as far round the point as can be seen from station Moore. The underground mark is a brick surrounded with cement. Over it was placed a 4-inch terra-cotta pipe 2 feet long set in cement, its top projecting 6 inches above the cement. The reference mark was placed on the bluff among some oak trees. It is a 4-inch terra-cotta pipe 2 feet long set in cement, flange up, its top being 3 inches above the ground. The following distances and directions are from the triangulation station: Station Huntington, 0° 00′; reference mark, 27.87 meters, 89° 37′ 50″; two cypress trees below the bluff each marked with a triangle, 5.4 meters, 92° 30′, and 6.4 meters, 151° 30′.

Middle (Clay County, H. G. O., 1876; 1909).—On the west side of St. Johns River, about 1¼ miles north of Hibernia Wharf. Marked underground by a brick with hole in it; above this was placed a cedar stub with galvanized iron nail in its top. In 1909 part of the old signal was recovered, but no trace of the marks.

Hibernia (Clay County, H. G. O., 1876).—A pole set in the water off Hibernia Point.

Magnolia (Clay County, H. G. O., 1876; 1909).—On Magnolia Point. Marked by a brick and a cedar stake. Searched for in 1909 without success.

Remington (St. John County, H. G. O., 1876; 1909).—On the east side of St. Johns River below the bluff in front of the Remington Park House. It is marked underground by the half of a claret bottle set in cement 2 feet below the surface of the ground. Over this is a 4-inch terra-cotta pipe 2 feet long set in a concrete block 15 inches square, and projecting 3 inches above it. The reference mark is a pickle bottle set 2 feet below the surface of the ground, and having above it a concrete post 8 inches square, with diagonal lines cut on its top. It is on the bluff and 13.20 meters from the station in azimuth 251° 20′ 49″, and in line with the station and an old cypress tree which stands at the water's edge and is the only tree of the kind growing along shore in the locality. This tree is 3.55 meters from the station in azimuth 73°. An oak tree on the bluff was marked with a triangle; it is 10.10 meters from the station in azimuth 263°.

Hallowe's wharf house, north gable (St. John County, H. G. O., 1876; 1909).—This wharf is in ruins and the station is lost.

White (Clay County, H. G. O., 1876; 1909).—On the west bank of the St. Johns River, on the point of land about 1 mile southeast of Green Cove Springs. Marked

underground by a hole in a brick, around which was placed cement. Over this was placed a 4-inch terra-cotta pipe set in cement, and projecting 4 inches above it. The reference mark is a bottle 2 feet below the surface of the ground, above it being built a concrete post 8 inches square, with diagonal lines marked on its top. It is 15.31 meters from the station in azimuth 355° 24′ 45″. There is an oak tree 10.70 meters from the station in azimuth 266°. Two pine trees are at the following distances and azimuths from the station: 23 meters, 7°; and 30 meters, 96°. The reference mark is 18.42 meters from the oak and 8 meters from the first-mentioned pine.

Hampton (St. John County, H. G. O., 1876; 1909).—In 1909 this station was searched for without success. It has probably been washed away.

Sappho (Clay County, H. G. O., 1876; 1909).—On the west side of St. Johns River, on Old Field Point. This station is washed over at high water. Marked by a piece of 2-inch galvanized iron pipe 4 feet long driven in the ground; around this pipe was placed a 4-inch terra-cotta pipe 2 feet long, and around the terra-cotta pipe a concrete block 15 inches square and 2 feet deep. On the low bluff back of the station was set the reference mark consisting of a brick with a hole in it 2 feet below the surface, over which was built a concrete post 8 inches square with diagonal lines on its top. It is 30.36 meters from the station in magnetic azimuth S. 10° E. A triangle cut on a live oak tree is 24.70 meters from the station, and a triangle cut on the westerly branch of a double magnolia tree is 24.36 meters, and to the live oak tree is 9.20 meters. There are two small oak trees southwest of the reference mark, and 1.30 meters from it.

Patricio (St. John County, H. G. O., 1876; 1909).—This station was searched for in 1909 without success. It has probably been washed away.

Eliza (St. John County, H. G. O., 1876; 1909).—This station has been washed away.

Hogarth's wharf (St. John County, H. G. O., 1876).—The flagstaff on the wharf house at Hogarth's landing.

Red (Clay County, H. G. O., 1876; 1909).—This station has been washed away.

Bayard 2 (Clay County, F. W. P., 1878; 1909).—On the west side of St. Johns River, on the high bank of Bayard Point. The underground mark is a stone jar with a small hole in its center, buried 2¼ feet below the surface of the ground. At the surface the station is marked by a copper tack in a piece of yellow-pine scantling. In 1909 this station was searched for without success, but it was not evident that the marks had been destroyed.

Hale (St. John County, H. G. O., 1876; 1909).—On the east side of St. Johns River, on low flat ground covered at very high tides, on the point just above Picolata. Marked by a stone jar with a hole in it 14 inches below the surface, and by a cedar stub with a copper tack in its top. In 1909 all reference marks were gone and the station was not found.

Stream (Clay County, H. G. O., 1876; 1909).—In 1909 it was determined that this station had been washed away.

Hicks (Clay County, H. G. O., 1878; 1909).—This station was searched for in 1909 without success. It has undoubtedly been washed away.

Straight (St. John County, F. W. P., 1878; 1909).—This station could not be found in 1909.

Water (St. John County, F. W. P., 1878; 1909).—This station could not be found in 1909.

Cypress (*Ash*) (Clay County, F. W. P., 1878; 1909).—This station could not be found in 1909.

Tocoi (St. John County, H. G. O., 1876; 1909).—At Tocoi on the east side of St. Johns River, on a high bluff near the shore line and about 300 meters south of the old wharf of the St. Johns Railroad. The marks are a hole in a brick 45 inches below the surface of the ground, above which is an inverted earthen jar, with a hole in its center, while at the surface the station was marked by a cross on a copper tack in the head of a cedar stub. In 1909 the station was searched for without success.

Cedar (Putnam County, F. W. P., 1878; 1909).—On the west side of St. Johns River, on the second point below Nine Mile Point. This point has a commanding view up and down the river. The station was marked underground by an inverted earthen jar with a ⅛-inch hole in it. The surface mark is a copper tack in the head of a live oak stub. In 1909 the station was searched for without success. One reference mark was recovered. It was a large live oak tree with a triangle cut on it; it had fallen on the ground. The station is 21 meters outshore from this tree.

Racy (St. John County, F. W. P., 1878; 1909).—On the east side of St. Johns River, on Racy Point. It is about 10 feet back from the edge of the bluff. The underground mark is an inverted earthen jar nearly 3 feet below the surface of the ground; it has a ⅛-inch hole in its center. Over this was placed a foot of white sand, and then the surface mark, a 4-inch terra-cotta pipe, was set in cement with its top projecting 3 inches. The reference mark is a bottle buried 2 feet in the ground, over which was placed a concrete post 8 inches square with diagonal lines on its top. It is 12.60 meters from the station in azimuth 272° 10′ 31″. A 1½-inch iron pipe set by the United States Engineers as a reference mark for their station, which is out in the river, is 2.87 meters from the station in azimuth 309° 35′. The following azimuths and distances are from the triangulation station: Oak tree marked with old and new triangles, 10.10 meters, 251°; oak tree marked with old and new triangles, 7.00 meters, 317°; oak stump, 3.42 meters, 69°. The reference mark is 4.70 meters from the first oak tree and 9.00 meters from the second one.

Cohanzy (Putnam County, F. W. P., 1878; 1909).—This station could not be recovered in 1909.

Nine Mile Point (Putnam County, W. I. V., 1878; 1909).—On the west side of St. Johns River, on solid ground on Nine Mile Point. In 1909 the old subsurface mark was recovered broken to pieces, but observations showed it to be practically in place. Station re-marked with a 2-inch galvanized iron pipe 4 feet long driven in till 10 inches of it projected above the surface of the ground. A hole 15 inches square and nearly 2 feet deep was dug around this pipe; a 4-inch terra-cotta pipe 2 feet long was placed around the iron pipe, their tops at the same height; the box and the pipes were then filled with concrete. The reference mark was set on hard land and is 31.72 meters from the station in azimuth 18° 52′ 15″. It consists of a hard paving brick set in cement 3 feet below the surface of the ground; over this was placed a cement post with a top 8 inches square marked with diagonal lines. The following distances and azimuths are from the triangulation station: (*a*) Oak tree marked with triangle, 19.97 meters, 64°; (*b*) oak tree marked with triangle, 25.77 meters, 46°. From the reference mark it is 23.00 meters to (*a*); 14.75 meters to (*b*); 9.42 meters to (*c*), a sweet gum tree marked with a triangle facing the reference mark; and 10.87 meters to (*d*), a sweet gum tree

marked same as (*c*). From (*a*) to (*b*) is 9.60 meters; (*b*) to (*c*) is 5.25 meters; (*c*) to (*d*), 13.40 meters.

Chafer (St. John County, W. I. V., 1878; 1909).—In 1909 this station could not be recovered.

Deep 2 (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

Bridgeport (Putnam County, E. E., 1885; 1909).—On the west bank of St. Johns River, in the town of Bridgeport. The history of the station mark recovered in 1909 is not known. It does not tally with the old mark of 1885, but is in the position of the station as determined from two witness trees. The station is now marked by a 3-inch iron pipe driven into the ground till but 10 inches of it projects above the surface of the ground. This is surrounded by a concrete block 15 inches square and 2 feet deep, its upper side being heaped up around the pipe for 4 inches. This pipe is probably about 7 feet in the ground. The reference mark consists of a bottle set in cement 3 feet below the surface. Over the bottle is placed a 4-inch terra-cotta pipe 2 feet long set in cement, above which it projects about 3 inches. It is back on the bluff and is 29.55 meters from the station in azimuth 67° 59′ 12″. An old oak blazed with a triangle is 6.1 meters from the station in azimuth 37°, and another oak much larger and blazed with a triangle is 14.8 meters from the station in azimuth 94°. Four large oaks were blazed with triangles on the sides facing the reference mark. They are at the following distances from the reference mark: (*a*) 8.12 meters; (*b*) 14.0 meters; (*c*) 5.56 meters; (*d*) 13.15 meters. The distances between the various trees are: (*a*) to (*b*), 19.20 meters; (*b*) to (*c*), 11.60 meters; (*c*) to (*d*), 15.20 meters; (*d*) to (*a*), 15.60 meters.

Federal Point (Putnam County, E. E., 1885).—No description of this point is available.

Renz (Putnam County, E. E., 1885; 1909).—On the west side of St. Johns River on a prominent point about 1 mile south of Bridgeport. The station was marked by a quart bottle, with its neck 4 inches below the surface of the ground. In 1909 the station was not recovered, but it was not evident that the mark had been destroyed.

Bob (Putnam County, E. E., 1885; 1909).—On the east side of St. Johns River, on Middle Point. Marked by a bottle with its top 5 inches below the surface of the ground. In 1909 no trace of this station could be found, but it was not evident that the mark had been destroyed.

Lynwood (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

Cole (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

George (Putnam County, E. E., 1885; 1909).—On the west side of St. Johns River, the southeast side of Verdiere Point, on the property of Mr. George. The station was marked by a quart bottle. Heavy theodolite stubs, 3 inches square, were driven in out of sight. The following witness marks were made: Barkless stump, 3½ feet high, marked with a copper nail in a blazed triangle, 16.1 meters, N. ½° E.; nearer and larger of two live oak stumps, marked by copper nail in blazed triangle, 12.3 meters, southeast.; live oak tree marked by copper nail in blazed triangle, 7.9 meters, west by south. In 1909 these witness marks were all found, but the center mark was not recovered.

Whetstone (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Cowgill (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Sunnyside (Putnam County, E. E., 1885; 1909).—On the right side of St. Johns River, on the first point west of Penn post office. A 9-inch hickory tree marked with a blazed triangle bears east from the station distant 8.8 meters. This was recovered in 1909, but the center mark, a bottle 8 inches below the surface of the ground, was not.

Larson (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

Warner (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

Tally (Putnam County, E. E., 1885; 1909).—On the left bank of the St. Johns River, 20 meters from the edge of the bluff and about 40 meters S. 15° E. from an old house. This house is 40 meters back from the edge of the bluff. A triangle was cut on a water oak, 2½ feet in diameter, and 22.12 meters north of the station. In 1909 this oak, which is 20 meters from the edge of the bluff, was found, but the center mark, which was probably a glass bottle, was not found.

Bight (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Stevens (Putnam County, E. E., 1885; 1909).—On the right bank of St. Johns River, on the southern end of Forresters Point. Marked by a bottle about 4 inches below the ground. This station could not be found in 1909, as all references had been destroyed.

Sauble (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Shellbank (Putnam County, E E., 1885; 1909).—This station has been destroyed.

Quake (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Washington (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Harding (Putnam County, E. E., 1885; 1909).—This station has been destroyed.

Bog (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Palatka Point (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

Hart (Putnam County, E. E., 1885; 1909).—On the right bank of St. Johns River, on Harts Point, opposite the town of Palatka. It is 3.6 meters from the water's edge, and 14.3 meters north-northwest of the marine railway over high-water mark. An oak stump stands 21.26 meters from the station bearing N. by W. ½ W. The station was marked in 1909 by a bottle set in cement 2½ feet below the surface of the ground, over which has been placed a 4-inch terra-cotta pipe, set in cement and projecting 1 inch above it. The reference mark was set back of the station among some palmettos, and consists of the upper part of a small fruit jar set in cement, above which was placed a cement post 8 inches square, having diagonal lines on its top. It is 29.60 meters from the station in azimuth 201° 10′ 44″. Two oak trees marked with triangles are at the following distances and azimuths from the station: 25.88 meters, 192° 35′, and 7.39 meters, 8°. The azimuth of beacon 70 from the station is 58° 53′.1.

Muck (Putnam County, E. E., 1885; 1909).—This station could not be recovered in 1909.

South End (Putnam County, E. E., 1885; 1909).—In the south end of the city of Palatka, on the lot at the southwest corner of River and Morris Streets. The lot belongs

to the Moragne estate. The station is marked by a 1-inch galvanized iron pipe 4 feet long driven in the ground; about this was placed a 4-inch terra-cotta pipe 2 feet long, and filled in and around with cement. The top of the terra-cotta pipe and upper surface of the cement are flush with the ground, while the iron pipe projects 5 inches above it. In the lot on the opposite side of River Street and 3.77 meters from the fence was set the reference mark, consisting of a bottle set in cement 2 feet below the surface, above which was placed a cement post 8 inches square with diagonal lines on its top. Between the reference mark and the fence is a triple stump. The reference mark is 24.13 meters from the station in azimuth 124° 33′ 31″. The following distances and azimuths are from the triangulation station: Magnolia tree marked with triangle, 11.83 meters, 135°; ironwood tree, 3.21 meters; oak tree at southeast corner of River and Morris Streets, marked with triangle, 27.75 meters, 221°; an oak tree at the southwest corner of Morris and River Streets marked with triangle, 14.24 meters, 191°; beacon 70, 284° 26′ 01″; beacon 72, 289° 39′ 31″.

ST. JOHNS RIVER.

SUPPLEMENTARY POINTS.

Sister (Duval County, A. W. E., 1855; 1909).—Lost.

Pelot (Duval County, A. W. E., 1855; 1905).—Lost.

St. Johns Bluff (Duval County, A. W. E., 1855; 1905).—This station has been destroyed.

Palmetto (Duval County, A. W. E., 1855; 1906).—On the marsh about ½ mile up St. Johns River from Fulton. Alligator Creek heads in a lagoon very near the station and affords the easiest means of reaching it. Marked by a bottle set mouth up in cement 2 feet below the surface of the ground; above the bottle but not touching it was placed a marble post, around which cement was placed for a distance of 6 inches above the surface of the ground. The post extends 5 inches above the cement and has a cross cut in its top to mark the center. The reference mark is a bottle set bottom up in cement, above which is placed a terra-cotta pipe 2 feet long also set in cement and projecting 4 inches above the ground, and 12.24 meters from the station. The angle at the station between station Radcliffe and the reference mark is 292° 19′ 20″.

Merrill (*U. S. E.*) (Duval County, U. S. E., 1909).—On the marsh point on the right bank of the St. Johns River, on the property of Dr. J. H. Durkee, and about 1 000 feet up the river from Merrill-Stevens marine railway. Marked by a 2-inch galvanized-iron pipe which stands 3 feet above the marsh land.

Anhauser (*U. S. E.*) (Duval County, U. S. E., 1909).—On the left bank of the St. Johns River, a short distance above the Florida East Coast Railway bridge. It is in front of a house belonging to a man named Anhauser. The underground mark is a terra-cotta chimney pot set in cement 2½ feet below the surface of the ground. Over this is a 4-inch terra-cotta pipe 2 feet long set in cement with its top flush with the ground. In this is centered a 2-inch galvanized iron pipe 3 feet long and projecting above the surface.

Dad (*U. S. E.*) (Duval County, U. S. E., 1909).—On the right bank of St. Johns River, at the edge of the marsh, and 300 feet down the river, following the shore line from the center of the Florida East Coast Railway bridge, and 114 feet in direct line from the railway. Marked by a 2-inch galvanized iron pipe projecting about 1 foot above the ground.

ST. JOHNS RIVER TO ST. AUGUSTINE.

PRINCIPAL POINTS.

Palmer (Duval County, B. H., 1858; 1905).—On the plantation of David L. Palmer, and about 40 yards west-southwest of his sugar mill. Two live oaks, a myrtle, and several palmettos grow in a circle around the small open space in which the station is located. The station was marked in 1905 according to note 3, page 474. The top of the upper pipe is about 3 inches below the surface of the ground. Reference marks are two joints of 4-inch terra-cotta pipe filled with concrete and placed, one to the north and one to the south as indicated later. These reference pipes project 6 inches above the ground. The following distances and directions (not azimuths) are from the triangulation station: Southwest corner of old chimney, 0° 00′; dead cedar, 1.74 meters, 74° 50′; cedar tree, 13.54 meters, 99° 00′; palmetto, 3.55 meters, 111° 30′; young live oak (two-branched), 117° 40′; south reference pipe, 1,728 meters, 120° 54′; young live oak (three-branched), 3.65 meters, 167° 20′; cedar stump, 1.55 meters, 158°; north reference pipe, 1.03 meters, 303° 10′.

Haynes (Duval County, B. H., 1858).—In a field on Mr. Haynes's plantation on the west side of Pablo Creek. The center was marked by a copper tack in the head of a large stub of water oak driven in the ground. Four other stakes with nails in their heads were placed at a distance of 3.048 meters from the station. These stakes form a square with the station at the intersection of its diagonals.

Pine Island (Duval County, B. H. ,1858).—On the western end of Pine Island, on the east side of Pablo Creek, and nearly east from Mr. Haynes's house. Vistas were cut through the woods to stations Haynes, Palmer, and Sea. Marked by a champagne bottle buried 2 feet below the surface of the ground.

Sea (Duval County, B. H., 1858).—About 3 miles south of St. Johns Point, and on the second row of sand hills from the beach, on a hill immediately back of which is a very thick growth of scrub. Marked by a quart bottle 23 inches below the surface of the ground, above which is a square pine stub with a tack in its head. North, south, east, and west of the station, at a distance of 0.914 meter are driven four stubs of pine scantling. A vista was cut to station Palmer.

Drumruck (Duval County, B. H., 1858).—On the second row of sand hills from the sea beach, about 300 meters north of the trail leading from Gen. Hopkins's house to the beach. The center was marked by a copper tack, surrounded by a ring of iron nails, in the head of a yellow pine stub, 2 feet 8 inches long, and projecting about 2 inches above the surface of the ground.

Hopkins (Duval County, B. H., 1858).—In a cotton field belonging to Gen. Hopkins, and about 200 meters south of his house. The center was marked by a champagne bottle 2 feet below the surface of the ground, above which was a copper tack in the head of a stub 18 inches long and 5 inches in diameter.

St. Isabelle (Duval County, B. H., 1858).—On the first row of sand hills from the beach, about 3 275 meters south of station Drumruck. The center was marked by a copper tack in the head of a 6 by 4 inch yellow-pine stub 3 feet 4 inches long. A half circle of iron nails was placed around the copper tack.

Mulatto Jack (Duval County, B. H., 1858).—On a point on the west side of Pablo Creek, about 250 meters south from the junction of Pablo and Mulatto Jack Creeks.

The station is on the hard marsh about 50 meters west of the bank of the creek. Center marked by an iron nail in the top of a stub 5 inches in diameter.

Tam Smith (Duval County, B. H., 1858).—On a sand hill on the beach, just east of Mr. Maill's house. Center marked by a cross on the head of a large brass nail in a piece of timber, 4 by 9 inches, and 2½ feet long, buried in the top of the hill.

Maill (St. John County, B. H., 1858).—On the hard marsh on the east side of a small creek which joins San Pablo Creek from the eastward. The station is about 400 meters north of some old log camps, and about 1 mile west of Mr. Maill's house, which is on the road from Mayport to St. Augustine. Center was marked by a copper tack in the head of a large oak stub. Three smaller stubs are placed around the station. Vistas were cut to stations Tam Smith and Point Solana.

Point Solana (St. John County, B. H., 1858).—On the beach of sand hills, a short distance north of the salient point known as Point Solana, and just east of and about 150 meters distant from Solana's old fields. Center marked by a cross on the head of a large brass nail in a piece of timber buried in the top of the hill.

Jenks (St. John County, B. H., 1859).—On the second row of sand hills from the beach, about 100 meters from high-water mark and about 800 meters east of Guano River. It is about 3 miles in a southeast direction from Mr. Jenks's old place, and about due east from a thick wood of pines which stands on the west bank of the Guano River. The station was marked according to note 8, page. 474.

Smith (St. John County, B. H., 1859).—On the west side of North River, on a small round hammock in the marsh. This hammock is about 40 feet in diameter and has bushes around it. The hammock may also be known by three stumps of palmetto trees which were cut down, and by the stump of a large palm tree. There is an old live oak landing on the bank of a creek near a point of pines which is 250 meters southwest of the station. Marked by a copper tack in a live-oak stub projecting about 6 inches above the surface of the ground, and by 4 stakes, the diagonals between which intersect at the station in a right angle.

Hernandez (St. John County, B. H., 1859).—On a sand hill on the sea beach, 400 meters east of Guano River, and about 2 miles northeast of Mr. Perpaul's landing. It is southeast of Mr. Hernandez's old place, which is on the opposite side of the river, and is said to be 14 miles from St. Augustine. The station was marked according to note 8, page 474.

Deep Creek (St. John County, B. H., 1859).—On the main land on the west side of North River, about 100 meters from a creek, and at a projecting point of pine woods, just west of a large lone pine hammock, better known as Pine Island. The station was marked according to note 8, page 474.

Mauran (St. John County, B. H., 1859).—On a small shell mound in the marsh on the west side of North River, and about ⅞ mile northerly from Shell Bluff. The mound is not more than 25 feet in diameter, and is about 100 meters east of a thin point of pines, west of which are two fresh water ponds. To make room for the signal, bushes were cut down, leaving their stumps. The station was marked according to note 8, page 474, except that there was no bottle buried.

Big Sandhill (St. John County, B. H., 1859).—On a sand hill on the east side of Guano River, about 1 mile from its mouth. This sand hill is known as one of the Twin Sisters, and is the largest sand hill in the vicinity; it is about 400 meters southeast of Mr. Perpaul's landing. The station was marked according to note 8, page 474.

Casacola (St. John County, B. H., 1859).—On the property of Mr. Alvarez, and about 120 yards east of his house. On the west side of North River, and near a creek which leads to the landing place of Mr. Alvarez. The station was marked according to note 7, page 474.

Harrison (St. John County, B. H., 1859).—On North Beach, on the second row of sand hills from the sea, and east of the house of Mr. Alvarez. It is just north of a road which connects the beach with an old landing on a creek which makes into North River, and the mouth of which is directly opposite the mouth of Casacola Creek. The center was marked according to note 7, page 474.

Sanchez (St. John County, B. H., 1859; 1905).—About 45 meters from the marsh in a westerly direction, and in the northeast end of an old field belonging to Mr. Sanchez. An old barn stands in the southwest corner of this field, several hundred meters from the station. In 1905 this old field was so overgrown with trees and brush as to render any attempt at its recovery inadvisable. The center was marked according to note 7, page 474.

Cocked Hat (St. John County, B. H., 1859; 1905).—On North Beach, about 4 miles from the lighthouse in a northerly direction, and east of Mr. Sanchez's barn on North River. Marked according to note 7, p. 474. In 1905 it was reported that the ocean beach in this vicinity had washed away from 200 to 400 feet.

Allen (St. John County, B. H., 1859; 1905).—On the highest sand hill in the vicinity, on the border of a swamp which lies between it and the North River. It is the only swamp within a mile or so, the land on both sides of it being covered with thick scrub. Marked as follows: A seasoned pine stub, 1 foot long, and having a tack in its top was buried 3 feet below the surface of the ground. Above this was placed an earthenware bottle, 2 feet from the surface, while above the bottle is another stub 1 foot long, on the top of which the center was marked by a nail surrounded by 4 tacks in the form of a square. Four stakes were placed each 3 feet 1 inch from the center, forming a square with the station at the intersection of its diagonals. Two other stakes having crosses cut on them were placed, one on the north and one on the south side of the station, and each 16 feet 7 inches from the center.

Baya (St. John County, B. H., 1859; 1905).—This station has been destroyed.

St. Augustine north base (St. John County, B. H., 1859; 1905).—In 1859 this station was in a pine barren about 1½ miles northwest of St. Augustine, and about 600 meters north from the Picolata road. The center was marked by an earthenware bottle 2 feet under the surface of the ground, above which was a nail in the head of a large pine stub 2 feet long projecting 9 inches above the surface of the ground. In 1905 the marks were not found, the country being overgrown with pine trees and scrub palmettos.

St. Augustine south base (St. John County, B. H., 1859; 1905).—In a pine barren, a short distance from the Palatka Road, and about 2½ miles in a southwesterly direction from St. Augustine (in 1859). The center was marked according to note 9, page 474. In 1905 the marks were not found, the country being overgrown with pine trees and scrub palmetto.

SUPPLEMENTARY POINTS.

St. Augustine Catholic Cathedral spire (St. John County, I. W., 1905).—The tower of the cathedral on the northeast corner of Cathedral and St. George Streets. The center of the tower is 24 meters east of St. George Street and 3 meters north of Cathedral Street.

St. Augustine water tower (St. John County, I. W., 1905).—This tower stands 75 feet back from Hypolita Street, between Charlotte and St. George Streets, being 50 yards from Charlotte Street and 55 yards from St. George Street. It is about 20 feet in diameter and 120 feet high.

Alcazar Hotel chimney (St. John County, I. W., 1905).—A tall square brick chimney 12 meters south of the north end of a small brick building on Cordova Street, St. Augustine, in the rear of the Alcazar Hotel. This building contains the electric plant of the hotel.

St. Augustine Presbyterian Church dome (St. John County, I. W., 1905).—The iron cross on top of the round dome on the church which stands at the northwest corner of Valencia and Sevilla Streets. It is 32 meters from Valencia Street and 28 meters from Sevilla Street.

St. Augustine Methodist Church spire (St. John County, I. W., 1905).—The center of a square tower with a round cupola on a church which stands at the northwest corner of Carrera and Cordova Streets. It is covered with red tiles. The center is 5 meters north of Carrera Street and 25 meters east of Cordova Street.

Ponce de Leon Hotel chimney (St. John County, I. W., 1905).—A tall round brick chimney which stands near Valencia street, and just outside of the northwest corner of the kitchen of the Ponce de Leon Hotel, at St. Augustine. It is 12 meters from Valencia Street to the center of the chimney.

St. Augustine latitude station (St. John County, W. H. B., 1906).—On the wireless telegraph reservation of the United States Navy on Anastasia Island near St. Augustine. Latitude observations were made on a wooden pier. The reference mark is a ¼-inch copper wire, bent at the lower end, and set in the southeast corner of the concrete pier used as an anchorage for the west guy to the tall wireless telegraph pole, and about 150 meters north of the lighthouse. This copper wire is set in cement and projects ¼ inch. It is 6½ inches from the east edge of the pier and 7 inches from its south edge. The pier is 12 by 16 feet on base, 12 feet in ground, and 4 feet square on top, which is 5 inches above the surface of the ground. The latitude station is 3.70 meters southeast of the reference mark; from the latitude station the reference mark is 115° 23′ to the right of the line to St. Augustine lighthouse.

ST. AUGUSTINE TO MOSQUITO LAGOON.

PRINCIPAL POINTS.

Canova (St. John County, B. H., 1859; 1871).—In an old cornfield on Mr. Canova's place, and about 20 meters southeast of his house. Center marked according to note 7, page 474. This station was searched for in 1867 and in 1871 and could not be found. (See *Canova 2*, p. 501.)

Scrub (St. John County, B. H., 1859; 1905).—On Anastasia Island, on a small sand hill covered with thick scrub oak. It is more than ⅝ mile east-southeast of the house on Fish Island. The hill on which the station stands is much higher than any other ground in the vicinity. The station is most easily reached by following the road down the island from the lighthouse for about 2 miles, and then crossing the woods to the station. The station was marked by two joints of terra-cotta pipe placed one above the other, and a mass of cement and sand placed around the bottom of the lower pipe and the

junction of the two pipes and around the top of the upper pipe. The lower pipe is 6 inches by 2½ feet, and the upper pipe is 4 inches by 2 feet. A joint of 4-inch terra-cotta pipe, filled with cement and sand, was placed on a line to the lighthouse, 1.11 meters from the station. Both the center pipe and the reference pipe project about 6 inches above the surface of the ground. A trail was cleared through the scrub from the station eastward to the road where it passes through the old quarry.

Anastasia 2 (St. John County, B. H., 1859; 1867).—On the highest sand hill on Anastasia Island, about 3 miles south of the lighthouse, and marked by a copper tack in the head of a large oak stub. In 1867 this station was searched for and reported lost, and in 1871 station *Merritt* was established a little to the southward. (See below.)

Manly (St. John County, B. H., 1859; 1905).—On the west bank of the Matanzas River, about 30 meters from high-water mark and near the southeast corner of the land owned by Mr. H. S. O'Brien, of New York, whose winter residence, built of concrete, stands a little northwest of the station. The residence of Mr. W. K. Swink, of St. Louis, stands a short distance southwest from the station. The station was marked by two joints of terra-cotta pipe placed one above the other; the lower pipe is 6 inches in diameter, the upper one 4 inches. Both pipes were filled with cement and sand, and a mass of concrete was placed around the bottom of the lower pipe and around the junction of the two pipes. The upper pipe projects 10 inches above the surface of the ground. The reference mark is a joint of 4-inch terra-cotta pipe placed on the prolongation of the line from the lighthouse. The following directions (not azimuths) are from the station: O'Brien's house cupola, 0° 00′; St. Augustine water tower, 54° 00′; end of old wharf piling, 56° 50′; end of Swink's wharf, 160° 16′; cedar tree north of fence, 215° 22′; front gable of O'Brien's wharf, 332° 00′; reference pipe, 251° 54′.

Merritt (St. John County, J. A. S., 1871; 1906).—On Anastasia Island, a little to the southward of *Anastasia 2*. (See above.) It is on top of a sand hill about ¼ mile back from the beach. A lone pine tree, the only one in this vicinity, stands at the foot of this hill on the side toward the ocean. "Scrub" grows on the sides of the hill, but the top is bare. The station can be reached from St. Augustine by following the road on Anastasia Island south from the lighthouse for about 5 miles, to a point where a considerable space east of the road is clear of scrub, and following a trail from this point to the beach. The station is on the first sand hill south of this trail. A pool of water is at the foot of the western slope of the hill. The station was marked according to note 2, page 474. The lower pipe is placed with its bottom 6 feet below the surface of the ground and the upper pipe with its top 6 inches below the surface. The reference pipe was placed on the slope of the sand hill on line to St. Augustine Lighthouse and 6.41 meters from the station.

Government (St. John County, B. H., 1859; 1905).—On the west side of the Matanzas River, just off a point of pines, the first prominent point south of Mr. Manlay's place. It is about 1½ miles north of Mr. Braddock's place, and is on an oval-shaped piece of hard ground, 100 meters outside the line of woods. Outside and inside of the station are bare sand flats, and a small ridge covered with white sand is between the marsh and the river. The ground covering a space 10 feet square just west of the station has been dug up and left piled up. The station was marked according to note 2, page 474, the reference pipe being placed on line to St. Augustine Lighthouse and 15.30 meters from the station. Three instrument stubs were left in position. A large pine tree marked with a triangle is on the edge of the woods inshore from the station and is 104 meters

from the station in azimuth 75° 54′. From the station the azimuth of McCall's house, west gable, is 199° 46′, and of William Middleton's house, center chimney, is 312° 01′.

Canova 2 (St. John County, C. S. P., 1882; 1906).—In front of a residence owned by David Dunn, of St. Augustine, and occupied by L. C. Johnson. The ground slopes from the house toward the water, and is all sand around the station. The center was marked underground by a joint of 6-inch terra-cotta pipe 2½ feet long, on which was placed a joint of 4-inch pipe 2 feet long. The upper pipe projects 6 inches above the surface of the ground. The pipes were filled with cement and sand and this material was also placed around the bottom of the lower pipe and around the junction of the two pipes. Reference mark is a joint of 4-inch terra-cotta pipe 18 inches in the ground on prolongation of the line to the lighthouse, and 5 or 6 feet from the station. The following azimuths and distances are from the triangulation station: Lone palmetto, 34 meters, 120° 07′; Boyce's house, south gable, 140° 46′; Boyce's barn, east gable, 150° 58′; lone cedar (10 inches diameter), 27 meters, 197° 31′; easternmost of twin oaks, 47 meters, 79° 50′; David Dunn's house, northeast corner of roof, 97° 37′.

March (St. John County, J. A. S., 1871; 1906).—On top of a sand ridge ¼ mile south of a trail cleared through the scrub from the house of Capt. John McCall, on the Matanzas River, to the beach. A lone palmetto tree, the only one in the vicinity, stands a short distance north of this trail and between the sand ridge and the ocean. The station is 125 meters from high-water mark, on top of the second row of sand hills back from the beach, and on the first sand hill south of the trail which opens the horizon to the south. The ridge is covered on its seaward slope and on its summit by scrub palmettos and on its western slope by "scrub." The station was marked according to note 2, page 474. The bottom of the lower pipe is 6 feet below the ground, while the upper pipe has its top even with the surface of the sand. The reference pipe was placed with its top flush with the surface of the ground and 25.20 meters from the station in the direction of St. Augustine Lighthouse.

Braddocks Point (St. John County, J. A. S., 1871; 1906).—On the extreme point of hard land southeast of Braddock's clearing, and near a few pine trees back of which is a clearing covered with scrub palmettos. A hole 4 by 10 feet and 18 inches deep was dug in 1906 immediately east of the station in the search for it; this hole was left open. The station is about 3 meters from the western edge of this hole in line with its southern edge. The station was marked according to note 2, page 474. The bottom of the lower pipe is 3½ feet below the surface of the ground. The upper pipe projects 20 inches above the general level of the ground and a pile of earth was made around it. The reference pipe is buried 2 feet in the ground on line to St. Augustine Lighthouse and 20.67 meters from the station. The following distances and directions (not azimuths) were observed from the triangulation station: Pine tree, marked with a triangle, 100.5 meters, 90° 57′; dead stump, 34.5 meters, 154° 40′; north gable of Middleton's cottage, 238° 18′; west edge of hammock, ½ mile, 332° 46′; chimney of Virtree's house at Summer Haven, 326° 20′.

Anastasia (St. John County, J. A. S., 1871; 1906).—On a sand hill on the ocean beach. Marked according to note 2, page 474, except that the upper pipe is only 2 feet long, as 6 inches of its top was cut off, leaving a ragged edge. The reference pipe was placed on the sand ridge with its top 6 inches above the ground and 20.48 meters from the station in line to St. Augustine Lighthouse.

Dunham (St. John County, A. M. H., 1872; 1906).—On a bare sand flat covered at high water, a little over a mile northwest from Spanish Fort, and 600 meters west of the west shore of Matanzas River. The center was marked by two pieces of 4-inch terra-cotta pipe, one 2½ feet long and the other 1½ feet long, placed one on the other, the top of the upper one flush with the ground, and the two of them filled with and surrounded with concrete. Four cedar stubs surround the station in the form of a square. Three instrument stubs, 3 by 4 by 18 inches, are also in position. The reference mark is a 4-inch terra-cotta pipe, 2½ feet long, placed with its top 6 inches above the surface of the ground and 16.55 meters from the station on line to Fort triangulation station. A tall lone pine in the woods shows across the nearest wooded hammock (small), and a dead cedar on this hammock is 68 meters (paced) from the station.

Last (St. John County, A. M. H., 1872; 1906).—On Anastasia Island, on a flat-topped sand hill in the western of the two ridges which follow this portion of the coast. It has a growth of grass and scrub palmetto on it, and the "scrub" comes to the top of the western slope. Marked according to note 2, page 474, the top of the upper pipe being flush with the surface of the ground. The bottom of the lower pipe was placed 5 feet below the surface of the ground. The reference pipe projects 4 inches above the ground and is 19.66 meters from the station on line to station Fort. The following directions were observed at the station: Lone palmetto, distant about ⅓ mile, 0° 00′; dead palmetto stump, marked with a triangle, 58 meters, 13° 53′; Fort station, 20° 04′; small palmetto marked with triangle, 22.85 meters, 44° 30′; small house on river, 170° 21′.

Swamp (St. John County, A. M. H., 1872; 1906).—In the soft marsh, 100 meters from the hard ground, and across the marsh from Summer Haven, a small settlement on the beach a short distance south of Matanzas Inlet. It is 55 meters north of a small creek leading into the woods. Marked according to note 1, page 473. The upper pipe projects 1 foot above the surface of the marsh. The three instrument stubs were left in place. The reference mark is a coquina stone with lead and cross lines in its top placed 20.27 meters from the station in line to station Fort. The following distances and azimuths are from the triangulation station: Palmetto tree, 75 meters, 136° 13′; chimney Virtree's house at Summer Haven, 255° 30′; pine tree at point of woods, ½ mile, 344° 32′.

Camp (St. John County, A. M. H., 1872; 1906).—Mr. J. J. Virtrees, of Nashville, Tenn., has built a house at Summer Haven on the sand hill on which this station was located, and the station has been destroyed.

Dupont (St. John County, A. M. H., 1872; 1906).—On the extreme north edge of what is known as Daly's grove, marked by a coquina stone with lead and cross lines. In 1906 it was reported that the shell mound on which this station was located was more than half washed away, and that the station was lost.

Hemmings Point (St. John County, A. M. H., 1872; 1906).—On Hemmings Point, a prominent point of land on Pellicers Creek. The station was marked according to note 9, page 474. This station was searched for in 1906, but was not found.

Virgil (St. John County, A. M. H., 1872; 1906).—On a bare sand flat nearly opposite the Washington House on the Matanzas River; this sand flat is covered with 8 inches of water at high tide, and extends from the station to a prominent palmetto hammock on the north (290 meters to the nearest palmetto trees) and to the river on the east. It is 34 meters to the edge of the marsh grass to the northeast, and in the same direction 90 meters to the nearest portion of a pond in the marsh. Marked according to note 2,

page 474, the upper pipe projecting 1 foot above the surface of the ground. A stone ale bottle was placed bottom up in the upper pipe. The reference pipe is 2 feet in the ground and 18.60 meters from the station on line to the north chimney of the Washington House. On the prolongation of this line was placed a coquina stone 4 inches square on top, with lead and cross lines 11.55 meters from the station, and projecting 6 inches above the ground. The three instrument stubs were left in position. The following directions are from the station: Washington House, north chimney, 0° 00′; lone pine at point of woods ½ mile distant, 63° 48′; west edge palmetto hammock, 223° 02′; east edge same (lone palmetto), 230° 53′; Dupont's house, 247° 53′.

Buena Vista (St. John County, A. M. H., 1872; 1906).—In 1906 it was reported that the sand hills on one of which this station stood have been washed away, and the station destroyed.

Hernandez (St. John County, A. M. H., 1872; 1906).—On West Branch Creek, on a pine hammock, about ½ mile south of what was known as the Raller Landing. The Haulover Road passes 270 meters west of the station. Marked according to note 9, page 474. In 1906 this station was searched for without success, but it was not evident that the marks had been destroyed.

Mala Compra (St. John County, A. M. H., 1872; 1906).—In 1906 this station was reported destroyed by erosion of the shore.

De Leon (St. John County, A. M. H., 1872; 1906).—About 1½ miles south of Hernandez. Marked according to note 9, page 474. In 1906 the station was searched for without success, but it was not evident that the marks had been destroyed.

De Soto (St. John County, A. M. H., 1872; 1906).—On a line of sand hills about 8½ miles from Matanzas Inlet. Marked according to note 9, page 474. In 1906 it was reported that the shore opposite this station was being eroded and that the station was lost.

Bikes Prairie (St. John County, A. M. H., 1872; 1906).—In the water in the midst of willow swamp in Bikes Prairie. Marked by a large block of coquina 4 inches square on top and 2 feet long, standing 1 foot above bottom and 6 inches above level of water. In 1906 this station was searched for without success, but it was not evident that the marks had been destroyed.

Rebaut (St. John County, A. M. H., 1872; 1906).—Up the coast from an old house on the bluff owned by William Painter It was marked in 1872 according to note 9, page 474, but in 1906 only the underground mark was recovered, the surface mark having been destroyed by the washing away of the sand bluff. The underground mark was exposed and apt to be destroyed at any time. A new station was established 18.865 meters from the station in azimuth 44° 04′ 05″. As it was not determined with precision, its position is not given in this publication and it is to be regarded as a reference mark. It is on a sand ridge, between which and the station there is a slight depression. This ridge is covered with scrub palmettos, but the ground in the immediate vicinity of the new station was cleared. It was marked according to note 4, page 474, the upper pipe projecting 6 inches above the ground. The single reference pipe was placed 32.56 meters south from the new station and at the south end of a bare spot. The following distances and directions are from the new station: Campbell station, 0° 00′; north gable Painter's house, 1 783 meters, 0° 08′; tall pine tree, 24° 10′; palmetto marked with triangle, 21.30 meters, 44° 50′; tall pine tree, 56° 25′; reference pipe, 32.56 meters, 358° 38′.

De Luna (St. John County, A. M. H., 1872; 1906).—On a small sand hill in the midst of a thin pine forest 400 meters east of the southern part of Bikes Prairie. Marked according to note 9, page 474. In 1906 the station was searched for without success. The ground was covered with scrub palmetto and bushes. It was not evident that the marks were lost.

De Solas (St. John County, A. M. H., 1872; 1906).—In the open pine woods about 1 300 meters from the ocean shore. Marked according to note 9, page 474. In 1906 the station was searched for without success, but it was not evident that the marks had been destroyed. The ground is covered with scrub palmetto and bushes.

Campbell (St. John County, A. M. H., 1872; 1906).—On a sand hill about 1 mile south of Rebaut station. It is 3.35 meters from the top of the bluff and 7.62 meters from high-water mark. The inner sand ridge is continuous south of the station and small sand hills begin opposite the station and continue to the north. The outer ridge on which the station is located is level. Marked according to note 2, page 474, the reference mark being 2 feet in the ground, and 53.19 meters from the station in direction noted below. It is on a sand hill of the inner ridge with bare places on both sides of it, the one to the south being distant 22 meters, and the one to the north 15 meters. The rest of the ridge is covered with scrub palmetto. The following directions and distances are from the triangulation station: Umbrella-topped pine tree (slender) near gap in woods, 5° 43′; southernmost of 5 palmettos at a pond half-way to woods, 58° 41′; reference pipe, 72° 03′; tall pine tree, 73° 18′; tall dead pine tree, 80° 01′; tall pine tree, 84° 52′; gable William Painter's house (460 meters), 156° 02′; point of bluff to north, 159° 05′; south end of body of water, 345° 21′; north end of body of water, 349° 38′.

Leonardo (St. John County, A. M. H., 1873; 1906).—About 1 170 meters from station De Solas, and 2 or 3 meters to the east of the line from station De Solas to station Sheppard. Marked by a cross in a lead bolt in a coquina block. It is in the open pine woods, and the ground is nearly all covered with scrub palmetto. The station was searched for in 1906 without success, but it was not evident that the marks had been destroyed.

Haulover (St. John County, A. M. H., 1873; 1906).—On a sand hill on the inner ridge, some 600 yards south of the Haulover, a road connecting the head of Smiths Creek with the beach. In 1906 the old tripod was recovered lying on the ground, but the coquina block could not be found. A flagpole was erected, and three 4-inch terra-cotta pipes, 2½ feet long were buried on their sides, 1 foot underground, and radiating from the flagpole. The top of the hill was cleared and grubbed.

Sheppard (St. John County, A. M. H., 1873; 1906).—On the edge of a swamp-grass pond in the pine woods, west of a ridge running south from station De Solas. Marked by a cross in a lead bolt in the top of a coquina block 6 inches square and 2 feet long. This station was searched for in 1906 without success, but it was not evident that the marks had been destroyed.

Griffith (St. John County, A. M. H., 1873; 1906).—On a sand hill in the midst of pine woods and scrub-oak bushes. It is on the eastern slope of the sand ridge, several feet below the top, 21 meters east of the Bulow Road and opposite a pond surrounded by marsh and a growth of palmettos. Mr. A. F. Brown has a bee shed 200 meters north of the station on top of the ridge, but it can not be seen from the station without cutting bushes. Marked according to note 2, page 474, the upper center pipe projecting 4 inches above the ground, and the reference pipe being 12.65 meters from the station on line to

station Bulow. The four bottles originally marking the station underground were broken up and the pieces scattered around the station. The stone formerly at the center was left lying near the center. The following distances and directions are from the triangulation station: Dead pine across road, 24 meters, 66° 46′; small pine marked with triangle, 7.73 meters, 118° 45′; pine with triangle, 32 meters, 175° 22′; pine with triangle (tree is double 15 feet above the ground), 43 meters, 203° 07′; pine with triangle, 50 meters, 230° 58′; dead pine at edge of marsh, 42 meters, 272° 00′; pine with triangle (at south end of marsh), 58 meters, 297° 54′; avenue to Bulow station, 338° 37′. No other pine trees are within the area surrounded by the marked trees.

Bard (St. John County, A. M. H., 1873; 1906).—On a sand ridge near the ocean beach, about 2⅔ miles south of Haulover. It is 65 meters inshore from the top of the bluff. The sand hills both to the north and to the south of the station are a little higher than the ground at the station. The ridge in the immediate vicinity of the station is bare, and a trail leads to the top of the bluff at the ocean. The station was marked according to note 2, page 474, the upper center pipe projecting 6 inches above the ground, while the reference mark also projects 6 inches above the surface. The reference mark is 16.00 meters distant from the station on line to the chimney of the house of refuge which is on the bluff 3 600 meters to the south. It is on the west slope of a sand hill. The following distances and directions are from the triangulation station: Palmetto marked with triangle, 6.70 meters, 59° 41′; small palmetto, 15.45 meters, 114° 25′; flag near Haulover, 156° 17′; house of refuge chimney and reference pipe, 337° 58′.

Bulow (St. John County, A. M. H., 1873; 1906).—In "Bulow's old field," between Smiths and Bulows Creeks, about northeast of Knight's house on Bulows Creek. It is 24 meters west of the Bulow Road. The avenues cut to stations Coligny, Griffith, Bard' and Nelson are still (1906) easily distinguishable, but are closing up. The station was marked according to note 2, page 474, the upper center pipe projecting 4 inches above the ground, and the reference pipe being 16.70 meters from the station on line to a large pine tree marked with two triangles one above the other. The following distances and directions are from the station: Pine with triangle, 32 meters, 32° 27′; palmetto with triangle, 15.20 meters, 59° 48′; palmetto, 6.60 meters, palmetto, 4.57 meters; pine with two triangles, 27 meters, 147° 16′; pine with triangle, 18 meters, 222° 51′; pine with triangle, 19.00 meters, 310° 55′.

Nelson (St. John County, A. M. H., 1873; 1906).—On a sand ridge between the ocean and Smiths Creek. It is on the second sand ridge back from the ocean, and is 900 meters south of the house of refuge. Mr. Mann's house is on the ocean front about ½ mile south of the station. There are no trees or other objects near the station. Marked according to note 2, page 474, the reference pipe being in the sand ridge, 26.32 meters south of the station. Both reference and center pipes project 6 inches above the ground.

Coligny (Volusia County, A. M. H., 1873; 1906).—In the orange orchard of Mr. Knox, between Smith and Bulow Creeks. In 1906 this station was searched for, but no marks could be found.

Oso (Volusia County, A. M. H., 1873; 1906).—On the third sand ridge back from the ocean, and about 1 mile north of the mouth of Bulows Creek or of the head of Halifax River. It is 200 meters north of an old canal cut through to the creek; the mouth

of this canal is closed by sand on the ocean front. High sand hills were thrown up on the second and third ridges when the canal was cut through them. Marked according to note 2, page 474, the upper pipe projecting 6 inches above the surface, while the reference pipe is 14.25 meters from the station in line to the chimney of the United States house of refuge. The following distances and azimuths are from the station: Northernmost of two palmettos, ¼ mile, 71° 49′; lone palmetto, ½ mile, 140° 21′; house of refuge chimney and reference pipe, 160° 03′; flagstaff, house of refuge, 160° 05′; Mann's house, east gable, 161° 23′; cut in ridge for old canal, 317°.

Tomoka (Volusia County, A. M. H., 1873; 1906).—On the marsh about ⅓ mile from the Halifax River near its head, and between it and the line of main woods of the interior. Marked underground by an iron cone lettered U.S.C.S.; above this was placed a coquina block 3 feet long, with lead bolt and crosslines to mark the center. Theodolite stakes were left in position. In 1906 this marsh was covered with grass 6 to 8 feet high, and the station was not found. It was not evident that the marks had been destroyed.

Paloma (Volusia County, A. M. H., 1873; 1906).—On the second sand ridge from the ocean beach back of Mr. J. R. Bacon's house. Marked by a coquina block; the three theodolite stubs were left in position, and the marks covered with a mound of earth 18 inches high and 5 feet in diameter. In 1906 the station was searched for without success. A road had been cut through to the beach close to the station and a telephone pole erected on the sand hill on which the station stood. It is possible that the marks have been removed.

Oswald (Volusia County, A. M. H., 1873; 1906).—On the west bank of Halifax River, about 2 miles from its head and about 1 mile south of the south point of the mouth of Tomoka Creek. It is 23 feet from the waters edge on a low sand bank covered with bushes. One palmetto stump stands 7.0 meters northwest of the station and another is 13.4 meters southeast of the station. Center marked by cross mark in a lead bolt in the center of the top of a coquina block 3 feet long. This station was searched for without success in 1906, but it was not evident that the marks had been destroyed.

Esperanza (Volusia County, E. S., 1873; 1906).—On a narrow sand ridge (about 6 meters wide) between the marsh and the west bank of the Halifax River, and about ½ mile south of the house of J. S. Bryan. This sand ridge is covered with scrub palmettos, with tree palmettos at intervals. The ground in the immediate vicinity of the station was cleared. Marked according to note 3, page 474. The following distances and directions are from the triangulation station: Lone palmetto to the south, 0° 00′; palmetto marked with triangle, 13.15 meters, 15° 03′; tall pine, ½ mile, 86° 25′; palmetto marked with triangle, 19.61 meters, 171° 56′; lone palmetto, 191° 12′; end of Bryan's wharf, 188° 03′; center pile, end of Baker's wharf, 328° 52′.

Arena (Volusia County, A. M. H., 1873; 1906).—On a sand hill on the second ridge from the ocean and 200 meters north of the nineteenth milepost of the Ormond-Daytona automobile race course. The hill is the highest in the vicinity, and is bare on the east, north, and south sides. There is a deep depression between this ridge and the ridge which lies between it and the ocean. Marked according to note 2, page 474, the reference mark being 2 feet in the ground, and 28.10 meters from the station in line to the flagstaff of Breton Inn Hotel at Ormond Beach. The following distances and directions are from the triangulation station: Clump of pines east of river, 60° 30′; gap in clump of pines, 136° 23′; J. E. Bacon's water tower, flagstaff, 150° 22′; Bacon's cottage on beach,

gable, 157° 42′; reference pipe and Breton Inn flagstaff, 336° 55′; Ormond Hotel chimney, 344° 44′.

Quixote (Volusia County, A. M. H., 1873; 1906).—On Tall Pine Point, on the west bank of Halifax River. Marked by crosslines on a lead bolt in the top of a coquina block. In 1906 this station was searched for, but could not be found. The station mark has probably been destroyed.

Hercules (Volusia County, A. M. H., 1873; 1906).—This station has been destroyed by the building of a house on the sand hill on which it was located.

Halifax (Volusia County, A. M. H., 1874; 1906).—On the river flats on the western shore of Halifax River, and 42 meters north-northeast (mag.) of the tip of Beldens Point. Marked by a ¾-inch auger hole in center of pile, around which were 9 other piles, in form of three triangles to support instrument and observer. Two reference stones were set on the shore, but in 1906 only one of these stones was found, and only two of the piles, the center pile being lost. The station is lost for triangulation purposes.

Homer (Volusia County, A. M. H., 1874; 1906).—On a sand hill about halfway between the second and third telephone poles north of milepost 14 of the Ormond-Daytona automobile race course. The station is 31 meters from high-water mark, and 14 meters from the top of the bluff. The hill near the station to the southwest is higher than the ground at the station. Marked according to note 2, page 474, the reference mark being 22 inches in the ground, and 16.50 meters from the station on line to Clarendon Hotel (Seabreeze) flagstaff. A coquina block 6 inches square and 4 feet long was buried 42 inches in the ground, and 22.86 meters from the station on line to the flagstaff of Coquina Hotel (on the beach opposite Ormond).

Pine Point (Volusia County, A. M. H., 1874; 1906).—On Pine Point, a prominent point on the west shore of Halifax River. Marked according to note 9, page 474. In 1906 the station marks could not be found. The point is being eroded and the surface has been removed to be used as road covering.

Chaucer (Volusia County, A. M. H., 1874; 1906).—On a round-topped sand hill, the highest in the vicinity 50 paces north of the trail to Russell's farm, and halfway between the tenth and eleventh telephone poles north of milepost 12 of the Ormond-Daytona automobile race course. The top of the hill was covered with a thick growth of scrub palmetto; the hill was cleared and the palmetto roots removed in the immediate vicinity of the station. Marked according to note 2, p. 474, the reference pipe being 26 inches in the ground, and 11.20 meters from the station in line to the flagstaff of Clarendon Hotel at Seabreeze.

Orange Island (Volusia County, A. M. H., 1874; 1906).—The upper bridge at Daytona, across the Halifax River, is built at this station, and the station was destroyed when the west abutment was built.

Mollison (Volusia County, A. M. H., 1874; 1906).—On a prominent sand hill about 1 mile north of Mollison's trail. This hill a little north of the station is about 6 feet higher than the ground at the station. Marked according to note 2, page 474, the upper pipe extending 2 inches above the surface of the ground, while the reference pipe is 2 feet in the ground and 14.70 meters from the station on line to the Automobile Clubhouse flagstaff. A coquina stone 6 inches square and 4 feet long was placed in prolongation of this line and 10.12 meters from the station.

Bethune Point (Volusia County, A. M. H., 1874; 1906).—On the second sand ridge back from the shore on Bethune Point, a point to the south of Daytona, and on the west shore of Halifax River. A narrow marsh is in front of the station, with a sand ridge for the bank of the river. The station is in the middle of the sand ridge with marsh on both sides. The ridge is covered with scrub palmetto and a scattering growth of oak, pine and cedar trees. The ground in the vicinity of the station was cleared and the roots of the scrub palmetto taken up. Marked according to note 4, page 474, the upper pipe projecting 6 inches above the ground and 15.50 meters north of the station. A coquina stone 6 inches square and 4 feet long was buried 42 inches in the ground, and 15.33 meters south of the station. The following distances and azimuths are from the triangulation station: Palmetto marked with triangle, 24.46 meters, 141° 56′; reference pipe, 15.50 meters, 153° 21′; reference stone, 15.33 meters, 331° 25′; pine tree marked with triangle, 23.00 meters, 332° 18′.

Swatow (Volusia County, A. M. H., 1874; 1906).—On a sand hill about ½ mile south of the trail leading from Mr. Mollison's house to the beach. It is opposite the eighth telephone pole south of milepost 9 of the automobile race course. Marked according to note 2, page 474, the upper pipe projecting 2 inches above the sand. The reference pipe is 2 feet in the ground and 10.35 meters from the station on line to the flagstaff of the Automobile Clubhouse.

Snow (Volusia County, A. M. H., 1874; 1906).—This station has been destroyed.

Dobbin (Volusia County, A. M. H., 1874; 1906.)—This station has been destroyed.

Weiser (Volusia County, A. M. H., 1874; 1906).—This station has been destroyed. (See *Weiser 2*, p. —.)

McDaniel (Volusia County, A. M. H., 1874; 1906).—On a low marshy point, the most prominent one after passing Mr. Allen's wharf, which is the next one south of McDaniel's boarding-house wharf. On land owned by Mrs. M. E. Meeker and nearly in front of her house. In front of the station is a wall of loose coquina stones. The station is in soft mud outside the grass line, and is covered at high tide by 12 to 18 inches of water. It is 12 feet inside the stone wall near the point where high water covers the wall. An oyster reef is at the end of the wall on the river side. Marked according to note 2, page 474, the upper pipe projecting 6 inches above the surface of the mud. The reference pipe was placed 2 feet in the ground, just outside the line joining two palmetto trees (7 feet apart) which are growing by the roadside; it is 23.30 meters from the station in azimuth 48° 59′. The old center mark, a coquina block, was left lying on the mud near the station. The following azimuths are from the triangulation station: Loughbury's house, southwest corner, 193° 53′; house on beach, south corner, 201° 42′; lone palmetto on beach, 276° 50′; flagstaff on wharf (near point south of station), 307° 28′; lone pine, 336° 08′.

Sutton (Volusia County, A. M. H., 1874; 1906).—On the northeast corner of a long narrow hammock which makes out into the marsh from the Daytona–New Smyrna road about ¼ mile south of milepost 7 (from Daytona). The hammock is much wider at the end, and the station is just outside the growth of palmetto and cedar trees and oak bushes. Marked according to note 2, page 474, the reference pipe being 9.82 meters from the station in azimuth 349° 40′. The following distances and azimuths are from the triangulation station; Palmetto tree marked with triangle, 8.97 meters, 74° 36′; palmetto tree marked with triangle, 3.10 meters, 124° 35′; coquina stone with lead and

crosslines, 7.90 meters, 169°; ruins of old mill on the marsh, 325° 48′; palmetto marked with triangle, 13.15 meters, 358° 13′.

Patroclus (Volusia County, A. M. H., 1874; 1906).—On a sand hill about 50 meters north of milepost 3 of the automobile race course. The sand ridge north and south of this sand hill is 4 or 5 feet higher than the hill. The top of the hill was cut away, making a small level space around the station. Marked according to note 2, page 474, the reference pipe being 22.60 meters from the station in azimuth 153° 03′. The old station mark, a coquina post, 6 inches square and 4 feet long, with a hole in its top, was placed 17.30 meters from the station in azimuth 333° 03′. The center pipe projects 4 inches above the ground, and the reference pipe and stone each 6 inches. The following azimuths are from the triangulation station: Mrs. Fowler's house, south gable, 38° 14′; south gable of house (2 windows in end), 98° 36′; lone palmetto on east slope of Green Hill, 344° 49′; lone palmetto on top of Green Hill, 347° 30′.

Weiser 2 (Volusia County, I. W., 1906).—Between the first and second telephone poles north of milepost 5 of the automobile race course, and on the only high sand ridge along this section of the coast. A survey line cut through from Halifax River to the beach ends about ⅓ mile north of the station; the river end of this line is a short distance north of a large shell mound. Marked according to note 2, page 474, the reference pipe being 2 feet in the ground and 18.10 meters from the station in azimuth 153° 07′. The following azimuths are from triangulation station: South gable of house, 48° 00′; white cupola, 112° 46′; Loughbrey's house, chimney, 143° 59′; end of Keating's pier, 157° 21′.

Odyssey (Volusia County, A. M. H., 1874; 1906).—The top of the shell mound on which this station was located has been removed a depth of 5 feet to provide road material. The station is lost. (See *Odyssey 2*, below.)

Odyssey 2 (Volusia County, L. W., 1906).—On a small shell mound on a prominent point of "Turnbull Hammock," bordered by one of the many small creeks cutting the marsh about the mouth of Spruce Creek. It is in the northeastern extremity of the hammock or old field. This is the shell mound on which station Odyssey was located (see above), and from which the top has been removed leaving a round space on the end of the point level, and covered with a thin layer of shells, beneath which is loose coquina which caves like quicksand when dug into. Odyssey 2 is located in the center of this bare round space. Marked according to note 2, page 474, the reference pipe being 5.05 meters from the station in azimuth 91° 27′. A coquina post, 6 inches square and 4 feet long, was placed 9.20 meters from the station in azimuth 271° 27′. The reference pipe and post both project 6 inches above the ground.

Iliad (Volusia County, A. M. H., 1874; 1906).—The shore at this point has been eroded and the station has been destroyed.

Osceola (Volusia County, A. M. H., 1874; 1906).—The greater portion of the hill on which this station stood has been removed. The portion on which the station stood still stands (1906) but the station marks have been removed and the station is lost.

North Base (proposed) (Volusia County, A. M. H., 1874; 1906).—On a particularly prominent sand hill just north of the trail leading from the pilots' house to the sand hills. Marked according to note 9, page 474. In 1906 the station could not be recovered and, due to the shifting of the sand hills, is probably lost.

Palo Blanco (Volusia County, A. M. H., 1874; 1906).—On the marsh on the north side of a small creek which leads into the mangrove swamp from Stonehouse Creek, at a point opposite the foot of Wayne Avenue, New Smyrna. The station is 14 meters from the waters edge, at a point where the creek becomes quite narrow. Marked by a coquina stone post in the top of which is a lead bolt with cross lines. Around this stone and extending to a depth of 18 inches is a mass of concrete made of cement, coquina, and shells. The three instrument posts which surround the station were trimmed down and a 4-inch terra-cotta pipe 2½ feet long slipped over each and a thin cement poured into each pipe and over each post. The pipes are 18 inches above the mud surface and the posts project 2½ feet above the pipes. Several stakes stand around the station, projecting 4 or 5 feet above the marsh. These reference pipes are distant from the station as follows: South pipe, 0.70 meter; west pipe, 0.75 meter; northeast pipe, 0.72 meter. The following azimuths are from the triangulation station: Connor's windmill, 35° 15′; Duss's windmill, 233° 41′.

South Base (*proposed*) (Volusia County, A. M. H., 1874; 1906).—On a prominent sand hill a few meters to the north of where Maj. Alden's trail strikes the sand hills. Marked according to note 9, page 474. In 1906 this trail could still be seen, though it was no longer used. The station was searched for without success. The sand hills are shifting, and the station is probably destroyed.

Palo Alto (Volusia County, A. M. H., 1874; 1906).—On the west side of the west branch of the Hillsborough River, on an open shell point in front of the gate leading to the packing house of W. T. Hart's orange grove. Marked according to note 2, page 474, the upper pipe projecting 6 inches above the ground. The reference pipe is 20 inches in the ground, and is just inside the fence of W. T. Hart's orange orchard and near the north gatepost. It is 5 meters from the station in azimuth 74° 15′. The following azimuths are from the triangulation station: Smoke flue of house on railroad wharf at New Smyrna, 156° 55′; windmill, 183° 51′; chimney of hotel on beach, 196° 13′; west gable of house on wharf, Hawks Park, 331° 06′.

Palo Negro (Volusia County, A. M. H., 1874; 1906).—On a sand hill about 4¼ miles south of the hotel which is on the beach opposite New Smyrna. The sand hill is bare on its west slope near the top. Several palmetto trees are growing on the slope to the west of the station and an old house (barn?) stands on the ridge about ½ mile west of the station. Marked according to note 2, page 474, the top of the upper pipe being even with the surface of the sand. The reference pipe projects 6 inches from the ground and is on the sand ridge 12.05 meters south of the station. A coquina stone 6 inches square and 4 feet long is buried 42 inches deep in the sand ridge to the north of the station and 18.50 meters therefrom. The following directions (not azimuths) are from the triangulation station: Reference pipe, 0° 00′; north gable of old house (distant ½ mile), 108° 02′; palmetto tree, 156° 30′; reference stone, 173° 15′.

Los Pinos (Volusia County, A. M. H., 1874; 1906).—On the west side of the marshes and small creeks generally known as Hillsborough River, on the first prominent sand hill to the south of New Smyrna. In 1906 the station marks were not recovered, but the hole where they had been was recovered and the station as now marked is not in doubt by more than 6 inches. Marked according to note 2, page 474, the upper pipe projecting 8 inches above the ground. The reference pipe was placed 22 inches in the ground and 10.80 meters from the station in azimuth 341° 30′.

Alden (Volusia County, A. M. H., 1874; 1906).—On a tall sand hill just off the main sand ridge, about midway between Turtle Mound and Palo Negro triangulation stations. Between this hill and the marsh is a wide space of hard ground, which extends to the inland water on the west. The sand hills extend to the water a little north of west from the station. A pine log 20 inches thick and 25 feet long lies on the sand bluff opposite the station and diagonal to the shore line. The station is near a small shelter house and on the north side of the trail which leads from the inland water, past this house, to the beach. Marked according to note 2, page 474, the upper pipe projecting 6 inches above the ground. The reference pipe was placed 10.45 meters from the station in azimuth 149° 06′. A coquina block 6 inches square and 4 feet long was placed 6.45 meters from the station in azimuth 75° 00′. The following distances and azimuths are from the triangulation station: East gable of old house, 200 meters, 28° 51′; lone palmetto on marsh, 40° 25′; shell mound with bare face (across river), 44° 34′; Seaside Inn, east gable, 150° 42′; De Graw's house (Eldora), west gable, 335° 20′; house, Oak Hill, 356° 38′.

Turtle Mound (Volusia County, A. M. H., 1874; 1906).—On Turtle Mound, a prominent mound about 50 feet higher than the surrounding country, situated between the Hillsborough River and the ocean. The station is on a round shell hill, which is slightly higher than the rest of the hill. It is 8 feet north of the trail which leads over the hill from the river, starting just south of the point of land which makes into the river from the hill. The ground immediately around the station was cleared of bushes. Marked according to note 1, page 473.

St. Agnan (Volusia County, A. M. H., 1874; 1906).—A house has been built on the top of the hill on which this station was located, and the station mark has been removed. The station is lost.

Live Oak (Volusia County, C. H., 1874; 1906).—On Live Oak Point about 10 feet from the shore line. Marked underground by a bottle 3 feet below the surface, and on the surface by a coquina block. The land on which this station was located belongs (1906) to Mr. Grover Allen of Oak Hill; he has a house on the shell mound back of the station. The stone has been removed and in 1906 no trace of the station could be found; but it was not evident that the underground mark had been destroyed. A road crosses the ground where the station was located.

Wallace (Volusia County, C. H., 1874; 1906).—Dr. Wallace's house in front of which this station was established has been removed, and the shell mound on which the station was located now belongs to Mr. E. M. Moore of Daytona, who has built a new house apparently over the location of the station. No trace of the station could be found.

Bear (Volusia County, C. H., 1874; 1906).—On the top of sand ridge along the beach about 1 000 meters south of the Mosquito Lagoon House of Refuge. Marked according to note 2, page 474, the upper pipe projecting 4½ inches above the ground. The reference mark was placed approximately 18 meters (paced) from the station in azimuth 150° 32′ (in line to chimney of house of refuge); a coquina stone 6 inches square and 3 feet long was placed approximately 14 meters from the station in the opposite direction from the reference pipe. The following azimuths are from the triangulation station: Old house in water, east gable, 7° 31′; Kuhl's house, east gable, 16° 20′; McCarty's house, south gable, 71° 03′; Turner's house, 110° 28′; Grover Allen's house, 115° 38′; house of refuge, chimney, 150° 32′, and flag, 151° 15′.

Ross Point (Volusia County, C. H., 1874; 1906).—On the west shore of Mosquito Lagoon, on a point covered with palmettos, and about 1,600 meters north of Kuhl's wharf and house. It is 3 meters from the shore and 15 meters from the mouth of a small creek. The ground is loose coquina. Marked according to note 2, page 474. The reference pipe projects 8 inches above the ground and is 8.02 meters from the station in azimuth 48°. A coquina post 6 inches square and 3 feet long was placed 14.22 meters from the station in azimuth 327° with its top projecting 8 inches above the ground. The following distances and azimuths are from the triangulation station: End of wharf, 1 600 meters, 327° 03′; palmetto marked with triangle, 16.60 meters, 343°; palmetto marked with triangle, 2.00 meters, 84°; palmetto marked with triangle, 12.10 meters, 133°; pile in water, 160° 19′.

Deer (Brevard County, C. H., 1874; 1906).—On the top of the only sand ridge along the beach and about northeast of Dr. Campbell's house. A group of five palmettos, which is on the shore of the lagoon just back from the marsh line, is a short distance south of the station. The sand ridge is of about even height in the vicinity of the station, and there is apparently higher ground on the ridge to the northward. Marked according to note 1, page 473. A coquina post 6 inches square and 2 feet long was buried 20 inches in the sand on top of the ridge and 26.85 meters from the station in azimuth 148° 56′. The following azimuths are from the triangulation station: Pile in water, 25° 22′; channel beacons, 38° 09′ and 53° 10′; Campbell house, south gable, 52° 48′.

Campbell (Northwest Base) (Brevard County, C. H., 1875; 1906).—On the west side of the lagoon, on land belonging to M. R. McHaffy (colored), a school-teacher of Dade County. It is 5 meters from high-water mark and 61 meters from the property line of B. W. Campbell (colored), whose house is about 250 meters north of the station. A fence on this property line extends into the water, and the Campbell property is cultivated as a truck garden. Campbell's house is the second one on the shore of the lagoon north of the east end of the Haulover Canal. Marked according to note 2, page 474. The reference pipe projects 6 inches above the ground and is 60.95 meters from the station in azimuth 145° 32′. The following distances and azimuths are from the triangulation station: Coquina stone 6 inches square and 4 feet long, 25.30 meters, 321° 50′; palmetto marked with triangle 22.40 meters, 127° 37′; old house in lagoon, south gable, 154° 01′.

Mosquito Lagoon (Southeast Base) (Brevard County, C. H., 1875; 1906).—On the west shore of Mosquito Lagoon, 400 meters south of the south bank of Haulover Canal, 186 meters south of George A. Hunt's house, and 7 meters back from the shore line. Marked according to note 2, page 474, the reference pipe being 11.92 meters from the station in azimuth 155°. A coquina stone 6 inches square and 4 feet long was placed 19.96 meters from the station, in azimuth 310° 12′. In the same direction as the coquina stone and 18.40 meters from the station is a palmetto marked with a triangle. A palmetto marked with triangles (old and new) is 1.70 meters from the station in azimuth 15°. The following azimuths are from the station: Hunt's house chimney, 132° 29′; south end of old house, east entrance to canal, 146° 53′.

Scorpion (Brevard County, C. H., 1875; 1906).—About 9 meters from high-water mark on a point on the eastern side of Mosquito Lagoon and nearly opposite the east entrance to Haulover Canal. Marked according to note 1, page 473. The reference

mark is a coquina post 6 inches square and 3 feet long buried 2 feet in the ground and 14.68 meters from the station on the prolongation of the line to the station from the east end of a small island lying off the point to the southward.

Whale (Brevard County, C. H., 1875; 1906).—This station has been destroyed.

Dummitt (Brevard County, C. H., 1875; 1906).—On the west side of Mosquito Lagoon and on the south edge of Dummitt's east orange grove. All the orange trees in the immediate vicinity were marked with triangles. Marked according to note 9, page 474. In 1906 the station was searched for, but not recovered. The man in charge of the grove remembered seeing the stone about 12 years previous. The ground is plowed every year and the stone has been removed or broken off. It was not evident that the bottle had been removed.

Panther (Brevard County, C. H., 1875; 1906).—This station has been destroyed.

SUPPLEMENTARY POINTS.

Fort (St. John County, A. M. H., 1872; 1906).—A single-pole signal braced in the northeast corner of the Spanish fort. In 1906 the fort was still standing.

Damon (Volusia County, A. M. H., 1872; 1905).—On the west bank of the Halifax River, on a point which is rendered quite conspicuous when approached along shore by three palmetto trees which surround the station in the form of a triangle. Marked according to note 1, page 473. The ground in the immediate vicinity of the station is cleared and the three trees above referred to are marked with triangles and are at the following distances and magnetic azimuths from the station: 8 meters, 5°; 10 meters, 134°; 2 meters, 252°.

Daytona (Volusia County, I. W., 1906; 1907).—On the north end of the marsh island in Halifax River opposite the city of Daytona. The south bridge across the river crosses the southern end of this island. The station is 7 meters from the shore line on the sand ridge which surrounds the island. This island belongs to the city and already a public library has been built upon it. The station is 2.70 meters south and 8.95 meters west of the longitude pier established in 1907. (See below.) Triangulation station marked according to note 1, page 473. Two palmetto trees were marked with triangular cuts on sides facing the station; one is 2.87 meters from the station, in azimuth 240° 47′, and the other 9.96 meters, in azimuth 73° 28′.

Daytona longitude station (Volusia County, W. B.–J. S. H., 1907).—On the north end of an island in the Halifax River opposite the town of Daytona. It is 9.35 meters from triangulation station Daytona (see above), being 2.70 meters north and 8.95 meters east of that point. It was marked by a concrete pier 19 by 34 inches and 5½ feet long, being 2½ feet below and 3 feet above the surface of the ground. It was marked with the letters U.S.C.G.S. '07 and the center of the space between the letters C.G.S. marks the station.

Duss (Volusia County, A. M. H., 1874; 1906).—On the only high ridge of sand in the vicinity of the location of the old station North Base (see p. 509), on land belonging to Mrs. Duss, who lives in a house facing the river opposite the station. The station is 115 meters south of a house belonging to Mrs. Duss. This house stands on the same ridge on which is located the station and faces the beach. Marked according to note 1, page 473.

INDIAN AND BANANA RIVERS.

PRINCIPAL POINTS.

Black Point (Brevard County, C. H., 1875; 1906).—Three meters outside the shore line on a marsh point on the east side of Indian River and about halfway between Haulover Canal and Sand Point. The water is very shallow for some distance off this point. Marked according to note 1, page 473.

Sand Point (Brevard County, C. H., 1875; 1906).—On a sand point on the west side of Indian River, about 600 meters north of the Titusville Wharf and 30 meters back from the shore. Marked according to note 9, page 474. In 1906 no marks could be found.

Otter (Brevard County, C. H., 1875; 1906).—Thirty-two meters from the south bank of Banana Creek, on hard marsh ground at the edge of the scrub palmetto, which grows on hard ground near the creek at this place. Three large pine trees stand together a short distance south of the station. These, with two others near by, are the only large pine trees in the locality. Four palmettos are inshore from the station and in line from it. Marked according to note 2, page 474. The reference pipe is 14.47 meters from the station in prolongation of the line from the pine tree marked with triangle; in line to that tree and 17.81 meters from the station was placed a coquina stone 6 inches square and 4 feet long. The following distances and directions are from the station: Pine tree marked with a triangle, 42.5 meters, 0° 00′; palmetto marked with triangle, 16.23 meters, 17° 37′; palmetto marked with triangle, 24.12 meters, 58° 58′; lone palmetto, 136° 00′; south, one of three palmettos on bank of creek, 100 meters, 171° 58′; lone palmetto on hammock, 287° 44′; pine tree, 329° 45′.

Wild Cat (Brevard County, C. H., 1875; 1906).—This station has been destroyed.

Addison Point (Brevard County, C. H., 1875; 1906).—On the second prominent point south of and distant 6 miles from Sand Point, 1 meter from the edge of a bluff about 2 meters high, 9 meters from the bank of the river, 8 meters from the public road, and 2 meters north of a path leading down the bluff to the river. In 1906 the shore in front of the station was cleared and several pine and palmetto trees to the northward cut down in order to give a view of Titusville. A triangular cut on a pine tree across the road is distant 13.20 meters. Station marked according to note 1, page 473; reference mark is a coquina post 6 inches square and 4 feet long, buried 42 inches in the ground, on line to Indian River Hotel flagstaff and distant 17.50 meters from the station.

Jones Point (Brevard County, C. H., 1876; 1906).—The bank has washed away at this point and the station has been destroyed.

Sanders (Brevard County, C. H., 1876; 1906).—About 2 miles north of Indianola, on Merritts Island, on the east bank of Indian River, on a small point covered with palmetto trees in front of the residence of W. H. Sanders, and 150 meters south of the small wharf in front of his house. The point has a double end with a small cove between its ends; the station is on the southern end. The ground has washed and 1 meter inshore is 0.6 meter higher than at the station. The low portion of the point is covered at high water. Marked according to note 2, page 474, the reference pipe being 10.93 meters from the station in direction noted below. The following distances and directions are from the triangulation station: Indianola Wharf flag, 0° 00′; Sanders'

wharf house, west gable, 3° 32′; channel beacon, red, No. 8, 9° 53′; house on bulkhead, west gable, 29° 45′; City Point schoolhouse belfry, 75° 17′; channel beacon off Jones Point, 143° 02′; W. H. Sanders's wharf, 162° 43′; lone palmetto, 180° 46′; palmetto marked with triangle, 12.20 meters, 251°; palmetto marked with triangle, 5.15 meters, 267°; palmetto marked with triangle, 8.56 meters, 298°; reference pipe, 10.93 meters, 275° 40′.

Higs (Brevard County, C. H., 1876; 1906).—On Higs Point. In 1906 this station could not be found; it has been destroyed.

Aqua (Brevard County, C. H., 1876; 1906).—The land on which this station was located is now owned by Mr. J. L. Crawford, of Indianola. The ground has been graded to fill in on the river front and the station has probably been destroyed.

City Point (Brevard County, C. H., 1876; 1906).—On Magnolia Point. Mr. Dixon, on whose land the station was located, states that the station has been washed away. In 1906 no trace of the station could be found.

Oleander Point (Brevard County, C. H., 1876; 1906).—Lost. (See *Oleander Point 2*, p. 526.)

Gopher (Brevard County, C. H., 1876; 1906).—Lost. (See *Gopher 2*, p. 527.)

Cleveland (Brevard County, C. H., 1876; 1906).—The bank has been washed away at this point and the station has been destroyed.

Coquina (Brevard County, C. H., 1876; 1906).—About 1 mile south of Rockledge, on the west side of Indian River, in front of J. P. Garvey's orange grove, and on a rock point, the first point south of Garvey's old wharf. The station is about 4 meters from the edge of the rock bluff, and is marked as follows: A triangle with sides 20 inches in length was cut into the rock to a depth of 8 inches, all the material within the sides being removed. This space was then filled with cement, and the center of the station marked by a 40-penny wire spike inserted in the center of the cement block thus formed. The following azimuths and distances are from the triangulation station: Palmetto marked with triangle (old), 5.08 meters, 24°; oak tree marked with triangle, 8.77 meters, 97°; palmetto marked with triangle (old), 4.45 meters, 118°; A. R. Moore's house, tower, 189° 11′; Georgiana wharf house, west gable, 320° 41′.

Hill (Brevard County, C. H., 1876; 1906).—Located on the east bank of the Indian River, on Merritts Island, about ½ mile north of O'Hara's wharf and 2 miles north of Georgiana post office. It is on the slope of the ridge about 3 meters back from the edge of the bluff and 15 feet above the water. There are a number of large rocks in the water near the shore off the station and a large burnt pine stump is near to and north of the station. Marked according to note 2, page 474, the reference pipe being 20 inches in the ground and 9.90 meters from the station, in azimuth 268° 19′. Two pine trees marked each with a triangle are at the following distances and azimuths from the station: 4.48 meters, 164° 58′; 12.80 meters, 311° 25′.

Stewart (Brevard County, C. H., 1876; 1906).—(See *Stewart 2*, p. 527.)

Georgiana (Brevard County, C. H., 1876; 1906).—On the east bank of the Indian River, about ¼ mile north of Georgiana, on a round flat point of loose coquina in front of Rev. A. V. Hiscock's dwelling, 16 meters south of the end of Hiscock's small wharf and 6 meters from the shore line. There is a large bunch of scrub palmetto immediately inshore from the station. Marked according to note 2, page 474, except that 4 inches of the upper pipe was cut off. The reference pipe was placed 10.65 meters from

the station, in azimuth 270° 16′. A coquina post 5 inches square and 2 feet long was placed 15.82 meters from the station, in azimuth 287° 18′. Two palmettos marked with triangles are at the following distances and azimuths from the station: 17.60 meters, 270° 16′; 18.75 meters, 262° 27′.

Cultus (Brevard County, C. H., 1876; 1906).—The recovery of this station in 1906 was very uncertain. It was re-marked according to note 4, p. 474, the reference mark being 17.90 meters from the station in azimuth 162° 06′.

Meta (Brevard County, C. H., 1876; 1906).—The shore has washed away at this point and the station has been destroyed.

Cape Cod (Brevard County, C. H., 1876; 1906).—On the east shore of the Indian River, on the second prominent point south of Lake Wittfeld. Marking not known. This station was searched for in 1906 without success, but it is not evident that the marks have been destroyed.

Plover (Brevard County, C. H., 1876; 1906).—This point has been washed away and the station is lost.

File (Brevard County, C. H., 1876; 1906).—On the east bank of the Indian River, 640 meters north of —— Stewart's house. The station is marked by a galvanized tack in the head of a mangrove stump sawed off 5 feet above the ground. In 1906 the station could not be recovered, as the stump had rotted and the tack was gone.

Mangrove (Brevard County, C. H., 1876; 1906).—On Mangrove Point on the east shore of the Indian River. Numerous exposed rocks show off this point. The station is at high water line and is marked by a 4-inch terra-cotta pipe, 2½ feet long, resting on rock and surrounded by and filled with concrete. Reference mark is a 4-inch terra-cotta pipe, 2½ feet long, 2 feet in the ground, placed 5.40 meters from the station, in azimuth 260° 06′. The following distances and azimuths are from the triangulation station: House with dormer windows, pointed roof, 27° 51′; house with striped roof, east gable, 49° 58′; Hancock's boathouse, 154° 35′; palmetto marked with triangle, 11.43 meters, 201° 36′; palmetto marked with triangle, 7.20 meters, 284° 46′; boathouse cupola, 333° 58′; ice factory smokestack, Eau Gallie, 350° 33′.

Keno (Brevard County, C. H., 1876; 1906).—Four feet inside the edge of a 12-foot bluff on the west shore of the Indian River, 1½ miles north of Horse Creek, 100 meters south of the first prominent point above Horse Creek, and 100 meters north of a small cove, being midway between the point and the cove. In 1906 the center stone was recovered, leaning 0.05 meter to the west. The station is now on a mass of coquina rock, which is separated by a crack 0.3 meter wide from the rock back of it, and it is possible that the whole mass has moved toward the river, as it is partially undermined. The old stone mark was replaced by a 4-inch terra-cotta pipe, 2½ feet long, its top 6 inches above the ground; this center pipe was filled with and surrounded by cement mortar. Reference pipe is a 4-inch terra-cotta pipe 2½ feet long, buried 22 inches in the ground, and placed inshore from and about 5 feet lower than the station. It is 6.63 meters from the station in azimuth 78° 36′. The following distances and azimuths are from the triangulation station: C. Merrill's boathouse at Tropic, cupola, 299° 53′; railroad warehouse at Eau Gallie, east gable, 335° 28′; palmetto marked with triangle, 5.60 meters, 2° 52′; palmetto marked with triangle, 2.73 meters, 10° 57′; palmetto marked with triangle, 6.25 meters, 83° 57′.

Cove (Brevard County, C. H., 1876; 1906).—This station has been destroyed.

Centennial (Brevard County, C. H., 1876; 1906).—On the west shore of Banana River, 53 meters from the river bank. Marked according to note 9, page 474. In 1906 the location of this station was found covered with pine trees, and a thick mass of underbrush, vines, etc. The station was not recovered, but it was not evident that the marks had been destroyed.

Bluff (Brevard County, C. H., 1876; 1906).—On the west bank of the Indian River, 25 meters north of the north point of the entrance of Horse Creek and 3 meters inside of the top of the coquina bluff. Station was marked by a drill hole in a flat coquina stone. In 1906 the station was searched for and not found. The coquina bluff at this point is being undermined by the water and is breaking off with apparent rapidity; it is probable that the station is lost.

Banana (Brevard County, C. H., 1876; 1906).—On the west bank of Banana Creek, about ½ mile from its entrance into Banana River, on land owned by the Canaveral Club. It is 7 meters from the edge of the bank about the middle of a long cove, on open ground, and is near the northern limit of the growth of scrub palmetto where the marsh grass grows behind it. About ¼ mile north of the station is a group of palmetto trees. Marked according to note 2, page 474, the reference pipe being set 18.86 meters from the station, in azimuth 145° 55′; a coquina post 6 inches square and 4 feet long was placed 11.22 meters from the station in the same azimuth as the reference pipe. The reference pipe and stone are on a line from Canaveral lighthouse through the station extended. The following distances and azimuths are from the triangulation station: Lone palmetto, 52° 15′; palmetto marked with triangle, 82 meters (paced), 162° 41′; palmetto marked with triangle, 100 meters (paced), 179° 48′.

De Soto (Brevard County, C. H., 1876; 1906).—This station was searched for in 1906 without success. The station is probably lost.

Burnham (Brevard County, C. H., 1876; 1906).—On top of a low sand ridge (1.5 meters higher than the ordinary level) 15 meters from the edge of the bluff on the beach side (1.5 meters high). It is 7 800 meters south of a road cut through the scrub from the river to the beach and marked at the beach end, and 400 meters north of the wreck of a large vessel lying on the beach. The beach is steep in front of the station and is covered with broken shells; the sand hills in the vicinity of the station are covered with low scrub palmetto. The station is marked by a wooden plug in a hole in the top of a coquina stone post. The following azimuths are from the triangulation station: Group of five palmettos, 9°; south one of a group of palmettos, 54°; two palmettos near together, 137°; house on Cape Canaveral, 315°.

Moccasin (Brevard County, C. H., 1877; 1906).—On a narrow strip of land between the Banana River and a creek which enters the river a short distance to the north. It is on open ground and there are are only two palmettos on the strip to the north. The station is 275 meters from the end of the strip at the mouth of the creek, 44 meters from the two palmettos to the north, and 3 meters from the edge of the low bluff on the Banana River side. A narrow strip of marsh covered at high water is in front of the station. Marked according to note 2, page 474, the reference pipe being 2 feet in the ground and 9.61 meters from the station in azimuth 97° 48′. The following distances and azimuths are from the triangulation station: Boathhouse flag, east bank of Banana River 295° 02′; palmetto marked with triangle, 14.30 meters, 33° 53′; palmetto, 44 meters, 192° 38′.

Wesson (Brevard County, C. H., 1877; 1906).—This station is lost.

Scrub (Brevard County, C. H., 1877; 1906).—On Merritts Island, west bank of the Banana River, about 7 miles north of Georges Island. It is 0.5 meter from the edge of the low bluff back of a narrow strip of low land, which is covered at high water. A large pine tree (marked with triangle) stands near the shore back of the station—it is the only one near the shore in this vicinity. Marked according to note 2, page 474, the reference pipe being 2 feet in the ground and 9.90 meters from the station in azimuth 111° 11′. The following distances and azimuths are from the triangulation station: Boathouse flag on east bank of the Banana River, 231° 07′; pine tree marked with triangle, 20.60 meters, 129° 53′; palmetto marked with triangle, 6.40 meters, 165° 06′.

Stone (Brevard County, C. H., 1876; 1906).—On a sand hill about 30 meters from high-water mark on the ocean beach. The station was searched for in 1906 without success, and it is most probable that the station is lost.

Crane (Brevard County, C. H., 1876; 1906).—This station is lost.

Georges I., (Brevard County, C. H., 1876; 1906).—On the southeast end of Georges Island, about 20 meters west from the southeast point of the island, and 15 meters from the shore. Marked according to note 9, page 474. In 1906 the station was searched for, and it was determined that the surface stone had been removed. The underground mark may still be in place.

Sea Bean (Brevard County, C. H., 1876; 1906).—This station is lost.

Alligator (Brevard County, C. H., 1876; 1906).—On the west bank of the Banana River and on the eastern shore of Merritts Island, about midway between station Centennial and the mouth of New Found Harbor. It is in a grove of scrub oak on land belonging to Dr. Bigelow of Maine, being 135 meters south of the line between the properties of Dr. Bigelow and of Mrs. Thomas Green, and 190 meters south of Mrs. Green's residence. It is 1 meter from the top of the bluff (2 meters high), and 9 meters from the road along the shore. Scrub palmettos grow along the bluff, and a coquina rock, the only one to be seen, shows above the water 30 meters off shore and opposite the station. Marked according to note 2, page 474, the top of the center pipe being flush with the surface of the ground, while the top of the reference pipe is 6 inches above the ground. The reference pipe is 8 meters from the station in azimuth 67°. The following azimuths and distances are from the triangulation station: A small oak marked with a triangle, 2.40 meters, 45°; small oak marked with a triangle, 3.90 meters, 82°; Mrs. Green's house chimney, 143°; house on wharf (Oceanus), west gable 221°; house on beach (Oceanus), chimney, 223°.

Porpoise (Brevard County, C. H., 1876; 1906).—On the ocean front, about 10 175 meters south of the house at the beach end of the trail from Banana River to the ocean at Oceanus. It is on the highest ground in the vicinity, about 3 meters above the ocean; there is a low bluff (0.6 meter) back of the beach, a second bluff (1.5 meters), 9 meters back of the first bluff, and the station is 3 meters back of this second bluff. A group of Spanish bayonet grows about 100 meters south of the station; these, with some others a little farther south, are the only ones along this portion of the beach. Marked according to note 9, page 474. A pile of coquina rocks was placed over the station.

Beach (Brevard County, C. H., 1876; 1906).—The sand ridge on which this station was located has undergone much erosion, and the station is lost.

College (Brevard County, C. H., 1876).—(See *College 2*, p. 527.)

King (Brevard County, C. H., 1877; 1906).—On the ocean beach, 7 meters back of the sea beach bluff, and 230 meters south of trail from Kings Hammock on the Indian River to the beach. Marked according to note 9, page 474. In 1906 this station was searched for but could not be found.

Peter Wright (Brevard County, C. H., 1877; 1906).—In the town of Melbourne just east of the walk along the bluff in front of the hotel (Carleton) and almost in front of the residence of Thomas Sayre. It is 1 meter from the edge of the bluff, which is about 30 feet high, and is covered with grass. The station was marked according to note 2, page 474, the reference pipe being 28 inches in the ground, close to the south end of the porch in front of Mr. Sayre's house, and halfway between the outer edge of the porch and the house. The reference pipe is 25.78 meters from the station in azimuth 70° 33′. The following distances and azimuths are from the triangulation station: Palmetto marked with triangle, 7.30 meters, 359° 38′; northeast corner of Carleton Hotel, 8° 41′; Carleton Hotel windmill, 37° 45′; Sayre's house, southeast corner, 27.18 meters, 69° 58′; palmetto marked with triangle, 10.82 meters, 76° 09′; Sayre's house, northeast corner, 87° 27′.

Turkey Creek (Brevard County, C. H., 1877; 1906).—In the middle of the end of a rock point on the north side of Turkey Creek, 4 meters from the edge of the rock at the water line. A small cove and a smaller point are between this point and the mouth of the creek. A larger cove and point are just north of the point on which the station is located. Marked according to note 2, page 474, the top of the upper center pipe being about even with the surface of the rock. The reference pipe was buried 2 feet in the ground and is 7.65 meters from the station in azimuth 95° 37′. The following azimuths and distances are from the triangulation station: Tall pine, 186° 52′; Golden's house, southeast corner, 22.00 meters, 38° 50′; northeast corner, 19.70 meters, 59° 37′; Carleton house flag, 153° 37′; water tank, 153° 52′; windmill, 153° 44′. There are three iron nails driven in the rock, and triangles cut around them. They are situated as follows with reference to the station: 2 feet 8 inches southeast, 2 feet 4 inches northeast, 2 feet 6 inches northwest.

Dante (Brevard County, R. M. B., 1878; 1906).—This station has been destroyed.

Hawthorne (Brevard County, R. M. B., 1878; 1906).—This station has been destroyed.

Malabar (Brevard County, R. M. B., 1878; 1906).—This station is lost.

Killer (Brevard County, W. I. V., 1878; 1906).—On top of the first ridge back of the edge of the sea bluff, and 23 meters distant. Marked by a cross on the head of a composition nail in the top of a coquina block 6 inches square and 3 feet long. In 1906 this station was searched for but without success. It was not evident that the station had been destroyed.

Rock (Brevard County, W. I. V., 1878; 1906).—On the west side of Indian River, on Rock Point, which is the first point north of Goat Creek. Numerous masses of coquina show above the surface along the shore of the point. The station is 1.2 meters above the river. The immediate vicinity of the station was cleared of bushes and scrub palmettos. The larger of two palmetto trees which are growing close together on the southern extremity of the point was marked with a triangle cut in the side facing the station. It is 35.00 meters from the station. Two palmetto trees are growing on the shore north of the station, and the station is about midway between the southern one of these and the tree

marked with a triangle. Another palmetto tree is growing a little back of the shore, and north of west from the first palmetto north of the station. These are the only tree palmettos on the point. Marked according to note 1, page 473. A pile of coquina rocks was placed around the station. The following directions were observed from the station: Coquina post buried 12 inches in the ground, 92° 30′; tall lone pine tree, 95° 10′; burnt stump of tree (distant 3.94 meters), 126° 10′; palmetto, 166° 40′; palmetto marked with triangle, 185° 37′.

Opera (Brevard County, W. I. V., 1879; 1906).—On a sand ridge on the ocean beach, 21 meters back from the edge of the cliff. Marked by a cross on the head of a composition nail driven into the top of a coquina post 5 inches square and 30 inches long. This station was searched for in 1906 without success, but it was not evident that the marks had been destroyed.

Trout (Brevard County, W. I. V., 1879; 1906).—This station is lost.

Smith (Brevard County, W. I. V., 1879; 1906).—This station has been destroyed. (See *Smith 2*, p. 521.)

Shell (Brevard County, W. I. V., 1879; 1906).—The shell mound on which this station was located is being removed and the station has been destroyed.

White (Brevard County, W. I. V., 1879).—On the west shore of Indian River, on a flat sandy point, back of a broad white sand beach. Back of the station the point is covered with a thin growth of palmetto and pine. Marked by a cross on the head of a composition nail driven in the top of a coquina post 5 inches square and 2½ feet long, buried with its top nearly even with the surface of the ground.

Brig (Brevard County, W. I. V., 1879; 1906).—About 5 miles distant and about 15° east of north from the town of Sebastian, on the sea bluff of a long island east of Indian River. It is on the first ridge back from the edge of the bluff, and almost 2 miles north of Gibson Cut. Scrub palmetto about 4 feet high was cleared from around the station. Marked by a black bottle 26 inches below the surface of the ground, above which was placed a coquina stone 5 inches square and 20 inches long, projecting 2 inches above the surface of the ground. In the top of this block was driven a composition nail to mark the center.

White 2 (Brevard County, W. I. V., 1880; 1906).—This station has been destroyed.

Wind 2 (St. Lucie County, W. I. V., 1880; 1906).—On the first ridge back from the face of the sea bluff, on the outlying narrow island on the east side of Indian River, nearly opposite to Sebastian, and about 1½ miles below Gibson Cut. The ridge is covered with scrub palmetto about 4 feet high which was cleared out around the station, while to the westward on the Indian River side of the island is a heavy clump of trees which is known in the locality by the name of the "Big Hammock." The underground mark is a bottle, 3 feet below the surface of the ground. Above this is a coquina post 5 inches square and 30 inches long, projecting 7 inches above the ground and having in its top a composition nail on the head of which is cut a cross to mark the center.

Parks (St. Lucie County, W. I. V., 1880; 1906).—On the west bank of the Indian River, 230 meters south of the Eagle Fish Co.'s wharf at Sebastian. In marking the station quicksand was encountered just below the surface, and a barrel was used to prevent caving, the hole being dug inside the barrel, which was forced down as far as possible. A 4-inch terra-cotta pipe, 2½ feet long, was then placed with its flange end up and its center marking the station. The pipe was filled with concrete, and the barrel filled

nearly to the top of the pipe with the same material. The reference mark is a 4-inch terra-cotta pipe, 2½ feet long, buried 2 feet in the ground, and 21.83 meters from the station in azimuth 58° 45′. The following distances and directions are from the triangulation station: Old wreck, iron boiler, 231° 55′; four palmettos each marked with a triangle, as follows: 17.65 meters, 31° 05′; 8.50 meters, 40° 26′; 17.75 meters, 61° 58′; 17.90 meters, 103° 01′; stump of telegraph pole, 10.70 meters, 125° 54′. The recovery of this station in 1906 was only approximate.

White 3 (Brevard County, I. W., 1906).—On a point 1 mile north of Sebastian Creek, on the west bank of Indian River. Stations White and White 2 were both on this point. (See p. 520). It is on open grass-covered ground, about the middle of the point, and 5 meters back from the grass line. It is on a low sand ridge which has a slight depression back of it. Marked according to note 4, page 474, the reference pipe being 2 feet in the ground and 19.64 meters from the station in azimuth 75° 20′. Three palmettos, each marked with a triangle, are at the following distances and azimuths from the station: 8.63 meters, 4° 08′; 16.45 meters, 115° 56′; and 17.89 meters, 149° 38′. An oak tree marked with a triangle is 12.30 meters from the station in azimuth 90° 16′.

Smith 2 (Brevard County, I. W., 1906).—Located near the point where station Smith was located. (See p. 520.) On the west bank of Indian River, on land owned by Frank Smith, and about 1½ miles south of Grant. It is on open ground covered with short grass, 4 meters from the grass line and 70 meters south of the mouth of a small creek. There is a sand beach in front of the station, and an opening to the cleared land almost opposite the station. A truck farm is back of the station. Marked according to note 4, except that one piece of pipe was only 1 foot long. The reference pipe was 7.90 meters from the station in azimuth 74° 03′. The following distances and azimuths are from the triangulation station: Wreck (woodwork), 314° 50′; tall palmetto on hill, 44° 48′; palmetto marked with triangle, 14.08 meters, 74° 03′; house on east bank of river, brick chimney, 239° 15′.

Check (Brevard County, I. W., 1906).—A pole in a palmetto tree.

Fustic (St. Lucie County, W. I. V., 1881; 1906).—This station is lost.

Duck Point (St. Lucie County, W. I. V., 1886; 1906).—On the west side of Indian River, on the first prominent point south of Sebastian, about the middle of the point and 16 meters back of the grass line. It is on open ground covered with marsh grass, and is 30 meters S. S. E. of the mouth of Duck Creek. There is a broad sand beach on the end of the point in front of the station, while back of it is lower ground, then a sand ridge with palmettos growing on it, and then marsh. Marked according to note 4, page 474, the upper center pipe projecting 16 inches above the ground. The reference pipe is placed 2 feet in the ground and 18.20 meters from the station in azimuth 75° 51′. A palmetto marked with a triangle is 47 meters from the station in azimuth 76° 11′, while a small palmetto too small to mark is 14.80 meters from the station in azimuth 140° 57′. A hole 2 meters in diameter is quite near the station in azimuth 205°. A pile of oyster shells was placed around the station mark.

Two Dollar Bluff (St. Lucie County, W. I. V., 1881; 1906).—This station has been destroyed.

Gale (St. Lucie County, W. I. V., 1881; 1906).—On the first ridge back from the face of the sea bluff and 10 meters distant from it. Marked by a composition nail in a coquina block 5 inches square and 30 inches long, its top nearly even with the surface

of the ground. This stone is protected by a box about 2 feet square and 1 foot deep. In 1906 this station was searched for without success, but it was not evident that the marks had been destroyed.

Hole in the Wall (St. Lucie County, W. I. V., 1881; 1906).—On the west side of Indian River, on the first prominent point below Two Dollar Bluff. On a low ridge separating river and marsh, on a point covered with water grass. A small creek flows into the river 30 meters south of the station, and 20 to 25 meters back of the station is a growth of small trees and bushes. It is about ½ mile W. by N. ½ N. from the upper part of the island known as "Hole in the Wall." Several palmetto trees are growing near the station, also two large live oaks, one of which is of peculiar shape, like a letter S lying on its side; this tree is 2 feet in diameter. The station is 2 meters inside high water. Marked according to note 4, page 474, except that the pipes were all 6 inches in diameter. The following distances and directions are from the triangulation station: Telegraph pole to south, 0° 00′; reference pipe, 9.30 meters, 68°; live oak marked with triangle, 23 meters, 68°; palmetto marked with triangle, 25 meters, 124°; live oak marked with triangle, 33 meters, 126°; mangrove marked with triangle, 12 meters, 170°. The old mark, a coquina post, was left lying on the ground near the station.

Squall (St. Lucie County, W. I. V., 1881; 1906).—The sand ridge on which this station was located has washed away and the station is lost.

Narrows (St Lucie County, W. I V., 1881; 1906).—On a prominent point on the west side of Indian River, about 1½ miles below the island known by the name of "Hole in the Wall." It is 7 meters from the water, on the highest point of the strip which separates the river from the marsh. Marked according to note 2, page 474, except that the pipes were 6 inches in diameter. The upper center pipe projects 6 inches above the ground. The reference pipe was buried 2 feet in the ground. The following distances and directions are from the triangulation station: Beacon "R. 18," 0° 00′; palmetto marked with triangle, 13.0 meters, 2° 01′; reference pipe, 5.15 meters, 107° 38′; three palmettos marked each with a triangle, as follows: 5.3 meters, 144° 40′; 8.6 meters, 147° 05′; 15.1 meters, 183° 32′. The old mark, a coquina post, was left lying on the ground near the station.

Eggs (St. Lucie County, W. I. V., 1881; 1906).—About 100 feet back from the ocean beach, and about 1 160 meters above House of Refuge No. 1. In 1906 the center mark was recovered, and the old tripod was found in the scrub palmetto near the station. Marked by a galvanized nail driven in the top of a coquina block, buried with its top even with the surface of the ground, and surrounded by a box 2 feet square and 1 foot deep. Two pieces of hewn oak, 2 by 5 inches and 3½ feet long were buried 2 feet in the ground, and 3½ feet from the station, one up the coast or north from the station, and the other down the coast or to the south. A pine post 2 by 12 inches and 6 feet long was buried 3 feet in the ground, and 3½ feet inshore from the station.

May (St. Lucie County, W. I. V., 1881; 1907).—On the west side of Indian River, about ¾ mile above the point at the south end of the Narrows. It is about west by north of House of Refuge No. 1, and is on a low ridge covered with myrtle, with marsh grass in front. The station is 1 meter from the water, but the bank is not washing. There are several dead mangrove stumps near the station, and some palmettos to the north. A large mangrove is growing over the water 30 meters north of the station.

Marked according to note 2, page 474, except that the pipes were 6 inches in diameter. The upper center pipe projects 8 inches above the ground. The reference pipe is 2 feet in the ground. The following distances and directions are from the triangulation station: Palmettos on point to south, 0° 00′; reference pipe, 5.82 meters, 97° 59′; palmetto marked with triangle (on line with dead mangrove), 25 meters, 178° 57′; mangrove at water's edge, 205° 18′; small palmetto, 188° 27′. The original mark, a coquina post, was left lying on the ground near the station.

Bight (St. Lucie County, C. H. B., 1882; 1906).—On the seashore just above high-water mark, and about halfway between the house of refuge and the point at the south end of the bight. It is about 700 meters south of the point at the north end of the bight. It is 2 meters south of a trail leading from the beach to the river and is 1 200 meters north of Prang's trail; it is 35 meters inside the grass line at the outer edge of the palmetto growth. Several small palmetto trees are growing near the station. The station is 1 meter in front of the remains of a frame house, at its northeast corner. Marked by a cross on the head of a composition tack in the head of a coquina post, 8 inches square and 3 feet long, buried with 6 inches of its top projecting above the ground. Two pieces of 2 by 12 inch pine, 8 feet long, were buried 3½ feet in the ground, one 1.27 meters up the coast or north of the station and the other 1.60 meters down the coast or south from the station. Two pieces of 2 by 5 inch oak, 3½ feet long, were buried 2½ feet in the ground, on a line perpendicular to the coast line, one piece being 0.90 meter from the station and toward the sea and the other being inland from and 0.77 meter from the station.

Scorpion (St. Lucie County, C. H. B., 1882; 1907).—On a point on the west bank of Indian River, 1 meter from high-water mark and about ¼ mile south of the village of Vera. A mangrove tree having a dead top and marked with a triangle is growing in the water off the station. There is marsh grass in front of the station, and myrtle back of the reference mark. Marked according to note 2, page 474, except that 6-inch pipes were used. The upper center pipe projects 10 inches above the ground. The following distances and directions are from the triangulation station: Beacon "B. 15," 0° 00′; reference pipe, 4.15 meters, 102° 13′; three palmettoes each marked with a triangle, respectively, 3.90 meters, 45° 46′; 5.50 meters, 47° 52′; 50.00 meters, 188° 58′. The old mark, a coquina post, broken in two pieces, was left lying on the ground near the station.

Crawford 2 (St. Lucie County, C. H. B., 1882).—In an open space on the west bank of Indian River, 52 feet from the water's edge, and 230 meters (paced) north of the mouth of a large inlet forming a long pond. The point on which the station stands is known as Crawfords Point. Marked by a cross on the head of a composition tack in the top of a coquina post 8 inches square and 3 feet long, and projecting 6 inches above the ground.

Point (St. Lucie County, C. H. B., 1882; 1906).—This station is lost.

Palmetto (St. Lucie County, C. F., 1860; 1906).—On the west side of Indian River about 2½ miles south of Crawford Point, on a marsh point, at the inner edge of the marsh grass, 9 meters inside the outer grass line on the river bank, and 10 meters outside the old telegraph line. A point of woods is near the river bank about 150 meters south of the station. Marked according to note 4, page 474, except that 6-inch pipes were used. The following distances and directions are from the triangulation station: Beacon to southeast, 0° 00′; mangrove (2 feet in diameter) marked with triangle, 37.2

meters, 23° 00′; telegraph pole to southwest, 40° 24′; reference pipe, 10.85 meters, 101° 05′; mangrove marked with triangle, 11.6 meters, 170° 50′; iron pipe in river (channel mark), 211° 24′.

Lost Base (St. Lucie County, C. H. B., 1882; 1906).—About 2½ miles north of Indian River Inlet, on the highest point of the highest sandhill in the vicinity. It is the fifth one from the ocean. The underground mark is a quart bottle; the surface mark a sandstone post 4 inches square and 3 feet long, having in its top a lead bolt marked with a cross, a copper tack being driven in the center of the cross. In 1906 the station was searched for without success. The ridge was covered with scrub palmetto, and it was not evident that the marks had been destroyed.

Ridge 2 (St. Lucie County, C. H. B., 1882; 1906).—On a high ridge west of the Florida East Coast Railway track, and about 1½ miles north of St. Lucie. It is opposite a point on the railway, midway between the thirteenth and fourteenth telegraph poles north of milepost 238. The ridge is covered with pine trees, except in the immediate vicinity of the station, where there are low bushes. The underground mark is a black quart bottle filled with black sand and placed 3 feet below the surface. It is surrounded by three bricks in the form of a triangle. The surface mark is a brown sandstone post 4 inches square and 2 feet long, its top intercepted by cross lines, and marked with the letters USCS. The center of the cross marks the station. Around the station is a trench, 2 feet wide and 1 foot deep, forming a rectangle 16 by 18 feet. The bushes were cleared away from within this rectangle. Four pine trees, marked each with a triangle, are at the following distances and magnetic azimuths from the station: 15.9 meters, 72°; 9.1 meters, 174°; 7.4 meters, 230°; 5.0 meters, 319°. The tree in azimuth 230° is on line to a pine tree marked with an old triangle. The location of this station is known to C. Summerlin of Fort Pierce.

Inlet 2 (St. Lucie County, C. H. B., 1882; 1906).—This station has been destroyed.

Bell (St. Lucie County, C. H. B., 1882; 1906).—On the west shore of Indian River, 4 meters from the shore line and 70 meters south of the mouth of Taylors Creek. It is about 4.5 meters south of the dwelling house of J. W. Caldwell, about 1 mile north of Fort Pierce. Marked according to note 2, page 474, except that 6-inch pipes were used. The upper center pipe and the reference pipe project 6 inches above the ground. The following azimuths and distances are from the triangulation station: Reference mark, 11.15 meters, 91° 32′; J. W. Caldwell's house, southeast corner, 4.85 meters, 182°; three palmettos each marked with a triangle, as follows: 31.1 meters, 4°; 24.4 meters, 91°; 2.85 meters, 133°.

Robinson (Brevard County, C. H. B., 1882; 1906).—This station has been destroyed.

Cole (St. Lucie County, C. H. B., 1882; 1906).—On the west side of Indian River on the bluff 1⅛ miles south of Fort Pierce, and in a pineapple orchard about 100 yards S. S. E. of Mr. Ruple's house. In 1906 it was learned that the surface mark, a coquina stone, had been removed, but it is possible that the underground mark, a bottle filled with black sand, is still in place.

Brayton (St. Lucie County, C. H. B., 1882; 1906).—On the ocean beach, due east of Braytons Cove in Indian River. Marked by a bottle and by a copper tack in the head of a coquina post. In 1906 this station was searched for without success.

Spruce Ridge (St. Lucie County, B. A. C., 1883; 1906).—On a hill covered with pineapple plants and belonging to Mr. J. W. Mosier. The surface mark has been de-

stroyed. The underground mark is a cast-iron signal head. It was not recovered in 1906.

Richards (St. Lucie County, C. H. B., 1882; 1906).—This station has been destroyed.

Refuge (Palm Beach County, C. H. B., 1882; 1906).—On the ocean side of Hutchinsons Island, near and just to the westward of House of Refuge No. 2. It is on a rock bluff, 8 meters from its edge. Marked according to note 4, page 474, except that the reference pipe is 6 inches in diameter. The center pipe projects 6 inches above the ground. The reference pipe is 7.03 meters from the station in azimuth 68° 18′. The azimuth from the station of the house of refuge flag is 3° 20′, and of the house of refuge chimney, 14° 46′.

Pisgah (Palm Beach County, B. A. C., 1883).—On the north side of St. Lucie River, on a very prominent sand hill about 3 miles from its mouth. This sand hill is known as Mount Pisgah and has a very small summit, covered with bushes about 4 feet high; these were cut down in the vicinity of the station. Marked according to note 2, page 474, with the addition that an iron tripod head was placed around the top of the lower pipe. The reference pipe is 2 feet in the ground and 4.44 meters from the station in azimuth 117° 46′. The old mark, a coquina post, was left on the ground near the station.

Ten 2 (Palm Beach County, B. A. C., 1883; 1906).—This station has been destroyed.

Thomas (Palm Beach County, B. A. C., 1883; 1906).—On a flat topped sand ridge, 3 meters from the edge of the bluff toward the ocean and 367 meters north of F. W. Yates's bathhouse. A broad avenue leads from Mr. Yates's boathouse on Hobes Sound past his winter residence to the beach, and the bathhouse is on the north side of this avenue at the beach. Marked according to note 1, page 473, except that the lower pipe was only 1½ feet long. There was also an iron tripod head placed between the upper and lower pipes. The reference marks are a coquina post 6 inches square and 3 feet long buried 30 inches in the ground and inshore from the station, and an oak post 10 inches square projecting 4 feet above the ground and placed on line to the reference stone. The following distances and directions are from the triangulation station: Schneider's east windmill, 0° 00′; A. Pitou's house, chimney, 17° 32′; F. W. Yates's house, chimney, 45° 52′; reference post, 1.50 meters, 90° 00′; reference stone, 11.75 meters, 90°00′; F. W. Yates's bathhouse, 354° 00′.

Rifle (Palm Beach County, B. A. C., 1883; 1906).—On the highest part of the sand ridge west of the north end of Hobes Sound and opposite the railway station of this name. Go from the railway station to Grant's Hotel on top of the ridge and then follow the ridge for a half mile to the west, when the station will be reached; it is on a knoll on top of the ridge. There are no trees on the ridge in the immediate vicinity of the station. Marked according to note 1, page 473, with the addition of an iron tripod head placed between the two pipes. The reference mark is a coquina post with a tack in its head buried on line to Borden Hill station. Four pine trees, each marked with a triangle, are in the following azimuths from the triangulation station: 346° 16′; 60° 43′; 126° 48′; 212° 31′.

SUPPLEMENTARY POINTS.

River (Brevard County, C. H., 1875).—A palmetto post erected on the flats of Indian River, about 40 meters from the shore and about 2¼ miles west of Black Point.

Hood (Brevard County, C. H., 1875; 1906).—On the west side of Indian River, between the third and fourth telegraph poles north of the railroad whistle post south of

Arantia on the south side of the entrance to a small creek. It is 100 meters south of the third ditch south of Arantia. These ditches run to the river from the railroad, which is built along the river, and passes about 100 meters back from the station. The station is 5 meters outside the grass line, and the ground around it is covered with a few inches of water. Marked according to note 2, page 474, the reference pipe being buried 2 feet in the ground, and 19.60 meters from the station on line to the third telegraph pole north of the whistle post referred to above.

Watton (Brevard County, C. H., 1875; 1906).—On a large bare spot in the marsh, 300 meters back of a point of land on the east bank of Indian River, and about 3,200 meters north of Haulover Canal. It is 75 meters west of the west edge of a large hammock, which has pine trees and palmettos growing on it. A small hammock with palmettos is northeast of the station, and a larger one north and distant about 400 meters from the station. There are three ponds in front of the station toward the river, one small one to the north and two larger ones to the south, all connected by narrow drains. Marked according to note 1, page 473. The reference mark is a coquina post 6 inches square and 2 feet long, buried 20 inches in the ground, and 19.35 meters from the station in azimuth 223° 34′. The following azimuths are from the triangulation station: Two lone palmettos, 146°; small hammock, 185°; three palmettos marked with triangles, 216° 28′; 223° 34′; and 231° 37′.

Stump (Brevard County, I. W., 1906).—On the northwest corner of Merritts Island, on the point on the south side of the entrance from Indian River to Banana Creek. Several large stumps are in the water off the point, and one is on the shore quite close to the station. The station is 7 meters from the shore line to the west and 7 meters from the shore line to the south. Marked according to note 2, page 474, the reference pipe being 16.60 meters inshore from the station and 2 feet in the ground.

Titusville latitude station (Brevard County, W. H. B., 1906).—In the town of Titusville on land said by some to belong to the Indian River Hotel and by others to Mrs. Titus. The latitude station was not permanently marked, observations being made on a wooden pier. The reference mark is a nail set head down in the cement filling a sewer pipe, which was also set in cement. It is in the southeast corner of the open plot in front of and west of the Indian River Hotel. It is almost in the center of a triangle formed by two cabbage palmettos and a telephone pole and is in line with the telephone pole and electric-light pole. It is 3.06 meters from palmetto to northwest; 3.42 meters from palmetto to northeast; 2.76 meters from the telephone pole to south; 15.680 meters from the southwest corner of the hotel, and 11.369 meters from the southwest corner post of the fence surrounding the hotel. The latitude station is 20.310 meters from the reference mark, the angle at the reference mark between the station and the flagpole on the hotel is 108° 27′, the distance and azimuth of the flagpole from the station being 44.80 meters, 236° 37′.

Oleander Point 2 (Brevard County, I. W., 1906).—On a prominent point on the west bank of the Indian River between Cocoa and Rockledge. The point has shifting sand on its end. The station is back of a low marshy depression, near the palmetto trees, and about the middle of the point (up and down the river). Quicksand was found close to the surface at the station. Marked according to note 4, page 474, except that the upper pipe is but 16 inches long; the large ends of the pipes were placed together. The reference pipe is 15.00 meters from the station in azimuth 80° 49′. The distances and azimuths

from the station of three palmettos marked with triangles are: 18.93 meters, 15° 26′; 11.32 meters, 67° 49′; and 138° 44′.

Gopher 2 (Brevard County, I. W., 1906).—On the east bank of the Indian River nearly opposite Cocoa, on land belonging to Mr. J. Dardonville. It is near the northwest corner of the subdivision of his land known as "Church lot," 40 centimeters south of the north line of this lot, and 30 centimeters west of the first fence post west of the west gate-post, at the edge of the bluff and 16 meters from the river. Marked according to note 1, page 473. Triangular marks were cut on two pine trees at the following distances and azimuths from the station: 8.00 meters, 273° 09′; and 11.85 meters, 291° 19′.

Stewart 2 (Brevard County, I. W., 1906).—About 4 miles south of Rockledge, on a point on the west side of Indian River and 90 meters north of a wharf in front of the residence of Mr. John Kendig. Marked according to note 2, page 474, except that the upper center pipe was but 20 inches long. The reference pipe is 13.85 meters from the station in azimuth 153° 26′. A triangle blazed on a palmetto tree is 28.10 meters from the station in the same azimuth as the reference pipe. The azimuth of the northeast corner of Kendig's wharf from the station is 310°.

Lou (Brevard County, C. H., 1876; 1906).—On the high-water line, on land belonging to C. Ensey, and near the northwest corner of his property. Marked by a 4-inch terra-cotta pipe, 2½ feet long, placed 20 inches in the ground, resting on rock, and filled with and surrounded by concrete. The reference mark is the corner stone between the properties of C. Ensey and M. F. Dwyer; it is 7.04 meters from the station in azimuth 198° 28′. The following distances and azimuths are from the triangulation station: House with dormer window, pointed roof, 121° 11′; house with striped roof, east gable, 126° 26′; three palmettos marked with triangles as follows: 4.90 meters, 209° 54′; 6.07 meters, 272° 56′; 7.15 meters, 300° 58′.

College 2 (Brevard County, I. W., 1906).—On the west shore of Indian River, on White Point. It is at the end of an old embankment which was used for a switch by the Florida East Coast Railway, and is 2.28 meters from the southeast corner of the south post of the backstop, 24 meters from the railroad track in front of the warehouse on the wharf at Eau Gallie, and 2 meters inshore from the high-water line. Marked according to note 2, page 474, the reference pipe being 2 feet in the ground and 12.00 meters from the station in azimuth 59° 49′. Other distances and azimuths from the station are: Railroad warehouse, northeast corner, 255° 12′; northwest corner, 282° 06′; telegraph pole at end of warehouse, 303° 44′; dead pine tree marked with triangle, 10.8 meters, 29° 10′; pine tree marked with triangle, 20.6 meters, 96° 50′.

Houstons Hill (Brevard County, C. H., 1876; 1906).—This station was located on a tall shell pile in the cove at the mouth of Banana River, east from the south point of Merritts Island, and 160 meters south of the trail to the ocean beach known as John Houston's trail. In 1906 a hole 20 feet across was found on this hill, in digging which the old station marks had been removed. The shell mound was then 40 to 50 feet high, and part of it had been washed into the river. The old underground mark, an ale bottle, was found in the dirt which had been removed from the hole. The river face of the mound is nearly vertical and material from it is falling into the river. The center of the hole was used as a station, and marked according to note 2, page 474. The reference pipe is 2 feet in the ground, and 7.03 meters from the station, being on the slope of the mound, 4 feet lower in elevation than the station. The station is 2.7 meters from and 0.45 meter

lower in elevation than the ground at the edge of the bluff. It is seen from this description that the present position is in doubt by too great an amount for it to be safely used for triangulation purposes.

Gibson Cut (*U. S. E.*) (Brevard County, W. H. B., 1906).—About 40° east of north of the town of Sebastian, 10 paces north of the north side of the cut and 12 paces west of the ocean bluff, on the first high ridge back from the sea. Marked by a ¾-inch galvanized-iron pipe driven in the ground and projecting 8 inches above the surface of the ground.

Sebastian 2 (St. Lucie County, W. H. B., 1906; 1907).—In the town of Sebastian, northeast of the railway station, on land belonging to the Florida East Coast Railway Co. It is 50.30 meters northeast of the northeast corner of the northeast brick column supporting the northeast corner of the main portion (not platform) of the railway station house, and is 34.16 meters southeast of the southeast corner of Mr. Kitching's general merchandise store. It is 13½ paces south of the center of the shell road leading from north of the railway station to the fish wharf. The underground mark is a bottle incased in concrete, placed with its top 30 inches below the surface of the ground; the center of the top marks the station. The surface mark is a 4-inch terra-cotta pipe, 2 feet long, filled with concrete and incased in a concrete cylinder 18 inches in diameter, and projecting about 2 inches above the surface of the ground. The center is marked by the point of a 40-penny nail placed head down in the concrete and projecting ¼ inch above the top of the pipe. The concrete around the pipe is lettered U.S.C. & G.S. 1906. The reference mark is 12.35 meters north of the switch rod, just south of the crossing at the north end of the depot, and 13.68 meters east of the east rail of the main track. It is 59.820 meters from the station, in azimuth 103° 36′, and was marked by a 4-inch terra-cotta pipe, 2 feet long, incased in a concrete cylinder 12 inches in diameter and filled with concrete, and having in its top a 40-penny nail placed head down. The magnetic station is 122.52 meters from the triangulation station, in azimuth 186° 24′. It was marked underground by a copper nail in the concrete stopper of a bottle filled with white sand and burried 18 inches below the surface of the ground. The surface mark of the magnetic station was a 4-inch terra-cotta pipe, 2 feet long. The pipe is incased in a concrete cylinder 12 inches in diameter for two-thirds the distance from its bottom to the surface of the ground. Sand was then filled in to the surface of the ground. The pipe is filled with sand to within 10 inches of its top, then with concrete; an inverted copper nail marks the point. The pipe projects about 5 inches above the ground and is surrounded with concrete formed into a dome, and lettered U.S.C. & G.S.M.S. 1906. The longitude station may also be used as a reference mark. (See below.)

Sebastian longitude station (St. Lucie County, W. B.-J. S. H., 1907).—In the town of Sebastian, 1.74 meters west and 2.38 meters south of the triangulation station Sebastian 2. (See above.) Marked by a concrete pier, 19 by 34 by 60 inches, about 3 feet above the ground and 2 feet below.

Payne 2 (St. Lucie County, C. H. B., 1882; 1906).—On the southwestern side of Jack Island, in 18 inches of water and 5.5 meters from the river bank. It is almost directly opposite Fort Capron. A large dead mangrove tree stands on the water's edge 7 meters from the station, in azimuth 193° 46′. A large live mangrove tree is on the shore 30 meters from the station. Both of these trees have triangles cut on them.

Marked according to note 4, page 474, except that 6-inch pipes were used. The upper center pipe projects about 18 inches above the river bottom, and comes to the water's surface at ordinary tide. The reference pipe was buried 2 feet in the ground, and is 9.30 meters from the station, in azimuth 263° 52′.

Russell (St. Lucie County, I. W., 1906).—Situated 9 meters from high-water mark, on a small low point on the west bank of the Indian River, about ½ mile north of the St. Lucie Clubhouse. A small creek enters the river at almost right angles, 25 meters north of the station. The mouth of this creek shifts in the sand, and in 1906 was a little south of the station. The station is at the outer edge of the thick growth of bushes along the river, and is about 100 meters north of the house occupied by J. A. Russell. Marked according to note 4, page 474, the upper center pipe projecting 20 inches above the ground. The reference pipe is 2 feet in the ground and 6.30 meters from the station, in azimuth 64° 56′. Two palmettos marked with triangles are at the following distances and azimuths from the station: 5.6 meters, 82° 39′, and 16.0 meters, 152° 48′.

Pierce (St. Lucie County, I. W., 1906).—About 1 mile northeast of Fort Pierce, on the east bank of Indian River, on the end of a point where the shore bends to the northeast. It is on a low ridge of mud covered with sand which separates the river from the lower ground in the rear of the station. It is 2 meters back of the grass line or high-water mark. The point is covered with a thick growth of mangrove trees except for a small open space back of the station. Marked according to note 2, page 474, the reference pipe being 2 feet in the mud and inshore from the station at a distance of 7.90 meters and in azimuth 301° 21′. The distances and azimuths from the station of two palmettos marked with triangles are: 50.00 meters, 211° 16′, and 50.00 meters, 215° 36′.

Rocky Point (Palm Beach County, C. H. B., 1882; 1906).—On the ocean shore above St. Lucie Inlet, on a sand hill on a point 165 meters north of a pavilion and 400 meters (approximate) south of C. H. Hook's house. A number of large coquina rocks are off the point between high and low water lines. The station is at the edge of the palmetto scrub. Marked by two pieces of 6-inch sewer pipe, placed one above the other, with a layer of sand between them, and a mass of cement mortar around the top and bottom of the lower pipe, which is 2½ feet long, and around the bottom of the upper pipe which is 16 inches long and projects 2 inches above the ground. Both pipes were filled with cement mortar. The reference mark is a piece of 6-inch sewer pipe 2½ feet long, buried 2 feet in the ground, and 6.25 meters from the station, in azimuth 73° 14′. The flag on the pavilion is distant 165 meters, in azimuth 346° 52′.

Sewall (Palm Beach County, I. W., 1906).—Established by the United States Engineers in 1898 in making a survey of St. Lucie Inlet. Situated on the highest part of Sewalls Point, on land belonging to Mr. H. E. Sewall; on top of the bluff at the southern extremity of the point, and about 4 meters from the upper edge of the bluff where it begins to slope toward St. Lucie River. The ground is cleared of undergrowth and is used as a park back of Mr. Sewall's house, which is under the bluff at the junction of Indian and St. Lucie Rivers. Marked according to note 1, page 473, with the addition that a 2-inch iron pipe was placed inside the upper pipe and projects 3 inches above its upper end. Triangles blazed on two palmetto trees are at the following distances and azimuths from the station: 6.2 meters, 345° 55′, and 8.8 meters, 64° 11′.

Cemetery (St. Lucie County, I. W., 1906).—On the highest portion of the ridge on the west bank of the Indian River ½ mile north of Jensen. A family cemetery is located 10 meters south of the station, and a large oleander bush grows at the northwest corner of the cemetery. The hill is covered with a thick growth of pineapple plants. The land belongs to Mr. J. W. Mosier, who lives on the bank of the river east of the station. Mr. Mosier's tramroad crosses the ridge north of the station. Marked according to note 2, page 474, the reference pipe being 2 feet in the ground and 9.8 meters from the station, in azimuth 338° 59′. This reference pipe is at the northeast corner of a small inclosure in the family cemetery.

Jensen (St. Lucie County, I. W., 1906).—On the east bank of the Indian River, on the point of land opposite the town of Jensen. The point is low and is covered with a dense growth of mangrove trees, some of which are quite large. The station is on the south side of the point, where the shore begins to turn to the east. A mud ridge covered with sand runs along the shore of the point; palmettos grow on this ridge, while there are mangroves on both sides of it. Some of the palmettos near the station have been cut down, and there is one tall dead one standing a short distance south of the station. Marked according to note 1, page 473. Some large mangroves were cut in front of the station, and to the south on the line to Pisgah station. Triangular marks made on two palmetto trees are at the following distances and azimuths from the triangulation station: 15.4 meters, 167° 10′, and 9.0 meters, 174° 45′.

Borden Hill (Palm Beach County, B. A. C., 1883; 1906).—On top of a sand ridge at the north end of Hobes Sound, and about ½ mile south of the railroad station of the same name. The east side of the ridge is cut away for the Florida East Coast Railway, which is between the station and the sound. The top of the ridge at this point is covered with small oak trees and bushes. Marked by two pieces of 4-inch sewer pipe, one 2½ feet long and the other 1½ feet long, the longer one placed above the shorter with an iron signal head between them, and cement placed around the bottoms of both pipes, and the pipes filled with that material. The old station mark, a coquina stone, was buried 7.20 meters from the station in azimuth 111° 01′. Triangular marks were cut on two small oaks inshore from the station, one 3.20 meters to the south, and the other 2.35 meters to the north of the station.

Simpson Hill (Palm Beach County, B. A. C., 1883; 1906).—On the range of sand hills west of Hobes Sound. The hill is covered with dead brush and a few live bushes. A number of pine trees are growing on the ridge a short distance north of the station. Marked according to note 1, page 473. A coquina stone 6 inches square and 3½ feet long was buried inshore from the station at a distance thereform of 2.27 meters.

Peck Flag (Palm Beach County, B. A. C., 1883).—A flag in the top of a large mangrove tree about 50 feet from the shore on the west side of Peck Lake, at a point from which one can see out through Pecks Landing to the ocean. The tree has a triangle blazed on its side nearest the lake.

Landing (Palm Beach County, B. A. C., 1883; 1906).—Near the south end of Peck Lake, where an arm of the lake extends through the mangroves to within 100 meters of the ocean beach. The station is on the first sand ridge outside the mangroves and about halfway between the mangroves and the beach. Nearer the ocean is a second and higher ridge. The station is 53 meters south of the trail leading from the lake to the beach, and is 40 meters from the low sand bluff back of the beach. An old

house used by fishermen is on the lake just north of the above-mentioned trail. The open space between the mangroves and the beach is covered with grass. Marked according to note 1, page 473. The reference mark is a coquina post 6 inches square and 30 inches long buried 24 inches in the ground and 7.50 meters inshore from the station.

Bar (Palm Beach County, C. H. B., 1882; 1906).—Lost.

Conch Bar Hill (Palm Beach County, B. A. C., 1883; 1909).—On top of the highest sand hill west of the north end of Jupiter Sound. The hill is covered with small bushes and young pine trees except in the immediate vicinity of the station, where it was cleared. To the eastward is a hill almost as high as the one on which the station is located. Marked according to note 1, page 473. A coquina post 6 inches square and 3 feet long was buried 2½ feet in the ground and 6.15 meters from the station in azimuth 342° 49′. A small pine tree marked with a triangle is 10.90 meters from the station in azimuth 00° 41′.

Wilner (Palm Beach County, B. A. C., 1883).—Lost. (See *Wilner 2*, below.)

Wilner 2 (Palm Beach County, I. W., 1906).—On the sand ridge back of the beach on the narrow strip of land between the ocean and Jupiter Sound. There is only one sand ridge along this portion of the coast, and there is a ledge of rock on the beach. The station is less than 2 meters from the edge of the sand ridge. It is opposite the house of Mr. D. Maddox on the west side of Jupiter Sound. Marked according to note 1, page 473. A coquina stone 6 inches square and 30 inches long was buried 24 inches in the ground and 9.70 meters from the station on line to Jupiter Inlet Lighthouse.

Jupiter Inlet longitude station (Palm Beach County, W. B.–J. S. H., 1907).—Located exactly 24.85 meters south and 39.35 meters east of the center of the lighthouse at Jupiter Inlet, being 46.54 meters therefrom. It is 19.88 meters from the southwest corner of the kitchen of the keeper's residence, and 24.16 meters from the northeast corner of the fence surrounding the assistant keeper's residence. Marked by a concrete pier 19 by 34 inches and 5 feet high, 3 feet above and 2 feet below the surface of the ground. Center of the upper surface of the pier marks the station. This station is practically identical with the latitude station.

JUPITER INLET TO MIAMI.

PRINCIPAL POINTS.

Tug (Palm Beach County, B. A. C., 1883; 1906).—On the ocean bluff about 4 meters from the edge of the bluff and 225 meters north of milepost 8 from Jupiter Inlet Lighthouse. The ground in the vicinity of the station was cleared. The underground mark is a copper tack in the stopper of a bottle buried 3 feet below the surface of the ground. Above this was placed a coquina stone 6 inches square and 30 inches long. The reference mark is an oak post 10 inches square and 11 feet long, buried 5 feet in the ground and 3.65 meters inshore from the station. Triangles were cut on two palmetto trees, one 20.2 meters and the other 21.9 meters, from the station. These two trees and the reference post are nearly in one straight line.

Haulover (Palm Beach County, B. A. C., 1883; 1906).—West of the first prominent point from the north end of Lake Worth on the west shore of the lake. It is 300 meters from the lake shore. The ground around the station is covered with bushes and scrub palmetto and a few pines. The immediate vicinity of the station was cleared. It is

about 250 meters north of the "Haulover," a well-known place, where boats are hauled across from Lake Worth to Lake Worth Creek. The underground mark is a copper tack in the wooden stopper of a bottle buried 30 inches below the surface of the ground. Above this is a coquina post 6 inches square and 30 inches long, with 3 inches of its top projecting above the surface. A copper tack in the middle of its top marks the center of the station. The coquina post leans slightly to the north. The reference mark is a 6-inch oak post buried 3 feet in the ground and projecting 4 feet above the ground. The following distances and directions are from the triangulation station: Pine tree, 12 inches in diameter, marked with triangle 15.2 meters, 0° 00′; reference post, 1.33 meters, 57° 40′; pine tree, 14 inches in diameter, and marked with triangle on limb, 19.8 meters, 149° 10′; pine tree, 14 inches in diameter, and marked with triangle, 17.6 meters, 178° 50′; oak tree 6 inches in diameter, and marked with triangle, 8.8 meters, 222° 50′.

Tom (Palm Beach County, B. A. C., 1883; 1906).—This station has been destroyed.

Spencer (Palm Beach County, B. A. C., 1883; 1906).—This station has been destroyed. (See *Spencer 2*, p. 535.)

Worth (Palm Beach County, B. A. C., 1883; 1906).—About 1½ miles north by west of West Palm Beach on top of the sand ridge overlooking the fresh-water lake from which water is taken to supply Palm Beach and West Palm Beach on land owned by Mrs. Nell Clow. The land is open and has been planted in pineapples. It is 34 meters in azimuth 320° 24′ to the northwest corner of the house of Hager Kelley, a negro. His house is just to the north of Swift's house and land. The station is 43 meters from the edge of the woods on the east, and was marked according to note 1, page 473.

Shell Mound (Palm Beach County, B. A. C., 1883; 1906).—On a high shell mound about midway between Lake Worth and the ocean beach, on what is known as the old Farrell place. It is about 6 miles down the lake from Hammonds Place and 400 meters north of milepost 10 north of House of Refuge No. 3. The shell mound is round and quite small on top; the top was cleared, but the sides are still covered with the small growth common to the locality. Two small houses belonging to fishermen are on the ocean bluff at the foot of the mound to the north. Marked according to note 1, page 473, except that the lower pipe was but 20 inches long. Triangles were blazed on three palmetto trees growing on the sides of the mound. Beginning with the one to the south they are at the following distances and directions from the station: 10.7 meters, 0° 00′; 16.4 meters, 95° 05′; 13.4 meters, 226° 50′. The old mark, a coquina post, was left lying on the ground near the station.

Ham (Palm Beach County, B. A. C., 1883; 1906).—South of Palm Beach on the ocean bluff and on land belonging to Mr. W. M. Lanehart. It is 60 paces north of the avenue of palm trees between Mr. Lanehart's house and the beach, and between the top of the bluff and a road across Mr. Lanehart's property, which is just back of the bluff, being 5 meters from the bluff and 10 meters from the road. The bluff is covered with bushes and palmettos. Marked according to note 1, page 473. Two palmettos marked with triangles are at the following distances and azimuths from the station: 10.1 meters, 88° 10′; and 7.6 meters, 108° 13′.

Lane (Palm Beach County, B. A. C., 1883).—A flag in a tree in the pine woods about ¾ mile back from the west side of Lake Worth.

Low (Palm Beach County, B. A. C., 1883; 1906).—On the ocean bluff about 50 meters from high-water line and about 350 meters south of the "Haulover" at the foot

of Lake Worth. It is about 1 200 meters north of the house of Steve Andrews, who is the keeper of House of Refuge No. 3. Marked by a copper nail in the top of a coquina post 6 inches square and 3 feet long and projecting 5 inches above the ground. In 1907 this station was searched for without success.

House (Palm Beach County, B. A. C., 1883; 1906).—On a low sand hill on the beach about 57 meters from high-water mark. It is 125 meters south of House of Refuge No. 3 (now abandoned) and almost in line with house and west end of boat-house. Marked by a black 2-quart bottle buried 3 feet in the ground; above the bottle was placed a coral rock projecting 5 inches above the surface. In 1907 the station was visited but the marks above described not recovered. A stone 2.5 feet by 1.3 feet and 4 inches thick was found 18 inches below the surface of the ground, and the position of the center of the stone's upper surface was re-marked according to note 1, page 473, except that the lower pipe was but 18 inches long. This mark is 165 meters north of the rock road from Delray to the beach, 60 meters from high-water mark, and 40 meters from the grass line on the beach. The ground just north has been cleared for building, and the hole (3 feet deep and 10 feet across) dug in the search was not completely filled in. It is very doubtful if this station was recovered, and the re-marked point must be used with caution.

False (Palm Beach County, B. A. C., 1883; 1906).—On the point known as False Boca Raton, about 5 miles south of the House of Refuge No. 3 (now abandoned). The bluff comes close down to the beach along here, so that the station is 40 meters back from high water and 20 feet above the level of the sea. The end of the point is faced with rock and the station is about the middle of the rock, north and south. There is a more prominent rock-faced point ¼ mile south of the station. Marked by a large piece of shell rock, set in concrete. The reference mark is a piece of 4-inch terra-cotta pipe 18 inches long buried 16 inches in the ground on a line inshore to a cocoanut tree with a triangle. From the station to the reference pipe is 3 meters and to the tree is 12.6 meters. A triangle cut on another tree inshore from the station is distant 9.7 meters therefrom.

Andrews (Palm Beach County, B. A. C., 1883).—A flag in a tree in the pine woods back of House of Refuge No. 3 (abandoned).

Boca (Palm Beach County, B. A. C., 1883; 1906).—On the bluff just back of the beach, on the first prominent point north of the old Boca Raton Inlet (now closed), from which it is distant about 1 100 meters. The recovery of this station in 1907 is uncertain. The supposed station is marked according to note 1, page 473, except that the lower pipe is but 18 inches long. A small wharf is on the shore of Boca Raton opposite the station. The land from Boca Raton to the beach has been cleared at this point to serve as a firebreak.

Bowers (Palm Beach County, B. A. C., 1883).—A flag in a pine tree in the pine woods.

Raton (Palm Beach County, B. A. C., 1883).—A flag in a tree.

Hills (Palm Beach County, B. A. C., 1883; 1906).—This station has been destroyed.

Junction (Palm Beach County, O. H. T., 1883; 1906).—On a high sand ridge near the beach, about 40 meters north of milepost 6 of House of Refuge No. 4, and about 3 miles south of Hillsboro Inlet. It is on land belonging to Dr. E. A. Jelks, of Quitman, Ga. An avenue was cut (in 1907) through the palmetto trees near Dr. Jelks's landing on line to station Burton. The station was supposed to have been originally marked

by a drain tile, but in 1907 a 6 by 6 inch post was found, and its center assumed to be the station; that point is now marked according to note 1, page 473. The reference mark is a piece of pine 2 by 8 inches and 9 feet long buried 4 feet in the ground and 1.86 meters from the station in azimuth 98° 46′. Behind this reference mark a 4 by 4 inch pine post was placed. From the station the azimuth of a lone palmetto on the beach is 8° 24′, and of the north gable of Dr. Jelks's house is 32° 51′.

Midway (Palm Beach County, O. H. T., 1883; 1906).—On a sand ridge about 60 meters from high-water mark, 13 feet from edge of grassy bluff, and 12.2 meters above milepost 3 of House of Refuge No. 4. It is on a decided point in the otherwise straight shore line. A wreck lies on the beach 590 meters to the southward. Marked by a drain tile having horizontal corrugations at its top. Two 4-inch terra-cotta pipes were placed inshore from and in line with the station and 1.95 meters and 3.93 meters from it.

Lauderdale (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

New River (Dade County, O. H. T., 1883; 1906).—On a sand ridge 23 meters from high-water mark, on the eastern edge of the sea grape thicket bordering New River. It is ¼ mile north of milepost 4 of House of Refuge No. 4, and about 3 000 meters below the Lauderdale Haulover, which is at the point where the main branch of the New River coming from the westward turns south and runs parallel to the beach. Marked by a drain tile from around which the sand was removed to a depth of 18 inches; it was then surrounded with a mass of cement and sand 10 inches wide and 12 inches deep. The tile was filled with cement and sand. Three pieces of pine 4 inches square were sunk 4 feet in the sand between the station and the ocean and 1.80 meters from the former. Two pieces of 4-inch terra-cotta pipe, 2½ feet long, were placed inshore from the station on line with the three pine posts and 1.80 meters and 3.47 meters from the station. The ground was cleared in the immediate vicinity of the station.

Inlet (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

Savanna (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

Dumfounding (Dade County, O. H. T., 1883; 1906).—On the ocean front east of Dumfounding Bay and 40 meters north of an avenue cut through the trees and used as a portage between the bay and the ocean. It is 14 meters from the grass line on the beach. Marked according to note 1, page 473, except that the lower pipe is a 4-inch drain tile, with one end broken. The upper pipe projects 6 inches above the ground. An 8-inch cedar post was buried 4 feet in the ground and inshore from the station at a distance of 3.95 meters. The post is hollow and projects 6 feet above the ground.

Baker (Dade County, O. H. T., 1883; 1906).—On the ocean front opposite the north end of Key Biscayne Bay and 80 meters north of where Baker's Haulover strikes the beach. A trail through the scrub palmetto (1907) still indicates where that haulover was located. The low sand hill on which the station is located is bare on the ocean face, but grass extends from its foot to the beach. Marked by a 6-inch drain tile buried 2½ feet in the ground, its top broken off in an irregular way even with the surface of the ground. A 6-inch mahogany post was set with its top projecting 5 feet above the surface of the ground and distant 2.55 meters inshore from the station.

Charles (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

Frank (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

Cape Florida Lighthouse (old tower) (Dade County, O. H. T., 1883; 1907).—The center of the lantern on the old lighthouse on the south end of Key Biscayne, known as Cape Florida. This structure has been abandoned as a light, and the land on which it stands is now the property of W. S. Davis.

Norris Cut (Dade County, O. H. T., 1883; 1906).—This station has been destroyed.

SUPPLEMENTARY POINTS.

B-2 (Palm Beach County, B. A. C., 1883; 1907).—This station has been destroyed.

Jupiter (Palm Beach County, I. W., 1907).—On top of a sand ridge south of Jupiter Inlet. A long sand spit entirely bare extends from the sand ridge northward to the inlet. The western slope of the ridge is covered with palmetto trees and bushes. The station is a short distance south of the north end of the ridge, and the slope of the ridge toward the ocean is steep. Marked according to note 1, page 473. Two palmettos, each marked with a triangle, are 14.0 meters from the station in azimuth 73° 52′, and 12.9 meters in azimuth 114° 52′.

Spencer 2 (Palm Beach County, I. W., 1907).—On a prominent shell mound between Lake Worth and the ocean beach, 75 meters back from the beach and 1 mile north of the pier at Palm Beach. The top of the mound was cleared and leveled. It is east of Mr. Swift's place on Lake Worth. Marked according to note 1, page 473.

Lake 2 (Palm Beach County, I. W., 1907).—On the end of the bluff north of Lake Worth Inlet. There is a long sand spit north of the inlet and from this rises a gradual slope to the top of the high sand ridge which is covered with bushes, scrub palmetto, palmetto, and coconut trees. The station is 20 meters north of the south end of the bushes, 2 meters from the top of the slope to the ocean beach, and about the middle of the bight between two points with rock exposed ends. Marked according to note 2, page 474, except that one of the pipes is but 10 inches long. The reference pipe is 2 feet in the ground and 2.25 meters from the station in azimuth 123° 22′. In the same azimuth as the reference pipe and 19.2 meters from the station is a palmetto marked with a triangle, while another palmetto marked with a triangle is 5.3 meters from the station in azimuth 26° 54′.

Burton (Palm Beach County, I. W., 1907).—In the pine woods on or near a piece of land owned by Mr. Burton, tax assessor of Dade County in 1907. It is about 1 mile southeast of Pompano railroad station. The pine woods come to a point at the station, and it is surrounded on three sides by hard open marsh. Marked according to note 3, page 474. The instrument was mounted on a large pine tree cleated to the top, and surrounded by a scaffold of pine trees, 30 feet high. The following distances and azimuths are from the station: Instrument tree, 1.65 meters, 298° 50′; pine trees each marked with a triangle, 7.80 meters, 346° 36′; 2.75 meters, 43° 27′; 4.78 meters, 159° 08′; palmetto marked with triangle, 14.45 meters, 202° 32′.

MIAMI TO LONG KEY AND CAPE SABLE.

PRINCIPAL POINTS.

Bluff (Dade County, O. H. T., 1883; 1907).—On the west bank of Key Biscayne Bay, about 2 200 meters south of the mouth of Miami River, and about 1 100 meters north from Punch Bowl. It is about the middle of a coral rock bluff, and is about 100

meters south of the old fort, and on the second lot south of a large white house which stands on the bluff just south of the old fort. When visited in 1908 the owner of the ground on which the station stands was putting up a house just back of the station and had erected a flagpole near the station. The flagpole is 0.15 meter square, and the face nearest the station is 0.42 meter from it; the azimuth of the pole from the station is 318°.

Shoal Point (Dade County, J. E. H., 1849; 1906).—Near the west bank of Key Biscayne Bay, in the water 100 meters from the shore and 100 meters above a sharp point in the shore line. It is marked by an iron nail or bolt driven vertically in the top of a flat coral rock 2 feet long and 1½ feet wide, projecting about 3 inches above the ground. The top of this rock is about 6 inches under water at low tide.

Key Biscayne south base (Dade County, A. D. B., 1855; 1906).—In 1908 it was reported that this station had been destroyed.

Soldier Key (Dade County, J. E. H., 1849; 1906).—Reported lost in 1908. (See *Soldier Key 2*, p. 548.)

Elliotts Beach (Dade County, J. E. H., 1849; 1906).—Reported lost in 1908. (See *Elliotts Beach 2*, p. 548.)

Key Biscayne north base (Dade County, A. D. B., 1855; 1906).—On the west shore of Key Biscayne, about ¾ mile south of its northern end. The center mark is a dressed granite post 16 inches square and 3 feet high with a pyramidal top. It is inscribed as follows: On north face, "No. 7 N"; on east face, "U. S. Coast Survey"; on south face, "A. D. Bache, Supt."; and on west face, "1856." This granite post rests on a rough granite block, 3 feet square, projecting 6 inches above the ground. There are four granite posts set as reference marks about 35 meters north, east, south, and west of the station. These granite posts are dressed at the top, the north one being 5 inches square and the others 4 inches square. In the top of each is leaded a copper bolt marked with cross lines.

Key Biscayne (Dade County, J. E. H., 1849; 1906).—On the ocean side of Key Biscayne, 1 200 meters south of the first point south of Bears Cut from which the old tower at Cape Florida can be seen. The station is on a low sand hill covered with bushes and is 75 meters from high-water mark. The station is 34 meters north of an old wreck on the beach and 90 meters north of a cocoanut tree with a pole nailed to it. Cocoanut trees grow along this portion of the beach, but a space in front of the station and about 100 meters wide has only two cocoanut trees in it. There is open ground from the beach to the station. It is 366 meters to the end of the grove to the south. The station is marked by a coral rock dressed to 12 by 18 inches with rough top and projecting 12 inches above the ground. A ½-inch hole in the center of the top of the rock marks the station.

Black Point (Dade County, J. E. H., 1849; 1906).—This station has been destroyed.

Sands Point (Dade County, J. E. H., 1849; 1906).—This station has been destroyed.

Turkey Point (Dade County, J. E. H., 1849; 1907).—This station has been destroyed.

Rubicon Point (Dade County, J. S. T., 1852; 1907).—This station has been destroyed.

Mangrove (Dade County, I. W., 1908).—On the second one of the Ragged Keys, reckoning from the north. The first or most northerly of these keys being a very small key less than ½ mile distant. The station is on the bare rock point which forms the southeastern end of this key, and is 3 meters from the water. Marked as follows: A

hole about 8 inches in diameter was dug 2 feet deep in the rock and in this was placed a 4-inch sewer pipe 2½ feet long. The pipe and hole were filled with cement and broken coral. A very large spreading mangrove growing on the shore line was marked with a triangular cut. It is 21.4 meters from the station in azimuth 82°. Four 1-inch iron pins 15 inches long were driven in the rock around the station at the following distances and azimuths: 1.42 meters 53°; 3.63 meters 142°; 2.23 meters 233°; and 3 meters, 322°. An iron rod found driven in the rock is 5.41 meters from the station in azimuth 317°.

Sands Cut (Dade County, J. E. H., 1849; 1907).—On the ocean side of Elliotts Key, on the first point south of Sands Cut, the channel between Elliotts Key and Sands Key. The rock in the vicinity of the station is bare and much worn and is covered with water at high tide. A wide reef of coral rock extends seaward off the point and is exposed at low water. In 1907 the station was recovered within less than 4 inches; a hole 2 feet deep was dug in the rock and a 4-inch sewer pipe 2½ feet long set in the hole and the pipe and hole filled with cement and sand. The center of the pipe marks the station. The reference marks are 4 iron pins, 1 by 15 inches, driven 12 inches into the rock at distances and azimuths from the station as follows: 1.80 meters, 216° 46′; 1.66 meters, southeast (approx.); 1.26 meters, southwest (approx.); 1.47 meters, northwest (approx.). The wreck of a house is on the beach about halfway to the next point to the south.

Log (Dade County, I. W., 1908).—On a rock point on the eastern side of Elliotts Key, about ½ mile from its northern end. This point is very prominent from both up and down the coast, and no land is seen beyond it from either direction. The station is near the north side of the point where the shore line turns abruptly to the west. The coral rock is wearing away in front of the station, and the station is under water at high tide. A hole 10 inches in diameter and 2 feet deep was dug in the rock, and in this was placed a 4-inch sewer pipe 2½ feet long, the center of which marks the station. The pipe and hole were filled with cement and broken coral. Two iron pins 1 by 15 inches were driven 12 inches in the rock on line to Fowey Rocks Lighthouse and 0.40 meter and 2.10 meters from the station. Two similar pins were driven 12 inches in the rock, one 2.90 meters from the station in azimuth 305° 19′ and the other 1.36 meters from the station in azimuth 124° 28′. The line between these two pins intersects the line through the other two at the station. Triangular cuts were made on two trees, one 19.53 meters from the station in azimuth 87° 34′ and the other 21.50 meters from the station in azimuth 100° 23′.

Point Adelle 2 (Dade County, I. W., 1908).—On a rock point on the ocean shore of Elliotts Key about 2¼ miles south of Sands Cut. The rock is much water worn and is covered at high water. The station was marked by an iron pin driven into the rock and surrounded with cement. It is midway between two round wooden stakes which were found driven in the rock. Four iron pins were driven in the rock around the station, two in azimuth 99° 13′ at distances of 1.79 meters and 2.94 meters and two in azimuth 188° 35′ at distances of 1.95 meters and 2.73 meters from the station.

Elliott, 1908 (Dade County, I. W., 1908).—On the end of the first prominent point on Elliotts Key north of Caesars Creek. The point is rock bound, and rock exposed all along the shore. The station is 8 meters from the water. A hole was dug 14 inches in diameter and 22 inches deep, and in it was placed a 4-inch sewer pipe 2½ feet long

to mark the station. The pipe and hole were filled with sand and cement. Triangular cuts were made on three trees; a 4-inch sewer pipe 2½ feet long was buried 2 feet in the ground inshore from the station; four iron pins 1 by 15 inches were driven 12 inches in the rock around the station; these witness and reference marks are at the following distances and azimuths from the station: East pin, 1.02 meters, 292°; south pin, 0.75 meter, 11°; west pin, 1.03 meters, 112°; north pin, 1.48 meters, 191°; trees marked with triangles, 4.73 meters, 97°; 8.61 meters, 27°; and 4.85 meters, 49°; reference pipe 13.45 meters, 74° 55′.

Ragged Key No. 1 (Dade County, J. E. H., 1850; 1908).—This station has been destroyed.

Elliotts Key No. 1 (Dade County, J. E. H., 1850; 1852).—On the ocean side of Elliotts Key, on the second prominent point south of Sands Cut, the channel which separates Elliotts Key from Sands Key. A line was cut across the key from this station toward Black Point. Marked according to note 10, page 474.

Triumph Reef (Dade County, J. T., 1853).—A screw pile sunk to the depth of 3 feet in the solid material of Triumph Reef, off Elliotts Key.

Elliotts Key No. 2 (Dade County, J. T., 1853; 1908).—Lost. (See *Elliott 1908*, p. 537.)

Christmas Point (Dade County, J. T., 1853).—On the southern point of Elliotts Key, on the right just as one enters Caesars Creek. Marked according to note 10, page 474. A mangrove stump which is within a few feet of the station bears from it by compass NW. ¾ W.

Caesars Creek Bank (Dade County, J. T., 1853).—Marked according to note 10, page 474.

Ajax Reef (Dade County, J. T., 1853).—On Ajax Reef off Elliotts Key. Marked by a screw pile 7 feet in the branch coral and 3 feet in the solid coral of the reef.

Pacific Reef (Dade County, J. T., 1853).—On Pacific Reef off the mouth of Caesars Creek which is the channel between Elliotts Key and Old Rhodes Key. Marked by an iron screw pile sunk 3⅓ feet into the solid coral of the reef.

Old Rhodes (Dade County, J. T., 1853; 1907).—This station was recovered in 1907 within a few inches. It is on a rock point on the ocean shore of Old Rhodes Key on the north side of the entrance to Broad Creek, ½ mile north of the north entrance to Old Rhodes Creek. The point shows prominently from both up and down the coast. The rock at the station is bare and is covered by high water. A hole 10 inches in diameter and 14 inches deep was dug in the coral rock and a 4-inch sewer pipe 2½ feet long was placed therein to mark the station. Both hole and pipe were filled with sand and cement, which was also heaped up so that the pipe projects but 6 inches. Four 1-inch iron pins 15 inches long were driven in around the station, and north, east, south, and west of it.

Turtle Reef (Monroe County, J. T., 1853).—On Turtle Reef, which is the northern extremity of Carysfort Reef off Key Largo. Marked by an iron screw pile sunk to a depth of 3½ feet in the coral rock.

Angelfish Key (Monroe County, J. T., 1853; 1908).—On Angelfish Key, which is close to the upper end of Key Largo. Proceeding north from Little Angelfish Creek on the outside of the key a small prairie with few trees on it is reached; the station is about the middle of this prairie and near the shore. Originally marked according to note 10, page 474, except that iron bolts driven in the rock were used instead of stakes. In 1908

it was re-marked as follows: The iron bolts of the old marking were left in place except the one to the west. A hole 18 inches deep was cut in the solid coral, and in this a 4-inch sewer pipe 2½ feet long was placed to mark the center. The hole and pipe were filled with concrete; a quantity of loose rock was placed around the pipe. The reference mark is a 4-inch sewer pipe 2½ feet long buried in rock inshore from the station and 11.36 meters from the station in azimuth 119° 02′.

El Camino (Monroe County, J. T., 1853; 1908).—On the ocean shore of Key Largo. Marked according to note 10, page 474. In 1908 the station was searched for without success, but it was not evident that the marks had been destroyed.

Basin Bank (Monroe County, J. T., 1853).—On the shoalest part of Basin Bank, a bank of white sand, inside the line of Carysfort Reef. It is close to the northwest corner pile of an old pier used by workmen in building the Carysfort Reef Lighthouse, from which lighthouse it bears S. 67¾° W. by compass. The center was marked by a nail driven into a nassau stone sunk in the sand. Nine feet 2 inches to the north and 9 feet to the west are two nassau stones marked with nails driven into the intersection of crosslines; north, east, south, and west of the station and 50 feet from it are posts sunk in the sand with 2 feet projecting; these posts were fitted with 50-pound iron shoes.

Point Elizabeth (Monroe County, J. T., 1853; 1908).—On the outside shore of Key Largo on a rocky point, the first prominent point northward from the narrow portion of Key Largo, which is opposite Barnes Sound. The point is covered by high water. Originally marked according to note 10, page 474, except that iron bolts driven in the rock were used instead of stakes. Re-marked in 1908 by removing the center stone and driving in at the center a 1-inch iron pin 15 inches long; around this pin was placed a mass of concrete. The three old witness bolts to the north, east, and south, were left in position and a small quantity of cement placed around them. A new iron pin was placed to the west and cement placed around it. An additional iron bolt was found driven in a high piece of coral to the eastward. The azimuths and distances of these marks from the station are as follows: 0.82 meter, 274°; 5.66 meters, 302° 06′; 0.83 meter, 7°; 1.03 meters, 94°; 1.25 meters, 187°. The old center mark, a nassau stone, was placed on the rock in the bushes, about 5 meters inshore from the station.

Upper Sound Point (Monroe County, J. T., 1853; 1908).—On a bare rock point on the ocean shore of Key Largo, and on the south side of a bay called Garden Cove. The point is covered at high water. The center was re-marked in 1908 by an iron bolt driven into the rock and surrounded by cement and sand. The old reference marks, consisting of 4 bolts in the rock and 2 small nassau stones with nails in their heads, were recovered and were further secured by placing a small quantity of cement and sand around them. They are at the following distances and azimuths from the station: Bolt, 1.57 meters, 276°; bolt, 2.47 meters, 276°; bolt, 0.86 meter, 4°; nassau stone, 2.48 meters, 96°; bolt, 0.98 meter, 184°; nassau stone, 1.37 meters, 4°. The old center mark, a nassau stone, was placed in between the branches of a tree growing inshore from the station. These branches leave the same roots close to the ground.

Grecian Shoals (Monroe County, J. T., 1853).—On Grecian Shoals, off Key Largo. Marked by a cast-iron screw pile sunk into the rock.

Point Willie (Monroe County, J. T., 1853; 1908).—On a rock point on the ocean shore of Key Largo, about 2¼ miles south of Garden Cove. The point is overflowed by high tide, and the rock is badly waterworn, and seems to be washing away. This point

is opposite the upper end of Largo Sound. The center is marked by an iron pin 1 by 15 inches driven into the rock and surrounded by a mass of concrete. The reference marks are: A nassau stone with broken top 7 feet east of the station; a nassau stone with nail in top 6.7 feet north; a bolt driven in the rock 5 feet 11 inches to the south; a bolt driven in the ground 6 feet to the west and a mangrove stub with nail in its top 8 feet 9 inches to the east. In 1908 the south and west bolts and the east stone were surrounded with a small quantity of sand and cement.

Lower Sound Point (Monroe County, J. T., 1853; 1908).—On a prominent point of Julia Island (Key Largo) on the outside shore and 300 or 400 yards from the mouth of the most easterly creek entering Largo Sound from the south. The rock at the station is not honeycombed, though it is covered at high water. The center is marked by an iron bolt driven into the rock and surrounded by concrete, on the surface of which the letters U.S.C.S. were roughly traced. The reference marks are two small nassau stones with nails in their heads placed, one 1.62 meters northwest of the station and the other 2.01 meters to the northeast. A 1-inch iron pin 15 inches long was placed 1.54 meters south of the station and the two stones and this bolt had cement placed around them. There also are the following marks: A bolt 1.92 meters west of the station; a bolt 1.72 meters north of the station; and an unmarked stone 1.98 meters southwest of the station.

French Reef (Monroe County, J. T., 1853; 1908).—This station has been destroyed.

Dry Rocks (Monroe County, J. T., 1853; 1908).—On the Dry Rocks off Key Largo. Marked by a cast-iron screw pile, which, in 1908 projected about 4 feet above the water and was inclined about 30° from the vertical in a direction toward the land.

Point Charles (Monroe County, J. T., 1853; 1908).—On Point Charles, a rock point on the ocean side of Key Largo, nearly north of the eastern end of Rodriguez Key. Unusually large trees are growing along the high-water mark and the station is about on this tree line, and is covered at high tide. Two large stumps are northeast of the station, one distant 0.3 meter, and the other 3.0 meters. Several trees were cut down to clear the point. The center is marked by a copper nail embedded in lead and surrounded by four iron nails in top of a nassau stone 10 inches cube, with its top flush with the surface of the ground, and surrounded by concrete which extends down to bedrock. Three iron pins or bolts are in the rock at the following distances and azimuths from the station: 1.90 meters, 3° 19′; 2.30 meters, 91°; 2.13 meters, 183° 19′.

Dove Key (Monroe County, J. T., 1853; 1908).—Could not be recovered in 1908. (See *Dove Key 2*, p. 550.)

Tavanier Key (Monroe County, J. T., 1853; 1908).—This station could not be recovered in 1908.

Plantation Point (Monroe County, A. H. S., 1857; 1908).—On a prominent rock point on the ocean shore of Long Island, about 1¼ miles northeast of the mouth of Snake Creek. The house of Mr. J. W. Pinder is on this point and within 50 meters of the station. The station is on bare rock 2.5 meters from the water. The center is marked by a 1-inch iron pin, 15 inches long driven in the rock and surrounded by cement and sand; the pin projects 1 inch above the cement. Due south of the center at a distance therefrom of 9½ inches is a drill hole in the rock filled with lead in which is driven a copper tack. Old reference marks consisting of spikes in the rock are east and south from the station; west and north of the station are 1-inch iron pins 15 inches long. These spikes and pins are surrounded by a small quantity of cement. The following distances

and azimuths are from the station: South spike, 1.72 meters, 5° 27′; west pin 2.40 meters, 92° 42′; southeast corner of stone cistern between dwelling houses, 44 meters, 152° 55′; north pin, 1.48 meters, 185° 00′; east spike, 2.05 meters, 272° 45′; tack in lead, 0.225 meter.

Tea Table Key (Monroe County, A. H. S., 1857; 1908).—On Tea Table Key, about ½ mile off the lower end of Upper Matecumbe. It is about 100 meters from the grass line on the outer end of the key, and about the middle of the key up and down the coast. The ground is open and lower than it is near the water, and it is surrounded by a circular row of cocoanut trees. A hole 14 inches in diameter and 16 inches deep was dug to bed rock; in this rock a 1-inch iron pin 15 inches long was driven to mark the center of the station. Around this pin was placed an iron cone, and the hole was filled with cement and sand. In the top of this mass of cement and sand was placed a 30-penny wire nail, which marks the center. From this nail rough lines were drawn in the cement north, east, south, and west. North and south of the station are granite monuments projecting 14 inches above the surface, while to the west is a rough-topped stone, flush with the ground. Triangular marks were made on three cocoanut trees. The following distances and azimuths are from the station: South stone, 1.95 meters, 7° 50′; west stone, 1.51 meters, 94° 30′; cocoanut tree with triangle, 30 meters, 46° 41′; cocoanut tree with triangle, 31 meters, 116° 49′; north stone, 1.83 meters, 189° 14′; cocoanut tree with triangle, 16 meters, 253° 35′; northwest corner of stone foundation (remains of old house), 35 meters, 227°.

Indian Key (Monroe County, A. H. S., 1857; 1908).—On a small key off the northern end of Lower Matecumbe Key. There is a row of cocoanut trees around this key, and the station is inside of these trees. The seaward face of the key is rockbound and the station is about the center of the key when seen from the outside. It is 35 meters from the rock bluff on the ocean side, 42 meters from a stone cistern on the southern side of the key, and 85 meters from a large storehouse with a stone foundation in the form of a water tank. This storehouse is the only house left standing on the key. Marked by a granite monument set in a mass of concrete 6 inches wide and 16 inches deep. The monument is dressed 4 inches square on top and the center is marked thereon by the intersection of crosslines. The letters U.S.C.S. are roughly drawn in the cement around the post. The reference mark is a 1-inch iron pin 15 inches long, driven 7 inches into the rock, and 12.80 meters from the station in azimuth 295° 57′. Other distances and azimuths from the station are: Southeast corner of old house, 85 meters, 184° 47′; cocoanut tree marked with triangle, 9.26 meters, 7° 04′; old cistern, 42 meters, 82° 07′; cocoanut tree marked with triangle, 7.24 meters, 262° 42′.

Long Arsenicker Key (Dade County, J. E. H., 1849–50; 1907).—Off the south shore of Long Arsenicker Key and near its western end. It is 8 meters outside the wooded line which is overflowed at high water. Marked in 1908 according to note 4, page —, the upper center pipe projecting 8 inches above the ground and 4 inches above low water. The reference pipe is 2 feet in the ground, in line to a small tree on which a triangular cut was made. It is 13.50 meters from the station to the reference pipe and 16.46 meters to the blazed tree. There are also four stone reference marks, north, south, east, and west from the station and each distant 4 feet therefrom. The stones to the north and east are much waterworn on top. The original center mark, a stone 18 by 14 by 10 inches in size, was placed on the surface at the wood line between the station and the reference pipe.

Snapper Point (Monroe County, J. S. T., 1852; 1907).—Lost.

Cards Point (*S*) (Dade County, J. S. T., 1852; 1907).—Lost.

Jew Point (Monroe County, A. H. S., 1854; 1907).—Lost.

Mud Point (Dade County, A. H. S., 1854; 1907).—Lost.

Mosquito Creek (Monroe County, A. H. S., 1854; 1907).—On Key Largo, on the northern shore of Barnes Sound, on the westernmost bank of the third creek from Barnes Point and about 200 yards from its mouth. It is 15 meters from the creek bank. The marks are four stone monuments, dressed to 6 inches square on top and marked with crosslines and the letters USCS. The center stone is surrounded by a mass of cement 8 inches deep. The other three monuments are placed 4 feet from the station, and north, east, and south of it. Triangular marks were cut in 1908 on trees (three), one 8.3 meters southeast, one 10.0 meters southwest, and the third 7.55 meters northwest from the station. One of these trees is quite large; it grows on the bank of the creek and shows plainly in approaching the station.

Narrow Point (Dade County, A. H. S., 1854; 1907).—On a long narrow point of the same name in the northwest corner of Barnes Sound. The station is on the north shore of the point, about 400 meters from the end and 75 meters east from a point which is almost bare of trees. A great deal of the point has been washed away, and the station is on the bare mud flat along the shore; it is covered by high water. Marked according to note 3, page 474. The upper pipe projects 6 inches above the ground. The reference marks are three stone monuments with dressed tops marked with crosslines and the letters USCS, and set at the following distances and azimuths from the station: 1.90 meters, 296° 24′; 12.37 meters, 17° 43.5′; 1.25 meters, 197° 07′. These stones project 4 to 6 inches above the ground.

Main Key (Monroe County, A. H. S., 1854; 1908).—It is 40 meters southeast of a point on the east shore of Main Key in Barnes Sound and in water about 1½ feet deep. The mangroves on the shore are being undermined and washed away. It was recovered within a few feet in 1908 and is marked according to note 3, page 474, the pipes being but 2 feet long, and lean somewhat to the northwest, the center of the upper pipe being the station. The reference marks are three marble posts 3 feet long and dressed to 6 inches square on top and marked with crosslines and the letters USCS. These posts project 6 inches above the ground. A black mangrove post 10 inches in diameter and 8 feet long was buried 4 feet in the mud and water and in line with one of the reference stones. Triangular cuts were made on each of two mangrove trees standing near the shore line. The following distances and directions are from the station: Reference stone, 1.32 meters, 118°; reference post, 21.95 meters, 119° 50′; reference stone on shore, 40.05 meters, 119° 56′; reference stone, 1.63 meters, 201°.

Largo North (*S*) (Monroe County, J. T., 1854; 1908).—On the west shore of Key Largo and on the east shore of Barnes Sound; in the water 8 meters outside the edge of the mangroves. The water is about 2 feet deep at the station at high tide. Marked in 1908 as follows: A barrel was sunk in the mud and a hole 3 feet deep was dug inside the barrel; two pieces of 4-inch sewer pipe 2½ feet long were forced into the mud; the pipes and the space around them inside the barrel were filled with cement. The top of the upper pipe is about on level with the water at low tide, and its center marks the station. Reference marks are four stone posts set around the station. A pine post 0.3 meter in diameter and 1.6 meters long was buried 1 meter in the ground inshore from the

station and a triangular cut was made on a mangrove tree standing at the edge of the bushes. The following distances and azimuths are from the triangulation station: Reference stones, 1.38 meters, 191° 03′; 1.09 meters, 279° 10′; 1.41 meters, 5° 29′; and 1.50 meters, 103° 39′; reference post, 10.37 meters, 289° 04′; tree marked with triangle, 11.02 meters, 310° 15′.

Largo Point (Monroe County, A. H. S., 1854; 1907).—Lost.

Clay Point (Monroe County, A. H. S., 1854; 1908).—On the north shore of Cross Key which forms the south shore of Barnes Sound, and in a bight southwest of Main Key. The Florida East Coast Railway is a short distance southwest of the station. A small point is a short distance to the west, and the east point of the bight is distant about ½ mile. The station is 3 meters outside the shore line. The soil in this locality is white clay. Marked by a stone monument dressed to 6 inches square on top, which is marked with crosslines and the letters U.S.C.S. It is surrounded by a mass of cement mortar 1 foot thick. The reference marks are three stones similar to the center stone, set low in the ground around the station at the following distances: North stone 1.29 meters; west stone, 1.18 meters; south stone, 1.11 meters.

Crab Point (Monroe County, A. H. S., 1854; 1907).—On the north shore of Cross Key and on the southern shore of Barnes Sound. It was recovered within a few feet in 1908 and re-marked according to note 3, page 474, the upper pipe projecting 6 inches above the ground. The reference marks are two stone posts 6 inches square and 2½ feet long in line with and south of the station. The following distances and azimuths are from the station: Reference stones, 0.92 meter, 359° 49′; and 13.31 meters, 359° 49′; trees marked with triangles, 10.55 meters, 20° 30′; 6.32 meters, 50° 58; and 14.50 meters, 325° 51′.

Shell Key (Monroe County, A. H. S., 1854; 1908).—On the east end of Shell Key, which lies on the west side of Blackwater Sound. The station was established and marked in 1858, and its recovery in 1908 is uncertain, not having been verified by observations. The marks placed in 1908 are as follows: A hole was dug in the soft mud and a barrel placed in it; two pieces of 4-inch sewer pipe 2 feet long were placed in the barrel, one above the other, and these pipes were filled and surrounded with cement mortar. The center of these pipes is the station. The reference pipe is a piece of 4-inch sewer pipe, 2 feet long, 18 inches in the ground, and 49.5 meters inshore from the station. The station is in 30 inches of water, and 49 meters from high-water mark.

Alligator (Monroe County, A. H. S., 1854; 1908).—On the southern shore of Shell Key at the head of Florida Bay. There has been a great deal of erosion around this station since it was established in 1854, and its recovery in 1908 is uncertain, and it should be used with caution. It is covered by high tide, is 9 meters from the dry mud bank forming the shore line, and is midway between the points of a small bight. Marked according to note 4, page 474, the pipes being but 2 feet long. The upper center pipe projects 1 foot above the surface, and leans a little toward the shore. The reference pipe is large end up, 18 inches in the ground, and 19.83 meters from the station in azimuth 243° 31′ 30″. There are no large trees near the station.

Batti (Monroe County, G. A. F., 1860; 1908).—On the western shore of Key Largo, at the head of Florida Bay, about 3 miles north of the south entrance to Grouper Creek. It was recovered within a few feet in 1908 in water 12 inches deep, and 15 meters from the shore line. It is marked by two pieces of 4-inch sewer pipe, placed one above the

other. The lower pipe is 1 foot long and rests on bed rock, while the upper pipe is 2 feet long and projects 6 inches above the bottom of the bay. The pipes are surrounded by and filled with a mass of cement mortar. The center of the upper pipe marks the station. The reference marks are four old granite monuments placed around the station at the following distances and azimuths: 2.01 meters, 180° 33′; 13.03 meters, 271° 53′; 20.90 meters, 270° 02′; 1.82 meters, 4° 12′. All except the one at the distance of 20.90 meters are in the water.

Duck Key (Monroe County, A. H. S., 1855; 1908).—On Duck Key, a small wooded key in the eastern portion of the Bay of Florida. The old station was recovered within a few inches in 1908, and is at the eastern end of a strip of comparatively hard ground which extends along the southern shore of the key. The salt grass growing along the ridge is quite different from the growth on the low ground back of it. Marked according to note 3, page 474, the upper pipe projecting 8 inches above the ground. Triangular cuts were made on three trees, and a granite post dressed to 4 inches square on top was buried on line to one of the marked trees. The following distances and directions are from the station: Triangulation station Tony, 0° 00′; reference stone, 8.28 meters, 110° 54′; trees marked with triangles, 4.40 meters, 69° 49′; 10.00 meters, 110° 54′; 9.83 meters, 142° 09′.

Moat (Monroe County, G. A. F., 1860; 1908).—On the most easterly point of a large key in Florida Bay, southwest of Duck Key, and northwest of Whaleback Key. The recovery of this station is uncertain and it should be used with caution. Its most probable position was marked as follows: Two pieces of 4-inch sewer pipe were placed one above the other and filled with and surrounded with cement mortar. The lower pipe is 1 foot long and rests on bed rock, the upper pipe is 2 feet long and projects 6 inches above the bottom of the bay. They are in 15 inches of water, and are 9 meters from the shore line. The reference mark is a granite post 18 inches in the ground, and projecting 6 inches above the surface; it is 8 meters inshore from the water line, and is 16.90 meters from the station in azimuth 82° 54′ 50″.

Spit (Monroe County, G. A. F., 1861; 1909).—On a mud bank between the two keys of a group of three which are nearest Lake Key and about 1½ miles northeast therefrom. Two of these keys are shown on Coast and Geodetic Survey Chart 167, and the third has grown on a sandbank since the region was surveyed. The station as marked in 1861 was recovered within a few inches in 1909 and was re-marked according to note 4, page 474; the upper pipe extends 10 inches above the surface of the mud. The reference pipe is 2 feet in the sand in the edge of the mangroves, and is 40.7 meters from the station in azimuth 57° 58′. There is also a reference mark consisting of a granite post dressed to 6 inches square on top and marked with crosslines; it is 2.9 meters from the station in azimuth 243° 30′.

Pie (Monroe County, G. A. F., 1860; 1909).—Lost.

Sever (Monroe County, G. A. F., 1860; 1909).—Near the head of Florida Bay, on a small key about 1 mile from and nearly south of Whaleback Key. The station as marked in 1860 was recovered within less than 1 foot in 1909 and re-marked as follows: A piece of 2 by 4 inch pine scantling was driven in the mud at the center, and surrounded with two pieces of 4-inch sewer pipe, 2 feet long, and the whole forced down to bed rock. A mass of cement mortar was placed around the pipes and they were filled with the same material. The reference marks are four granite posts, dressed to 6 inches square

on top, and placed around the station at the following distances and azimuths: 2.38 meters, 5° 03′; 2.13 meters, 94° 44′; 2.11 meters, 183° 01′; 37.34 meters, 300° 20′. The last mentioned stone is on shore; the others are in the water.

Pigeon (Monroe County, A. H. S., 1859; 1909).—Lost.

Low (Monroe County, A. H. S., 1859; 1909).—Lost.

Middle Plantation (Monroe County, A. H. S., 1859; 1908).—On a rock point on the inside shore of a key called Long Island. The point is near the middle point of the key. The station is 5 meters from the shore line, and the rock in its immediate vicinity is bare. Marked (1908) by a 30-penny wire nail embedded in cement, which fills a hole 5 inches in diameter drilled in the natural rock. The surface of the rock close to and surrounding the center was also covered with cement. The reference marks are four 1-inch iron pins, 15 inches long, driven into the rock around the station, the lines connecting them diagonally intersect at the center. Triangular cuts were made on four trees around the station. The following distances and directions are from the station: Trees marked with triangles, 4.38 meters, 0° 00′; 5.70 meters, 166° 25′; 10.89 meters, 202° 20′; 8.35 meters, 247° 30′; four reference pins, 2.33 meters, 36° 15′; 2.37 meters, 121° 15′; 1.62 meters, 216° 15′; 1.33 meters, 301° 15′.

East (Monroe County, A. H. S., 1859; 1909).—At about the middle of the southwest side of East Key. It is about 60 meters from the shore line and is in open ground inshore from the mangroves which grow close together along the shore. Marked by the intersection of two lines cut in the top of a granite post buried in the ground so that but 3 inches of its top projects, and surrounded to a depth of 16 inches by a mass of cement. This post is rough except at its top, which is dressed to 6 inches square. The reference marks are two posts similar to the one at the center and buried 2 feet in the ground, one 2.0 meters from the station in azimuth (mag.) 334°, the other 2.76 meters from the station in azimuth (mag.) 154°.

Mark Key (Monroe County, A. H. S., 1859; 1909).—Lost.

West Key (Monroe County, A. H. S., 1859; 1909).—On a small point on the southeast shore of and near the south end of West Key, and opposite the deepest part of a decided bight in the west shore of that key. There is a small cove with white clay beach on each side of the point, and the station is only 3 meters from the shore line on the east and 4 meters from the water on the south. The recovery of this station in 1909 is uncertain. Marked (1909) according to note 4, page 474, the reference pipe being 2 feet in the ground inshore from the station, distant 15.48 meters, in azimuth 120° 50′. There are no large trees near the station and the bushes in front of it were cut away. Two trees marked with nails in the form of a triangle are at the following distances and azimuths from the station: 4.72 meters, 94° 20′; and 6.92 meters, 157° 06′.

Upper Matecumbe (Monroe County, A. H. S., 1856; 1909).—This station has been destroyed.

Torry (Monroe County, A. H. S., 1856; 1909).—This station has been destroyed.

Lignum Vitae (Monroe County, A. H. S., 1856; 1909).—This station has been destroyed.

Twin Key (Monroe County, A. H. S., 1856; 1909).—Near the middle of the west side of the western one of the Twin Keys. The mangroves grow thick along the water and the station is just back of these and at the edge of the open or grass line of the inner portion of the key. Marked by a granite monument set in cement. The monument

is rough except the top, which is dressed to 4 inches square and has the center marked on it by cross lines. A rough granite monument is 1.92 meters from the station in azimuth 2° 40′. Two 4-inch sewer pipes 2½ feet long were placed 2 feet in the ground, one 2.20 meters from the station in azimuth 99° 06′, and the other 1.55 meters from the station in azimuth 277° 20′.

Buchanan (Monroe County, A. H. S., 1856; 1909).—On the extreme northwestern point of the western one of the Buchanan Keys. It is 30 paces from the water. The mangroves grow thick along the shore, but the land near and back of the station is open, with a few scattered trees. The recovery of this station in 1909 was uncertain and the station must be used with caution. Marked in 1909 according to note 3, page 474, the upper pipe projecting 10 inches above the ground. The witness marks are two stones placed one 1.60 meters north and the other 1.58 meters east of the station.

Matecumbe (Monroe County, A. H. S., 1857; 1909).—This station is lost.

Jew Fish (Monroe County, J. C. C., 1857; 1909).—This station is lost.

Rabbit Key (Monroe County, A. H. S., 1856; 1909).—On the south end of a small key known as Rabbit Key. Mangroves grow thick along the water, but the central portion is open and covered with grass and flags. The station is about the middle of this open part at the south end. The center is marked by crosslines on top of a granite post set in cement. The post is dressed to 4 inches square on top, and leans slightly to the west. Stones similar to the center stone are north and south of the station, while one with rough top is west of the center. The following distances and directions are from the station: South reference stone, 1.90 meters, 0° 00′; west reference stone, 1.98 meters, 90° 20′; north reference stone, 1.88 meters, 183° 20′; three trees each marked with a triangle: 19.1 meters, 7° 20′; 17.2 meters, 85° 54′; and 16.9 meters, 313° 56′.

Horseneck Shoal East (Monroe County, J. C. C., 1857; 1909).—This station is lost.

Middle Shoal (Monroe County, J. C. C., 1857; 1909).—On a long narrow shoal 7½ miles northwest of the south end of Long Key. Channel Key covering the north end of Duck Key is a good range for the bank. Marked by an iron screw pile around which on the surface of the mud a mass of concrete was placed. Alongside the pile and projecting about 1 foot above it was placed a piece of 4-inch sewer pipe 2½ feet long, in which was a 2 by 4 inch stake.

Long Key (Monroe County, J. C. C., 1857; 1909).—This station has been destroyed

Schooner Bank (Monroe County, A. H. S., 1858; 1909).—This station is lost.

Man of War Bush (Monroe County, A. H. S., 1858; 1909).—On the west end on Man of War Key, in open ground covered with tall coarse grass. Trees and bushes grow along the water on this portion of the key. The station is 7 meters from the edge of the low bank and trees on the north, 13 meters from the trees on the south, and 40 meters from the trees on the west. At this point in 1909 two granite monuments were found instead of five, the number used in the original marking of the station. This places some doubt on the recovery of the exact point. The station as recovered is now marked by crosslines in top of a granite monument 4 inches square on top, set in cement. It projects 4 inches above the ground. South of the center stone at a distance of 1.97 meters is set a stone similar to the one at the center. Two pieces of 4-inch sewer pipe 2½ feet long were set 2 feet in the ground, one 2.01 meters west of and the other 1.88 meters east of the center stone.

Sandy Key (Monroe County, A. H. S., 1858; 1909).—This station has been destroyed.

Oyster Key (Monroe County, A. H. S., 1858; 1909).—On the west one of the Oyster Keys, on the extreme west point of the key, 20 meters from high-water mark on the end of the key, 5 meters from high-water mark on the north, and 13 meters from high-water mark on the south. Tall mangroves grow thick along the water around the key, and the middle portion is covered with bushes. The ground immediately around the station is cleared. The recovery of this station in 1909 is slightly in doubt. Marked by crosslines in top of a granite monument 6 inches square on top, set in cement. A rough granite stone was set 1.85 meters east of the station, while two 4-inch sewer pipes 2½ feet long were placed one 2.18 meters north and the other 1.75 meters south of the station. A large mangrove tree marked with a triangle is on the shore 11.8 meters northeast of the station.

Cape Sable east base (Monroe County, A. D. B., 1855; 1909).—Near the southwest corner of SE. ¼ sec. 4, T. 61 S., R. 33 E., being N. 58° E. (mag.), distant 137 meters from that corner. The house of Mr. S. L. Roberts is 1/6 mile distant from the station in bearing (mag.) S. 75° E., and the distance and bearing of the house of David Griffin are ½ mile S. 66° W. (mag.). Marked by a large screw pile in the center of the iron cap of which a drill hole was made. Around this central pile were placed four smaller piles, each having in its top a copper bolt with cross lines inscribed thereon. These are at the following distances from the station: West, 15.27 meters; north, 15.27 meters; east, 15.24 meters; south, 15.21 meters. Four large nassau stones 12 inches square and 20 inches long and some smaller pieces were placed over and around the station. A granite monument was placed close beside the screw pile to the south.

Cape Sable west base (Monroe County, A. D. B., 1855; 1909).—The location of this station was still plainly marked in 1909 by the opening through the woods along the base made when it was measured. This vista was made more distinct by cutting the trees on each side of the base line through the thin woods to the eastward for a half mile to the prairie. The station is 40 meters from the shore line, which is gradually washing away. The center was marked by a screw pile, its top broken off, and stones placed over and around it. Four smaller screw piles with copper bolts and cross marks in their tops were placed around the station in the following positions: South, 15.21 meters; east, 15.15 meters; north, 15.24 meters; and west, 15.24 meters. These piles had beds of shells placed around them.

Cape Sable latitude station (Monroe County, J. H., 1886; 1909).—In a large grove of cocoanut trees 72 meters from the sand beach and 41 meters from a cocoanut tree marked with a triangle. The tombstone of Guy M. Bradley is 300 meters east and 80 meters south of the station. This tombstone is concrete, with a bronze plate on it. The north gable of the nearest of several deserted houses is 38 meters from the station in bearing (mag.) S. 71° E. A deep ditch (very old) is within 6 meters of the station; this ditch continues for some distance and is not straight. The station is marked by a brick pier 24 by 18 inches and 6 feet high, 2 feet of this being under ground. In 1909 the pier was leaning to the north (5 inches at the top), and a few of the upper tier of bricks were gone.

Sandy Key 2 (Monroe County, J. H., 1886; 1909).—On the north end of Sandy Key, about the middle of the point, 40 paces from the north end, 38 paces from the east

beach, and 29 paces from the west beach. The ground near the station is open, with grass growing on it, and a few bushes are growing north of the station. Trees and a large bunch of cactus are 25 meters to the south. Marked according to note 1, page 473. The position of this station as recovered in 1909 is in doubt by some feet.

Cape Sable middle base (Monroe County, A. D. B., 1855; 1909).—In the open prairie ¼ mile northeast of a house recently erected by the Cape Sable Land Co., which owns the land on which the station is located. It is between two roads and is 14 meters from the one to the south, which leads to the house above referred to. A lone tree is 200 meters distant, N. 14° E. (mag.) from the station. The station is north of one of the numerous groups of trees which form "islands" in this prairie. Marked by cross-lines in a copper bolt set in the top of a granite monument 12 inches square and 3 feet long; the top of the monument is flush with the surface of the ground.

SUPPLEMENTARY POINTS.

Elliotts Beach 2 (Dade County, I. W., 1907).—On the west shore of Key Biscayne Bay, on Elliotts Beach, which is known locally by the name of "Cocoa Plum," and is about 6 miles south of Miami. The station is covered by high tide. Marked according to note 3, page 474. The reference marks are two granite posts both in azimuth 100° 41′ from the station and distant from it 3.50 meters and 5.95 meters. In azimuth 67° 52′ from the station are two trees each marked with a triangle. These are a palmetto tree, distant 10.5 meters from the station, and a mangrove tree, distant 22 meters from the station.

Soldier Key 2 (Dade County, I. W., 1907).—On Soldier Key, about 5 miles south of Cape Florida. It is 23 meters from the water on the east and 65 meters from the water on the north, and is east of the line joining two houses on the key. Marked by two pieces of 4-inch sewer pipe, one 2½ feet long and the other 1 foot long, placed one above the other in a hole in the rock and the hole and both pipes filled with cement mortar. The following distances and azimuths are from the station: Mangrove standing near the water and marked with a triangle, 12.6 meters, 290° 24′; northeast corner of large house, 18.9 meters, 84° 03′; southeast corner of small house, 21.2 meters, 179° 47′.

South Hill (Dade County, W. H. B., 1906; 1907).—About 3¾ miles east of Miami, on a large bare sand hill about 12 feet high. It is about 90 meters from high-water mark on the ocean to the east, 75 meters south of New Cut, and ½ mile north of Norris Cut. The station was originally marked by the United States Engineers by a piece of 1¾-inch iron pipe driven into the ground with 20 inches projecting. In 1907 the sand was removed from around the pipe to a depth of 4 feet, and two pieces of 4-inch sewer pipe each 2½ feet long were placed around it. A mass of cement mortar was placed around the bottom of the lower pipe and around their junction, and they were filled with the same material. The shore on the ocean front is washing away, and it is only 25 meters to the top of the bluff.

Miami north base (Dade County, W. H. B., 1905).—Lost.

Miami south base (Dade County, W. H. B., 1905).—Lost.

Miami longitude station (Dade County, W. H. B., 1905; 1907).—In the northeast corner of the courthouse grounds at Miami, about 8.7 meters from the street curbing on the north, and about 6 meters east of the center of the walk leading to the courthouse

from the north. Marked by a cross cut on the upper face and near the center of a concrete block 19 by 32 inches, 3 feet above and 1½ feet below the ground and resting on solid rock. The letters "U. S. C. & G. S., Long. Sta. Feb. 1907" were cut on the west face of the pier. The east reference mark is a ½-inch copper bolt, 3 inches long, set in cement horizontally and not projecting, in the north face of the courthouse. It is 0.3 meter from the northeast corner of the building, 0.6 meter above the ground, 6.78 meters east from the east edge of the stone doorsill of the north entrance, and is 22.79 meters from the station. The west reference mark is similar to the east reference mark, and is 0.3 meter from the northwest corner of the courthouse, 0.6 meter above the ground, 6.73 meters west from the west edge of the stone doorsill, and is 26.54 meters from longitude station.

Lewis (*U. S. E.*) (Dade County, I. W., 1907).—About 150 feet east of the west shore of Key Biscayne Bay, off Lewis Point, in about 2 feet of water. It is about 4,500 feet south of the mouth of Miami River. Marked by the United States Engineers by a 2-inch galvanized iron pipe driven into the mud.

Caesars Creek Point (Dade County, J. T., 1852).—This station could not be recovered in 1908.

Old Rhodes Bank (Monroe County, J. T., 1852; 1908).—On Old Rhodes Bank, in 2 or 3 feet of water at low tide. Marked by a quantity of coral rock. Not recovered in 1908.

Basin Hill (Monroe County, J. T., 1852–53; 1908).—Lost.

Point Mary (Monroe County, J. T., 1852–53; 1908).—On a rock point on the ocean shore of Key Largo, about 1 mile north of Garden Cove. The coral rock at the station is more solid and uniform than is usually found, and having a fairly flat surface the station mark was cut in the rock. It consists of a cross cut in the rock, its arms pointing north, south, east, and west; at the intersection of these arms an iron spike was driven to mark the center. Four spikes were driven in around the station as follows: North, 0.88 meter; east, 0.95 meter; south, 1.19 meters; west, 0.48 meter. The diagonals connecting these spikes intersect at the station. A nassau stone with a cross cut in its upper surface and a nail driven therein is 4 feet 1 inch west of the station. This stone is loose in position. In 1908 concrete was placed in a water-worn hole close to and east of the station, and concrete was also placed around the south spike. The station is covered by high water.

Wreck Point (Monroe County, A. H. S., 1857; 1908).—On a bare rock point on the ocean shore of Key Largo, about ½ mile north of Planter post office. It is about 3 meters from the water. The point recovered in 1908 was found marked by a spike driven into the rock and rusted away to a blunt point which projected 0.03 meter above the rock. A mass of concrete was placed around this. The reference marks are two 1-inch iron pins 15 inches long driven into the rock and projecting 0.05 meter therefrom, and having a small quantity of cement placed around them. The distances and azimuths of these pins from the station are: 0.73 meter, 44° 44′; and 1.53 meters, 224° 44′.

Excelsior (Monroe County, J. T., 1852–53; 1908).—On a rock point on the ocean shore of Key Largo, about 1 mile south of Newport. The rocks form a bluff 2 feet high at low water, and the station is about 3 meters inshore from the edge of the bluff. A small bank with a tree on it is offshore just north of the station. Marked by a 4-inch sewer pipe 2 feet long, projecting 0.2 meter above the rock. A mass of concrete sur-

rounds the pipe, and it is filled with the same material. Rocks are piled around the station. Several short posts of an old wharf are in the rock at this station. An iron bolt driven into the rock is 2.60 meters from the station in azimuth 95° 00′.

Libra (Monroe County, A. H. S., 1857; 1908).—Lost. (See *Libra 2*, below.)

Taurus (Monroe County, A. H. S., 1857; 1908).—On the ocean shore of Long Island, about 250 meters south of a house and wharf owned by John Law, jr. It is on a straight piece of rock-bound shore about 1 mile south of the mouth of Tavernier Creek; the rock bluff to seaward is 2 feet high, and the station is 2.5 meters inshore from its edge. Marked by a 1-inch iron pin 15 inches long driven into the rock and surrounded by a mass of cement mortar. The reference marks are three iron pins driven into the rock. Two of them were established in 1857, and the third, established in 1908, is similar to the center pin. The following distances and directions are from the triangulation station: Alligator Reef Lighthouse, 20° 31′; west pin (1908), 1.80 meters, 82° 00′; north pin, 1.63 meters, 208° 05′; east pin, 1.92 meters, 262° 00′.

Dove Key 2 (Monroe County, I. W., 1908).—On a ridge (about 10 feet high) of fine broken shell, near the northeast point of Dove Key, which is off Key Largo about 2½ miles north of Planter post office. The station is on the highest ground on the key, which is bare except for a few weeds and bushes. Marked according to note 2, page 474. The reference mark is 20 inches in the ground, and 11.20 meters from the station in azimuth 225° 02′.

Libra 2 (Monroe County, I. W., 1908).—On Key Largo, on the first prominent point northeast of Tavernier Creek and distant therefrom about 1 mile. On land owned by Mr. Austin Sawyer, whose house is on the point. The station is on the bare rock just outside the line of bushes and outside the high-water mark, though the rock at the station is not usually covered by high tide. Marked by a 1-inch iron pin 15 inches long driven 12 inches into the rock. The reference marks are two similar pins. Cement was placed around all three pins, and the letters U.S.C.S. were roughly drawn in the cement around the station. The reference pins are at the following distances and azimuths from the station: 1.48 meters, 39° 08′; and 1.24 meters, 131° 28′. The azimuth from the station of the south gable of A. Sawyer's house is 115° 38′.

Walker Bank (Monroe County, A. H. S., 1857; 1908).—On a mud bank off the entrance to Snake Creek, about ¼ mile from the shore and ⅓ mile north of the channel leading into Snake Creek and separating Long and Windlys Islands. Marked by an iron screw pile (5 inches in diameter on top) which projects 16 inches above the mud and shows about 8 inches above low water. In 1908 a mass of cement 8 inches thick was placed around the pile at the surface of the mud, and the pile was filled with the same material.

Rodriguez Bank (E.) (Monroe County, A. H. S., 1857).—On a bank running east from Rodriguez Key, about 500 yards from the key. Marking not known.

Hull Key (Monroe County, J. T., 1852; 1908).—On a bare point of coral rock on the right as one enters Largo Sound by way of Northern Creek. It is 3 meters from the water, and is marked by a 1-inch iron pin 15 inches long in a cavity in the coral rock, which was filled with cement. The reference marks are iron spikes driven in the coral rock around the station as follows: 4.37 feet north, 5.62 feet east, 6.42 feet south, and 5.92 feet west.

Lesbos (Monroe County, J. T., 1852; 1908).—Lost.

Elba (Monroe County, J. T., 1852; 1908).—Lost.

Petit Coquille (Monroe County, J. T., 1852).—Not marked.

Tartarus (Monroe County, J. T., 1852).—In a mangrove swamp on Key Largo, about on line between the southern extremities of Largo Sound and Tarpon Basin. Marked by a nail in the top of a nassau stone sunk in the ground. A nail in a blazed mangrove tree is 9 inches north of the station. Three stakes with nails in their tops are placed around the station as follows: East, 6.67 feet; south, 3.92 feet; and west, 6.33 feet.

Avernus (Monroe County, J. T., 1852; 1908).—On the southeast shore of Key Largo, about 2 miles northeast of Point Charles, and just west of a number of islets at the entrance to a shoal inlet. Marked by a nail in the top of a nassau stone set in the coral rock. Small nassau stones with nails in their tops are placed around the station as follows: North, 5 feet; south, 5.17 feet; and west, 5.25 feet. This locality was covered with a thick growth of mangroves in 1908.

Styx (Monroe County, J. T., 1852).—On the mud banks east of the middle branch of the main creek leading into Largo Sound from the south. The only center mark was the signal pole of yellow pine which was sunk 6 feet in the mud. The reference marks are four in number: To the north and to the east were placed 6-inch posts iron bound and sunk deep in the mud. They are each 17.08 feet from the station. To the south is a stout mangrove post firmly fixed in the mud and 15 feet from the station. To the west is a white-pine post 15 feet from the station. All these posts have nails in their tops.

Julia Island No. 5 (Monroe County, J. T., 1852; 1908).—On a rock point on the ocean shore of Key Largo, about 1⅓ miles north of Lower Sound Point. The rock is honeycombed and is wearing away. It is bare in the vicinity of the station and covered by high water. In 1852 iron spikes were driven into the rock around the station as follows: North, 4.25 feet; east, 3.92 feet; south, 4.83 feet; and west, 5.92 feet. In 1908 the center as established from these marks was re-marked as follows: An iron bolt was driven into the rock and surrounded by a mass of concrete. Concrete was also placed around each of the old reference marks.

Julia Island No. 4 (Monroe County, J. T., 1852; 1908).—Lost.

Garden Cove No. 1 (Monroe County, J. T., 1852; 1908).—Lost.

Great Mangroves (Monroe County, J. T., 1852; 1908).—Lost.

Julia Island No. 2 (Monroe County, J. T., 1852; 1908).—Near the northern end of the creek leading into Largo Sound from the north. It is in a mangrove swamp, and is marked by a copper nail in the center of the top of a nassau stone sunk in the ground. North, east, south, and west of the station were driven dogwood stakes, the lines connecting them diagonally intersect at the station. In 1908 the locality was visited, but there was 1½ feet of water on the ground, and the station could not be recovered except by triangulation.

Garden Cove No. 2 (Monroe County, J. T., 1852).—This station has been destroyed.

Julia Island No. 1 (Monroe County, J. T., 1852; 1908).—This station has been destroyed.

Largo Sound (Monroe County, J. T., 1852–53; 1908).—On a rock point on the west shore of Largo Sound, just south of some houses and on land owned by E. A. Curry, of Key West. It is 5 meters from the water. In 1852 iron bolts were driven in the rock around the station as follows: North, 2.8 feet; east, 5.83 feet; south, 4 feet; and west,

2.8 feet. In 1908 the center was established from the above reference marks and was re-marked as follows: A 1-inch iron pin 15 inches long was driven in the coral rock, and a mass of cement was placed around it, filling the hole which was formerly occupied by the old mark, a stone. The center pin projects about 2 inches above the cement.

Julia Island No. 3 (Monroe County, J. T., 1852–53; 1908).—On a bare rock point on the ocean shore of Key Largo about 1 mile south of Garden Cove. The point is covered by high water. The station was originally marked by a nassau stone in the center and three iron pins driven in the coral rock to the north, south, and east of the station. In 1908 only the three pins were recovered, but the distance between the north and south pins proved to be nearly 0.2 foot greater than given in the original description. This difference was divided and the station reestablished and re-marked as follows: An iron bolt was driven into the coral rock at the center and was surrounded by a mass of cement mortar. Cement mortar was also placed around the reference pins. The following distances are from the station: South reference pin, 1.46 meters; tree marked with triangle, 3.79 meters; north reference pin, 0.98 meters; east reference pin, 1.26 meters.

The Elbow (Monroe County, J. T., 1852–53).—Situated on that part of the Florida Reef, known as "The Elbow." Marked by a cast-iron screw pile.

Rodriguez Bank (*W.*) (Monroe County, A. H. S., 1857).—On a bank running west from Rodriguez Key, about 200 yards from the key. Station marking not known.

Road (Monroe County, G. A. F., 1860; 1909).—On the inside shore of Key Largo, on a bare rock point about 1½ miles from Bakers Cut on the Inland Passage between Miami and Key West. The key is wooded inshore from the station and in approaching from Bakers Cut the trees are much higher beginning at the station and extending to the southward. The station is 4 meters inshore from the edge of the low coral bluff forming the shore line. A granite post is lying in the water just outside the shore line. The station was established in 1860, recovered within 2 feet in 1890, and re-marked in 1909 as follows: A hole in the coral rock, 0.2 by 0.25 meter is filled with concrete in which is embedded a 1-inch iron pin 6 inches long to mark the center. Three other similar iron pins were driven in the rock and a small amount of cement placed around each. Triangles were cut on four trees. The following distances and directions are from the station: West point of Bakers Cut, 0° 00′; north reference pin, 1.31 meters, 5° 08′; tree with triangle, 13.4 meters, 72° 34′; tree with triangle, 6.9 meters, 82° 15′; east reference pin, 0.97 meters, 114° 00′; tree with triangle, 10.5 meters, 143° 56′; tree with triangle, 10.5 meters, 205° 36′; west reference pin, 292° 44′.

Tony (Monroe County, G. A. F., 1860; 1908).—On a prominent point as approached from the east, on Key Largo about 1 mile northwest of the southern entrance to Grouper Creek. On a narrow neck of land between the head of Florida Bay and a large sound which is south of Blackwater Sound. It is about the middle of a broad point, 10 meters from the shore line and in 18 inches of water. The station was established in 1860 and probably recovered to within 2 feet in 1908 when it was re-marked as follows: Two pieces of 4-inch sewer pipe were placed one on the other and filled with and surrounded with cement mortar. The reference mark is a granite post 6 inches square and 2 feet long buried 20 inches in the ground and 14.9 meters from the station in azimuth 236° 48′. A triangular cut was made on a small mangrove tree which is just east of the post.

Bruin (Monroe County, G. A. F., 1860; 1908).—On Key Largo near the head of Florida Bay, and about 2 000 meters south of the south entrance to Grouper Creek. It is on a broad flat rock point which is covered with grass but is bare of trees. It was recovered within probably 1 foot in 1908 and was re-marked as follows: Five 1-inch iron pins, each 15 inches long were driven into the coral rock, one at the center and the others around the center as follows: North, 1.6 meters; east, 1.73 meters; south, 2.64 meters; west, 1.8 meters. The pins project 2 or 3 inches above the rock and the lines joining the reference pins diagonally intersect at the station.

Osceola Key (Monroe County, A. H. S., 1857; 1909).—On the point of a small key near the western end of Lower Matecumbe. By going to the narrowest part of the key and following the shore line to the northwest the station will be found at the point where the shore line turns to the southwest. A large mud flat is seaward from the station, and the mud flats on the other side of the key are becoming overgrown. This key is really a portion of Lower Matecumbe, and not a separate key, though it was formerly surrounded by water at high tide. The station is in the water at the edge of the growth of small mangroves and is 14 meters from high-water mark. A portion of the sand ridge on the point was cleared in 1909, and a flagpole was nailed to a tree about 50 feet east of the station. A large piece of piling lies on the mud between the flagpole and the station. Marked by a piece of 4-inch sewer pipe 2½ feet long buried 28 inches in the mud; inside the pipe is a piece of 2 by 3 inch pine, projecting 8 inches above the water and 14 inches above the pipe. A mass of cement mortar surrounds the pipe, and some of the same material was placed inside it.

Bowlegs Key (Monroe County, A. H. S., 1857).—Lost.

LONG KEY TO KEY WEST.

PRINCIPAL POINTS.

Grassy Key (Monroe County, J. C. C., 1857; 1909).—On a rock point, the northwest point of Grassy Key. A few mangroves are growing along the shore on each side of the station, but back of it and nearby, the key is treeless and grass covered. Marked by a section of 4-inch sewer pipe 2½ feet long resting on the coral rock which underlies the key and filled and surrounded with cement mortar. A pile of coral rock was placed around the top of the pipe. A piece of pipe similar to the center pipe was placed west of the station, and the old mark, a coquina post, was placed to the north. The following distances were measured: North stone, 2.11 meters; east stone, 2.15 meters; south stone, 2.12 meters; west stone, 1.88 meters; white rock to west, 5.45 meters. The recovery of this station in 1909 was uncertain, and it must be used with caution.

Horseneck West (Monroe County, J. C. C., 1857; 1909).—About the middle, lengthwise, of a narrow shoal of the same name. Marked by a screw pile 6 feet long, secured by a network of timber piled heavily with stones. The screw pile projects 2 feet above the bottom, and there is about 1 foot of water above it at low tide. It stands in a channel between two ridges in the shoal, the one to the west being the wider of the two.

Stirrup Key (Monroe County, J. C. C., 1857; 1909).—Lost.

Crescent Shoal (Monroe County, J. C. C., 1857; 1909).—On a shoal of the same name about 3 miles north of Knights Key. It is about 20 meters from the south end of the shoalest portion of this bank, which extends northwest and southeast. Marked by an

iron screw pile 5 feet long, secured by a network of timber piled with stones. It projects about 4 inches above the surface of the shoal.

Eagle Cove (Monroe County, A. H. S., 1856; 1909).—Lost.

Pigeon Key (Monroe County, A. H. S., 1856; 1909).—Lost. (See *Pigeon Key 2*, p. 555.)

Sombrero Key (Monroe County, A. H. S., 1856; 1909).—Lost.

Bahia Honda (Monroe County, J. T., 1856; 1909).—Lost. (See *Bahia Honda 2*, p. 555.)

Cocoanut Key (Monroe County, J. E. H., 1849; 1909).—Lost. (See *Cocoanut Key 2*, p. 555.)

Little Pine (Monroe County, J. T., 1856; 1909).—Lost.

Horseshoe Key (Monroe County, A. H. S., 1856; 1909).—Lost. (See *Horseshoe Key 2*, p. 555.)

Johnson (Monroe County, J. R.-J. A. S., 1856; 1909).—Near the north end of the northernmost of the Johnson Keys. Scattered bushes are growing around the station, but the ground in the immediate vicinity was cleared. Marked by the intersection of two lines in the top of a granite monument dressed to 4 inches square on top, and set in a mass of cement mortar 18 inches deep. The reference marks are three 1-inch iron pins 16 inches long driven in the rock around the station at the following distances and azimuths: 3.11 meters, 305° 25′; 2.02 meters, 122° 52′; 2.43 meters, 189° 35′.

Driftwood (Monroe County, 1856; 1909).—Lost.

Soldier Crab (Monroe County, 1856; 1909).—Lost.

Northwest Boca Chica (Monroe County, J. E. H., 1849; 1908).—On the southeast point of the western one of the Boca Chica Keys. Marked by a nail in a stone. In 1908 the mark could not be recovered, but a mangrove stump to which one of the braces of the signal in 1851 was nailed was recovered.

SUPPLEMENTARY POINTS.

Molasses Key (Monroe County, A. H. S., 1856; 1909).—On the westernmost of the two keys forming Molasses Key, 75 meters from the west end of the key, 22 meters from the water to the north, and 20 meters from the water to the south. The key in the vicinity of the station is nearly all bare rock; in places there is sand with bushes growing in it. A hole 1 inch in diameter was cut in the rock and filled with lead to mark the station. Some cement was placed around the lead mark; it is in a depression which will probably fill with sand. Two arrows were cut in the rock, one 0.70 meters northeast and the other 0.73 meters northwest of the station. The arrow to the northeast is not cut in bedrock. Four 1-inch iron pins 16 inches long were driven in the rock around the station at the following distances and azimuths: 2.52 meters, 168° 17′; 1.79 meters, 255° 56′;. 0.98 meters, 343° 43′; and 0.85 meters, 77° 20′.

Little Pine 2 (Monroe County, I. W., 1909).—On the east point of the south end of Little Pine Key, 40 meters from the mangroves growing along the water line to the south, and 40 meters and 36 meters, respectively, from the mangroves growing on the east and north. Excepting for a few bushes the ground around the station is open and covered with grass. There is only 16 inches of earth on the bedrock at the station. Marked by a 1-inch iron pin 16 inches long driven into the bedrock; around this pin was placed a piece of 4-inch sewer pipe, 18 inches long, and this pipe was filled and surrounded with cement. The reference marks are two pieces of 4-inch sewer pipe 2½ feet

long, filled and surrounded with cement, placed at the following distances and azimuths from the station: 18.09 meters, 241° 00′; and 4.17 meters, 155° 12′.

Horseshoe Key 2 (Monroe County, I. W., 1909).—On a small key close to the southeast end of Flat Key. This key is formed of mud about 2 feet deep on coral rock which shows around the key outside the shore line. The station is 85 meters from the mangroves at the south end of the key, 13 meters from the mangroves on line to station Johnson, and 42 meters from the mangroves in prolongation of this line. Marked by the intersection of two lines on a granite post resting on the coral and having its bottom surrounded with cement. The post leans slightly to the south. The reference marks are as indicated below, the distances and azimuths given being from the triangulation station: A 4-inch sewer pipe 2½ feet long, 2.24 meters, 199° 22′; a granite post, 3.48 meters, 300° 24′; a 4-inch sewer pipe 2½ feet long, 2.64 meters, 28° 45′.

Cocoanut Key 2 (Monroe County, I. W., 1909).—On the southernmost point of Cocoanut Key, on open ground, 10 meters from the water. A few scattered groups of mangroves are growing along the shore near the station and in the interior of the key one group of mangroves grows just off the mud point on which the station is situated. Bedrock is about 30 inches below the surface of the ground at the station. Marked by a piece of 4-inch sewer pipe 2½ feet long, resting on bedrock and filled with and surrounded with cement mortar. The reference marks are two pieces of pipe similar to the one at the center, one placed 3.55 meters and the other 6.68 meters from the station, both in azimuth therefrom 189° 25′.

Bahia Honda 2 (Monroe County, I. W., 1909).—On a sand point at the outer end of the channel at the east end of Bahia Honda Key. It is on a sand ridge 9 meters from high-water mark. The sand of the key was being removed for the use of the Florida East Coast Railway. Marked according to note 2, page 474, the reference pipe being 15.49 meters from the station in azimuth 153° 26′.

Pigeon Key 2 (Monroe County, I. W., 1909).—On the south end of Pigeon Key, on the bare rocks outside high-water mark. This key was cleared and used as a camp by the employees of the Florida East Coast Railway. The center is marked by 1-inch iron pin 16 inches long driven into the rock and surrounded with cement. The reference marks are three pins similar to the center pin, placed around the station at the following distances and azimuths: 1.74 meters, 186° 38′; 3.59 meters, 278° 20′; 1.43 meters, 98° 05′.

Boot Key 2 (Monroe County, I. W., 1909).—On a sand point on the ocean shore of Boot Key. The beach at this point is composed of white sand and shows quite prominently as the key is approached. The sand beach along the south side turns northward at this point and extends a short distance in that direction; farther to the northward mangroves grow out in the water. The station is 5 meters from the sand beach on the west. Marked by a piece of 4-inch sewer pipe 2½ feet long, set in the ground and surrounded by and filled with cement mortar. The reference mark is a pipe similar to the one at the center, placed 3.35 meters from the station in azimuth 208° 52′.

East Sister Key 2 (Monroe County, I. W., 1909).—On a small rock. Key of the same name off the ocean shore of Boot Key. The key is nearly round and about 100 meters in diameter. Most of the key is bare; there are some bushes and seaweed on it. The station is nearly in the center of the key and is marked by a 1-inch iron pin 16 inches long driven into the rock. The reference marks are three pins similar to the one in the

center, placed around the center at the following distances and azimuths: 1.87 meters, 90° 07′; 2.70 meters, 185° 58′; 2.93 meters, 269° 05′. Cement was placed on the rock around each of the pins.

West Bahia Honda 2 (Monroe County, I. W., 1909).—On the south point of Bahia Honda Key, on a sand point which is gradually washing away, and which has been cleared for use as a railway construction camp. A few scattering trees were left standing on the point. Marked according to note 2, page 474, the reference pipe being 4.85 meters from the station in azimuth 188° 10′, and 14 meters from the sand beach. From the station a railroad water tank is in azimuth 104° 31′.

Crayfish (Monroe County, W. E. P., 1909).—On the rock point off the south end of No Name Key, 35 meters outside the mangroves growing on the key; it is covered with 16 inches of water at high tide. Marked by a 1-inch iron pin 16 inches long driven into the rock and surrounded by a mass of cement. The reference marks are two pins similar to the one at the center, placed one 2.78 meters north and the other 2.13 meters west of the station.

Sand (Monroe County, W. E. P., 1909).—On the east shore of Big Pine Key, 8 meters inland from the high-water mark, on land belonging to W. H. Sand, whose house is 33 meters to the north. A wharf having a pipe line to a railroad water tank is 175 meters to the south. Marked according to note 3, page 474, except that one section of the pipe is only 16 inches long. The reference mark (which is also a tide gauge bench mark) is an iron bolt set in cement, just north of Sand's house and on line with the rear wall of a room projecting from the rear of his house. It is 51.15 meters from the station in azimuth 161° 25′. The south gable of Sand's house is 33 meters from the station in azimuth 170° 20′, and the west gable of a house in a cocoanut grove is 175 meters from the station in azimuth 358° 42′.

Pine (Monroe County, W. E. P., 1909).—On the southeast point of Big Pine Key, the first point on the ocean shore outside of the Florida East Coast Railroad, on land belonging to Judge Locke. Cocoanut trees are growing on the sand ridge on which the station is located, and there are three fishermen's huts near by—one to the south and two to the north. The underground mark is the bottom half of a square glass bottle encased in cement and buried 20 inches below the surface of the sand. Above this is a 4-inch sewer pipe 2½ feet long surrounded by and filled with a mass of cement mortar. The center of the pipe marks the station. The reference marks are triangular cuts made in three cocoanut trees, three nails being driven into each. These trees are at the following distances and directions (not azimuths) from the station: Sombrero Key Lighthouse 0° 00′; trees, 10.55 meters, 80° 00′; 7.10 meters, 233° 00′; 10.18 meters, 318° 22′.

Channel Key (Monroe County, J. C. C., 1857; 1909).—Lost.

Duck Key (Monroe County, J. C. C., 1857; 1909).—Lost.

Conch Key (Monroe County, J. C. C., 1857; 1909).—On the southeast point of the largest and most prominent of the three Conch Keys. Visited in 1909, and though the surface marks were gone, it was not evident that the underground marks had been disturbed. These consist of a bottle and an iron cone 2 feet below the surface of the ground.

Willie (Monroe County, J. C. C., 1857; 1909).—On the extreme end of the north point of Crawl Keys, on a small rock point, which is an islet at high water. The station

is in the center of the islet, not reached by high water. Marked by an iron cone in a hole in the rock. Through the center of this cone was driven a 1-inch iron pin 16 inches long, and the hole in the rock was then filled with cement. Two pins similar to the one at the center were driven in the rock and cement placed around them; one is 12.78 meters from the station in azimuth 330° 55′, and the other 4.66 meters in azimuth 151° 07′. The stump of a small tree is 1.05 meters east of the station, and a lone palmetto is in azimuth 310° 22′ from the station.

Bamboo (Monroe County, J. C. C., 1857; 1909).—On the northwest side of Bamboo Key, 3 meters from the water. The key on this side is bare coral rock, with patches of soil, and is waterworn. In 1909 the iron cone marking the station was recovered, and the earth removed from around it; a 1-inch iron pin, 16 inches long, was then placed in the center of the cone, and the hole in which the cone was found was filled with cement in the surface of which the letters U. S. C. & G. S. were roughly traced. Three iron pins similar to the one at the center were driven in around the station at the following distances and azimuths: 1.42 meters, 235° 28′; 3.12 meters, 335° 00′; 2.85 meters, 53° 58′.

Rockwell's No Name (Monroe County, J. C. C., 1856; 1909).—On a low rock point on the west shore of No Name Key, about ½ mile south of the north end of the key. The point is covered by high water, a few mangroves grow along the shore in front of the station. Marked by a 1-inch iron pin, 16 inches long, driven in the rock, in the center of a hole which was then filled with cement. Around the station were placed three pins similar to the ones at the center; they are at the following distances and directions from the center: Pine station, 0°; 00′; south pin, 5.50 meters, 16° 50′; north pin 3.03 meters, 213° 15′; east pin, 2.31 meters, 316° 07′. The recovery of this station in 1909 when the above marks were placed in position is uncertain, and the station should be used with caution.

KEY WEST HARBOR AND HAWK CHANNEL.

East Point (Monroe County, J. E. H., 1849; 1908).—Lost.

Fleming Key (Monroe County, J. E. H., 1849).—Lost.

Barracks (Monroe County, J. E. H., 1849).—Lost.

Cottrell Key (Monroe County, J. E. H., 1849–1851).—On the south point of Cottrell Key. Marked by a nail driven in a stone buried in the ground.

West Crawfish Key (Monroe County, J. E. H., 1849).—Lost. (See *West Crawfish Key, 1903*, p. 558.)

Man Key (Monroe County, J. E. H., 1851).—Near the north point of a small key just east of Man Key. Marked by a nail in a stone which was buried in the ground. (See *Man Key, 1903*, p. 558.)

Sand Key (Monroe County, J. E. H., 1849; 1851).—Lost.

Stock Island (Monroe County, J. T., 1853; 1909).—Lost.

Western Sambo (Monroe County, J. E. H., 1853).—Marking uncertain; the station can not be recovered.

Rock Point (Monroe County, J. T., 1854–55; 1909).—Lost.

Woman Key (Monroe County, W. I. V., 1903–4).—About 60 feet inland from the southeast point of Woman Key. Marked by an iron spike in the top of a 4 by 6 inch scantling driven 5 feet into the ground and projecting 4 feet above the ground.

Boca Grande (Monroe County, W. I. V., 1903; 1908).—In an open, grassy spot near the southeast point of Boca Grande Key. It is 30 paces from the point and 5

paces inshore from the high-water mark on the south. Marked according to note 11, page 474.

Mule Key (Monroe County, W. I. V., 1903).—In the water about 10 meters offshore from the mangroves along the southern shore of Mule Key. Marked according to note 11, page 474.

West Crawfish Key, 1903 (Monroe County, W. I. V., 1903; 1904).—About 200 meters offshore from the southeast point of West Crawfish Key, and about on the line which forms the east tangent to Snipe Key and the west tangent to West Crawfish Key. Marked according to note 11, page 474.

East Crawfish Key (Monroe County, W. I. V., 1903; 1904).—In the water about 10 meters offshore from the mangroves growing along the southern shore of East Crawfish Key. Marked according to note 11, page 474.

Man Key 1903 (Monroe County, W. I. V., 1903; 1908).—On the southwest point of a detached islet which forms the eastern extremity of Man Key. The islet is for the most part overgrown with thicket, but the southern end is open and grassy. The station is 35 feet from the south shore and 25 feet from the west shore. Marked according to note 11, page 474.

West Martello Tower (Monroe County, P. A. W., 1905; 1909).—On top of the magazine of a fortification of the same name. About 2 or 3 feet of earth cover the top of the magazine where the station is located. It is between two concrete gun foundations approximately in the center of the fort. It is 18.05 feet south of a wall to the northward; 29.02 feet distant from the corner of two walls to the northeast, and 30.66 feet from the corner of two walls to the northwest. Marked by a stone post 6 inches square and 2½ feet long, lettered U. S. C. & G. S. 1905, and sunk flush with the surface of the ground.

East Martello Tower (Monroe County, P. A. W., 1905; 1909).—On the southwest corner of the central tower of a fortification of the same name. It is on the rampart just outside the gun mounts and between the outer and inner walls. It is 4.6 feet and 5.2 feet south and west, respectively, of two ventilators and 10 feet southwest of an old gun mount. The station is marked by a copper bolt cemented in the concrete top of the rampart. This concrete top is covered with about 3 inches of sand and gravel.

Key West longitude station 1896 (Monroe County, C. H. S.-G. R. P., 1896).—(See description of Key West longitude station, 1907, below.)

Key West longitude station (Monroe County, G. R. P., 1896; 1907).—In 1907 the longitude pier used in 1896 could not be recovered, but the point it had occupied was reestablished from reference marks and a new pier built eccentric to the station of 1896. The transit in 1907 was 1.35 meters south and 0.97 meter east of the point occupied by the transit in 1896. The transit in 1907 rested on a brick pier 34 by 20½ inches and 5½ feet high (2½ feet below and 3 feet above the surface of the ground). In the center of the pier and 1 foot below its top is embedded a copper bolt, its top flush with the cement and in its center a punch hole to mark the center of the station. This pier is southwest of the post-office and customhouse building, being 15.10 meters from the southwest corner and 27.48 meters from the southeast corner of that building and 1½ meters north of the street fence (Green Street). It is 29.54 meters from a cross cut in the upper surface of the cement walk which forms the breakwater extending north from Green Street. The cross is in the extreme southeast corner of the concrete, about 0.15 meter from both the east and south edges of the walk.

Key West latitude station (Monroe County, C. H. S., 1896).—Fifty inches due west of the longitude station of 1896. (See p. 558.) Marked by a brick pier laid in cement; not recovered in 1907.

Kingfish Shoal (Monroe County, N. H. H., 1907).—Near the eastern edge of the large flat, bare at low water, to the northward of Kingfish Shoal and Screw-pile and about ¼ mile from the latter. It can best be reached by boat from the eastward. Marked by a copper tack in a 1-inch piece of oak in a drain tile filled with cement and partly buried in the ground. The tile projects about 1 foot above mean low water.

Rock Point 2 (Monroe County, I. W., 1909).—On the southernmost point of Boca Chica Key. This point is formed by a very much worn flat rock and the station is just outside the high-water mark. Marked by a 1-inch iron pin, 16 inches long, driven into the rock, cement mortar being placed around it. The reference marks are three similar pins driven into the rock around the station—one 2.06 meters to the west, one 3.13 meters to the north, and the third 2.51 meters to the east. A triangular mark on a cocoanut tree is 25 meters from the station in azimuth 158° 48′.

Saddle Hills N. 2 (Monroe County, I. W., 1909).—On the ocean shore of the second key northeast of Saddle Bunch Harbor. Mangroves grow along the shore and back of them is a sand ridge, covered with grass and about 30 meters wide and 125 meters long. The station is 14 meters inshore from the mangroves and 35 meters from the bushes at the west end of the sand ridge, and is marked according to note 1, page 473, except that the lower pipe is but 1½ feet long.

Saddle Hills S. 2 (Monroe County, I. W., 1909).—On the ocean shore of Saddle Hill Key. There is a sand beach about 200 meters long on this key; the remainder of the shore is covered with a growth of mangroves. Inshore from the sand beach for a distance of 50 meters the ground is open and covered with grass, while a large mangrove and several small ones grow in a bunch on the sand beach. The station is 10 meters directly inshore from a triangle cut on the large mangrove and 50 meters from the west end of the sand beach. Marked underground by a 1-inch iron pin 16 inches long set in a mass of cement mortar. Above this pin was placed a piece of 4-inch sewer pipe 2½ feet long, filled with cement mortar and its lower end surrounded with the same material.

Sugarloaf 2 (Monroe County, I. W., 1909).—On a prominent bare rock point on Sugarloaf Key, ½ mile east of the mouth of Sugarloaf Creek and just outside the mangroves and high-water mark. Marked by a 1-inch iron pin 16 inches long, driven into the rock at the center and surrounded by three similar pins—one 1.67 meters to the west, one 2.16 meters to the north, and the third 1.41 meters to the east.

KEY WEST TO REBECCA SHOAL AND DRY TORTUGAS.

Bad 2 (Monroe County, W. C. H., 1911).—Three piles connected by cross and diagonal braces and surmounted by a flagpole.

Quick (Monroe County, W. C. H., 1911).—Same as *Bad 2*. (See above.)

Squall (Monroe County, W. C. H., 1911).—Same as *Bad 2*. (See above.)

Moon (Monroe County, W. C. H., 1911).—Same as *Bad 2*. (See above.)

New (Monroe County, W. C. H., 1911).—A single pile with cross boards, surmounted by a flagpole.

Ground (Monroe County, W. C. H., 1911).—Same as *New*. (See above.)

Shoal (Monroe County, W. C. H., 1911).—Same as *New*. (See p. 559.)

East Key (Monroe County, P. A. W., 1901).—On a key of the same name. This key is composed of drifting sand and is constantly changing in outline and position. Station mark is a copper nail embedded in the center of a 4-inch drain tile filled with cement.

Bastion A (Monroe County, H. G. O., 1875; 1896).—On the north bastion of Fort Jefferson, on the second chimney from the south of the west side of the bastion. This chimney is 2 feet 3½ inches on its north and south sides, and 2 feet and ¼ inch on its east and west sides. The station is 15 inches south of the north side and 10 inches west of the east side of the chimney. The top of the chimney is three layers of bricks above the top of the parapet.

Hospital Key (Monroe County, H. G. O., 1875; 1901).—Marked by a copper nail in a 4-inch earthenware sewer pipe, set in cement.

Middle Key 2 (Monroe County, P. A. W., 1901).—Lost.

Bird Key 2 (Monroe County, P. A. W., 1901).—Situated 5.345 meters from *Bird Key* (see below) in azimuth 166° 10′. Probably marked by 5 nails in the top of a 4 by 4 scantling, driven into the ground and projecting 2 feet above the surface.

Stack (Monroe County, P. A. W., 1901).—The tall smokestack on the distilling plant at Fort Jefferson.

Signal Station (Monroe County, P. A. W., 1901).—Tall flagstaff on the top of the east wall at Fort Jefferson.

Loggerhead Key Northeast Base (Monroe County, H. G. O., 1875).—In 1896 reported lost.

Bird Key (Monroe County, H. G. O., 1875; 1901).—On the north end of Bird Key on its highest elevation. The grave of Thomas Murphy bears east, distant 10 meters. Marked by a copper nail in a 4-inch earthenware sewer pipe, set in cement.

Loggerhead Key Southwest Base (Monroe County, H. G., O. 1875).—In 1896 reported lost.

Long Key (Monroe County, H. G. O., 1875).—Lost.

Middle Key (Monroe County, H. G., O., 1875).—Lost.

East Key South Base (Monroe County, H. G. O., 1875).—Lost.

East Key North Base (Monroe County, H. G. O., 1875).—Lost.

House, south chimney (Monroe County, H. G. O., 1875; 1896).—The southerly of the two chimneys on the keeper's house at Loggerhead Key.

Index to positions, descriptions, and sketches.

Index to positions, descriptions, and sketches—Continued.

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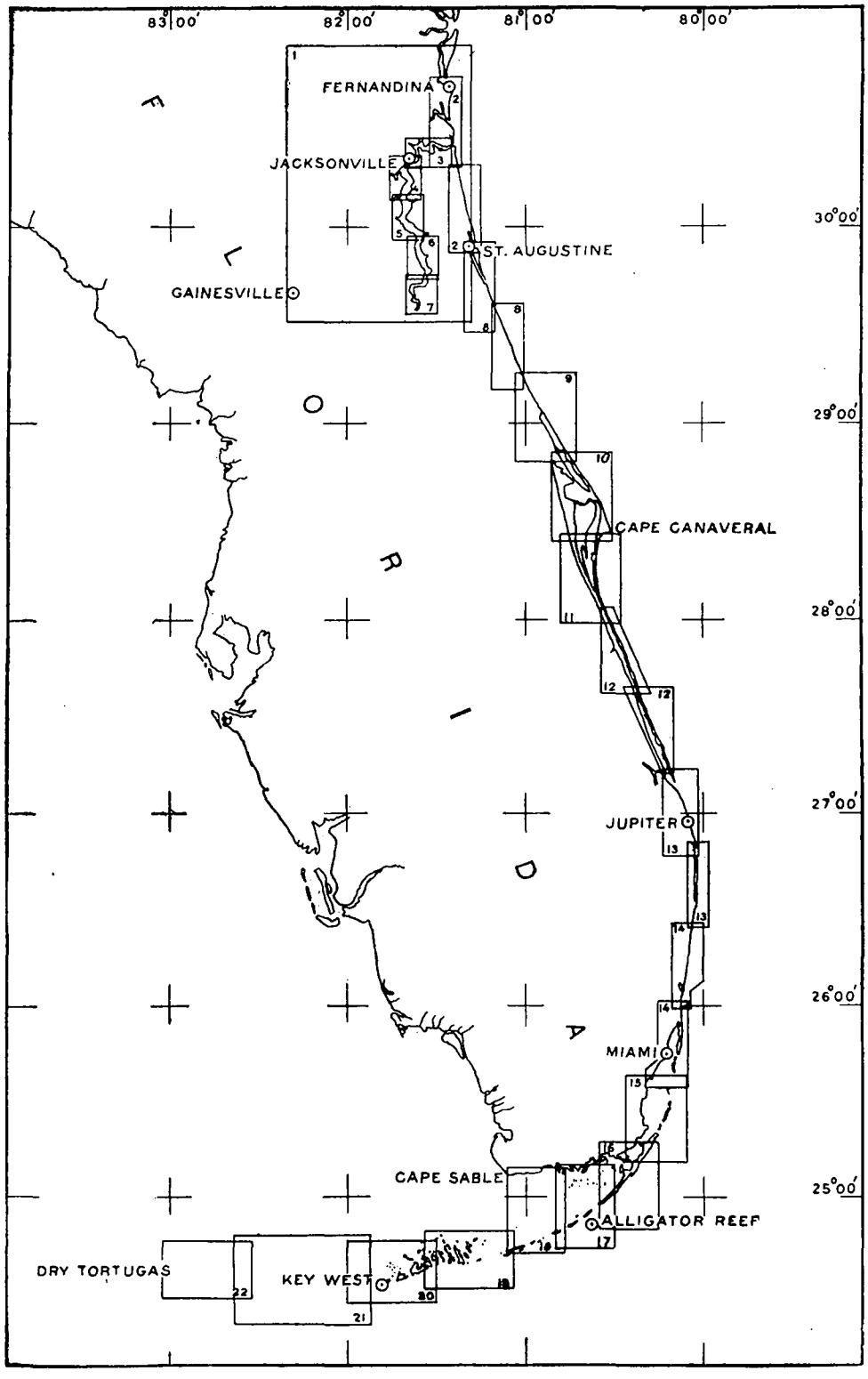

INDEX MAP TO TRIANGULATION SKETCHES.

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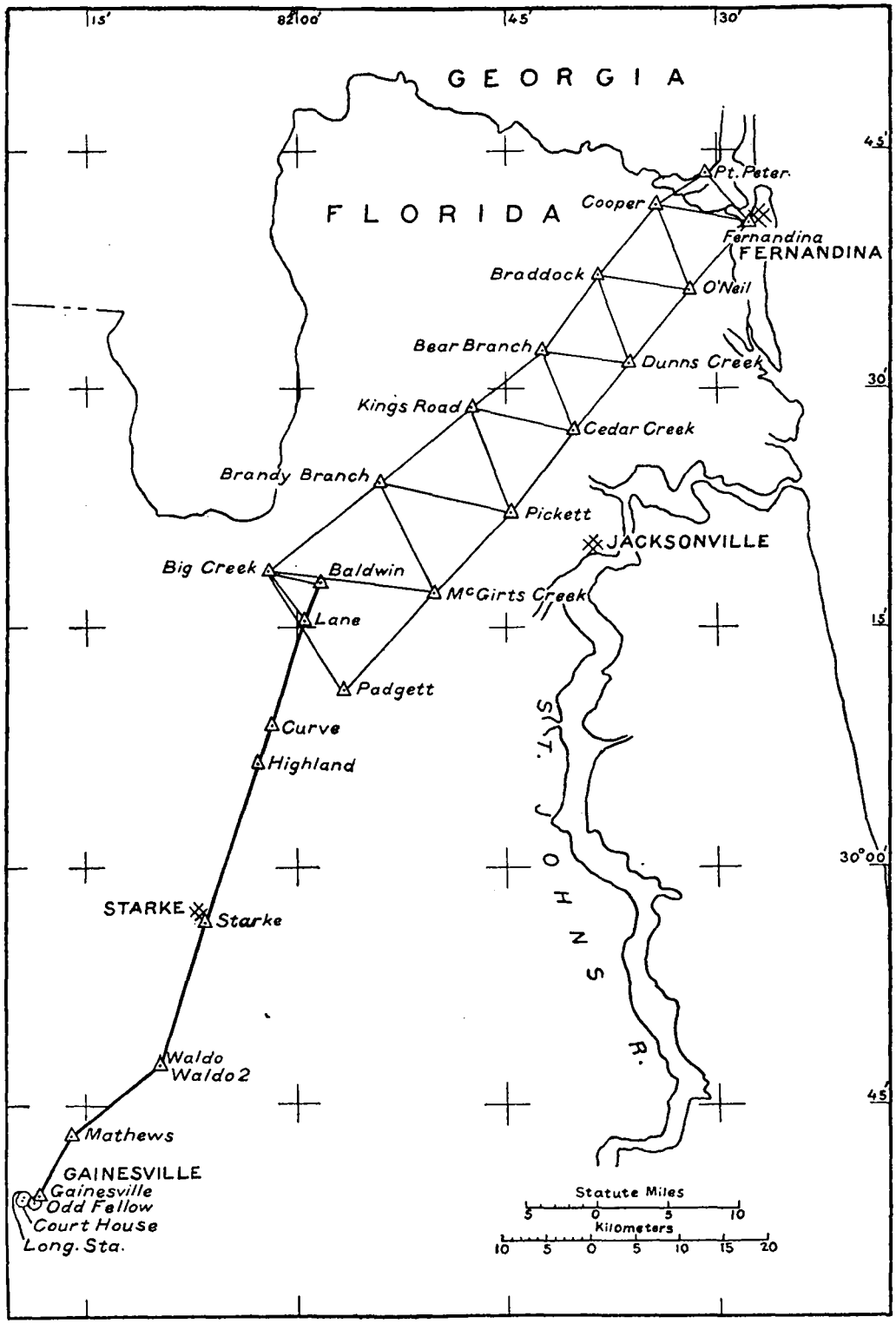

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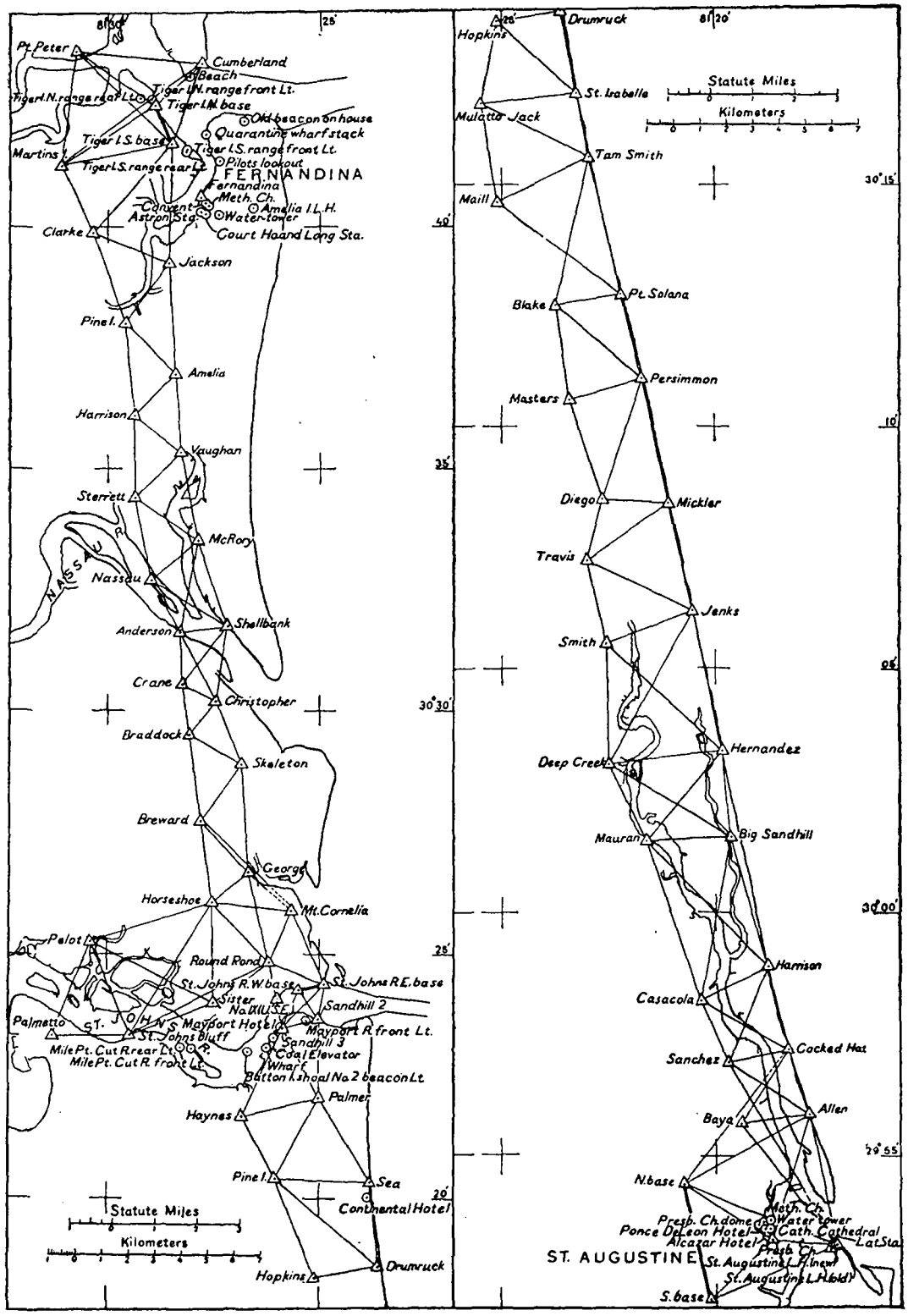

CUMBERLAND SOUND TO ST. AUGUSTINE.

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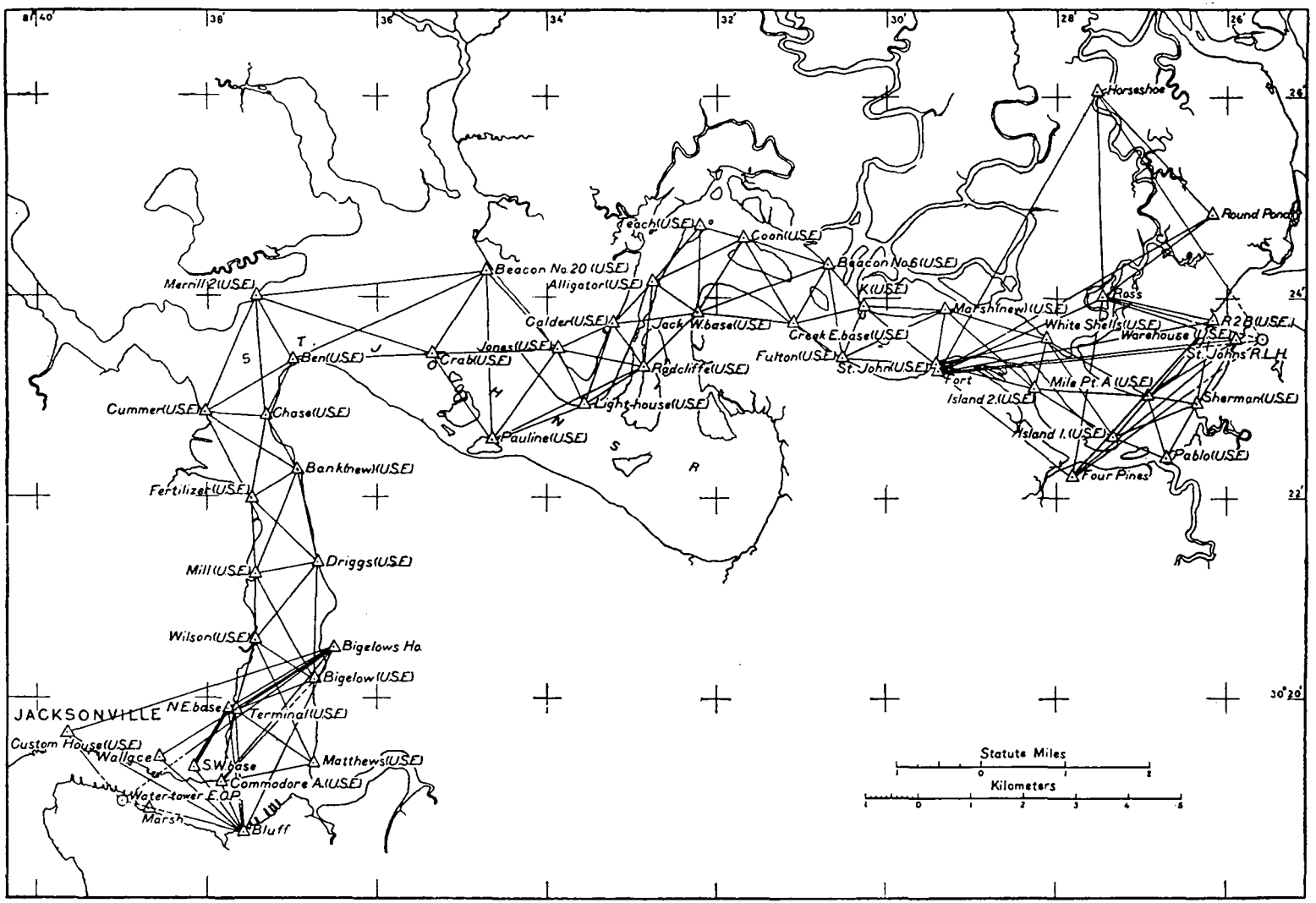
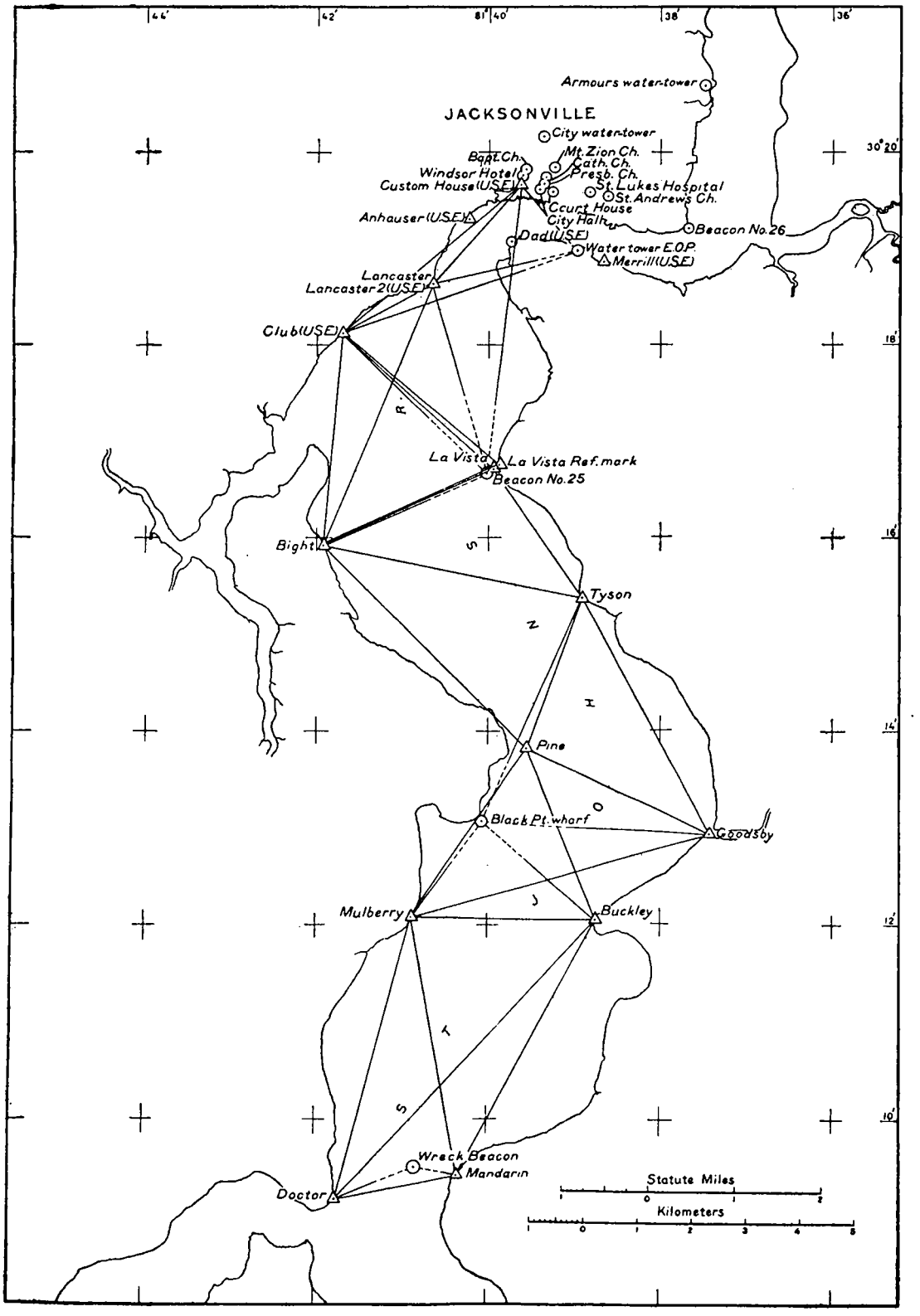
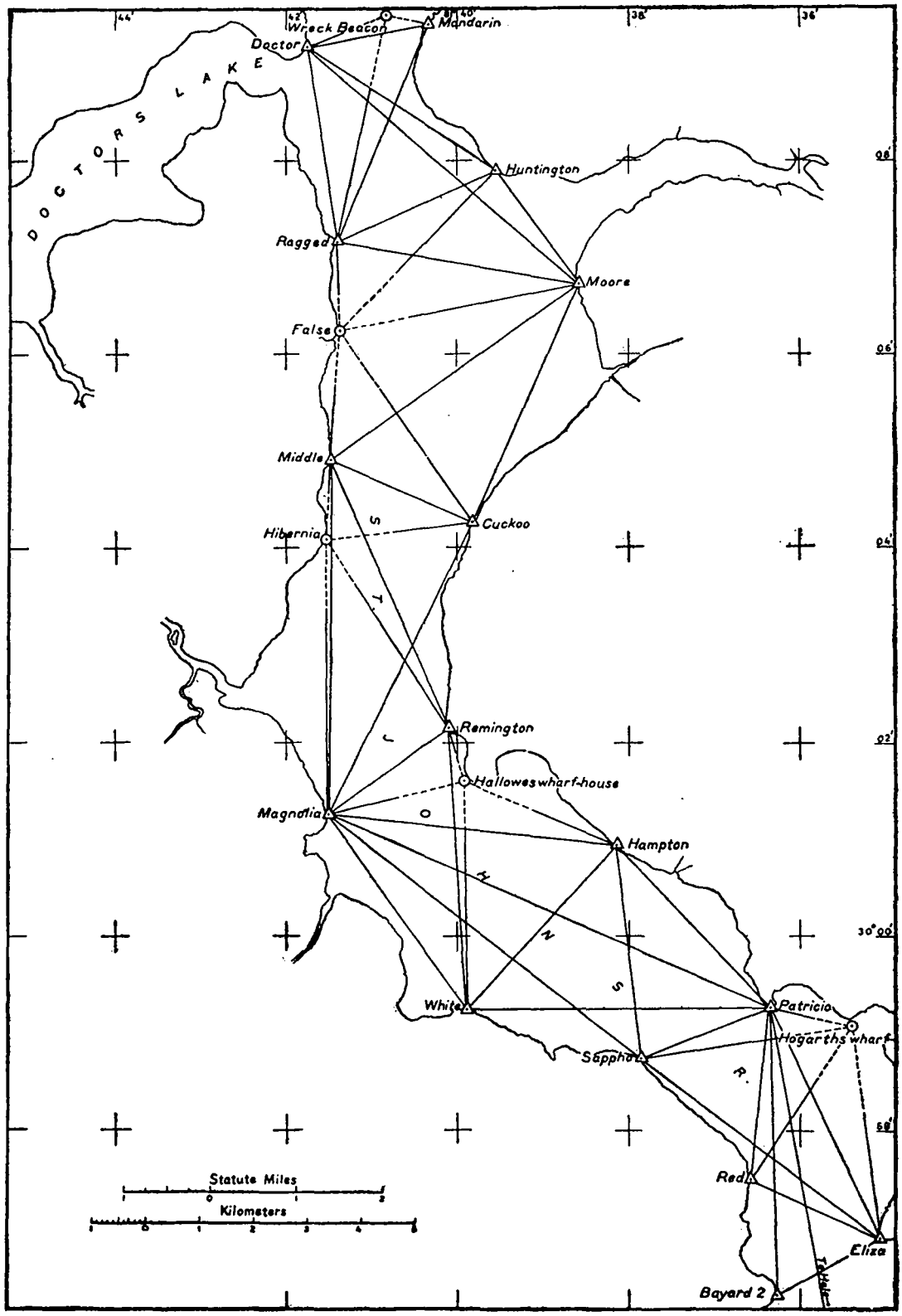


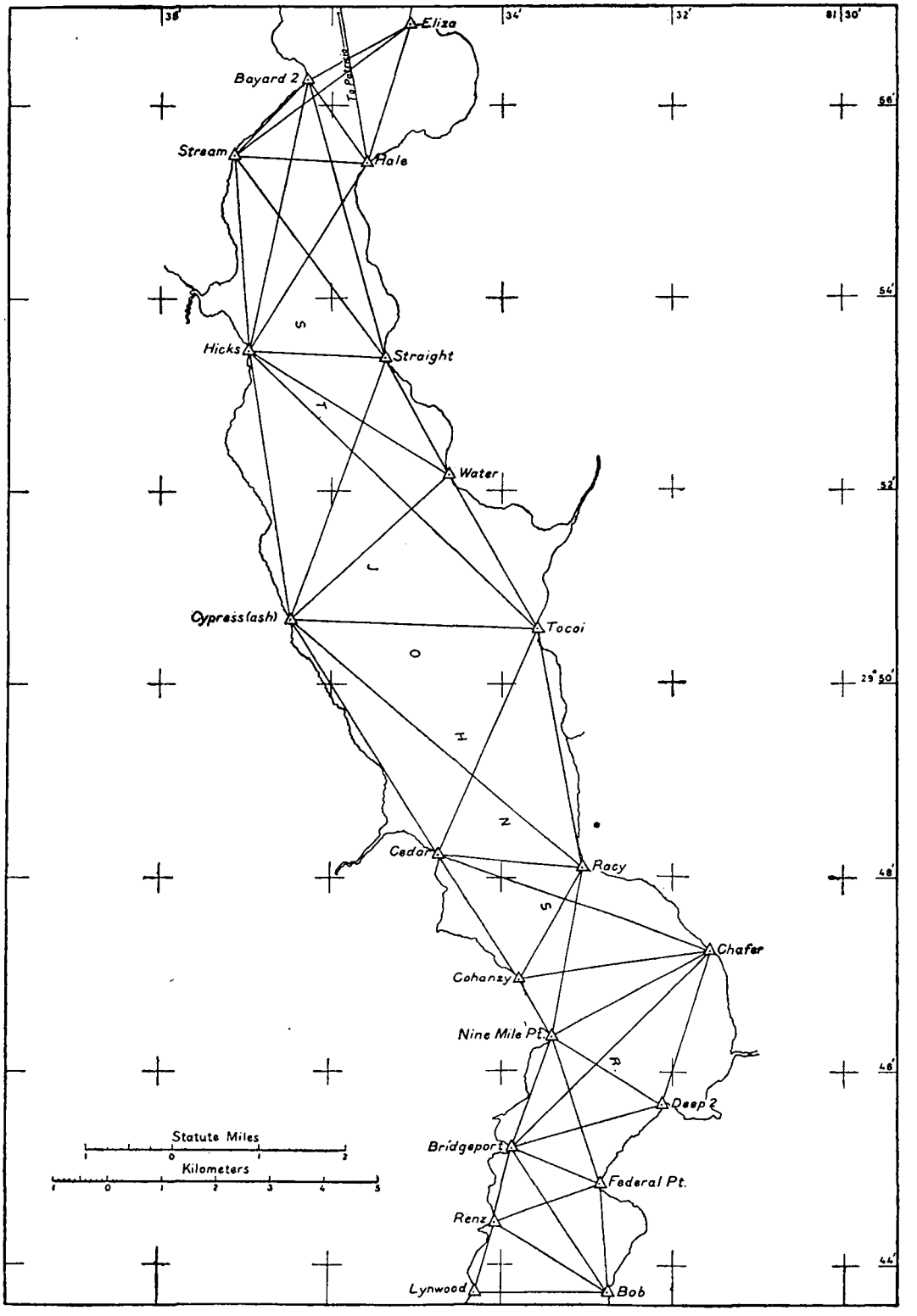
ST. JOHNS RIVER, COAST TO JACKSONVILLE.



ST. JOHNS RIVER, JACKSONVILLE TO DOCTORS LAKE.



ST. JOHNS RIVER, DOCTORS LAKE TO SIX MILE POINT.



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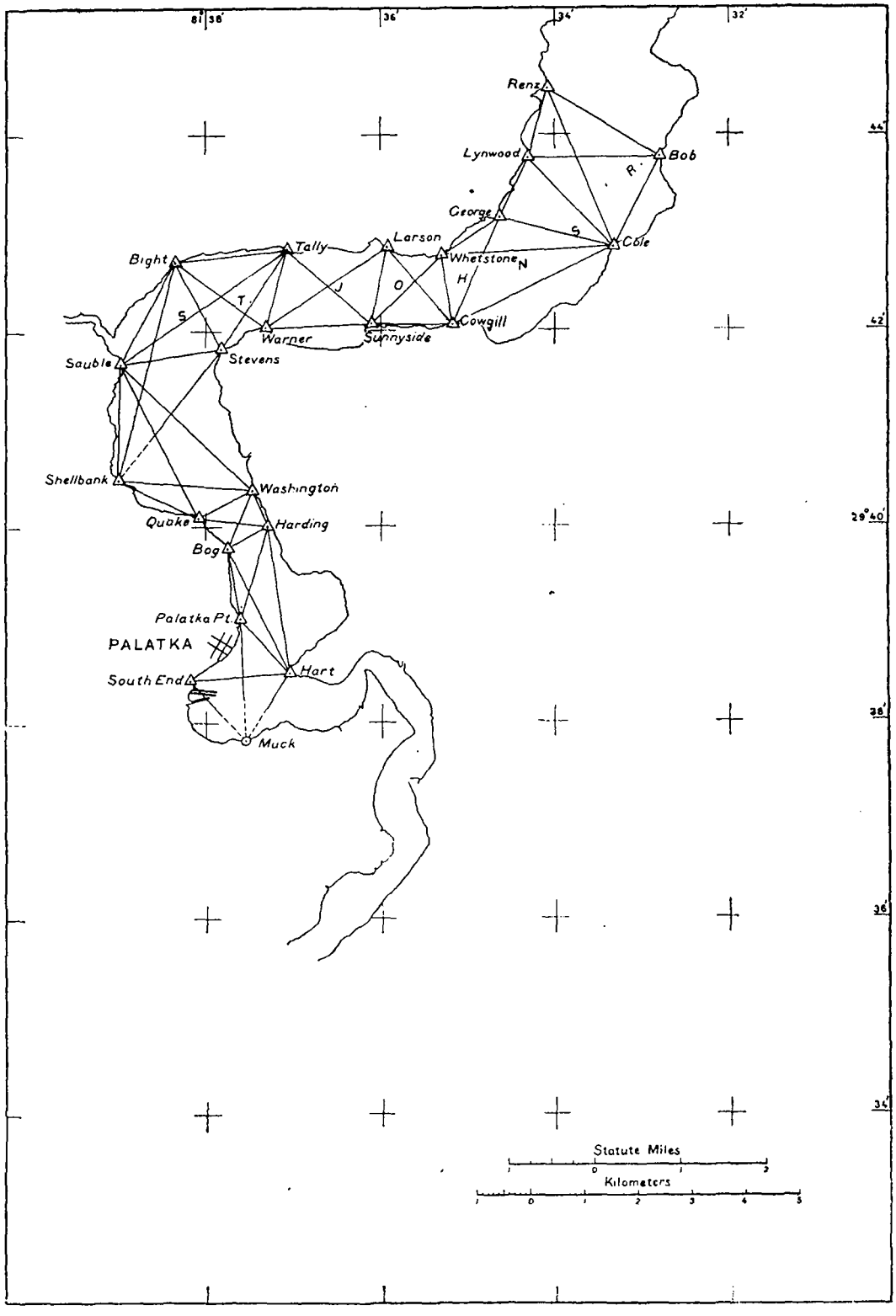

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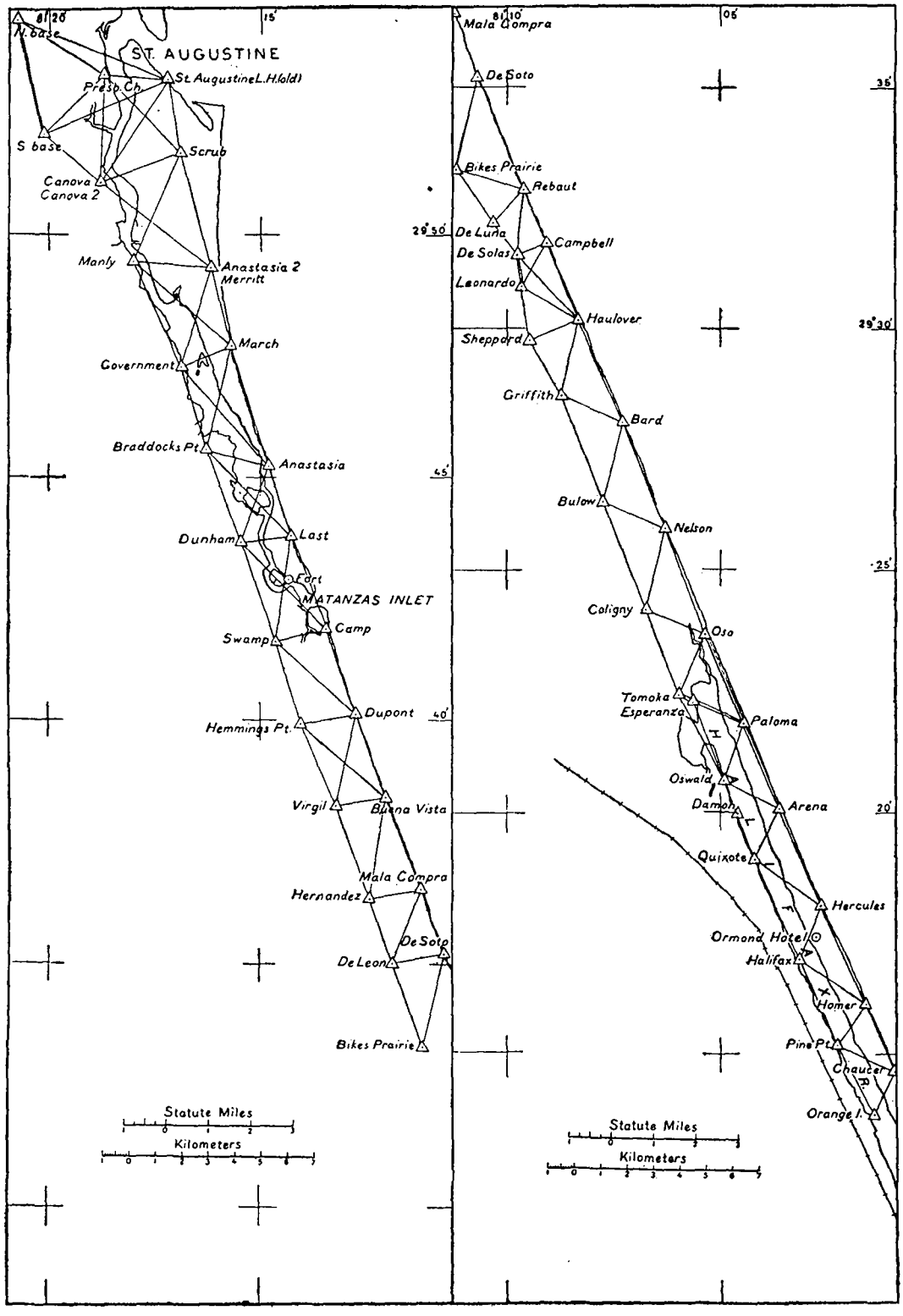
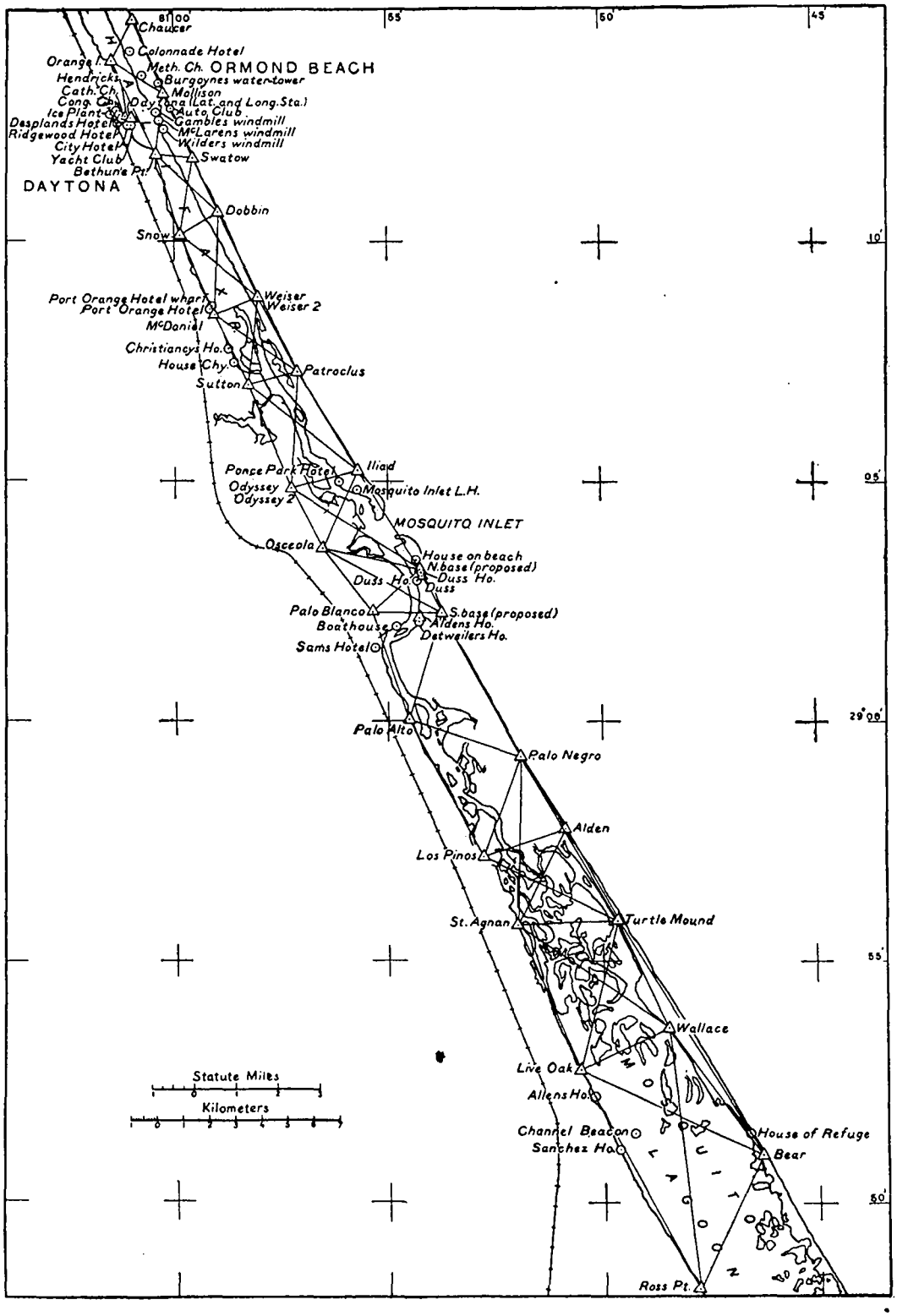
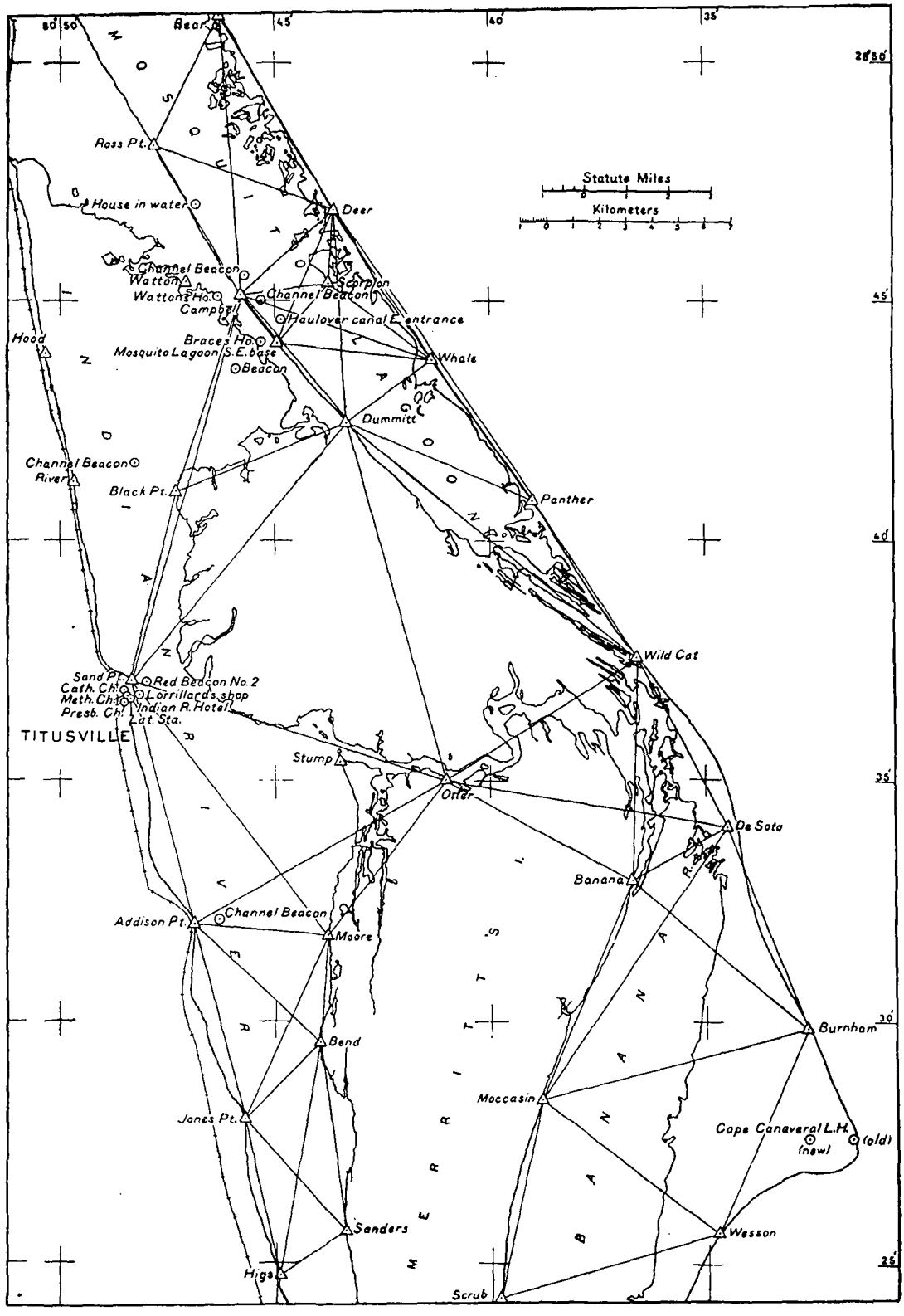


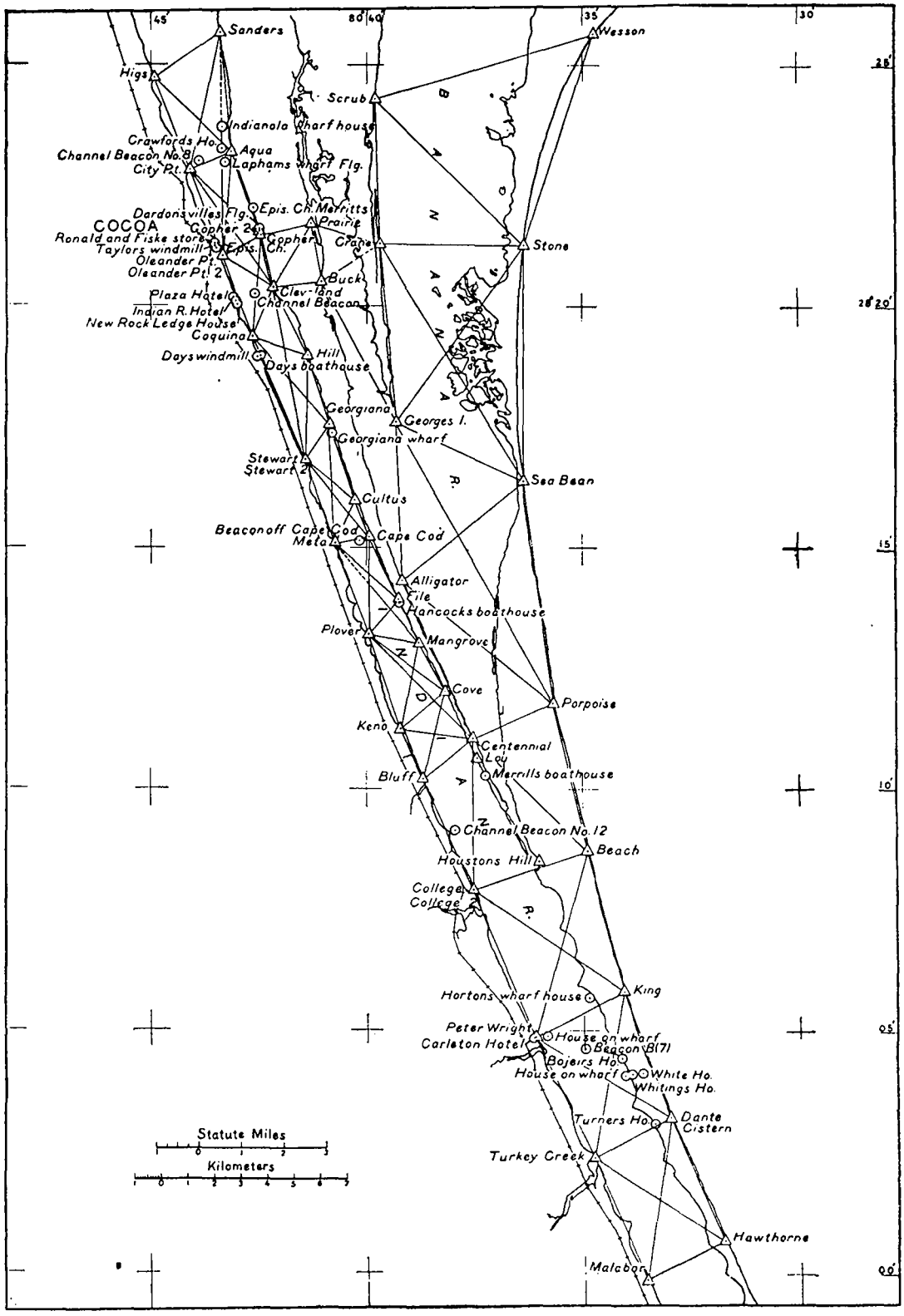
ST. AUGUSTINE TO DAYTONA.



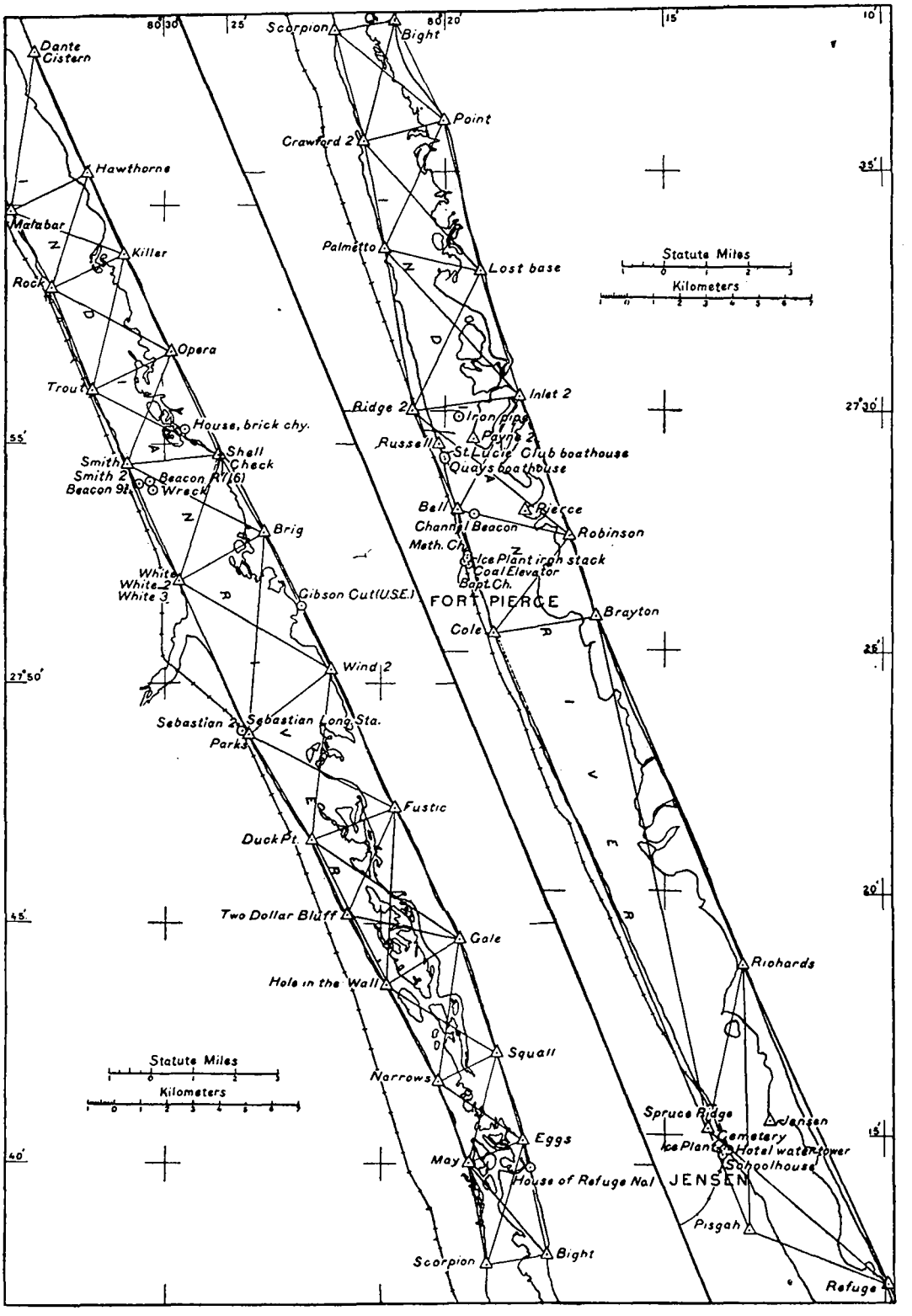
DAYTONA TO MOSQUITO LAGOON.



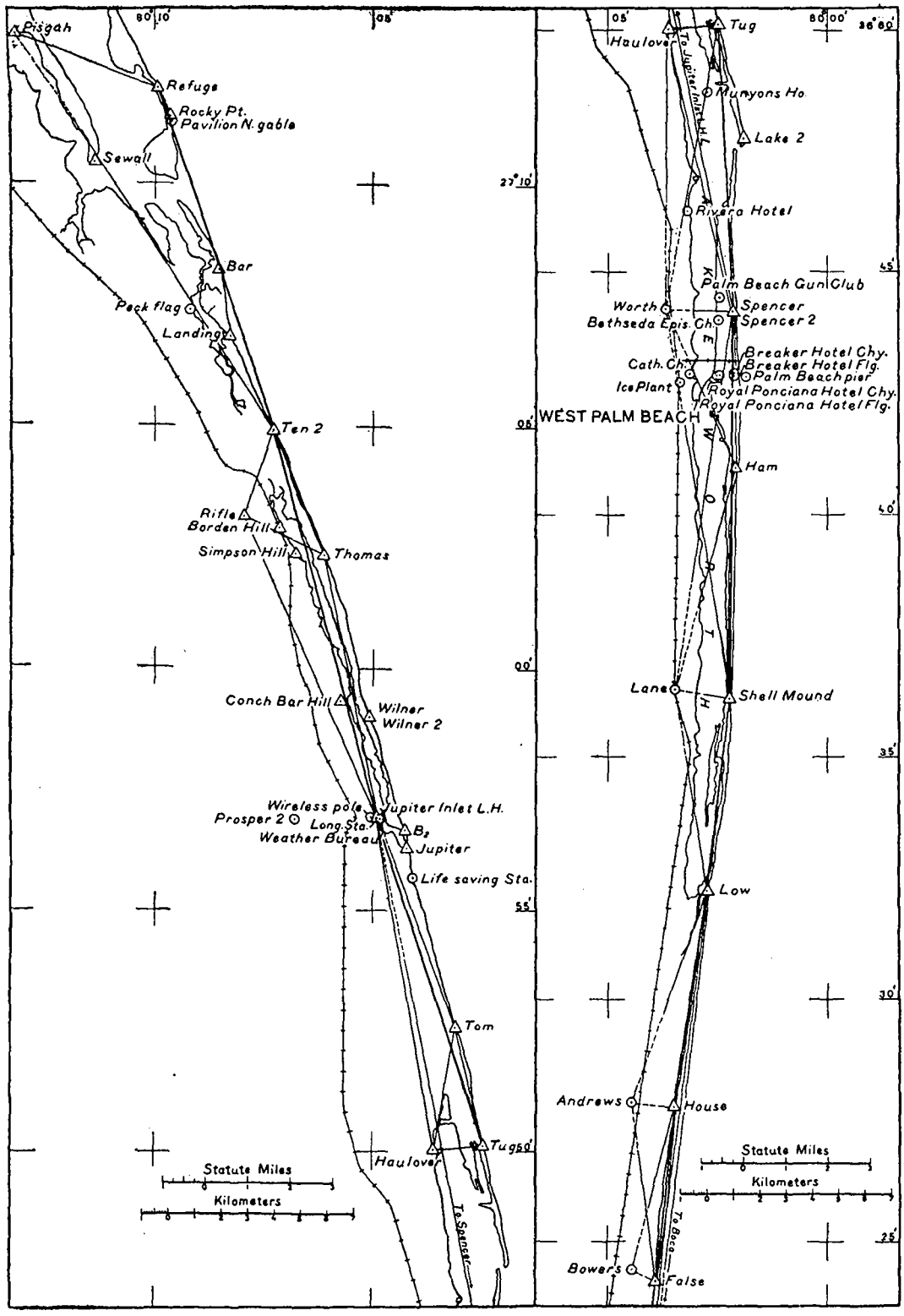
MOSQUITO LAGOON TO CAPE CANAVERAL.



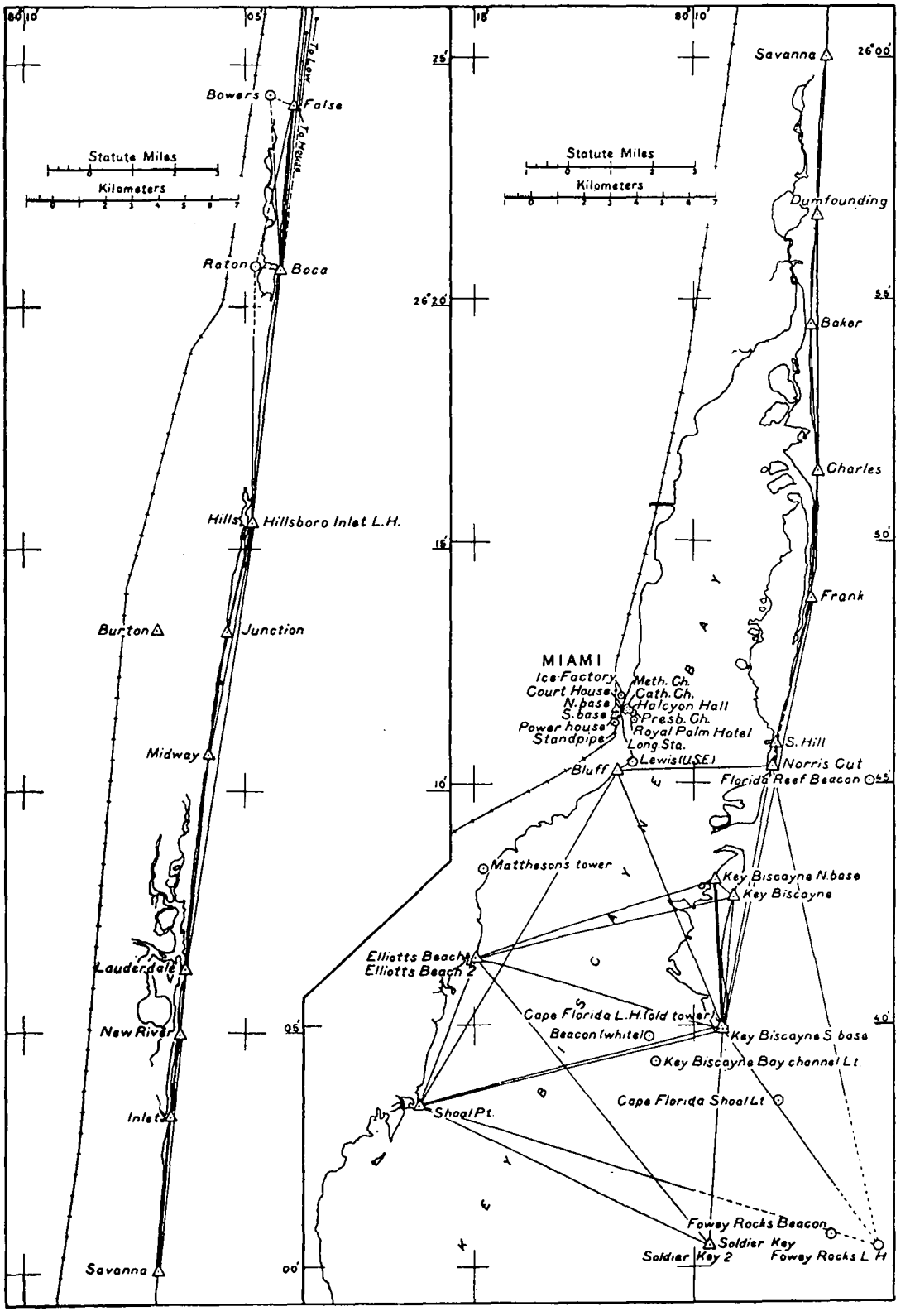
CAPE CANAVERAL TO MALABAR.



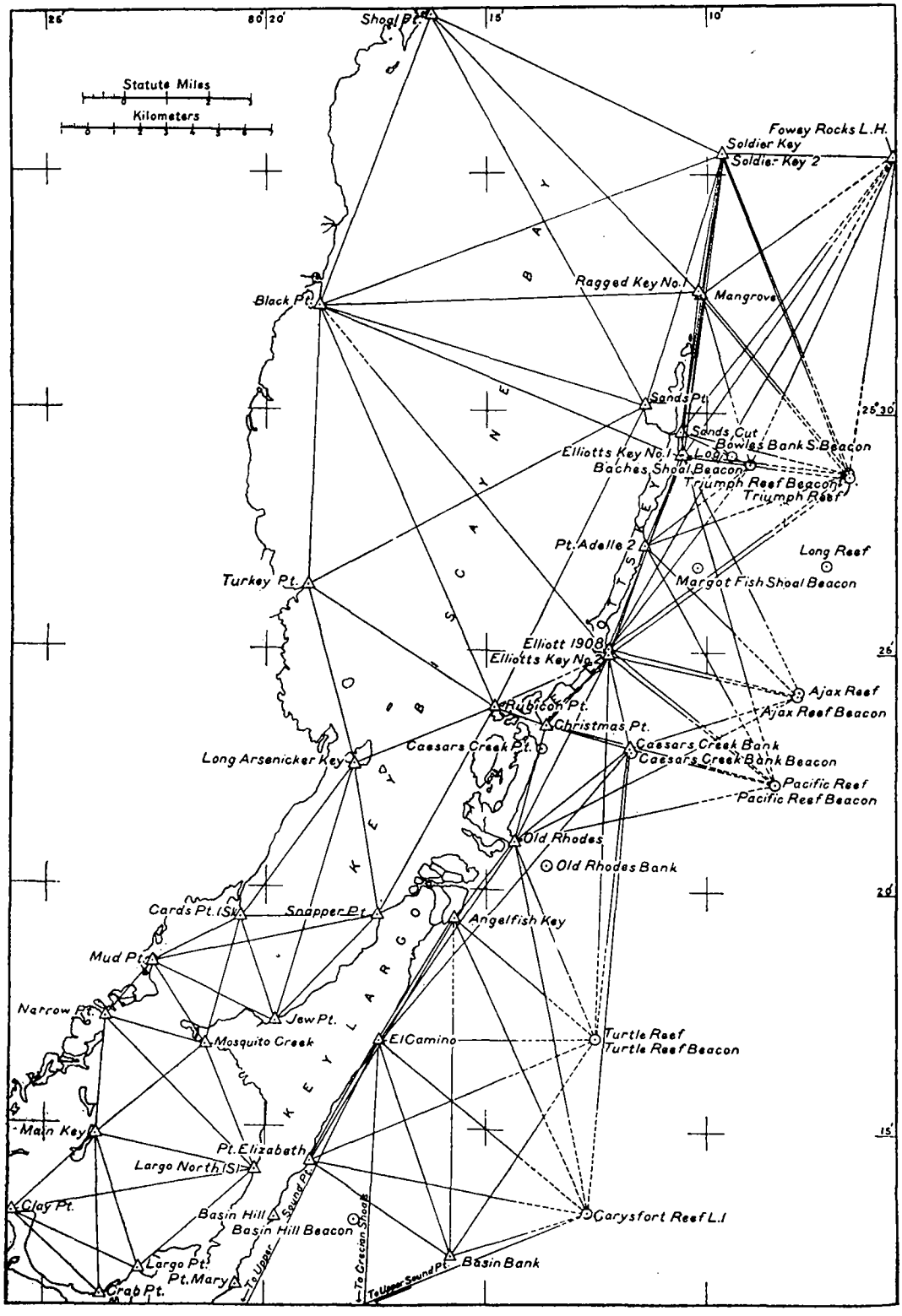
MALABAR TO JENSEN.



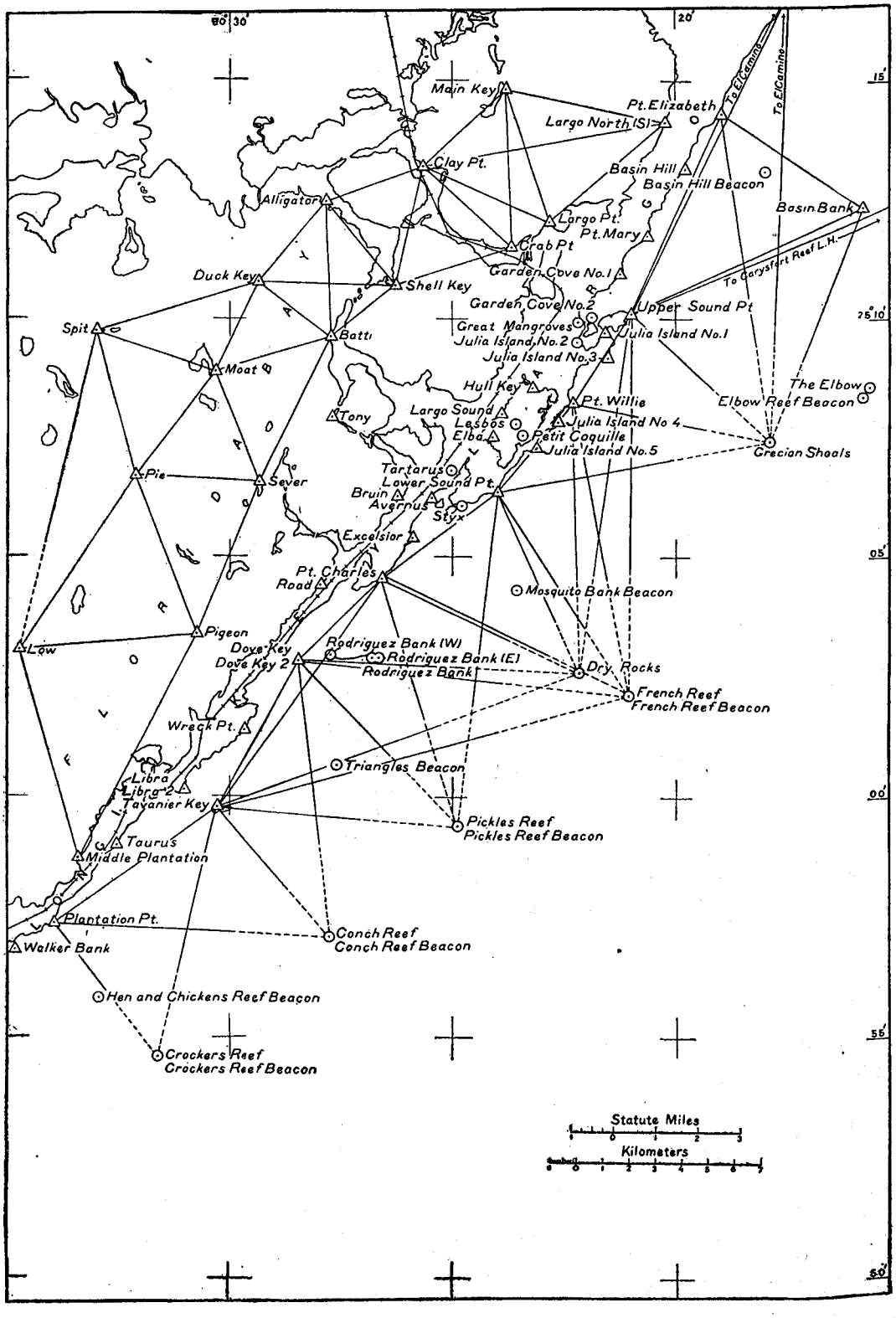
JENSEN TO FALSE.



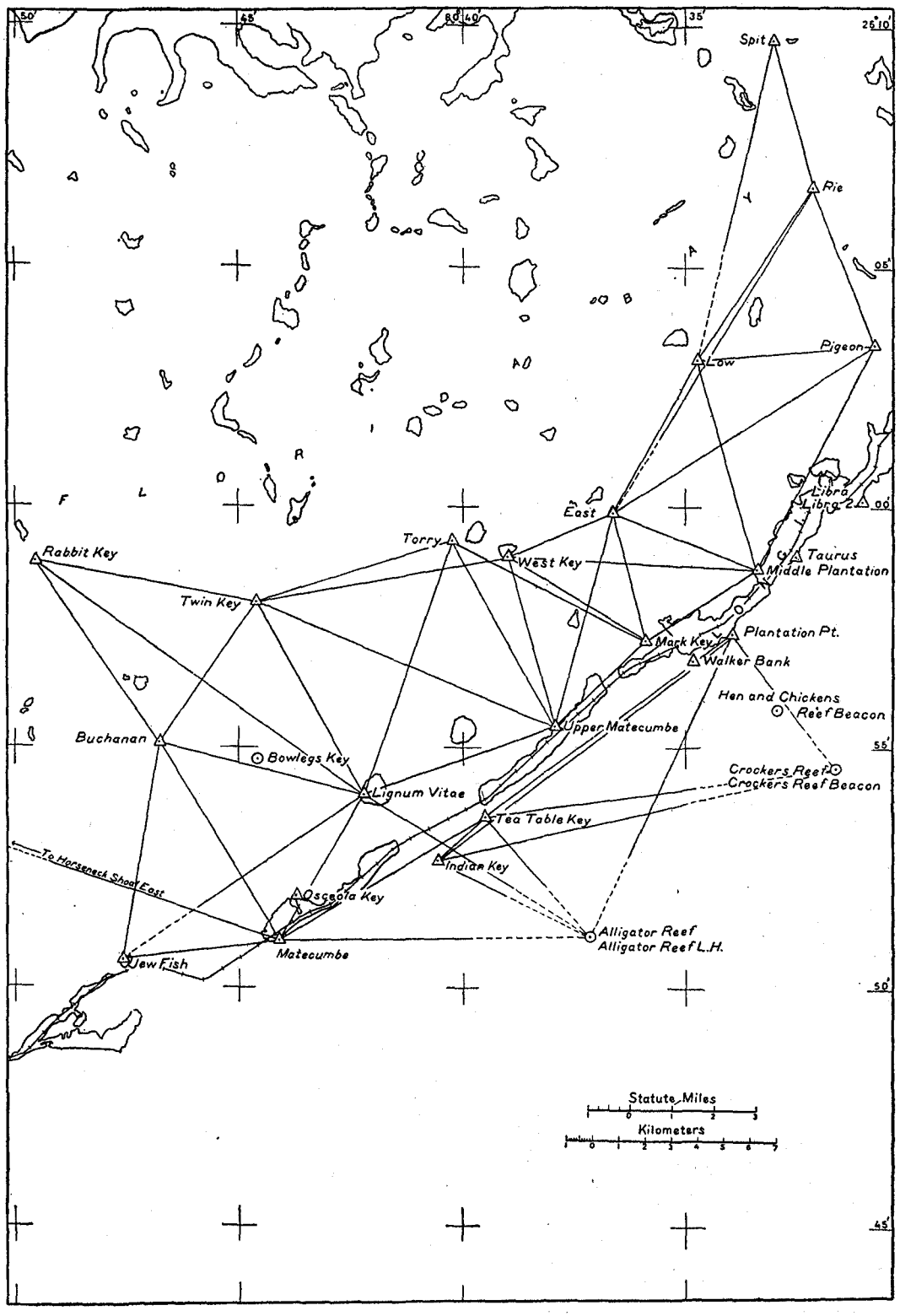
FALSE TO FOWEY ROCKS L. H.



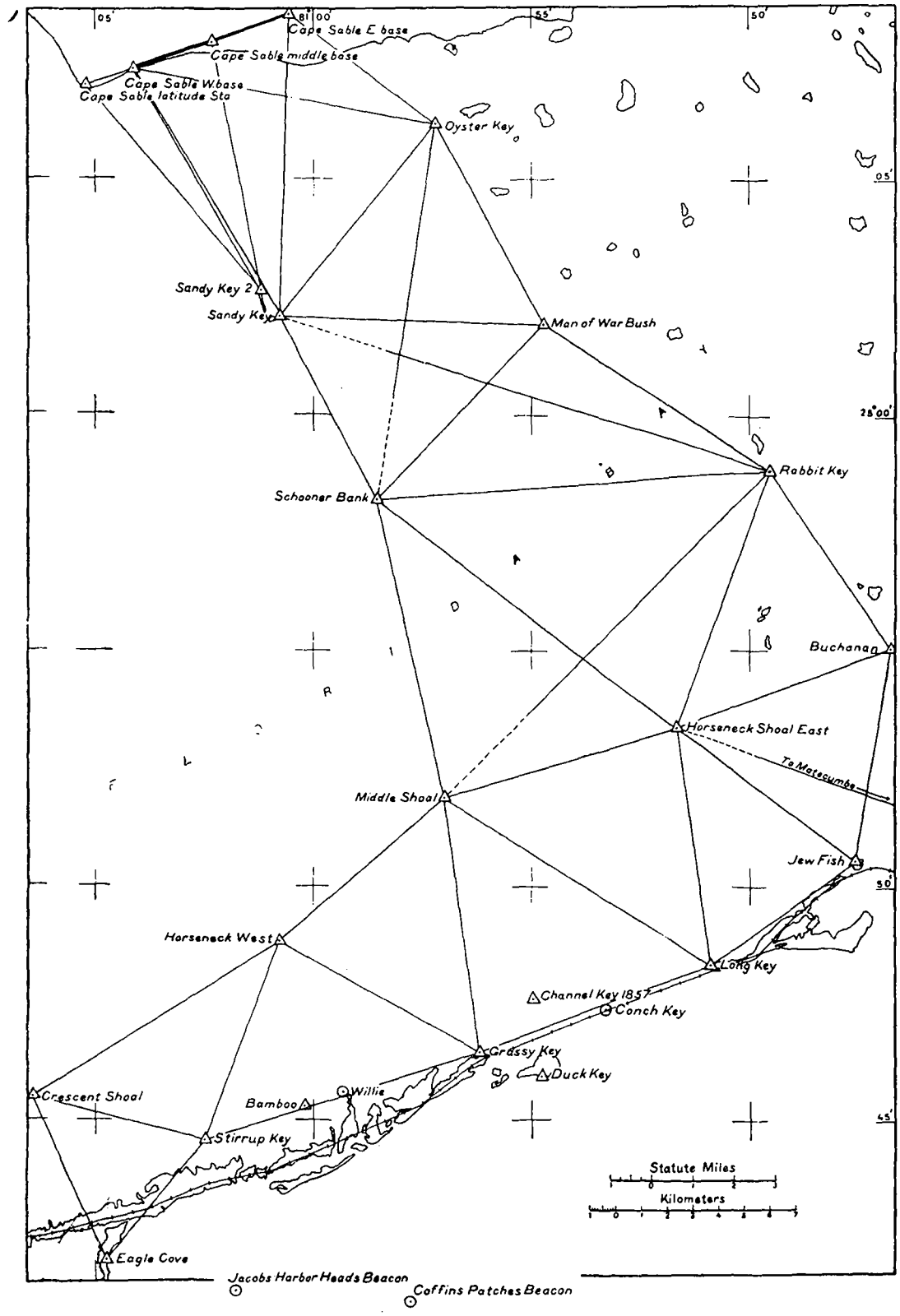
FOWEY ROCKS L. H. TO CARYSFORT REEF L. H.



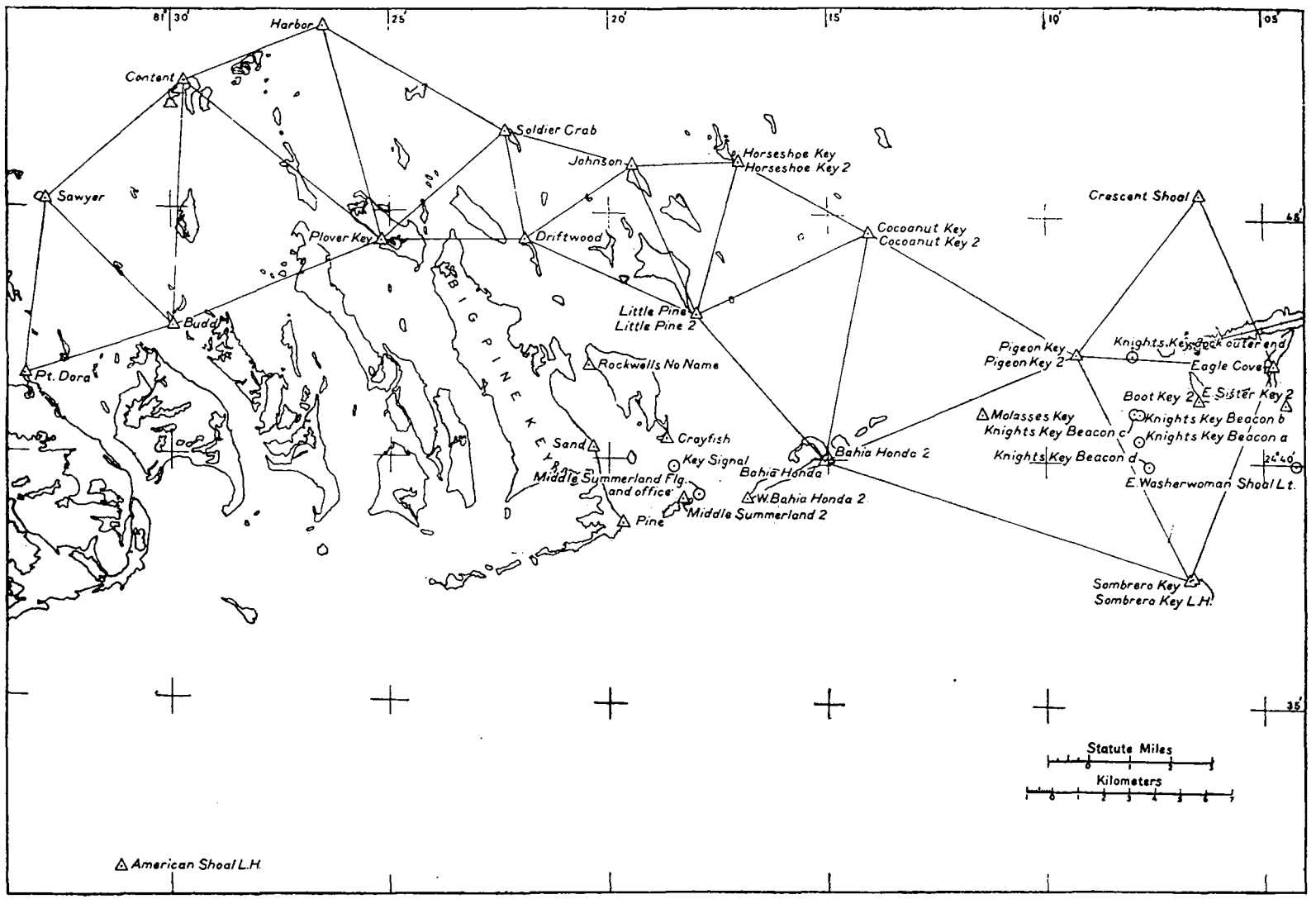
CARYSFORT REEF L. H. TO CROCKERS REEF.



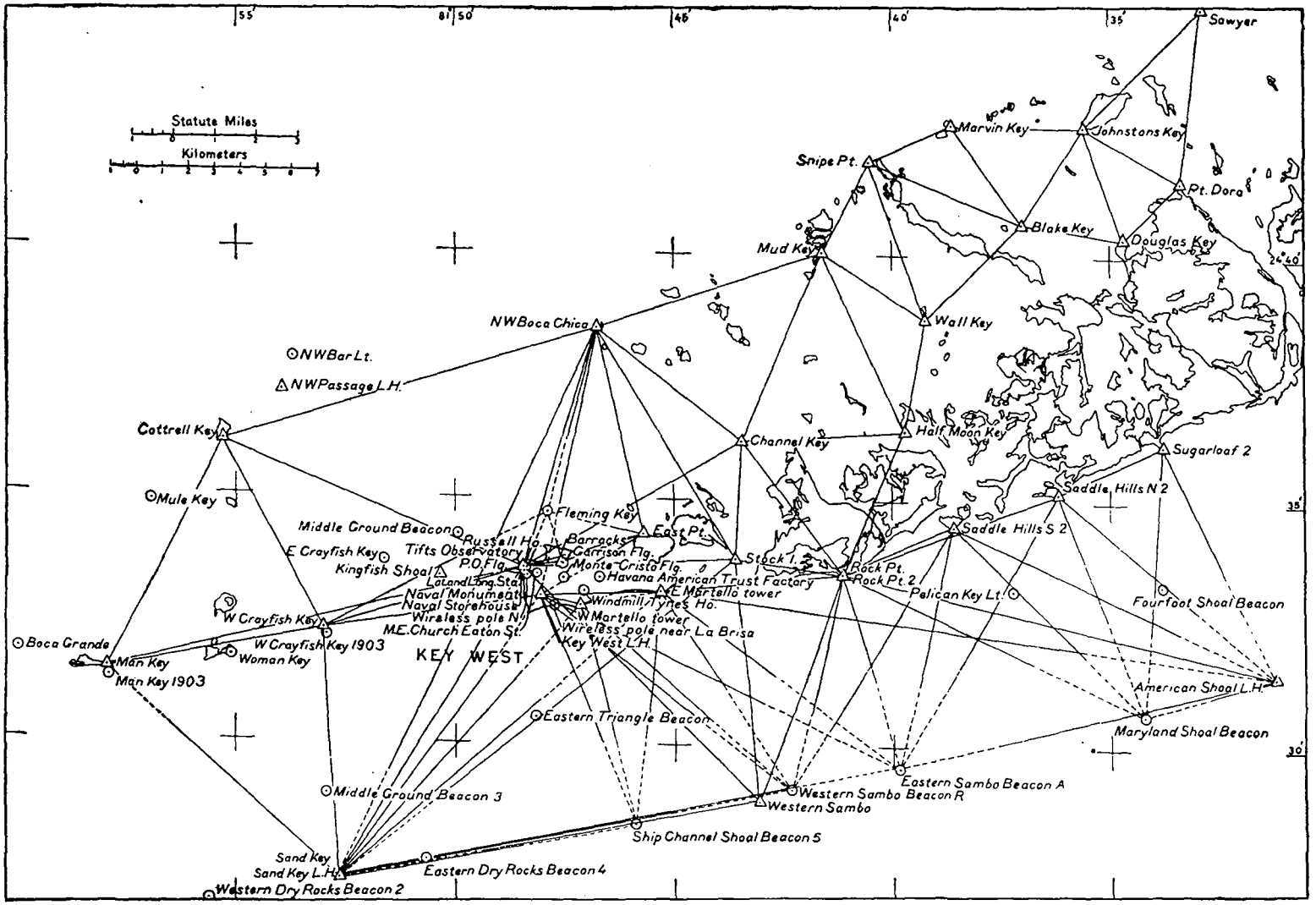
CROCKERS REEF TO JEWFISH-BUCHANAN-RABBIT KEY.



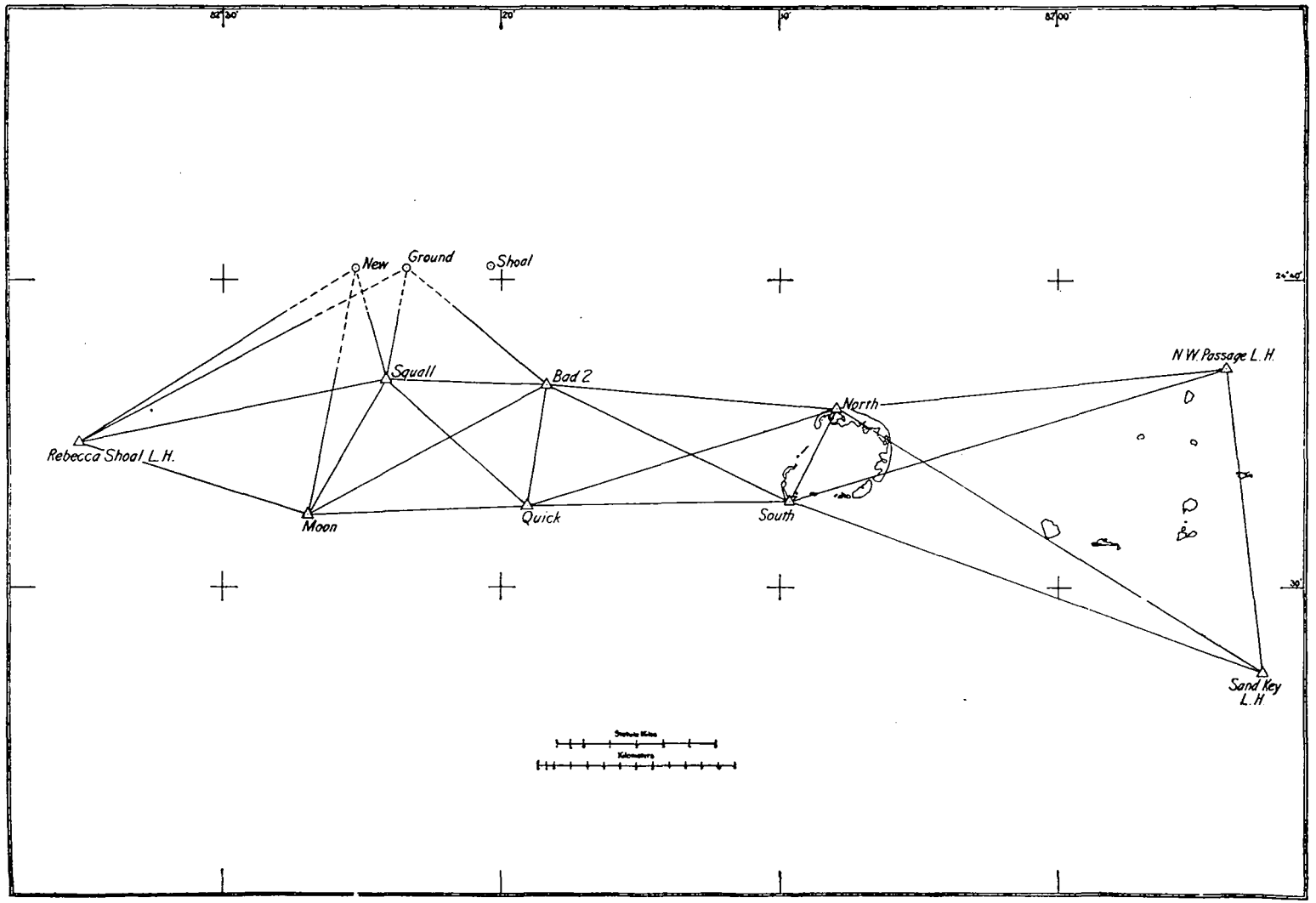
JEWFISH-BUCHANAN-RABBIT KEY TO CAPE SABLE AND KNIGHTS KEY



KNIGHTS KEY TO POINT DORA-SAWYER.

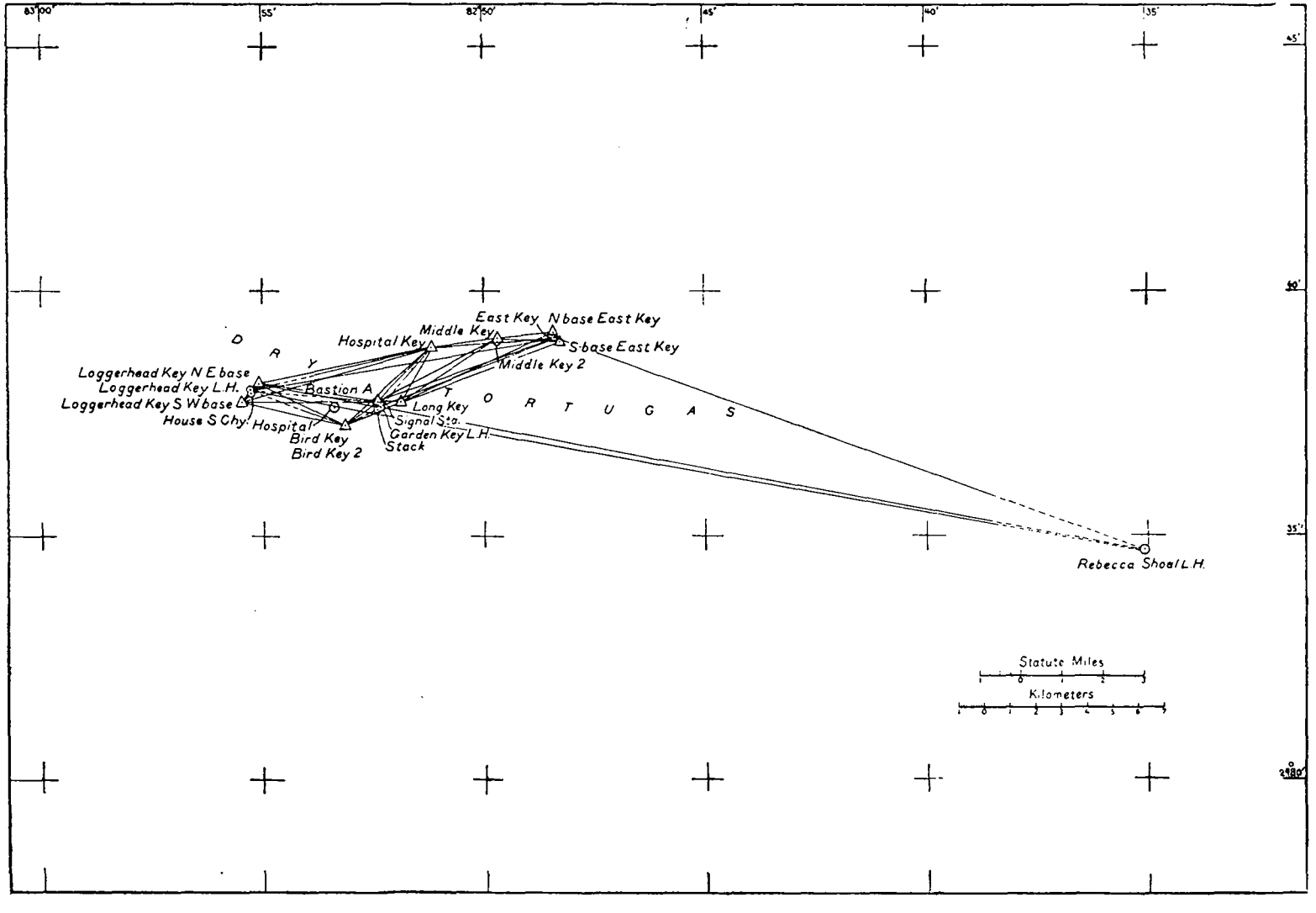


POINT DORA-SAWYER TO KEY WEST AND VICINITY.



KEY WEST TO REBECCA SHOAL L. H.

No. 22.



DRY TORTUGAS AND VICINITY.

ALPHABETICAL INDEX.

(Exclusive of Appendixes 3-6.)

N.

O.

P.

Q.

R.

FOR LIBRARY CATALOGUE CARDS.

U. S. Coast and Geodetic Survey.

. . . Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of work from July 1, 1910, to June 30, 1911. Washington, Gov't print. office, 1911.

584 pp. 5 progress sketches and 4 maps in pocket. 3 maps. 40 illus. 30 cm.

At head of title: Department of Commerce and Labor.

6 appendices: nos. 3, 4, 5, and 6 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, 1910, and June 30, 1911. By R. L. Faris. 4. Triangulation along the ninety-eighth meridian, Nebraska to Canada, and connection with the Great Lakes. By William Bowie. 5. Triangulation along the ninety-eighth meridian, Seguin to Point Isabel, Texas. By A. L. Baldwin. 6. Triangulation along the east coast of Florida and on the Florida Keys. By Hugh C. Mitchell.

SLIPS FOR LIST AND CATALOGUE.

LIST ENTRY.

1911.

Report of the Superintendent of the Coast and Geodetic Survey, showing the progress of the work from July 1, 1910, to June 30, 1911. Washington, Gov't print. office. 1911.

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APPENDIXES.

1. Details of field operations. p. 21–64.
2. Details of office operations. p. 65–76.
3. Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1910 and June 30, 1911. By R. L. Faris. p. 77–159.
4. Triangulation along the ninety-eighth meridian, Nebraska to Canada, and connection with the Great Lakes. By William Bowie. p. 160–342. 11 illus.
5. Triangulation along the ninety-eighth meridian, Seguin to Point Isabel, Texas. By A. L. Baldwin. p. 343–414. 7 illus.
6. Triangulation along the east coast of Florida and on the Florida Keys. By Hugh Mitchell. p. 415–580. 22 illus.

Faris, Robert Lee.

Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1910, and June 30, 1911. Report, 1911, app. 3, p. 77–159.

Terrestrial magnetism.

Faris, R. L. Results of magnetic observations made by the Coast and Geodetic Survey between July 1, 1910, and June 30, 1911. Report, 1911, app. 3, p. 77–159.

Bowie, William.

Triangulation along the ninety-eighth meridian, Nebraska to Canada, and connection with the Great Lakes. Report, 1911, app. 4, p. 160–342. 11 illus.

Triangulation.

Bowie, William. Triangulation along the ninety-eighth meridian, Nebraska to Canada, and connection with the Great Lakes. Report, 1911, app. 4, p. 160–342. 11 illus.

Baldwin, Albert Le Sueur.

Triangulation along the ninety-eighth meridian, Seguin to Point Isabel, Tex. Report, 1911, app. 5, p. 343–414. 7 illus.

Triangulation.

Baldwin, Albert Le Sueur. Triangulation along the ninety-eighth meridian, Seguin to Point Isabel, Tex. Report, 1911, app. 5, p. 343–414. 7 illus.

Mitchell, Hugh.

Triangulation along the east coast of Florida and on the Florida Keys. Report, 1911, app. 6, p. 415–580. 22 illus.

Triangulation.

Mitchell, Hugh. Triangulation along the east coast of Florida and on the Florida Keys. Report, 1911, app. 6, p. 415–580. 22 illus.

PLATE No. 2199 PLATE No. 2200

Distribution of the principal astronomic stations occupied by the U.S. Coast and Geodetic Survey for Latitude, Longitude and Azimuth to June 30, 1911.

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

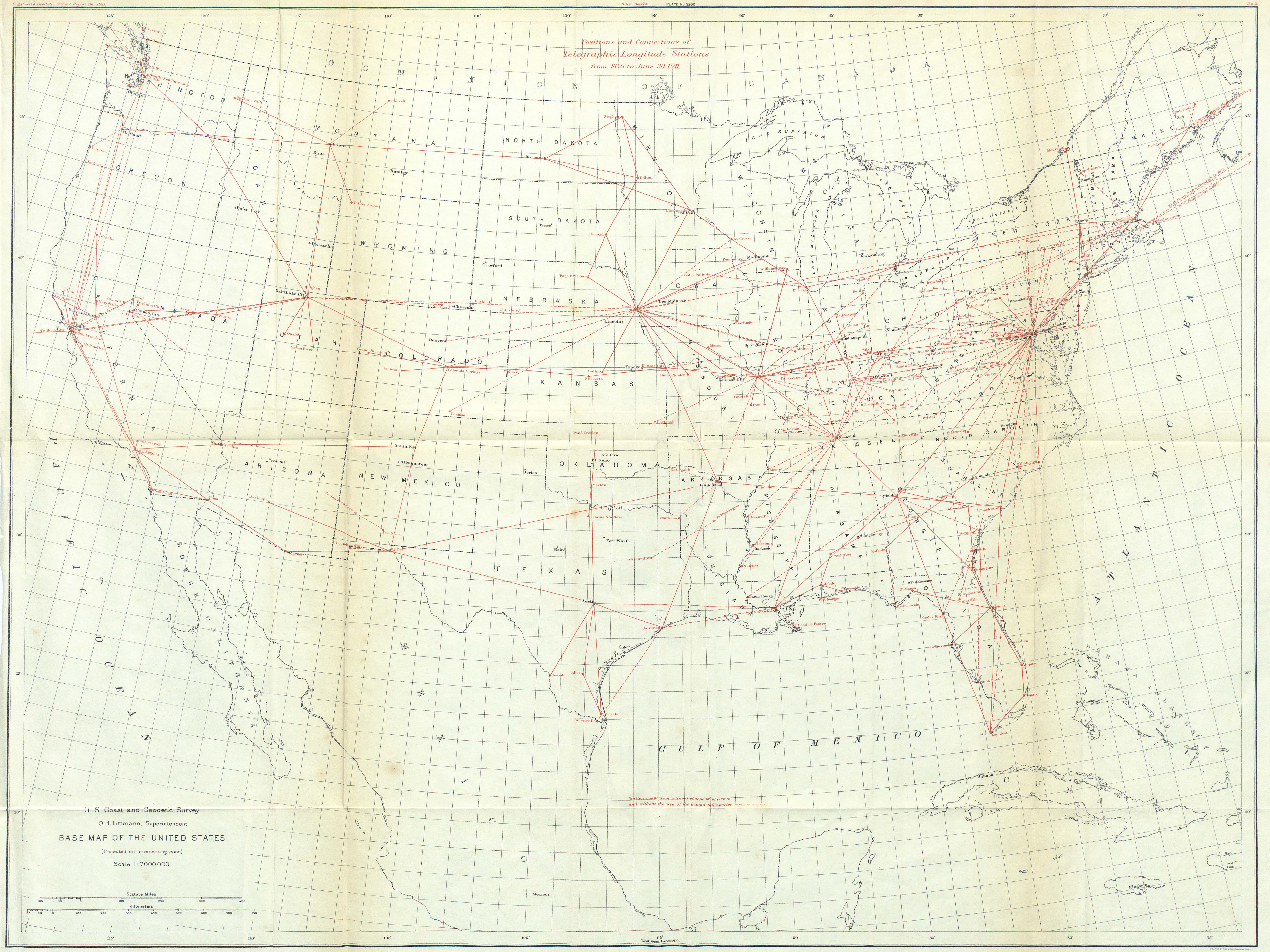
Kilometers 100 50 0 100 200 300 400 500 600 700 800

Explanation of Signs:
- Latitude Stations
- Longitude "
- Azimuth "
- Combination Stations

125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65°

55° 50° 45° 40° 35° 30° 25° 20°

115° 110° 105° 100° 95° West from Greenwich 90° 85° 80° 75°


Positions and Connections of
Telegraphic Longitude Stations
from 1846 to June 30 1911.
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
Kilometers
West from Greenwich
DOMINION OF CANADA
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
MEXICO
LOWER CALIFORNIA
CUBA
BAHAMA ISLANDS
WASHINGTON
OREGON
CALIFORNIA
NEVADA
IDAHO
MONTANA
WYOMING
UTAH
COLORADO
ARIZONA
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
PENNSYLVANIA
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
LAKE ONTARIO

Routes of Geodetic Spirit Leveling and Positions of Gravity and Tide Stations to June 1911

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

Kilometers 100 50 0 100 200 300 400 500 600 700 800

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.

DOMINION OF CANADA

UNITED STATES

PACIFIC OCEAN

ATLANTIC OCEAN

GULF OF MEXICO

MEXICO

CUBA

BAHAMA ISLANDS

WASHINGTON, OREGON, CALIFORNIA, NEVADA, IDAHO, MONTANA, WYOMING, UTAH, COLORADO, ARIZONA, 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, MAINE, VERMONT, NEW HAMPSHIRE, MASSACHUSETTS, CONNECTICUT, RHODE ISLAND

LAKE SUPERIOR, LAKE MICHIGAN, LAKE HURON, LAKE ERIE, LAKE ONTARIO

Olympia, Portland, Helena, Butte, Bismarck, Huntley, Boise City, Pierre, St.Paul, Bocatello, Madison, Lansing, Crawford, Salt Lake City, Cheyenne, Des Moines, Sacramento, Carson City, Lincoln, Denver, Springfield, Indianapolis, Columbus, Topeka, Jefferson City, Frankfort, Charleston, Harrisburg, Washington, Annapolis, Dover, Trenton, Richmond, Raleigh, Nashville, Santa Fe, Albuquerque, Prescott, Gallup, Guthrie, El Reno, Jerico, Little Rock, Fort Worth, Baird, Austin, Jackson, Montgomery, Atlanta, Columbia, Tallahassee, Baton Rouge, Augusta, Montpelier, Concord, Providence, Hartford, Boston, Albany, Nassau, Havana, Kingston

Mexico

Longitude West from Greenwich: 125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65°

Latitude: 45° 40° 35° 30° 25° 20°

PRINTED BY THE U.S.PUBLICATION SURVEY

Positions of Magnetic Stations

occupied to June 30, 1911

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

C O L O R A D O

A R I Z O N A

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

F L O R I D 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

M E X I C O

C U B A

B A H A M A I S L A N D S

Olympia
Portland
Helena
Butte
Bismarck
Pierre
Huntley
Boise City
Pocatello
Salt Lake City
Sacramento
Carson City
Cheyenne
Crawford
Lincoln
Denver
Des Moines
Madison
St. Paul
Lansing
Springfield
Topeka
Jefferson City
Columbus
Indianapolis
Frankfurt
Charleston
Richmond
Harrisburg
Albany
Boston
Concord
Augusta
Montpelier
Providence
Hartford
Nashville
Raleigh
Columbia
Atlanta
Montgomery
Tallahassee
Jackson
Baton Rouge
Little Rock
Jefferson City
Guthrie
El Reno
Santa Fe
Albuquerque
Jerico
Fort Worth
Baird
Austin
Prescott
Globe
Mexico
Nassau
Habana
Kingston

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

Kilometers 100 50 0 100 200 300 400 500 600 700 800

125° 120° 115° 110° 105° 100° 95° 90° 85° 80° 75° 70° 65°

45° 40° 35° 30° 25° 20°

115° 110° 105° 100° 95° West from Greenwich 90° 85° 80° 75°


UNITED STATES
COAST AND GEODETIC SURVEY
SKETCH OF GENERAL PROGRESS
JUNE 30, 1911
Western Sheet
Scale 1/5.000 000
Statute Miles
EXPLANATION OF SYMBOLS
Primary Triangulation
Secondary
Tertiary
Triangulation
Reconnaissance
Surveyed Topography
do. In-shore Hydrography
do. Off-shore do.
Lines of Deep Sea Soundings
do. Geodetic Levelling
WASHINGTON
OREGON
IDAHO
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
WYOMING
NEBRASKA
NEVADA
UTAH
COLORADO
KANSAS
CALIFORNIA
ARIZONA
NEW MEXICO
OKLAHOMA
TEXAS
LOWER CALIFORNIA
MEXICO
PACIFIC OCEAN
Cape Flattery
Cape Mendocino
Pt. Conception
Guadalupe I.
Cerros I.
Cape San Lazaro
Cape San Lucas
Cape Corrientes
Seattle
Portland
Spokane
Boise
Helena
Bismarck
Pierre
Salt Lake City
Cheyenne
Santa Fe
Prescott
Chihuahua
Mazatlan
San Blas
Manzanilla
Tampico
Monterey
Matamoras
MEXICO
125°
120°
115°
110°
105°
100°
45°
40°
35°
30°
25°
20°

PLATE No. 1654.

115° 110° 105° 100° 95° 90°

50° 45° 40° 35° 30° 25° 20°

Spokane
Shelby
Glasgow
Great Falls
Lewiston
Missoula
Walla Walla
Helena
Lewistown
Bismarck
Miles City
Baker City
Virginia City
Sheridan
Boise
Bellefourche
Deadwood
Pierre
Aberdeen
Watertown
St. Paul
Duluth
Rainy
Grand Forks
Minneapolis
St. Peters
Fond du Lac
Madison
Milwaukee
Dubuque
Sioux Falls
Sioux City
Yankton
Omaha
Columbus
Des Moines
Davenport
Rock Island
Peoria
Lincoln
Keokuk
Quincy
Springfield
Atchison
Topeka
KANSAS CITY
Jefferson City
Cairo
Scott
Colby
Dodge City
Wichita
Pueblo
Trinidad
Durango
Conejos
Monticello
Cheyenne
Alliance
North Platte
Julesburg
Rawlins
Green River
Logan
Ogden
Salt Lake City
Provo City
Junction
Grand Junction
Colorado Springs
Denver
Canon City
Pueblo
Kingman
Flagstaff
Prescott
Holbrook
Albuquerque
Santa Fe
Socorro
Roswell
Amarillo
Jericho
El Reno
Guthrie
Oklahoma
Memphis
Little Rock
Helena
Texarkana
Greenville
Dallas
Fort Worth
Baird
Shreveport
Jackson
Vicksburg
Natchez
Waco
Austin
Brownsville
Houston
Port Arthur
Galveston
San Antonio
Eagle Pass
Port Lavaca
Rockport
Corpus Christi
Laredo
Matamoras
Rio Grande
Monterey
Chihuahua
Guaymas
La Paz
Cape San Lucas
Mazatlan
San Blas
Cape Corrientes
Manzanilla
Tampico
Vera Cruz
Coatzacoalcos
Frontera
Campeche
Baton Rouge
NEW ORLEANS
Mobile Bay

MONTANA
IDAHO
WYOMING
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
COLORADO
KANSAS
IOWA
MINNESOTA
WISCONSIN
ILLINOIS
MISSOURI
INDIANA TERR.
OKLAHOMA
ARKANSAS
ARIZONA
NEW MEXICO
TEXAS
CALIFORNIA
MEXICO
LAKE SUPERIOR
MISSISSIPPI
MISSISSIPPI R.
GULF OF MEXICO

PRINTED BY THE U.S. GEOLOGICAL SURVEY.


UNITED STATES
COAST AND GEODETIC SURVEY
SKETCH OF GENERAL PROGRESS
JUNE 30, 1911
Eastern Sheet
Scale 1/5,000,000
Statute Miles
EXPLANATION OF SYMBOLS
Primary Triangulation
Secondary / Tertiary } Triangulation
Reconnaissance
Surveyed Topography
do. In-shore Hydrography
do. Off-shore do.
Lines of Deep Sea Soundings
do. Geodetic Levelling
GULF OF MEXICO
ATLANTIC
CUBA
BAHAMA
MEXICO
YUCATAN
Axis of the Gulf Stream

PLATE No 1655

UNITED STATES

COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

JUNE 30, 1911

Eastern Sheet

Scale 5.000000

Statute Miles

50 40 30 20 10 0 50 100 150 200

95° 90° 85° 80° 75° 70° 65°

45° 40° 35° 30° 25° 20°

MINNESOTA
LAKE SUPERIOR
WISCONSIN
MICHIGAN
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
NEW YORK
MAINE
VERMONT
NEW HAMPSHIRE
MASS.
CONN.
R.I.
IOWA
ILLINOIS
INDIANA
OHIO
PENNSYLVANIA
NEW JERSEY
MARYLAND
DELAWARE
WEST VIRGINIA
VIRGINIA
KENTUCKY
TENNESSEE
NORTH CAROLINA
SOUTH CAROLINA
GEORGIA
FLORIDA
MISSOURI
KANSAS
NEBRASKA
ARKANSAS
LOUISIANA
MISSISSIPPI
ALABAMA
INDIAN TERR.
GULF OF MEXICO
ATLANTIC OCEAN
BAHAMA ISLANDS
CUBA

Grand Forks, Duluth, St Paul, Minneapolis, Watertown, St Peters, Sioux Falls, Sioux City, Madison, Milwaukee, Fond du Lac, Dubuque, Davenport, Rock Island, Des Moines, Omaha, Lincoln, Kenkuk, Quincy, Springfield, Atchison, Topeka, KANSAS CITY, Jefferson City, St Louis, CHICAGO, Peoria, Terre Haute, Indianapolis, Fort Wayne, Evansville, Cairo, Saginaw, Grand Rapids, Lansing, Detroit, Toledo, Cleveland, Columbus, Zanesville, Cincinnati, Louisville, Frankfort, Lexington, Nashville, Memphis, Corinth, Little Rock, Helena, Texarkana, Greenville, Dallas, Fort Worth, Shreveport, Vicksburg, Jackson, Natchez, Baton Rouge, NEW ORLEANS, Mouths of Mississippi, Mobile, Pensacola, Tallahassee, Apalachicola, Montgomery, Birmingham, Atlanta, Macon, Augusta, Columbia, Charleston, Georgetown, Wilmington, Raleigh, Newberne, Cape Hatteras, Norfolk, Richmond, Lynchburg, Fredericksburg, Washington, Baltimore, Annapolis, Cumberland, Wheeling, Pittsburg, Harrisburg, Trenton, PHILADELPHIA, Atlantic City, Williamsport, Scranton, Binghamton, Albany, Rochester, Buffalo, Erie, Toronto, Oswego, Ogdensburg, Ottawa, MONTREAL, QUEBEC, St John, Bangor, Augusta, Portland, Concord, Manchester, Boston, Cape Cod, Springfield, Providence, Hartford, New London, Poughkeepsie, Cape Sable, Axis of the Gulf Stream, Warmest Band, Savannah, Brunswick, Fernandina, Jacksonville, St Augustine, Keys, Cape Canaveral, Tampa, Punta Gorda, Miami, Nassau, Tortugas, Key West, HAVANA, Cienfuegos, C. San Antonio, Santiago de Cuba, Cape Catoche, Progreso, Campeche, Vera Cruz, Frontera, Coatzacoalcos, Belize, Texas City, Galveston, Houston, Port Arthur, Rio Grande

EXPLANATION OF SYMBOLS

Primary Triangulation

Secondary, Tertiary Triangulation

Reconnaissance

Surveyed Topography

do. In-shore Hydrography

do. Off-shore do.

Lines of Deep Sea Soundings

do. Geodetic Levelling

PRINTED BY THE U.S.GEOLOGICAL SURVEY

UNITED STATES

COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

ALASKA

JUNE 30, 1911

Gravity stations	○
Latitude determinations	⊕
Longitude "	✦
Azimuth "	⚑
Tidal observations	⊓⊓⊓
Magnetic observations	⊛
Triangulation	△△△
Topography	▨▨▨
Hydrography	▨▨▨
Deep sea soundings	x x x x

Scale 5,000,000

Statute Miles

Nautical Miles

East from Greenwich | West from Greenwich

ARCTIC OCEAN

SIBERIA

BERING STRAIT

BERING SEA

ALEUTIAN ISLANDS

NORTH PACIFIC OCEAN

GULF OF ALASKA

YUKON DIST

ALASKA

BRITISH COLUMBIA

Pt. Barrow

C. Lisburne

R. Hope

C. Prince of Wales

Port Clarence

St. Lawrence I.

NORTON SOUND

St. Michael

St. Matthew I.

Nunivak I.

Kuskokwim Bay

BRISTOL BAY

Pribilof Islands

Yukon River

Porcupine

Ft. Egbert

Dawson

Valdez

Mt. St. Elias

Kodiak I.

Alexander Archipelago

Ketchikan

Queen Charlotte Is.

GENERAL PROGRESS SKETCH

D.

161° 160° 159° 158° West of Greenwich 157° 156° 155°

22° 21° 20° 19°

KAUAI

Niihau

OAHU

Honolulu

MOLOKAI

Kaunakakai

MAUI

Lahaina

Lanai

KAHOOLAWE

Kaheolawe

HAWAII

Hilo

HAWAIIAN ISLANDS

(Hawaiian Government Surveys also shown)

Triangulation

Topography

Hydrography

Deep Sea Sdgs. ++++

Longitude determination (telegraphic)

Magnetic observations

JUNE 30, 1911.

30' 18°

Desecheo I.

Mona I.

Mayaguez

Ponce

Cape Boca

Fajardo

Culebra I.

St. Thomas

Vieques I.

Mona Pass

Guayanilla Bay

Jobos Bay

PORTO RICO

Primary triangulation

Secondary and tertiary triangulation

Topography

Hydrography

Magnetic observations

68° 00' 30' 67° 00' 30' West of Greenwich 66° 00' 30' 65° 00'

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UNITED STATES

COAST AND GEODETIC SURVEY

SKETCH OF GENERAL PROGRESS

PHILIPPINE ISLANDS

JUNE 30, 1911

Latitude determinations
Longitude " (telegraphic)
Azimuth "
Tidal observations
Magnetic observations
Triangulation
Topography
Hydrography
Deep sea soundings

Formosa
Batan Islands
CHINA SEA
PACIFIC OCEAN
SULU SEA
SULU ARCHIPELAGO
PALAWAN
BORNEO
LUZON
MINDANAO
Aparri
Laoag
Tuguegarao
Agan
Candon
S. Fernando
Baguio
Dagupan
S. Cruz
Tarlac
Iba
Casiguran
Baler
Manila
Mariveles
Cavite
Batangas
Lucena
Atimonan
Paluan
Mindoro
Boac
Calapan
Lagonoy
Nueva Caceres
Virac
Tabaco
Legaspi
Sorsogon
Romblon
Masbate
Calbayog
Samar
Tacloban
Catbalogan
Borongan
Ormoc
Guiuan
Leyte
Capiz
Panay
Cuyo
San Jose
Iloilo
Negros
Cebu
Bohol
Dumaguete
Dapitan
Cagayan
Misamis
Iligan
Surigao
Lianga
Hinatuan
Cotabato
Davao
Mati
Zamboanga
Puerto Princesa
Cagayan Sulu
Sandakan
Jolo
Siasi
Bongao

Mercator projection $\frac{1}{5000000}$ in lat. 13° N.

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